

FCC PART 15.249

TEST REPORT

For

BRANFORD LIMITED

15TH FLOOR, RAILWAY PLAZA, 39 CHATHAM ROAD SOUTH, TSIMSHATSUI,
KOWLOON, Hong Kong

FCC ID: 2ADMY2-4GHZAB5016TR

Report Type: Original Report	Product Type: Remote Control Locomotive
Test Engineer: <u>Xiangguang Kong</u>	<i>Xiangguang Kong</i>
Report Number: <u>RSZ150807802-00</u>	
Report Date: <u>2015-08-31</u>	
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Note: This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
TEST FACILITY	3
SYSTEM TEST CONFIGURATION.....	4
JUSTIFICATION	4
EQUIPMENT MODIFICATIONS	4
SUPPORT EQUIPMENT LIST AND DETAILS	4
SUPPORT CABLE DESCRIPTIONS.....	4
BLOCK DIAGRAM OF TEST SETUP	4
SUMMARY OF TEST RESULTS	5
FCC§15.203 - ANTENNA REQUIREMENT.....	6
APPLICABLE STANDARD	6
ANTENNA CONNECTOR CONSTRUCTION	6
FCC§15.205, §15.209 & §15.249 - RADIATED EMISSIONS	7
APPLICABLE STANDARD	7
MEASUREMENT UNCERTAINTY.....	7
TEST EQUIPMENT SETUP.....	8
EUT SETUP.....	8
TEST PROCEDURE	9
CORRECTED AMPLITUDE & MARGIN CALCULATION	9
TEST EQUIPMENT LIST AND DETAILS.....	9
TEST RESULTS SUMMARY	10
TEST DATA	10
FCC§15.215(C) - 20DB EMISSION BANDWIDTH	14
APPLICABLE STANDARD	14
TEST PROCEDURE	14
TEST EQUIPMENT LIST AND DETAILS.....	14
TEST DATA	14

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *BRANFORD LIMITED* 's product, model number: *AB5016 (FCC ID:2ADMY2-4GHZAB5016TR)* or the "EUT" in this report was a *Remote Control Locomotive*, was measured approximately: 112 mm (L) × 38 mm (W) × 50 mm (H), rated input voltage: DC 2*1.5V battery.

**All measurement and test data in this report was gathered from production sample serial number: 1508801 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2015-08-07.*

Objective

This type approval report is prepared on behalf of *BRANFORD LIMITED* in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

N/A

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

Measurement uncertainty with radiated emission is 5.91 dB for 30MHz-1GHz.and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) 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 October 31, 2013. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10-2013.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. 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

Justification

The system was configured for testing in an engineering mode.

Equipment Modifications

No modifications were made to the unit tested.

Support Equipment List and Details

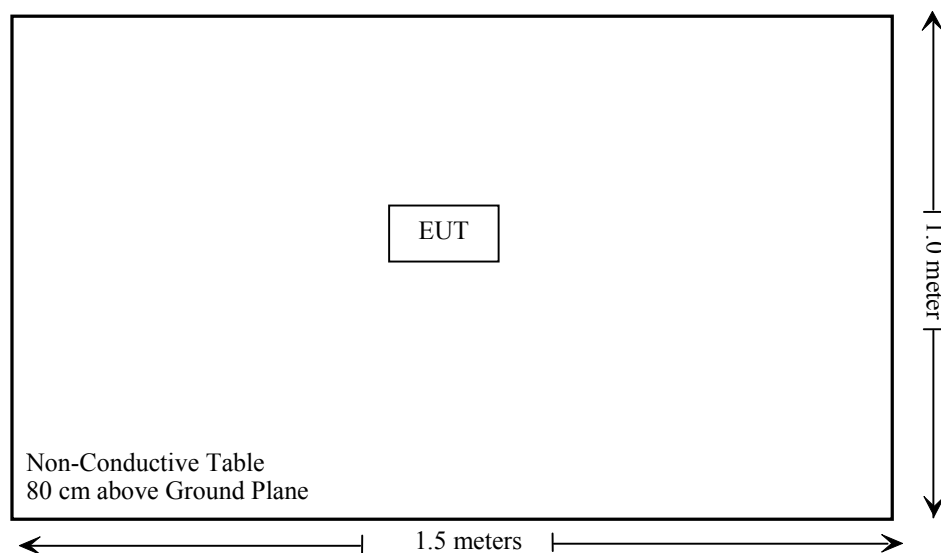
Manufacturer	Description	Model	Serial Number
/	/	/	/

Support Cable Descriptions

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

For Below 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§ 15.203	Antenna Requirement	Compliance
§ 15.207(a)	Conduction Emissions	Not Applicable
15.205, § 15.209, § 15.249	Radiated Emissions	Compliance
§ 15.215(c)	20dB Emission Bandwidth	Compliance

Not Applicable: The EUT is powered by the battery.

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, 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.

Antenna Connector Construction

The EUT has an internal monopole antenna arrangement which was permanently attached and the antenna gain is -0.3 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC§15.205, §15.209 & §15.249 - RADIATED EMISSIONS**Applicable Standard**

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is 5.91 dB for 30MHz-1GHz, 4.92 dB for above 1GHz, and it will not be taken into consideration for the test data recorded in the report

Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

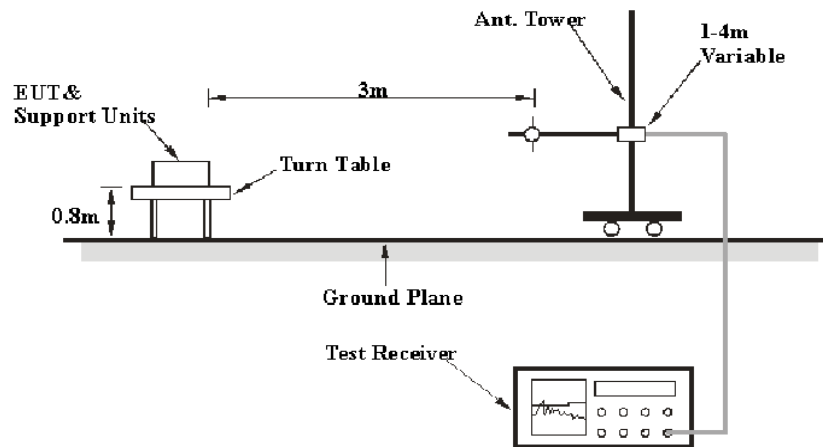
Above 1000MHz:

Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto

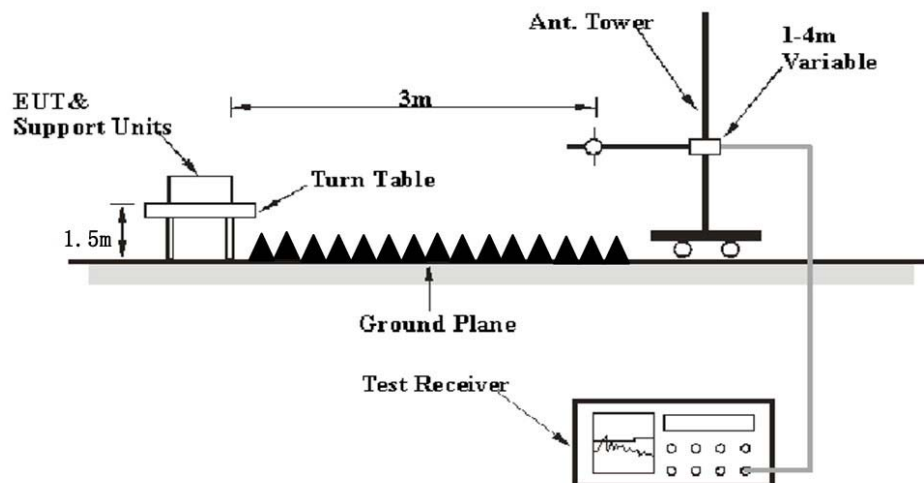
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission and out of band 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 15.209/15.205 and FCC 15.249 limits.

Test Procedure

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

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Amplifier	HP8447E	1937A01046	2015-05-06	2016-05-06
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2014-11-03	2015-11-03
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2014-12-07	2017-12-06
A.H. System	Horn Antenna	SAS-200/571	135	2013-02-10	2016-02-10
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2014-12-11	2015-12-11
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2015-06-13	2016-06-13
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2015-04-03	2016-04-03
DUCOMMUN	Pre-amplifier	ALN-22093530-01	991373-01	2015-08-03	2016-08-03
EMCO	Horn Antenna	3115	00027188	2013-07-30	2016-07-29
Rohde & Schwarz	Auto test Software	EMC32	V9.10	NCR	NCR

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

Test Results Summary

According to the data in the following table, the worst margin reading as below:

3.30 dB at 7215.00MHz in the Horizontal polarization for Low Channel

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(L_m)} \leq L_{\text{lim}} + U_{\text{cispr}}$$

In BACL, $U_{(L_m)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Xiangguang Kong on 2015-08-30.

Test Mode: Transmitting

Please refer to the following tables and plots.

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.249/15.205/15.209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2405 MHz)									
580.23	40.97	QP	340	1.6	H	-7.9	33.07	46	12.93
2405.00	79.57	PK	159	2.4	H	4.97	84.54	114	29.46
2405.00	75.31	Ave.	159	2.4	H	4.97	80.28	94	13.72
2405.00	75.86	PK	80	2.3	V	4.97	80.83	114	33.17
2405.00	71.97	Ave.	80	2.3	V	4.97	76.94	94	17.06
2381.02	34.32	PK	54	2.0	H	4.97	39.29	74	34.71
2381.02	20.52	Ave.	54	2.0	H	4.97	25.49	54	28.51
2356.81	34.14	PK	77	1.3	H	4.97	39.11	74	34.89
2356.81	20.52	Ave.	77	1.3	H	4.97	25.49	54	28.51
2487.33	37.92	PK	301	1.9	H	6.29	44.21	74	29.79
2487.33	17.00	Ave.	301	1.9	H	6.29	23.29	54	30.71
4810.00	42.95	PK	298	2.3	H	11.91	54.86	74	19.14
4810.00	37.00	Ave.	298	2.3	H	11.91	48.91	54	5.09
7215.00	40.22	PK	201	1.6	H	17.40	57.62	74	16.38
7215.00	33.30	Ave.	201	1.6	H	17.40	50.70	54	3.30
9620.00	30.14	PK	350	1.8	H	22.54	52.68	74	21.32
9620.00	15.34	Ave.	350	1.8	H	22.54	37.88	54	16.12
Middle Channel (2442 MHz)									
580.23	40.06	QP	67	2.3	H	-7.9	32.16	46	13.84
2442.00	75.19	PK	110	1.4	H	4.97	80.16	114	33.84
2442.00	71.06	Ave.	110	1.4	H	4.97	76.03	94	17.97
2442.00	70.14	PK	283	1.8	V	4.97	75.11	114	38.89
2442.00	65.98	Ave.	283	1.8	V	4.97	70.95	94	23.05
2382.14	34.97	PK	329	1.4	H	4.97	39.94	74	34.06
2382.14	21.43	Ave.	329	1.4	H	4.97	26.40	54	27.60
2370.12	35.44	PK	183	1.9	H	4.97	40.41	74	33.59
2370.12	23.71	Ave.	183	1.9	H	4.97	28.68	54	25.32
2489.65	33.30	PK	119	2.2	H	6.29	39.59	74	34.41
2489.65	18.34	Ave.	119	2.2	H	6.29	24.63	54	29.37
4884.00	42.54	PK	49	2.3	H	12.49	55.03	74	18.97
4884.00	36.55	Ave.	49	2.3	H	12.49	49.04	54	4.96
7326.00	38.88	PK	97	2.1	H	17.72	56.60	74	17.40
7326.00	30.98	Ave.	97	2.1	H	17.72	48.70	54	5.30
9768.00	30.02	PK	175	1.9	H	23.60	53.62	74	20.38
9768.00	15.41	Ave.	175	1.9	H	23.60	39.01	54	14.99

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.249/15.205/15.209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
High Channel (2468 MHz)									
580.23	39.69	QP	75	1.1	H	-7.9	31.79	46	14.21
2468.00	81.67	PK	107	1.0	H	6.29	87.96	114	26.04
2468.00	77.44	Ave.	107	1.0	H	6.29	83.73	94	10.27
2468.00	77.58	PK	176	2.2	V	6.29	83.87	114	30.13
2468.00	72.98	Ave.	176	2.2	V	6.29	79.27	94	14.73
2372.04	37.55	PK	212	1.2	H	4.97	42.52	74	31.48
2372.04	27.88	Ave.	212	1.2	H	4.97	32.85	54	21.15
2384.22	37.13	PK	270	2.0	H	4.97	42.10	74	31.90
2384.22	26.54	Ave.	270	2.0	H	4.97	31.51	54	22.49
2491.86	35.14	PK	50	1.3	H	6.29	41.43	74	32.57
2491.86	23.71	Ave.	50	1.3	H	6.29	30.00	54	24.00
4936.00	42.85	PK	353	2.0	H	12.49	55.34	74	18.66
4936.00	37.83	Ave.	353	2.0	H	12.49	50.32	54	3.68
7404.00	38.52	PK	259	2.2	H	18.01	56.53	74	17.47
7404.00	32.06	Ave.	259	2.2	H	18.01	50.07	54	3.93
9872.00	30.65	PK	159	2.2	H	23.60	54.25	74	19.75
9872.00	17.00	Ave.	159	2.2	H	23.60	40.60	54	13.40

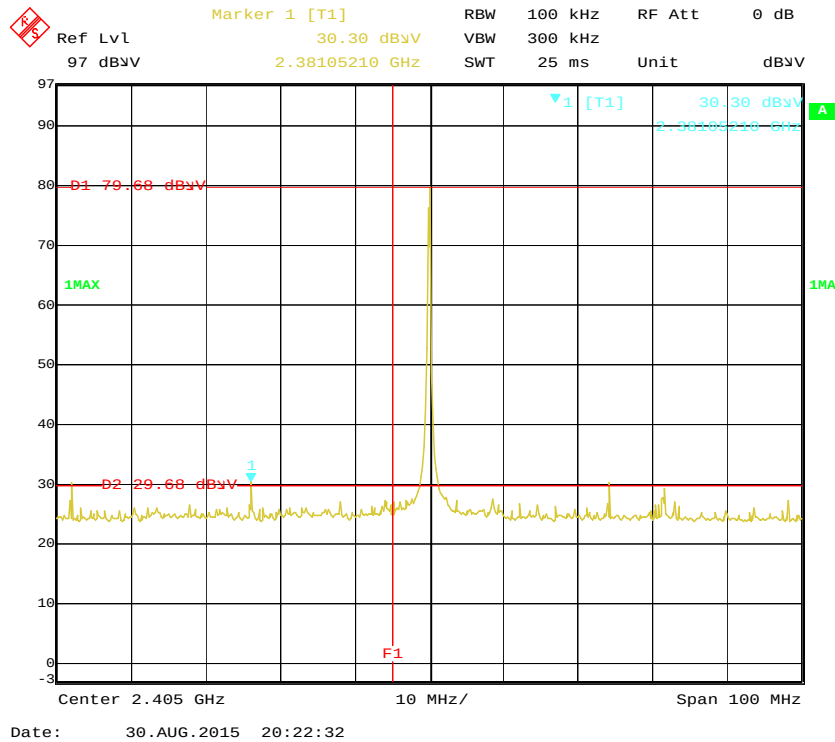
Note:

Corrected Amplitude = Corrected Factor + Reading

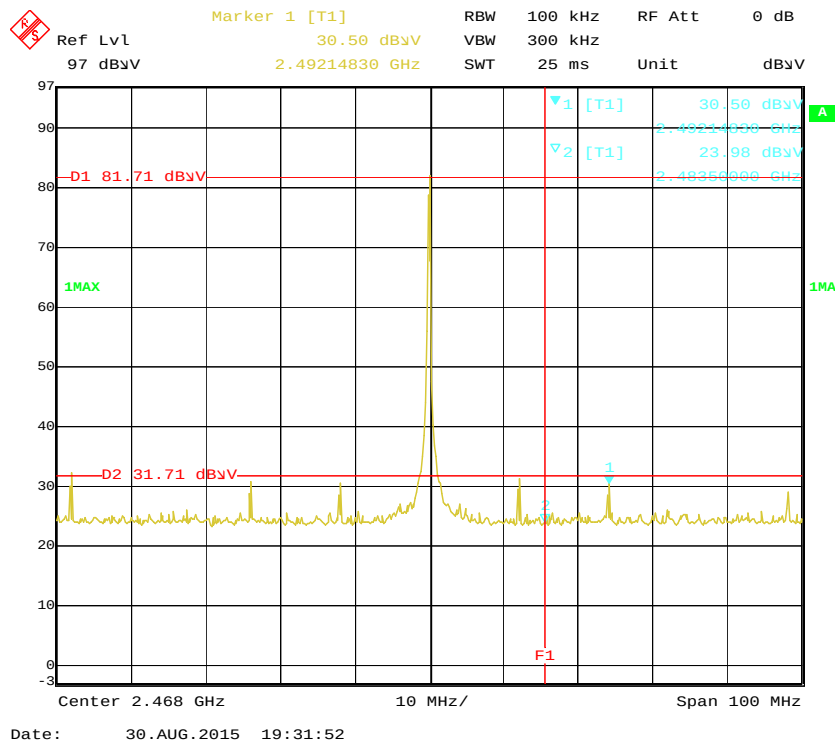
Corrected Factor = Antenna Factor (Rx) + Cable Loss – Amplifier Factor

Margin = Limit - Corr. Amplitude

Band edge -Left Side



Band edge -Right Side



Note: All the emission complies with 15.209 rules.

FCC§15.215(c) - 20dB EMISSION BANDWIDTH**Applicable Standard**

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. 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 indicated 20dB 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	Signal Analyzer	FSIQ26	8386001028	2014-12-11	2015-12-11

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

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Xiangguang Kong on 2015-08-30.

Test Mode: Transmitting

Please refer to the following table and plots.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2405	0.216
Middle	2442	0.182
High	2468	0.192

Ref Lvl 97 dBmV
 Marker 1 [T1] 58.47 dBmV
 2.40498096 GHz
 RBW 30 kHz
 VBW 100 kHz
 SWT 5 ms
 RF Att 0 dB
 Unit dBmV

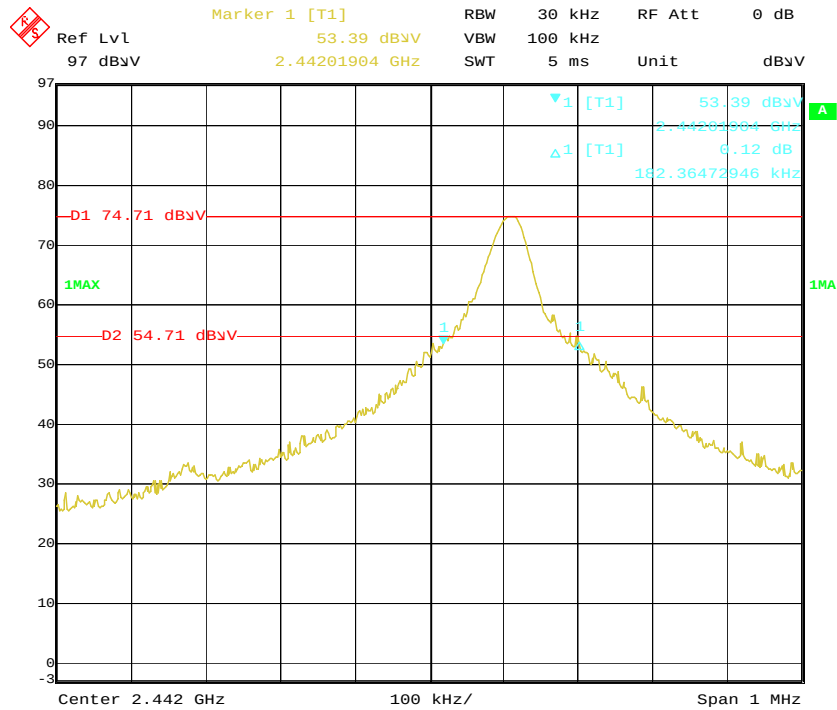
1 [T1] 58.47 dBmV
 2.40498096 GHz
 -6.44 dB
 236.43286573 kHz

1MAX
 2 59.25 dBmV
 F1

Center 2.405 GHz
 100 kHz/
 Span 1 MHz

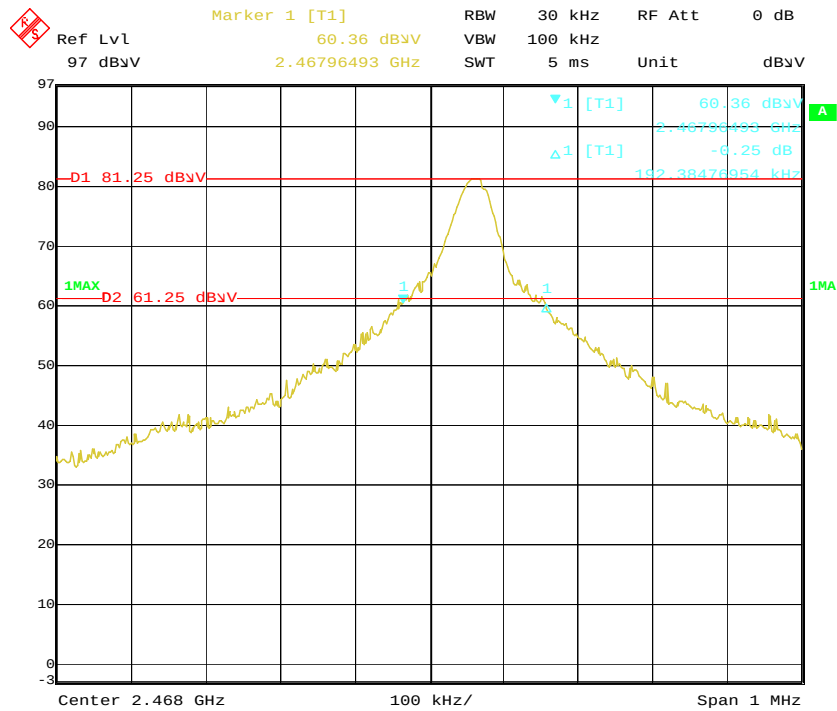
Date: 30.AUG.2015 20:20:05

Middle Channel



Date: 30.AUG.2015 20:02:08

High Channel



Date: 30.AUG.2015 19:30:10

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