



FCC PART 15.247

TEST REPORT

For

SHENZHEN MARKTRACE CO., LTD.

F3,Bldg,D,Changyuan New Material Port, Keyuan Rd,cience & Industry Park,Nanshan District, Shenzhen, China

FCC ID: WKXMR61XX

Report Type: Original Report	Product Name: UHF RFID Reader
Test Engineer: <u>Kevin Hu</u> <i>Kevin Hu</i>	
Report Number: <u>RDG161025805</u>	
Report Date: <u>2016-12-01</u>	
Reviewed By: <u>Henry Ding</u> <i>Henry Ding</i> EMC Leader	
Test Laboratory: Bay Area Compliance Laboratories Corp. (Chengdu) 5040, HuiLongWan Plaza, No. 1, ShaWan Road, JinNiu District, ChengDu, China Tel: 028-65523123, Fax: 028-65525125 www.baclcorp.com	

Note: This test report was 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. (Chengdu). Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. This report was valid only with a valid digital signature.

TABLE OF CONTENTS

GENERAL INFORMATION	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S)	4
TEST METHODOLOGY	5
TEST FACILITY	5
SYSTEM TEST CONFIGURATION	6
DESCRIPTION OF TEST CONFIGURATION	6
EUT EXERCISE SOFTWARE	6
EQUIPMENT MODIFICATIONS	6
EXTERNAL CABLE	6
BLOCK DIAGRAM OF TEST SETUP	7
SUMMARY OF TEST RESULTS	8
FCC §15.247 (i) & §1.1307 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)	9
APPLICABLE STANDARD	9
FCC §15.203 - ANTENNA REQUIREMENT	10
APPLICABLE STANDARD	10
ANTENNA CONNECTOR CONSTRUCTION	10
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS	11
APPLICABLE STANDARD	11
MEASUREMENT UNCERTAINTY	11
EUT SETUP	11
EMI TEST RECEIVER SETUP	12
TEST PROCEDURE	12
CORRECTED AMPLITUDE & MARGIN CALCULATION	12
TEST EQUIPMENT LIST AND DETAILS	13
TEST DATA	13
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS	18
APPLICABLE STANDARD	18
MEASUREMENT UNCERTAINTY	18
EUT SETUP	19
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	20
TEST PROCEDURE	20
CORRECTED AMPLITUDE & MARGIN CALCULATION	20
TEST EQUIPMENT LIST AND DETAILS	21
TEST DATA	21
FCC §15.247(a) (1) - CHANNEL SEPARATION TEST	26
APPLICABLE STANDARD	26
TEST EQUIPMENT LIST AND DETAILS	26
TEST PROCEDURE	26
TEST DATA	26
FCC §15.247(a) (1) – 20 dB BANDWIDTH TESTING	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29
TEST EQUIPMENT LIST AND DETAILS	29

TEST DATA	30
FCC §15.247(a) (1) (i) - QUANTITY OF HOPPING CHANNEL TEST	32
APPLICABLE STANDARD	32
TEST PROCEDURE	32
TEST EQUIPMENT LIST AND DETAILS	32
TEST DATA	32
FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)	34
APPLICABLE STANDARD	34
TEST PROCEDURE	34
TEST EQUIPMENT LIST AND DETAILS	34
TEST DATA	34
FCC §15.247(b) (2) - PEAK OUTPUT POWER MEASUREMENT	37
APPLICABLE STANDARD	37
TEST PROCEDURE	37
TEST EQUIPMENT LIST AND DETAILS	37
TEST DATA	37
FCC §15.247(d) - BAND EDGES TESTING	40
APPLICABLE STANDARD	40
TEST PROCEDURE	40
TEST EQUIPMENT LIST AND DETAILS	40
TEST DATA	41

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The **SHENZHEN MARKTRACE CO., LTD.**'s product, model number: **MR6121E, MR6111E, MR6111A and MR6121A (FCC ID: WKXMR61XX)** (the "EUT") in this report were a **UHF RFID Reader**, rated input voltage: DC12V from adapter. They were measured approximately as below table:

No.	Antenna	Length (cm)	Width (cm)	High (cm)	Note
MR6121E	9dBi	28	28	8	/
MR6121A	9dBi	28	28	8	Without RJ45 Port
MR6111E	12dBi	44	44	8	/
MR6111A	12dBi	44	44	8	Without RJ45 Port

Adapter information:

MODEL: KSAS0501200400M2

INPUT: 100V-240V~ 50/60Hz 1.2A

OUTPUT: DC12V 4.0A

Note: The 4 products, model: MR6121E, MR6111E, MR6111A and MR6121A. Their differences were presented in Product Difference Statement provided by the applicant. And we selected MR6121E to fully test, MR6111A for radiation test and AC line conducted test.

**All measurement and test data in this report was gathered from final production sample, serial number: 161025805-1(MR6121E) and 161025805-2(MR6111A) (assigned by the BACL, Chengdu). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2016-10-25, and EUT conformed to test requirement.*

Objective

This report is prepared on behalf of **SHENZHEN MARKTRACE CO., LTD.** in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communications Commission's rules.

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

Related Submittal(s)/Grant(s)

No related submittal(s)/grant(s).

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.

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

The uncertainty of any RF tests which use conducted method measurement is ± 3.17 dB, the uncertainty of any radiation on emissions measurement is:

30M~200MHz: ± 4.7 dB;
200M~1GHz: ± 6.0 dB;
1G~6GHz: ± 5.13 dB;
6G~25GHz: ± 5.47 dB;

And the uncertainty will not be taken into consideration for all test data recorded in the report.

Test Facility

The test site used by BACL to collect test data is located in the 5040, HuiLongWan Plaza, No. 1, ShaWan Road, JinNiu District, ChengDu, China.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on April 24, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 560332. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

The device employed 50 hopping channels as below table:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903	26	915.5
2	903.5	27	916
3	904	28	916.5
...	...	...	...
23	914	48	926.5
24	914.5	49	927
25	915	50	927.5

Channel 1, 25 and 50 were chose for testing.

EUT Exercise Software

The engineering mode configured the maximum power as default setting.

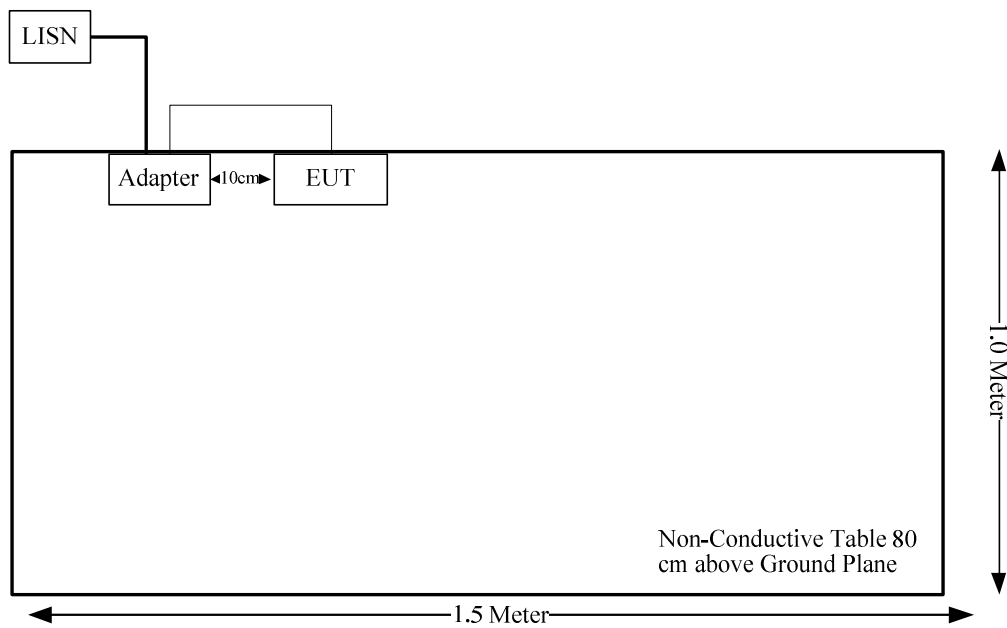
Equipment Modifications

No modification was made to the EUT.

External Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Adapter Line	No	Yes	1.15	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(1)	20 dB Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(i)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliant
§15.247(b)(2)	Peak Output Power Measurement	Compliant
§15.247(d)	Band Edges	Compliant

FCC §15.247 (i) & §1.1307 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) and subpart §1.1307, 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.

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

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

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

Calculated Data:

Frequency Range (MHz)	Antenna Gain		Maximum Power Including Tolerance		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
903-927.5	12	15.85	12	15.85	20.00	0.05	0.6

Note: The Maximum Power Including Tolerance was declared by manufacturer. The maximum antenna gain is 12 dBi.

Result: The device meet FCC MPE at 20 cm distance

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, the antenna gain is 9 dBi for model: MR6121E and MR6121A, 12dBi for MR6111E and MR6111A, 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

Measurement Uncertainty

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} of Table 1, then:

–compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
 –non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} of Table 1, then:

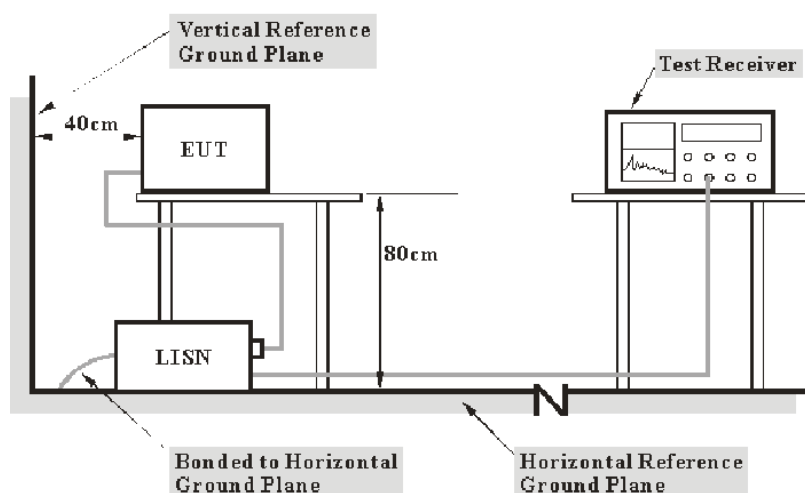
–compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;
 –non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.

Based on CISPR 16-4-2:2011, measurement uncertainty of conducted disturbance at mains port using AMN at Bay Area Compliance Laboratories Corp. (Chengdu) is ± 3.17 dB (150 kHz to 30 MHz).

Table 1 – Values of U_{cispr}

Measurement	U_{cispr}
Conducted disturbance at mains port using AMN (150 kHz to 30 MHz)	3.4 dB

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 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 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:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

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 maximum 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
Rohde & Schwarz	EMI Test Receiver	ESCS 30	836858/0016	2015-12-02	2016-12-01
Rohde & Schwarz	L.I.S.N.	ENV216	3560.6550.06	2015-12-02	2016-12-01
Rohde & Schwarz	PULSE LIMITER	ESH3Z2	357.8810.52	2016-10-31	2017-10-30
N/A	Conducted Cable	NO.5	N/A	2016-11-10	2017-11-09
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

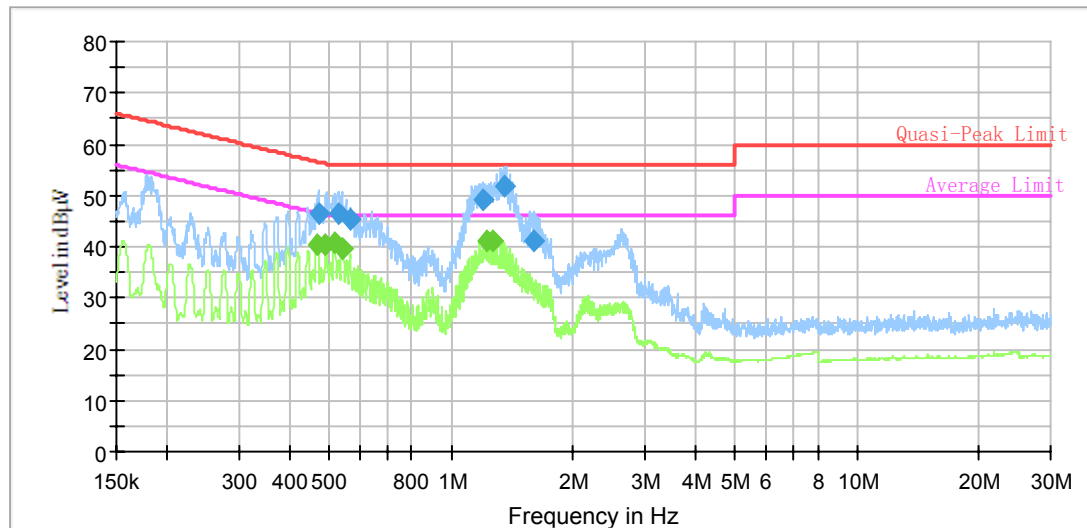
Temperature:	24.4°C
Relative Humidity:	36 %
ATM Pressure:	101.3 kPa

The testing was performed by Kevin Hu on 2016-11-28.

Test Mode: Transmitting

Tested Model: MR6121E

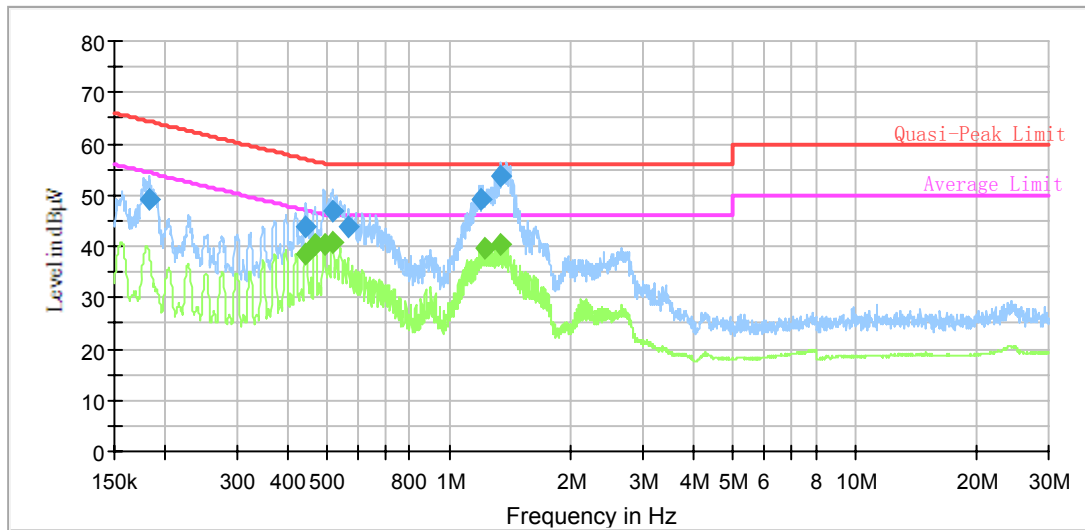
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.471298	46.4	9.000	L1	19.6	10.1	56.5	Compliance
0.529205	46.4	9.000	L1	19.6	9.6	56.0	Compliance
0.564145	45.5	9.000	L1	19.6	10.5	56.0	Compliance
1.202977	49.2	9.000	L1	19.6	6.8	56.0	Compliance
1.348086	52.0	9.000	L1	19.6	4.0	56.0	Compliance
1.607226	41.1	9.000	L1	19.7	14.9	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.468482	40.3	9.000	L1	19.6	6.2	46.5	Compliance
0.492477	40.3	9.000	L1	19.6	5.8	46.1	Compliance
0.516668	40.9	9.000	L1	19.6	5.1	46.0	Compliance
0.540965	39.6	9.000	L1	19.6	6.4	46.0	Compliance
1.224805	41.2	9.000	L1	19.6	4.8	46.0	Compliance
1.274739	41.1	9.000	L1	19.6	4.9	46.0	Compliance

AC120 V, 60 Hz, Neutral:

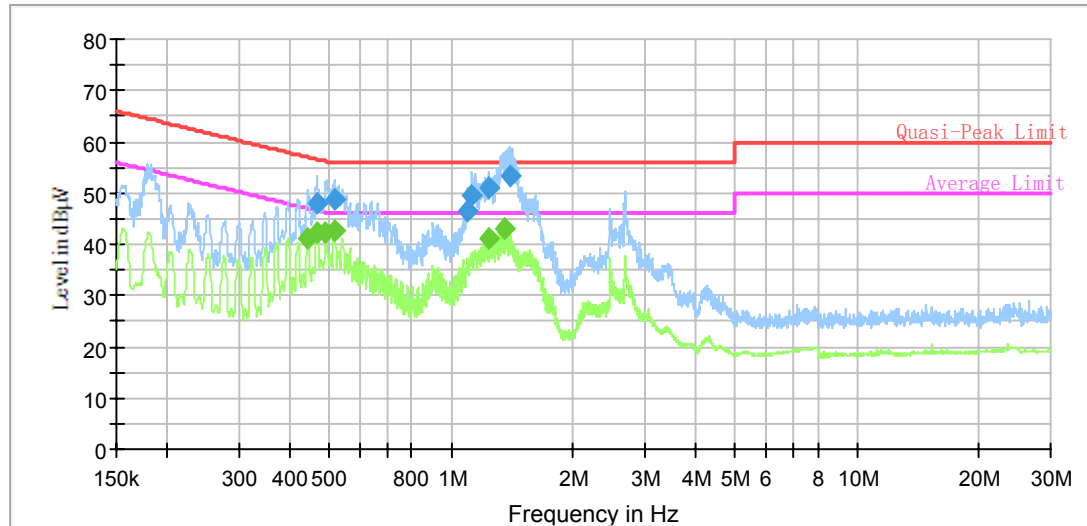


Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.182443	49.3	9.000	N	19.7	15.1	64.4	Compliance
0.444766	43.8	9.000	N	19.7	13.2	57.0	Compliance
0.516668	47.0	9.000	N	19.7	9.0	56.0	Compliance
0.564145	43.7	9.000	N	19.7	12.3	56.0	Compliance
1.205383	49.2	9.000	N	19.7	6.8	56.0	Compliance
1.342710	53.8	9.000	N	19.7	2.2	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.444766	38.4	9.000	N	19.7	8.6	47.0	Compliance
0.469419	40.2	9.000	N	19.7	6.3	46.5	Compliance
0.493462	40.2	9.000	N	19.7	5.9	46.1	Compliance
0.517701	40.7	9.000	N	19.7	5.3	46.0	Compliance
1.227254	39.8	9.000	N	19.7	6.2	46.0	Compliance
1.345395	40.4	9.000	N	19.7	5.6	46.0	Compliance

Tested Model: MR6111A

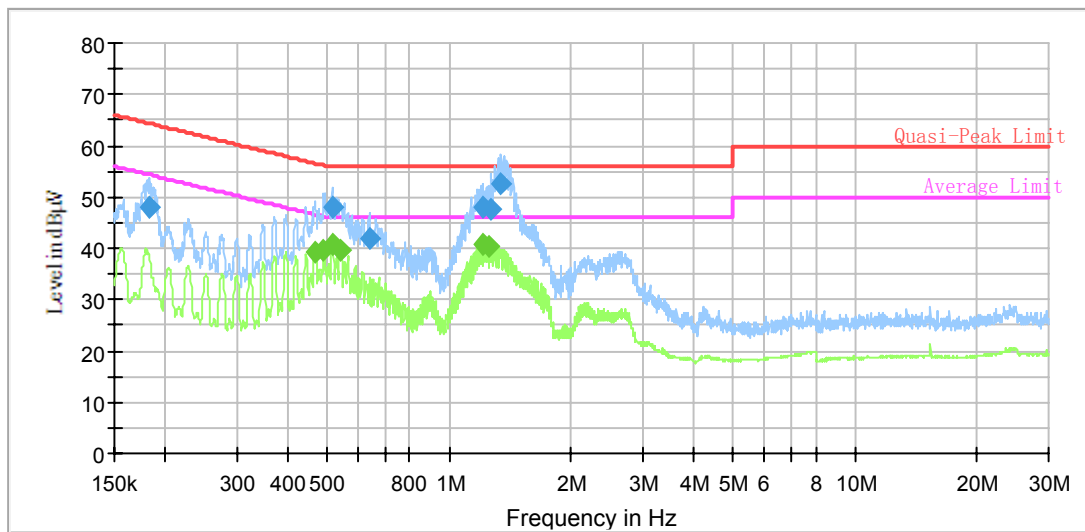
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.468482	48.1	9.000	L1	19.6	8.4	56.5	Compliance
0.517701	48.8	9.000	L1	19.6	7.2	56.0	Compliance
1.103940	46.4	9.000	L1	19.6	9.6	56.0	Compliance
1.128471	49.5	9.000	L1	19.6	6.5	56.0	Compliance
1.239576	50.9	9.000	L1	19.6	5.1	56.0	Compliance
1.394661	53.5	9.000	L1	19.6	2.5	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.444766	41.0	9.000	L1	19.6	6.0	47.0	Compliance
0.469419	42.2	9.000	L1	19.6	4.3	46.5	Compliance
0.492477	42.2	9.000	L1	19.6	3.9	46.1	Compliance
0.516668	42.8	9.000	L1	19.6	3.2	46.0	Compliance
1.239576	41.0	9.000	L1	19.6	5.0	46.0	Compliance
1.348086	43.0	9.000	L1	19.6	3.0	46.0	Compliance

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.182443	48.2	9.000	N	19.7	16.2	64.4	Compliance
0.516668	48.0	9.000	N	19.7	8.0	56.0	Compliance
0.637268	41.8	9.000	N	19.7	14.2	56.0	Compliance
1.215055	48.0	9.000	N	19.7	8.0	56.0	Compliance
1.272195	47.5	9.000	N	19.7	8.5	56.0	Compliance
1.345395	52.6	9.000	N	19.7	3.4	56.0	Compliance

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.468482	39.3	9.000	N	19.7	7.2	46.5	Compliance
0.492477	39.8	9.000	N	19.7	6.3	46.1	Compliance
0.516668	40.8	9.000	N	19.7	5.2	46.0	Compliance
0.540965	39.6	9.000	N	19.7	6.4	46.0	Compliance
1.215055	40.8	9.000	N	19.7	5.2	46.0	Compliance
1.252022	40.4	9.000	N	19.7	5.6	46.0	Compliance

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

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

Measurement Uncertainty

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} of Table 2, then:

–compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
–non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} of Table 2, then:

–compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit;
–non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cispr})$, exceeds the disturbance limit.

Based on CISPR 16-4-2-2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Chengdu) is:

30M~200MHz: ± 4.7 dB;

200M~1GHz: ± 6.0 dB;

1G~6GHz: ± 5.13 dB;

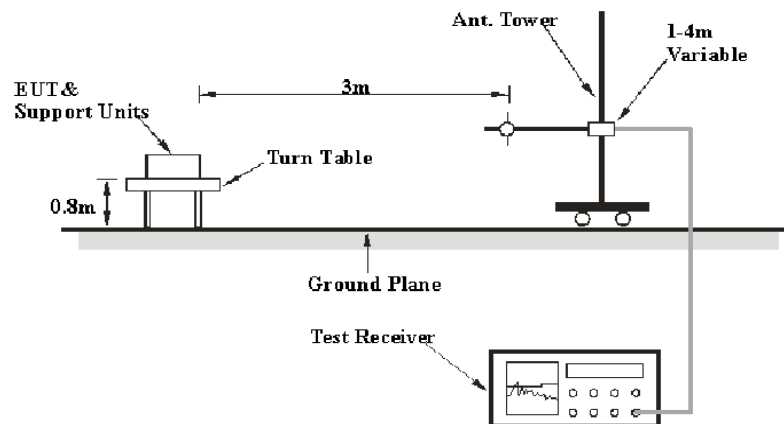
6G~25GHz: ± 5.47 dB;

Table 2 – Values of U_{cispr}

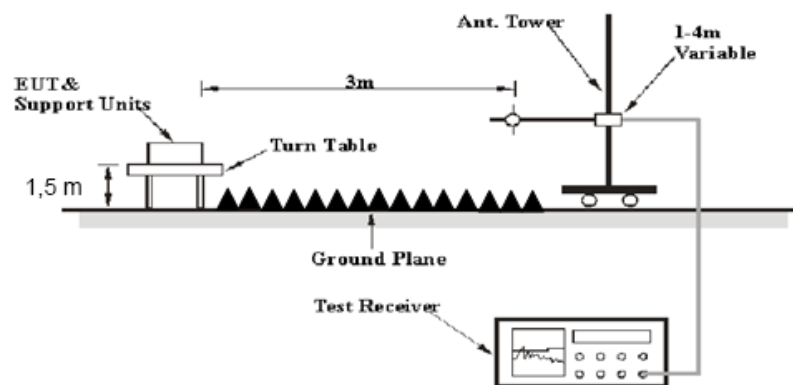
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

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	Detector
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.

Corrected Amplitude & Margin Calculation

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

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

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Amplifier	8447D	2944A10442	2015-12-02	2016-12-01
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2015-12-02	2016-12-01
Sunol Sciences	Broadband Antenna	JB3	A101808	2016-04-10	2019-04-09
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
ETS	Horn Antenna	3115	003-6076	2015-12-02	2016-12-01
Mini-circuits	Amplifier	ZVA-183-S+	771001215	2016-05-20	2017-05-19
EMCT	Semi-Anechoic Chamber	966	N/A	2015-04-24	2018-04-23
N/A	RF Cable (below 1GHz)	NO.1	N/A	2016-11-10	2017-11-09
N/A	RF Cable (below 1GHz)	NO.4	N/A	2016-11-10	2017-11-09
N/A	RF Cable (above 1GHz)	NO.2	N/A	2016-11-10	2017-11-09

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	61 %
ATM Pressure:	100.8 kPa

* The testing was performed by Kevin Hu on 2016-11-22.

Test Mode: Transmitting

30MHz-10GHz:

Tested Model: MR6121E

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: 903 MHz									
903	89.72	PK	H	22.84	2.40	0.00	114.96	N/A	N/A
903	78.91	PK	V	22.84	2.40	0.00	104.15	N/A	N/A
902	38.3	PK	H	22.82	2.40	0.00	63.52	94.96	31.44
1806	79.4	PK	H	24.59	2.90	26.63	80.26	94.96	14.70
2709	49.28	PK	H	23.62	3.17	26.69	49.38	74.00	24.62
2709	45.38	AV	H	23.62	3.17	26.69	45.48	54.00	8.52
2709	51.4	PK	V	23.62	3.17	26.69	51.50	74.00	22.50
2709	47.50	AV	V	23.62	3.17	26.69	47.60	54.00	6.40
3612	38.62	PK	H	27.45	4.35	26.58	43.84	74.00	30.16
3612	34.72	AV	H	27.45	4.35	26.58	39.94	54.00	14.06
3612	40.56	PK	V	27.45	4.35	26.58	45.78	74.00	28.22
3612	36.66	AV	V	27.45	4.35	26.58	41.88	54.00	12.12
1976	37.68	PK	V	24.86	3.03	26.80	38.77	74.00	35.23
1976	25.31	AV	V	24.86	3.03	26.80	26.40	54.00	27.60
400.018	40.53	QP	H	16.10	1.64	28.23	30.04	46.00	15.96
108	45.83	QP	V	12.85	0.51	28.22	30.97	43.50	12.53
Middle Channel: 915 MHz									
915	88.82	PK	H	22.98	2.45	0.00	114.25	N/A	N/A
915	82.05	PK	V	22.98	2.45	0.00	107.48	N/A	N/A
1830	72.71	PK	H	24.63	2.92	26.65	73.61	94.25	20.64
2745	45.96	PK	H	23.69	3.21	26.65	46.21	74.00	27.79
2745	42.06	AV	H	23.69	3.21	26.65	42.31	54.00	11.69
2745	46.09	PK	V	23.69	3.21	26.65	46.34	74.00	27.66
2745	42.19	AV	V	23.69	3.21	26.65	42.44	54.00	11.56
3660	37.58	PK	H	27.64	4.42	26.58	43.06	74.00	30.94
3660	33.68	AV	H	27.64	4.42	26.58	39.16	54.00	14.84
3660	39.26	PK	V	27.64	4.42	26.58	44.74	74.00	29.26
3660	35.36	AV	V	27.64	4.42	26.58	40.84	54.00	13.16
1976	37.77	PK	V	24.86	3.03	26.80	38.86	74.00	35.14
1976	25.14	AV	V	24.86	3.03	26.80	26.23	54.00	27.77
2361	36.56	PK	H	23.67	3.01	26.87	36.37	74.00	37.63
2361	24.03	AV	H	23.67	3.01	26.87	23.84	54.00	30.16
400.018	40.58	QP	H	16.10	1.64	28.23	30.09	46.00	15.91
108	46.08	QP	V	12.85	0.51	28.22	31.22	43.50	12.28

High Channel: 927.5 MHz									
927.5	86.85	PK	H	23.13	2.49	0.00	112.47	N/A	N/A
927.5	79.2	PK	V	23.13	2.49	0.00	104.82	N/A	N/A
928	40.1	PK	H	23.14	2.50	0.00	65.74	92.47	26.73
1855	64.34	PK	H	24.67	2.94	26.68	65.27	92.47	27.2
2782.5	42.39	PK	H	23.77	3.24	26.62	42.78	74.00	31.22
2782.5	38.49	AV	H	23.77	3.24	26.62	38.88	54.00	15.12
2782.5	44.51	PK	V	23.77	3.24	26.62	44.90	74.00	29.10
2782.5	40.61	AV	V	23.77	3.24	26.62	41.00	54.00	13.00
3710	37.41	PK	H	27.84	4.49	26.57	43.17	74.00	30.83
3710	33.51	AV	H	27.84	4.49	26.57	39.27	54.00	14.73
3710	39.12	PK	V	27.84	4.49	26.57	44.88	74.00	29.12
3710	35.22	AV	V	27.84	4.49	26.57	40.98	54.00	13.02
1976	37.53	PK	V	24.86	3.03	26.80	38.62	74.00	35.38
1976	25.23	AV	V	24.86	3.03	26.80	26.32	54.00	27.68
400.018	41.05	QP	H	16.10	1.64	28.23	30.56	46.00	15.44
108	45.99	QP	V	12.85	0.51	28.22	31.13	43.50	12.37

Tested Model: MR6111A

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: 903 MHz									
903	94.96	PK	H	22.84	2.40	0.00	120.20	N/A	N/A
903	81.36	PK	V	22.84	2.40	0.00	106.60	N/A	N/A
902	38	PK	H	22.82	2.40	0.00	63.22	100.2	36.98
1806	77.66	PK	H	24.59	2.90	26.63	78.52	100.2	21.68
2709	50.71	PK	H	23.62	3.17	26.69	50.81	74.00	23.19
2709	46.81	AV	H	23.62	3.17	26.69	46.91	54.00	7.09
2709	56.38	PK	V	23.62	3.17	26.69	56.48	74.00	17.52
2709	52.48	AV	V	23.62	3.17	26.69	52.58	54.00	1.42
3612	43.81	PK	H	27.45	4.35	26.58	49.03	74.00	24.97
3612	39.91	AV	H	27.45	4.35	26.58	45.13	54.00	8.87
3612	45.75	PK	V	27.45	4.35	26.58	50.97	74.00	23.03
3612	41.85	AV	V	27.45	4.35	26.58	47.07	54.00	6.93
2101	37.45	PK	V	24.56	3.04	26.83	38.22	74.00	35.78
2101	25.08	AV	V	24.56	3.04	26.83	25.85	54.00	28.15
400.018	40.9	QP	H	16.10	1.64	28.23	30.41	46.00	15.59
108	45.9	QP	V	12.85	0.51	28.22	31.04	43.50	12.46
Middle Channel: 915 MHz									
915	93.82	PK	H	22.98	2.45	0.00	119.25	N/A	N/A
915	80.65	PK	V	22.98	2.45	0.00	106.08	N/A	N/A
1830	77.63	PK	H	24.63	2.92	26.65	78.53	99.25	20.72
2745	48.42	PK	H	23.69	3.21	26.65	48.67	74.00	25.33
2745	44.52	AV	H	23.69	3.21	26.65	44.77	54.00	9.23
2745	54.08	PK	V	23.69	3.21	26.65	54.33	74.00	19.67
2745	50.18	AV	V	23.69	3.21	26.65	50.43	54.00	3.57
3660	42.59	PK	H	27.64	4.42	26.58	48.07	74.00	25.93
3660	38.69	AV	H	27.64	4.42	26.58	44.17	54.00	9.83
3660	44.57	PK	V	27.64	4.42	26.58	50.05	74.00	23.95
3660	40.67	AV	V	27.64	4.42	26.58	46.15	54.00	7.85
2101	37.58	PK	V	24.56	3.04	26.83	38.35	74.00	35.65
2101	25.03	AV	V	24.56	3.04	26.83	25.80	54.00	28.20
2306	36.02	PK	H	23.86	3.01	26.86	36.03	74.00	37.97
2306	23.51	AV	H	23.86	3.01	26.86	23.52	54.00	30.48
400.018	40.79	QP	H	16.10	1.64	28.23	30.30	46.00	15.70
108	46.08	QP	V	12.85	0.51	28.22	31.22	43.50	12.28

High Channel: 927.5 MHz									
927.5	93.17	PK	H	23.13	2.49	0.00	118.79	N/A	N/A
927.5	77.57	PK	V	23.13	2.49	0.00	103.19	N/A	N/A
928	40	PK	H	23.14	2.50	0.00	65.64	98.79	33.15
1855	75.75	PK	H	24.67	2.94	26.68	76.68	98.79	22.11
2782.5	45.34	PK	H	23.77	3.24	26.62	45.73	74.00	28.27
2782.5	41.44	AV	H	23.77	3.24	26.62	41.83	54.00	12.17
2782.5	50.99	PK	V	23.77	3.24	26.62	51.38	74.00	22.62
2782.5	47.09	AV	V	23.77	3.24	26.62	47.48	54.00	6.52
3710	42.45	PK	H	27.84	4.49	26.57	48.21	74.00	25.79
3710	38.55	AV	H	27.84	4.49	26.57	44.31	54.00	9.69
3710	44.41	PK	V	27.84	4.49	26.57	50.17	74.00	23.83
3710	40.51	AV	V	27.84	4.49	26.57	46.27	54.00	7.73
2101	37.35	PK	V	24.56	3.04	26.83	38.12	74.00	35.88
2101	25.31	AV	V	24.56	3.04	26.83	26.08	54.00	27.92
400.018	41.13	QP	H	16.10	1.64	28.23	30.64	46.00	15.36
108	45.88	QP	V	12.85	0.51	28.22	31.02	43.50	12.48

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
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested 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:	28.8 °C
Relative Humidity:	47 %
ATM Pressure:	101.1 kPa

* The testing was performed by Kevin Hu on 2016-11-23.

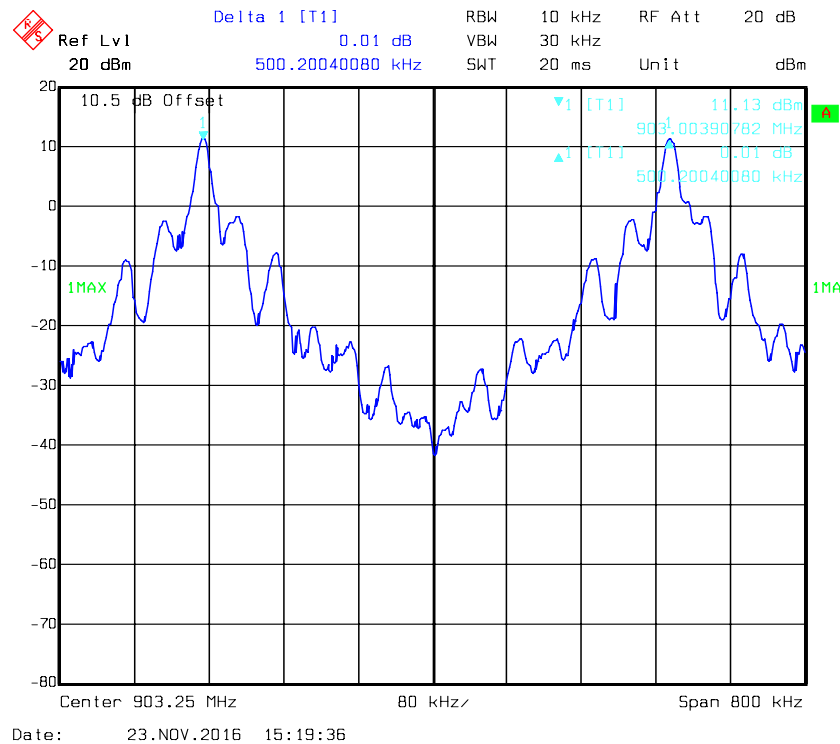
Test Result: Compliance.

Please refer to following tables and plots

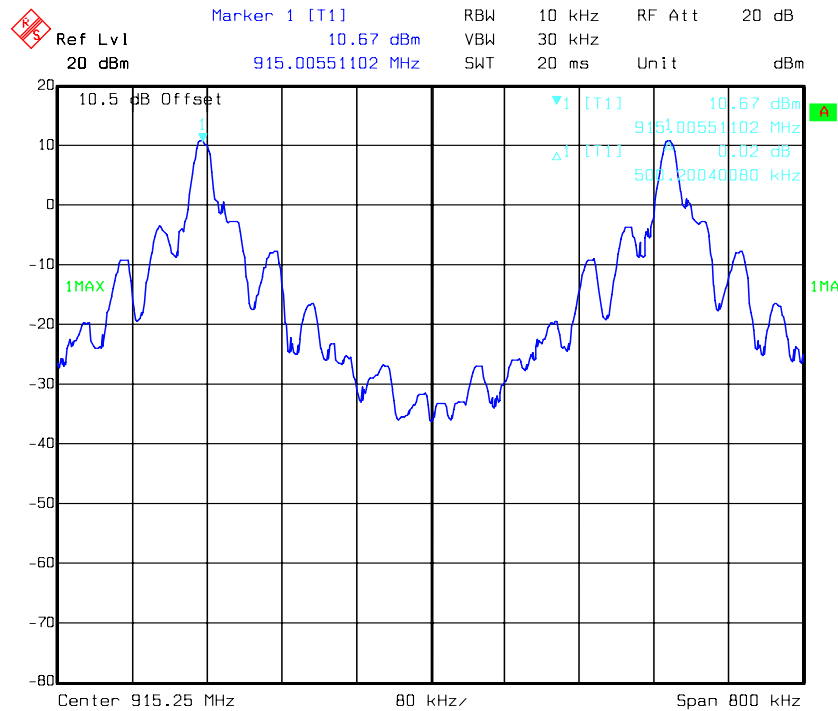
Test Mode: Transmitting

Channel	Frequency	Channel Separation	Limit
	MHz	MHz	MHz
Low	903	0.500	0.089
Middle	915	0.500	0.091
High	927.5	0.502	0.089

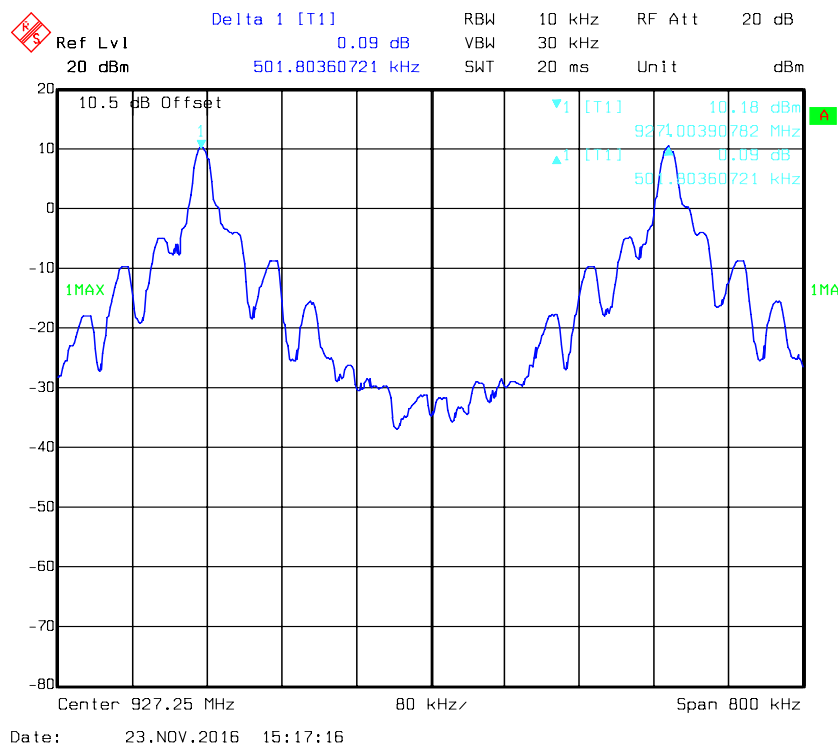
Low Channel



Middle Channel



High Channel



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
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	26.9 °C
Relative Humidity:	34 %
ATM Pressure:	101.1 kPa

* The testing was performed by Kevin Hu on 2016-11-23.

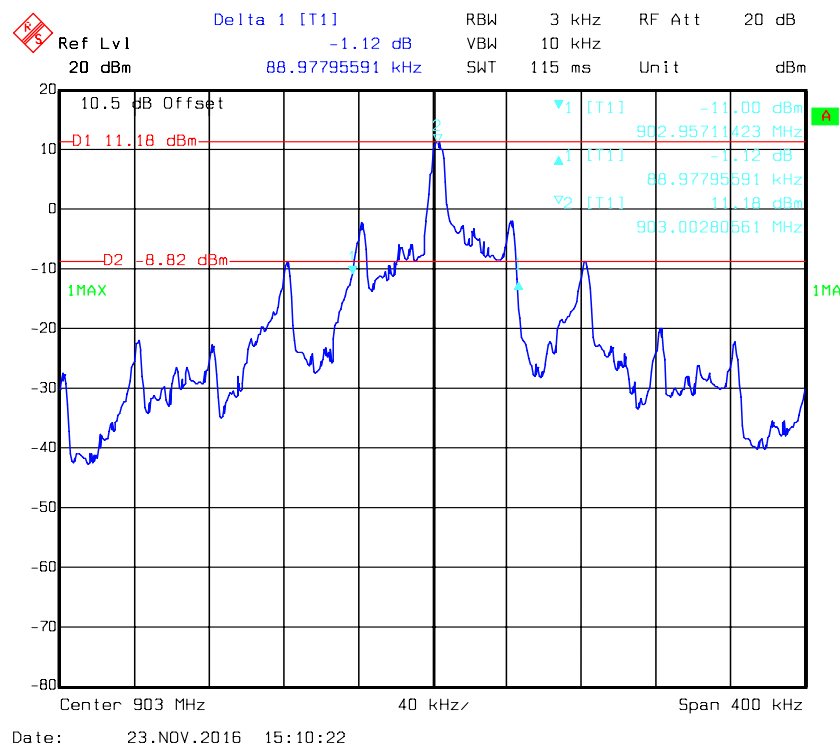
Test Result: Compliance.

Please refer to following tables and plots

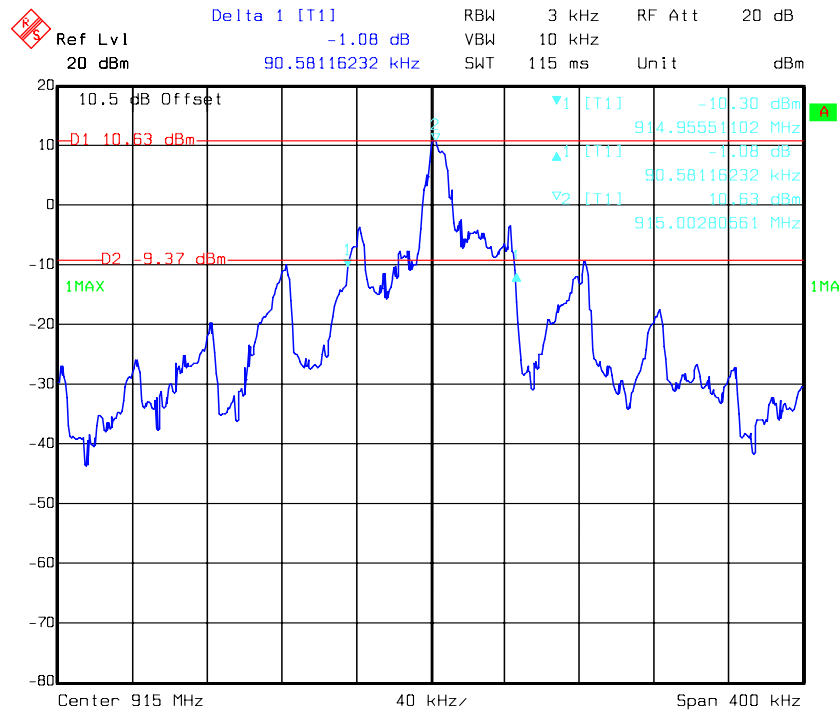
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	903	88.98
Middle	915	90.58
High	927.5	88.98

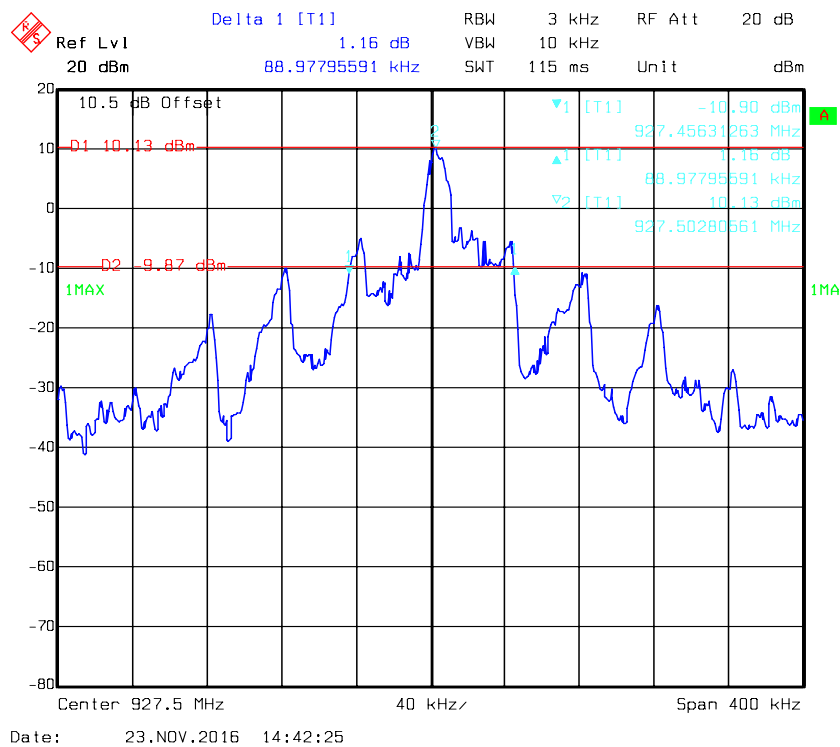
Low Channel



Middle Channel



High Channel



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
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	26.9 °C
Relative Humidity:	34 %
ATM Pressure:	101.1 kPa

* The testing was performed by Kevin Hu on 2016-11-23.

Test Result: Compliance.

Please refer to following tables and plots

Page 33 of 42

Number of Hopping Channels

Delta 1 [T1] -1.84 dB RBW 100 kHz RF Att 20 dB
 Ref Lvl 20 dBm VBW 300 kHz
 24.54108216 MHz SWT 6.5 ms Unit dBm

10.5 dB Offset

1 [T1] 11.24 dBm
 903.04208417 MHz
 903.04208417 MHz

1MAX

Start 902 MHz 2.6 MHz Stop 928 MHz

Date: 23.NOV.2016 15:22:30

FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWEIL 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; Spectrum SPAN was set as 0. Sweep was set as 20s. In addition, the time of single pulses was tested.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	26.9 °C
Relative Humidity:	34 %
ATM Pressure:	101.1 kPa

* The testing was performed by Kevin Hu on 2016-11-23.

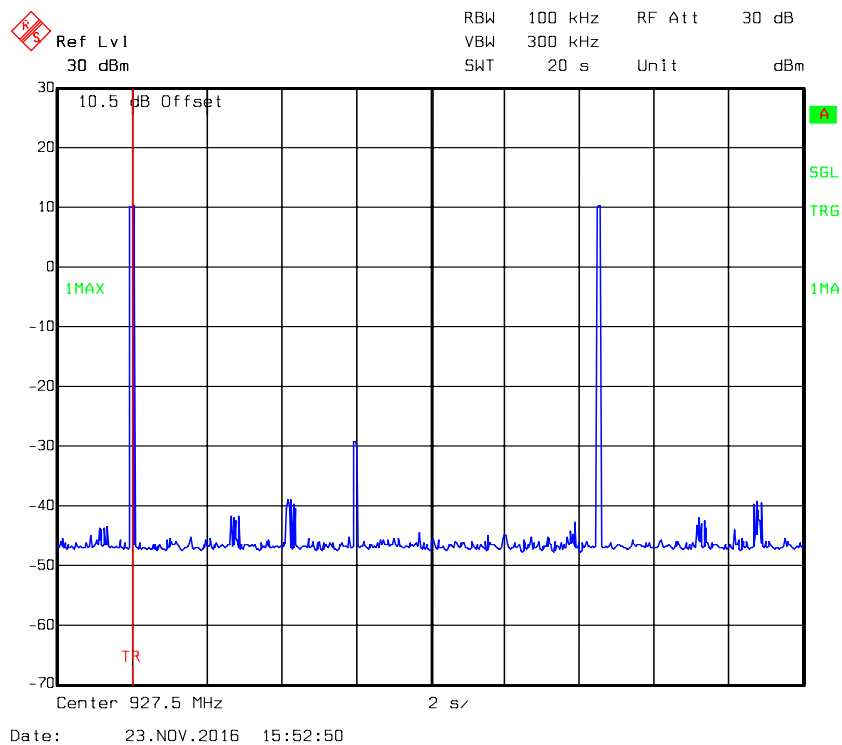
Test Result: Compliance.

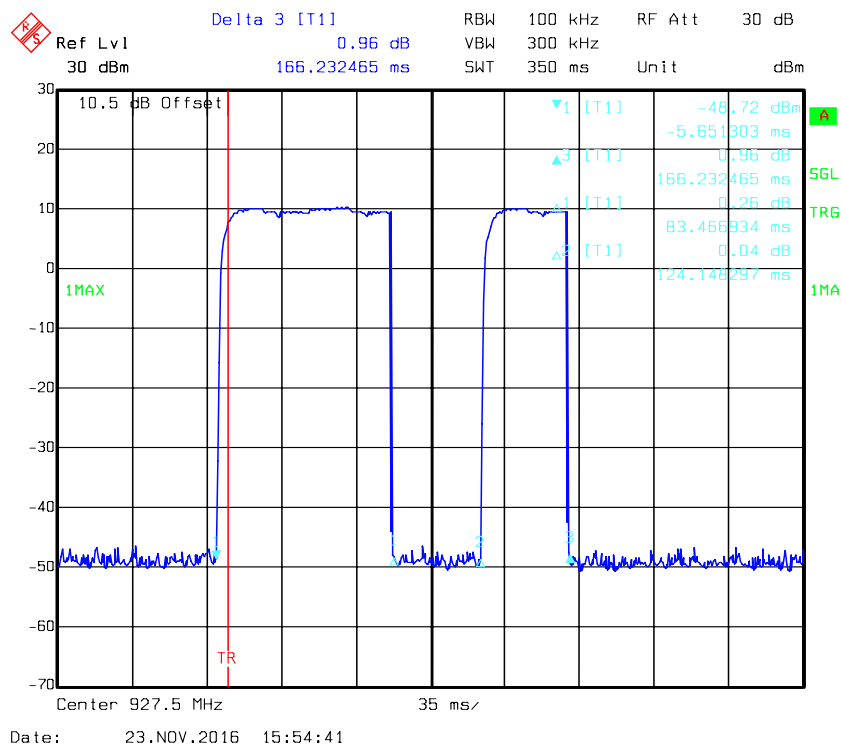
Please refer to following tables and plots

Test Mode: Transmitting

Channel	Pulse Width (ms)	Hopping Number Per 20s	Dwell Time (s)	Limit (s)	Result
Low	124	2	0.248	0.4	Compliance
Note: Dwell time=Pulse time (ms) × hopping number in 20s					

Low Channel





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
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	26.9 °C
Relative Humidity:	34 %
ATM Pressure:	101.1 kPa

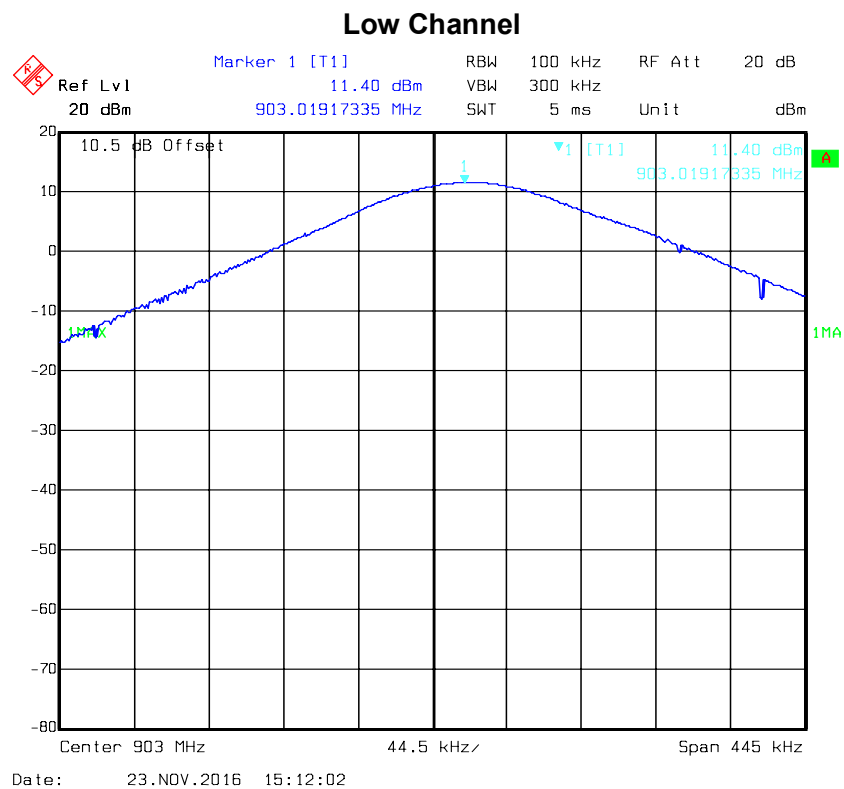
* The testing was performed by Kevin Hu on 2016-11-23.

Test Result: Compliance.

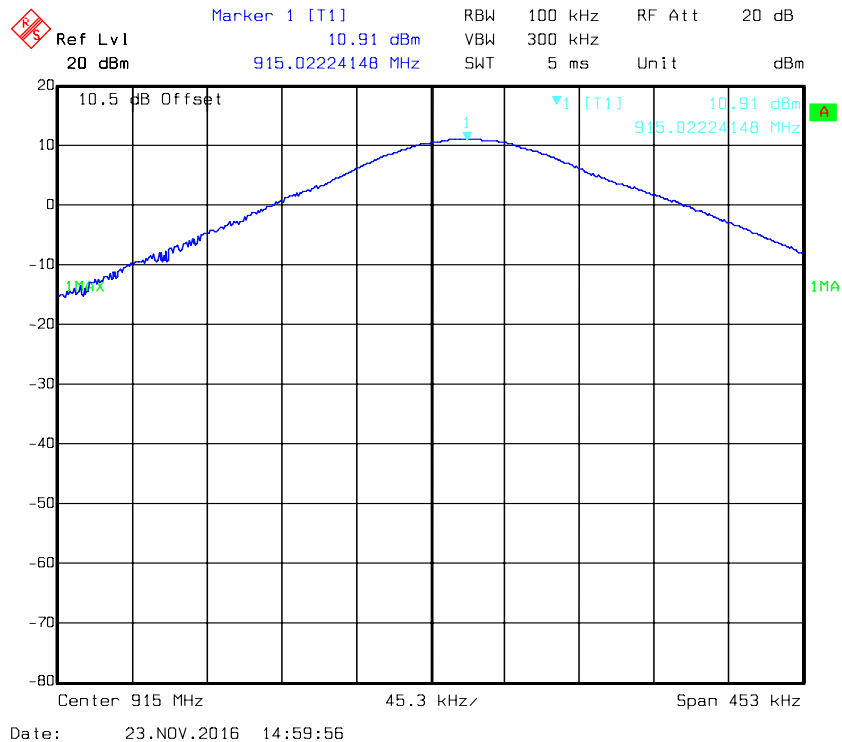
Test Mode: Transmitting

Frequency (MHz)	Peak Output power (dBm)	Limit (dBm)
903	11.4	24
915	10.91	24
927.5	10.39	24

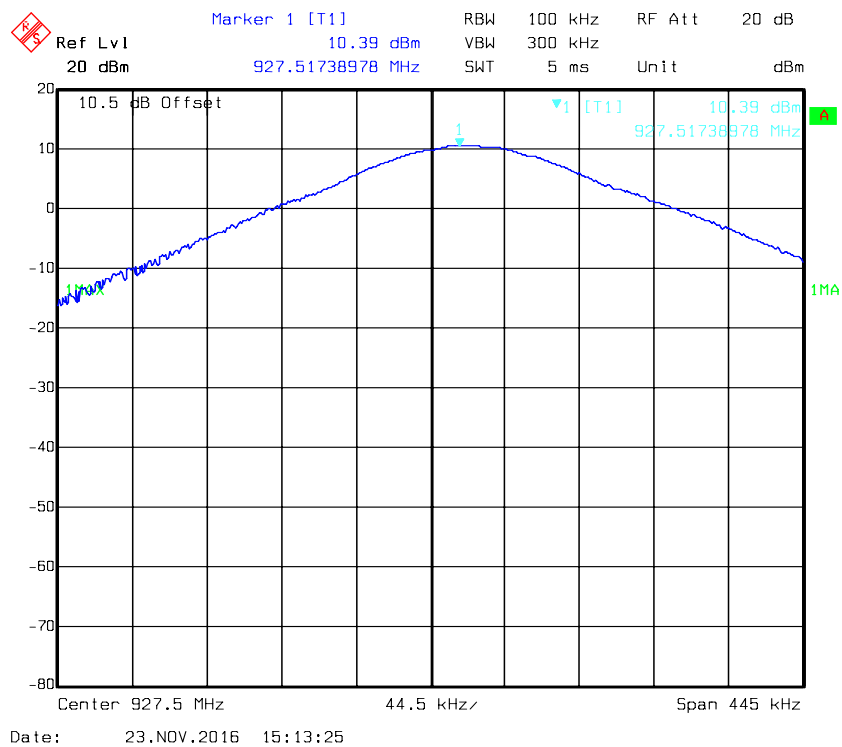
Note: The data above was tested in conducted mode.



Middle Channel



High Channel



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 both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2015-12-02	2016-12-01
N/A	RF Cable	N/A	N/A	Each Time	/
N/A	10dB attenuator	N/A	N/A	Each Time	/

* **Statement of Traceability:** BACL (Chengdu) attested that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

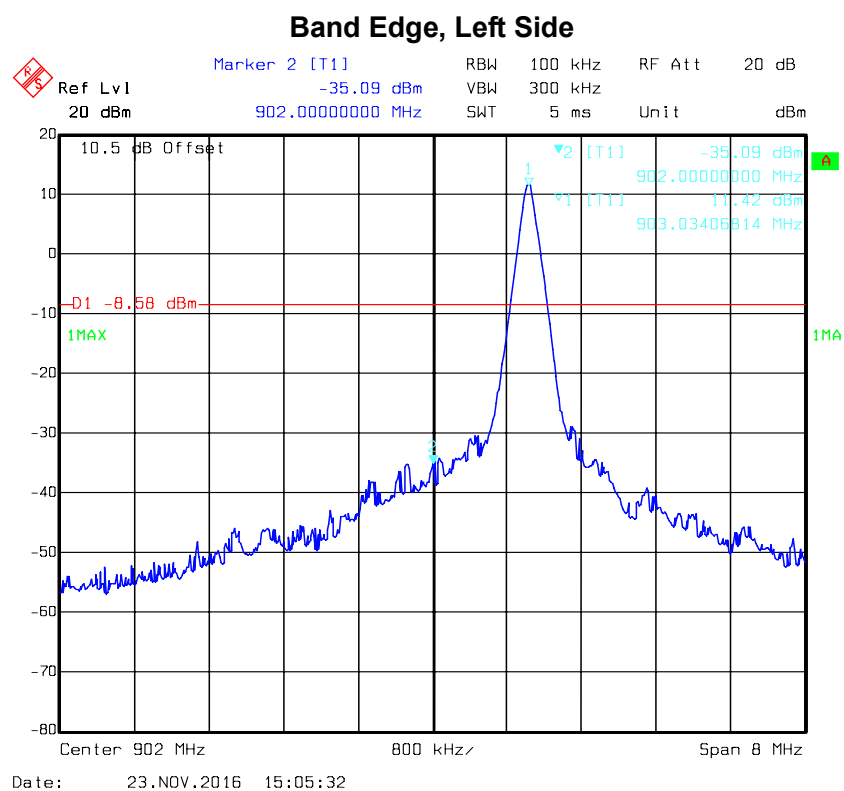
Test Data

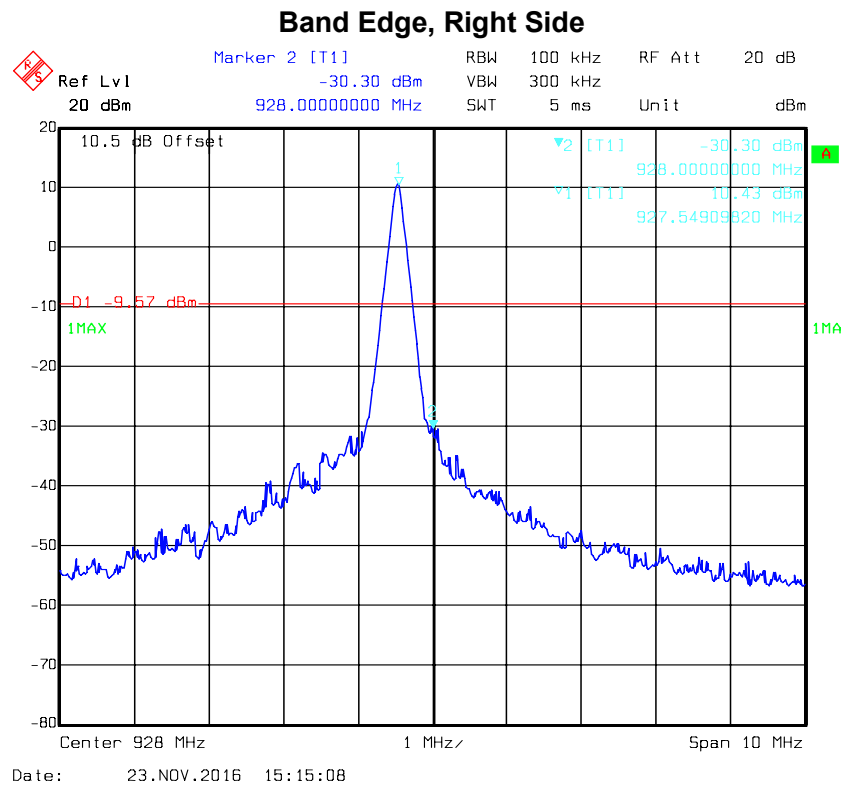
Environmental Conditions

Temperature:	26.9 °C
Relative Humidity:	34 %
ATM Pressure:	101.1 kPa

* The testing was performed by Kevin Hu on 2016-11-23.

Test Result: Compliance





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