

FCC PART 15.231


TEST REPORT

For

LA CROSSE TECHNOLOGY LTD.

2809 Losey Blvd. S.La Crosse Wisconsin United States 54601

FCC ID: OMOTX141-AV2

Report Type: Original Report	Product Type: Remote Transmitter
Test Engineer: Ares Liu	
Report Number: RDG140725004-00	
Report Date: 2014-08-15	
Reviewed By: Sula Huang RF Engineer	
Test Laboratory: Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn	

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *LA CROSSE TECHNOLOGY LTD.*'s product, model number: *TX141-AV2*(FCC ID: *OMOTX141-AV2*) (the "EUT") in this report is a *Transmitter*, which was measured approximately: 13.0 cm (L) x 4.0 cm (W) x 2.0 cm (H), rated input voltage: DC 3V from 2*AA battery.

All measurement and test data in this report was gathered from production sample serial number: 140725004. (Assigned by BACL, Dongguan). The EUT was received on 2014-07-28.

Objective

This document is a test report based on the Electromagnetic Interference (EMI) tests performed on the EUT. The EMI measurements were performed according to the measurement procedure described in ANSI C63.4-2003.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.35(c) and 15.231 rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4 - 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

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 Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) 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 February 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

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.

SYSTEM TEST CONFIGURATION

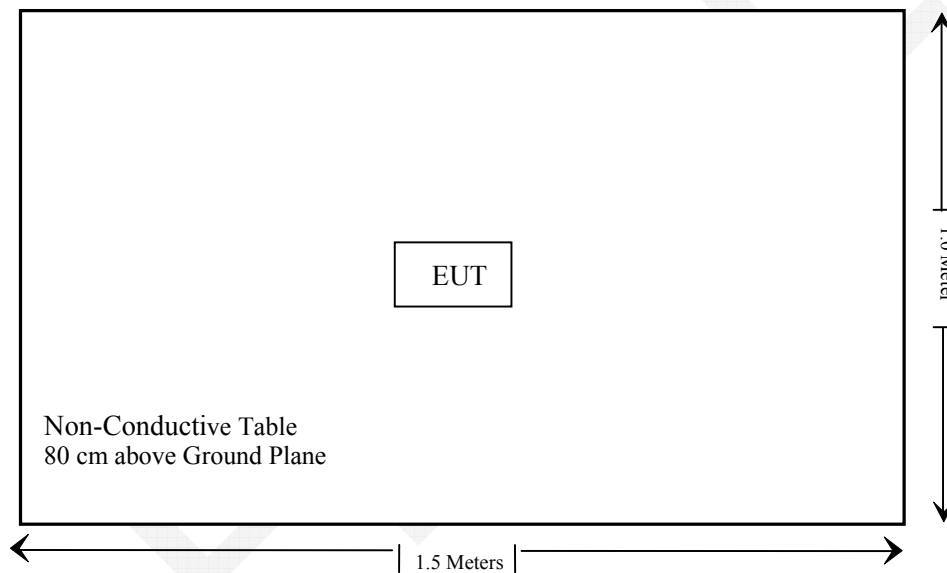
Justification

The system was configured in testing mode which was provided by manufacturer.

Equipment Modifications

No modifications were made to the unit tested.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Not applicable*
§15.205, §15.209, §15.231 (e)	Radiated Emissions	Compliance
§15.231 (c)	20dB Bandwidth Testing	Compliance
§15.231 (e)	Deactivation Testing	Compliance

Not applicable*: The EUT is battery operated equipment.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Result: Compliant.

The EUT has one integral antenna arrangement, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

FEMVA

FCC §15.205, §15.209, §15.231 (e) - RADIATED EMISSIONS

Applicable Standard

FCC §15.205, §15.209, §15.231 (e)

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 radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:

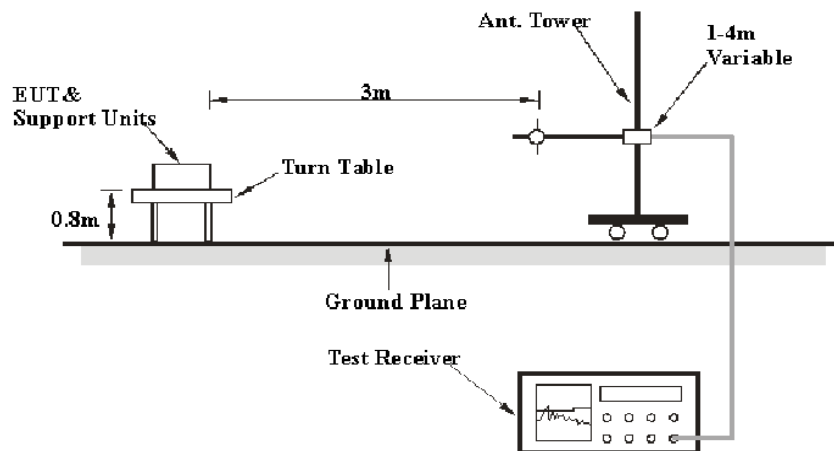
- 30M~200MHz: 5.0 dB
- 200M~1GHz: 6.2 dB
- 1G~6GHz: 4.45 dB
- 6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

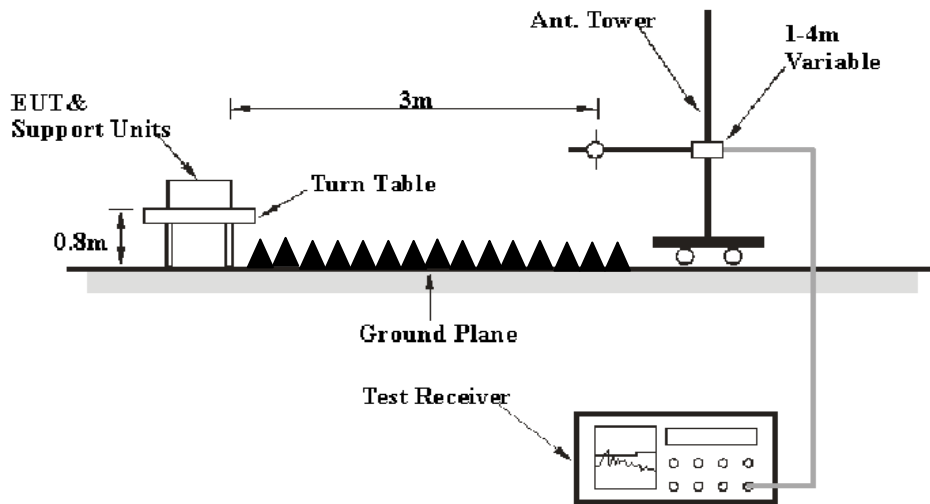
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.4 - 2003. The specification used was the FCC 15 § 15.209, 15.205 and 15.231.

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

EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	100 kHz	300 kHz	100kHz	PK
1 GHz – 5 GHz	1MHz	3 MHz	/	PK

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2014-05-09	2015-05-08
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
HP	Amplifier	8447E	2434A02181	2013-09-06	2014-09-05
R&S	Spectrum Analyzer	FSEM	DE31388	2014-05-09	2015-05-08
ETS-Lindgren	Horn Antenna	3115	000 527 35	2012-09-06	2015-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2014-02-19	2015-02-18

*** 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

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

According to §15.231, Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector

Applicable Standard

According to §15.231 (e), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field Strength of Fundamental (Microvolts /meter)	Field Strength of spurious emissions ((Microvolts /meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500 *	50 to 150 *
174-260	1,500	150
260-470	1,500 to 5,000*	150 to 500*
Above 470	5,000	500

*Linear interpolations.

The above field strength limits are specified at a distance of 3-meters the tighter limits apply at the band edges.

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 Results Summary

According to the data in the following table, the EUT complied with the CFR47 §15.205, §15.209, §15.231 (e), with the worst margin reading of:

6.0 dB at 433.92 MHz in the Horizontal polarization

Test Data

Environmental Conditions

Temperature:	26.8 °C
Relative Humidity:	57 %
ATM Pressure:	99.6 kPa

The testing was performed by Ares Liu from 2014-08-13.

Test mode: Transmitting

Field Strength (Peak)

Frequency (MHz)	Receiver Reading (dBµV)	Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	15.231(e)	
		Polar (H/V)	Factor (dB)				Limit (dBµV/m)	Margin (dB)
Operating Frequency:433.92 MHz								
433.92	75.37	H	16.85	2.49	21.85	72.86	92.87	20.01
433.92	69.08	V	16.85	2.49	21.85	66.57	92.87	26.30
867.84	39.76	H	22.50	3.59	22.23	43.62	72.87	29.24
867.84	38.13	V	22.50	3.59	22.23	41.99	72.87	30.87
1301.76	36.17	H	25.30	2.55	27.26	36.77	74.00	37.23
1301.76	35.77	V	25.30	2.55	27.26	36.37	74.00	37.63
1735.68	40.62	H	27.06	3.31	27.44	43.55	72.87	29.32
1735.68	39.07	V	27.06	3.31	27.44	42.00	72.87	30.87
2169.6	42.49	H	29.75	3.46	27.76	47.94	72.87	24.93
2169.6	41.65	V	29.75	3.46	27.76	47.10	72.87	25.77
2603.52	33.28	H	31.46	3.95	27.67	41.02	72.87	31.85
2603.52	33.41	V	31.46	3.95	27.67	41.15	72.87	31.72
3037.44	33.28	H	30.96	6.49	27.46	43.28	72.87	29.59
3037.44	33.87	V	30.96	6.49	27.46	43.87	72.87	29.00

Field Strength (Average)

Frequency (MHz)	Peak Measurement @ 3m (dBµV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dBµV/m)	15.231(e)	
					Limit (dBµV/m)	Margin (dB)
Operating Frequency:433.92 MHz						
433.92	72.86	H	-5.99	66.86	72.87	6.00
433.92	66.57	V	-5.99	60.57	72.87	12.29
867.84	43.62	H	-5.99	37.63	52.87	15.24
867.84	41.99	V	-5.99	36.00	52.87	16.87
1301.76	36.77	H	-5.99	30.78	54.00	23.22
1301.76	36.37	V	-5.99	30.38	54.00	23.62
1735.68	43.55	H	-5.99	37.55	52.87	15.31
1735.68	42.00	V	-5.99	36.00	52.87	16.86
2169.6	47.94	H	-5.99	41.95	52.87	10.92
2169.6	47.10	V	-5.99	41.11	52.87	11.76
2603.52	41.02	H	-5.99	35.03	52.87	17.84
2603.52	41.15	V	-5.99	35.16	52.87	17.71
3037.44	43.28	H	-5.99	37.28	52.87	15.58
3037.44	43.87	V	-5.99	37.87	52.87	14.99

Note:

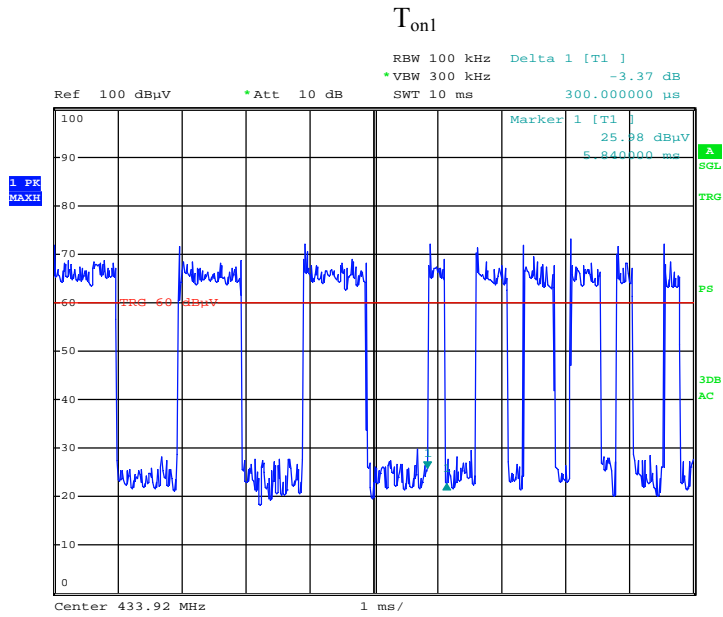
Calculate Average Value based on duty cycle correction factor:

$$\begin{aligned}
 \text{Duty cycle} &= T_{ON1} N_1 + T_{ON2} N_2 + T_{ON3} N_3 / 100 \\
 &= (0.3\text{ms} * 32 + 0.54\text{ms} * 28 + 1.06\text{ms} * 24) / 100 \\
 &= (9.6\text{ms} + 15.12\text{ms} + 25.44\text{ms}) / 100 \\
 &= 50.16\%
 \end{aligned}$$

$$\text{Duty cycle correction factor} = 20 * \log(\text{duty cycle}) = 20 * \log(50.16\%) = -5.99\text{dB}$$

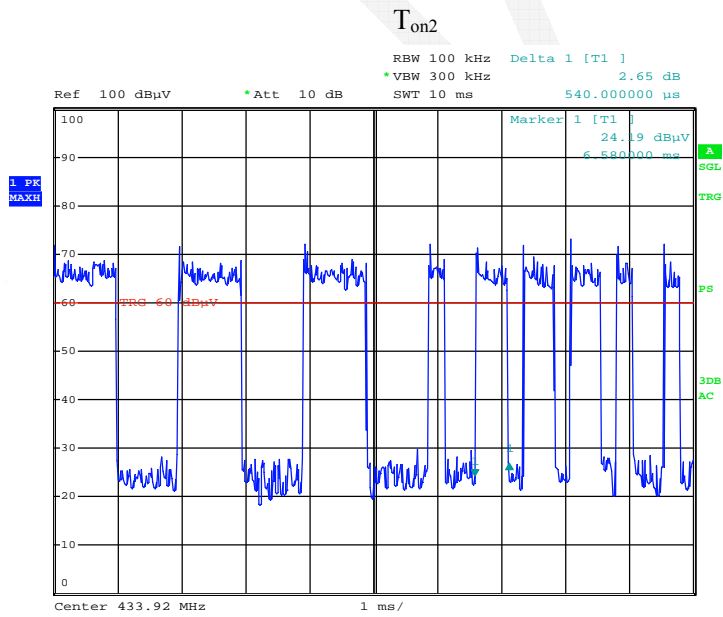
$$\text{Average} = \text{Peak} + \text{Duty cycle correction factor}$$

Please refer to following plot.



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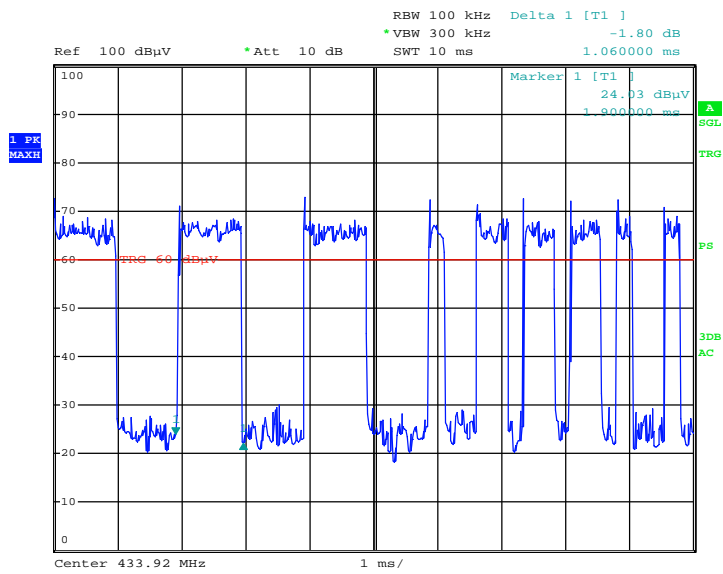
Date: 13.AUG.2014 21:42:05



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Date: 13.AUG.2014 21:42:33

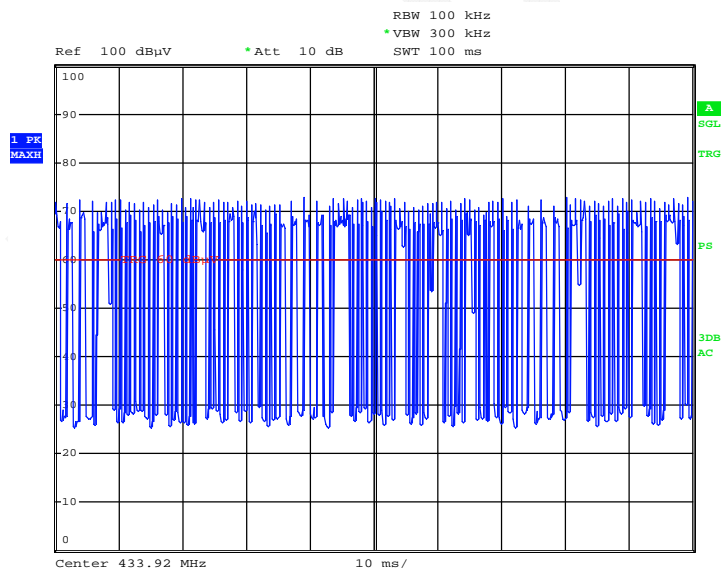
T_{on3}



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Date: 13.AUG.2014 21:45:31

T_p (100ms)



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Date: 13.AUG.2014 21:16:40

FCC §15.231(c) – 20 dB BANDWIDTH TESTING

Requirement

Per 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2014-05-09	2015-05-09
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
HP	Amplifier	8447E	2434A02181	2013-09-06	2014-09-06

* **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

With the EUT's antenna attached, the waveform was received by the test antenna which was connected to the spectrum analyzer, plot the 20 dB bandwidth.

Test Data

Environmental Conditions

Temperature:	26.8 °C
Relative Humidity:	57 %
ATM Pressure:	99.6 kPa

The testing was performed by Ares Liu from 2014-08-15.

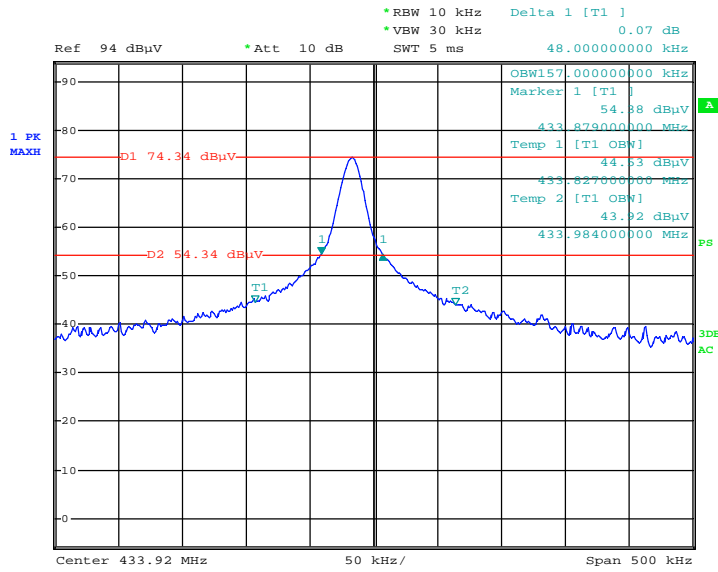
Test Mode: Transmitting

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	48	1084.8	Pass

Note: Limit = 0.25% * Center Frequency = 0.25% * 433.92 MHz = 1084.8 kHz

20 dB Bandwidth



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Date: 15.AUG.2014 21:17:43



FCC §15.231(e) - DEACTIVATION TESTING

Applicable Standard

Per 15.231(e) , devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2014-05-09	2015-05-08
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
HP	Amplifier	8447E	2434A02181	2013-09-06	2014-09-05

* **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:	26.8 °C
Relative Humidity:	57 %
ATM Pressure:	99.6 kPa

The testing was performed by Ares Liu from 2014-08-13.

Test Mode: Transmitting

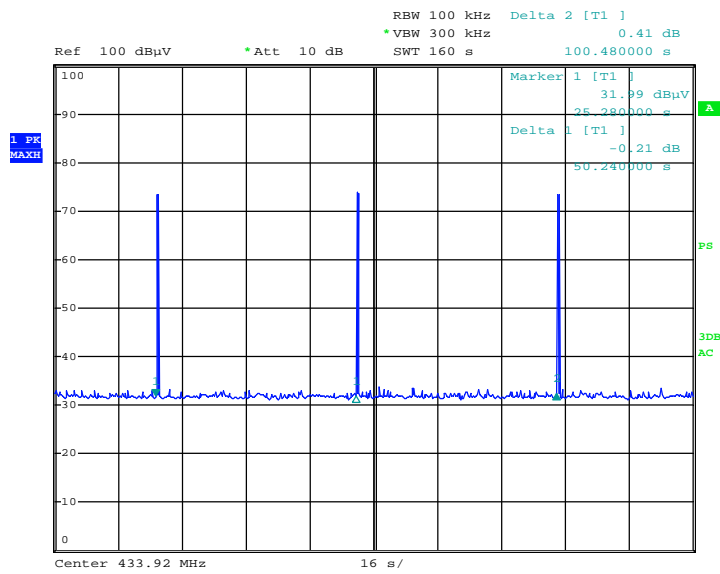
Test Result: Compliance. Please refer to following plot.

Transmission period (S)	Limit(S)	Result
0.27	<1.0	Pass

Period time(S)	Duration time(S)	Silent time(s)	Silent time Limit	Result
50.24	0.27	49.97	>10S and >30* Duration time	Pass

Note: Silent time= Period time- Duration time

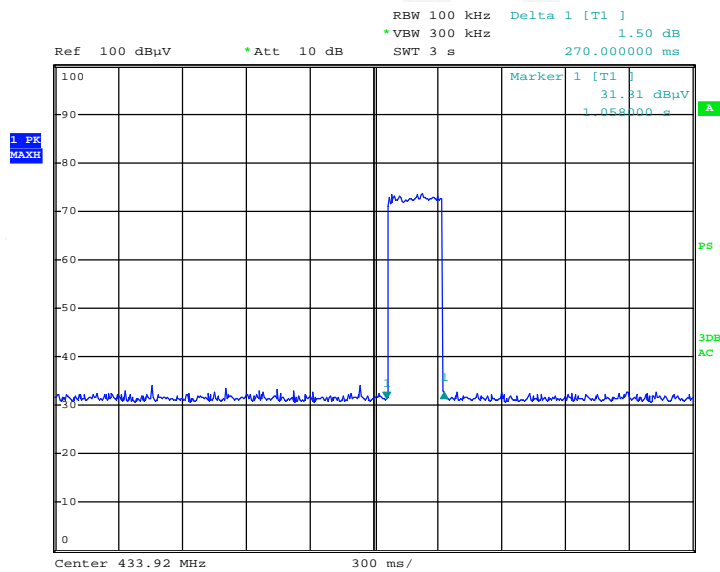
Period time



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Date: 13.AUG.2014 21:08:55

Duration Time



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Date: 13.AUG.2014 21:11:59

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