

FCC PART 15.231

TEST REPORT

For

**HAMATON AUTOMOTIVE TECHNOLOGY CO.,
LTD**

12 East Zhenxing Road, Linping, Yuhang, Hangzhou, Zhejiang, China

FCC ID: 2AFH7TP2A1

Report Type: Original Report	Product Type: TPMS Sensor
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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.....4

SYSTEM TEST CONFIGURATION.....5

 JUSTIFICATION.....5

 EUT EXERCISE SOFTWARE.....5

 EQUIPMENT MODIFICATIONS.....5

 BLOCK DIAGRAM OF TEST SETUP.....5

SUMMARY OF TEST RESULTS.....6

FCC§15.203 - ANTENNA REQUIREMENT.....7

 APPLICABLE STANDARD.....7

 ANTENNA CONNECTED CONSTRUCTION.....7

FCC §15.205, §15.209, §15.231 (E) - RADIATED EMISSIONS TEST.....8

 APPLICABLE STANDARD.....8

 MEASUREMENT UNCERTAINTY.....8

 EUT SETUP.....8

 EMI TEST RECEIVER SETUP.....9

 TEST EQUIPMENT LIST AND DETAILS.....9

 TEST PROCEDURE.....9

 APPLICABLE STANDARD.....10

 CORRECTED AMPLITUDE & MARGIN CALCULATION.....10

 TEST RESULTS SUMMARY.....11

 TEST DATA.....11

§15.231(C) - 20DB BANDWIDTH TESTING.....14

 REQUIREMENT.....14

 TEST EQUIPMENT LIST AND DETAILS.....14

 TEST PROCEDURE.....14

 TEST DATA.....14

FCC §15.231(E) - DEACTIVATION TESTING.....16

 APPLICABLE STANDARD.....16

 EUT SETUP.....16

 TEST EQUIPMENT LIST AND DETAILS.....17

 TEST DATA.....17

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The HAMATON AUTOMOTIVE TECHNOLOGY CO., LTD's product, model number: T-PRO1 (FCC ID: 2AFHTTP2A1) the "EUT" is a TPMS Sensor The EUT was measured approximately: 72.7 mm(L)* 53.5 mm(W)*17.5 mm(H). Rated input voltage: DC 2.1-3.3 V battery.

**The product's series model number: T-PRO1,T-PRO2,EU-PRO,U-PRO,DVT-1003A,DVT-1003B,PRO-1003A,PRO-1003B,97358,97359,72-020-X. They are electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics. Only using different name and may use different housing color and assemble with different valves.*

** All measurement and test data in this report was gathered from production sample serial number: 150710 (Assigned by the BACL, kunshan). The EUT supplied by applicant was received on 2015-07-10.*

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 C63.4-2014.

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 Submittals.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2014, 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 Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with radiated emission is 5.87 dB for 30MHz-1GHz, and 4.84 dB for above 1GHz, 1.85dB for conducted measurement.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the Chenghu Road, Kunshan Development Zone No.248, Kunshan, Jiangsu, China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) 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 December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. 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.

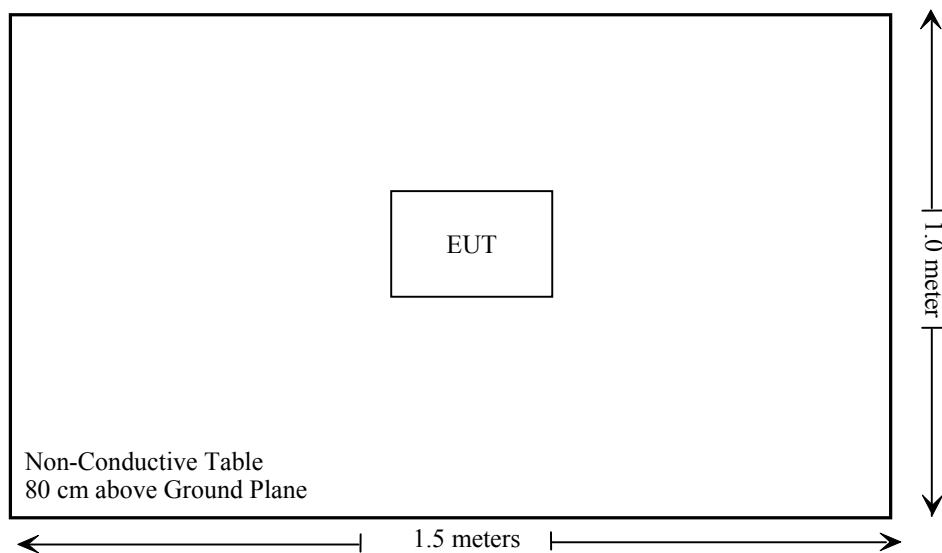
EUT Exercise Software

No exercise software.

Equipment Modifications

No modification on the EUT.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

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

Not applicable*: The EUT is powered by battery only.

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.

Antenna Connected Construction

The EUT has an internal antenna welded on the PCB and the antenna gain is 3 dBi, which complied with 15.203. Please refer to the EUT Internal photos.

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

Applicable Standard

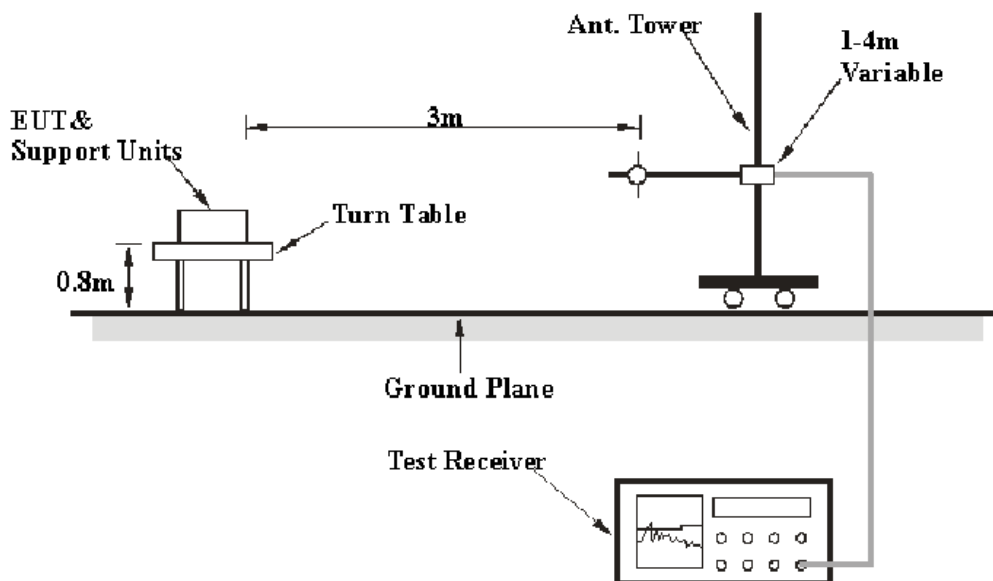
FCC §15.205, §15.209, §15.231 (e)

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 expanded combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Kunshan) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

EUT Setup



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.4-2014. The specification used was the FCC Part Subpart C limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30MHz – 1000MHz	100 kHz	300 kHz	100kHz	QP
1000 MHz – 5000 MHz	1MHz	3MHz	/	PK

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	330	171377	2014-09-16	2015-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2014-09-16	2015-09-16
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2014-09-12	2015-09-12
ETS	Horn Antenna	3115	6229	2014-09.-12	2015-09-12
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2014-09-16	2015-09-16
Mini	Pre-amplifier	ZVA-183-S+	857001418	2014-09-16	2015-09-16
champrotek	Chamber	Chamber A	1#	2014-09-17	2015-09-17
R&S	Auto test Software	EMC32	V 09.10.0	-	-
BACL	RF cable	KS-LAB-A01	KS-LAB-A01	2015-06-16	2015-12-15
BACL	RF cable	KS-LAB-A02	KS-LAB-A02	2015-06-16	2015-12-15

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that 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 emission (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:

7.24dB at 433.92 MHz in the vertical polarization

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

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

In BACL, $U_{(Lm)}$ 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:	101.0 kPa

*The testing was performed by Matt Yao on 2015-08-28
Test mode: Transmitting*

Field Strength (Peak)

Frequency (MHz)	Maximum Reading (dBuV)	RX Antenna		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	15.231	
		Polar (H/V)	Factor (dB)				Limit (dBµV/m)	Margin (dB)
433.92	82.25	H	15.5	1.4	25.2	73.95	92.87	18.92
433.92	84.32	V	15.5	1.4	25.2	76.02	92.87	16.85
867.84	32.98	H	22.4	2.3	25.2	32.48	72.87	40.39
867.84	32.34	V	22.4	2.3	25.2	31.84	72.87	41.03
1301.76	39.58	H	24.5	2.9	31.1	35.88	74.00	38.12
1301.76	40.47	V	24.5	2.9	31.1	36.77	74.00	37.23

Field Strength (Average)

Frequency (MHz)	Peak Measurement @3m (dBµV/m)	Antenna Polarity (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dBµV/m)	15.231	
					Limit (dBµV/m)	Margin (dB)
433.92	73.95	H	-10.39	69.56	72.87	9.31
433.92	76.02	V	-10.39	71.63	72.87	7.24
867.84	32.48	H	-10.39	22.09	52.87	30.78
867.84	31.84	V	-10.39	21.45	52.87	31.42
1301.76	35.88	H	-10.39	25.49	54.00	28.51
1301.76	36.77	V	-10.39	26.38	54.00	27.62

*Within measurement uncertainty!

Note:

Calculate Average value based on duty cycle correction factor:

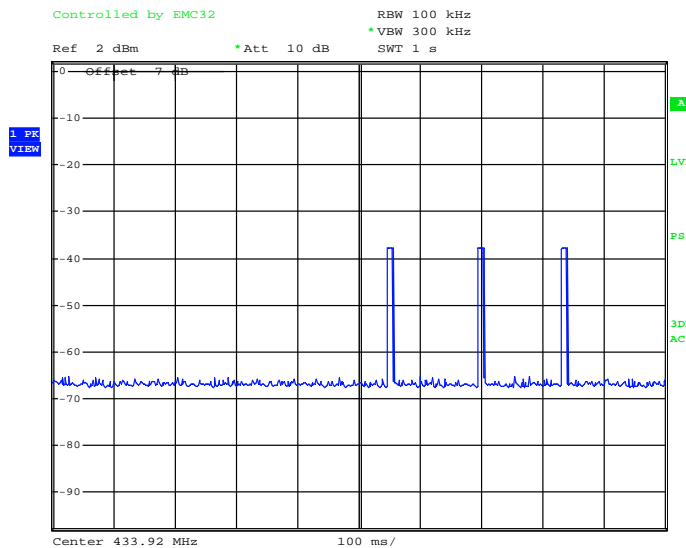
Duty cycle=3*(33*0.16+20*0.24)/100= 30.24%

Duty cycle correction factor= 20*log (duty cycle)=-10.39

So The Max. duty cycle is 30.24%, and correction factor is -10.39

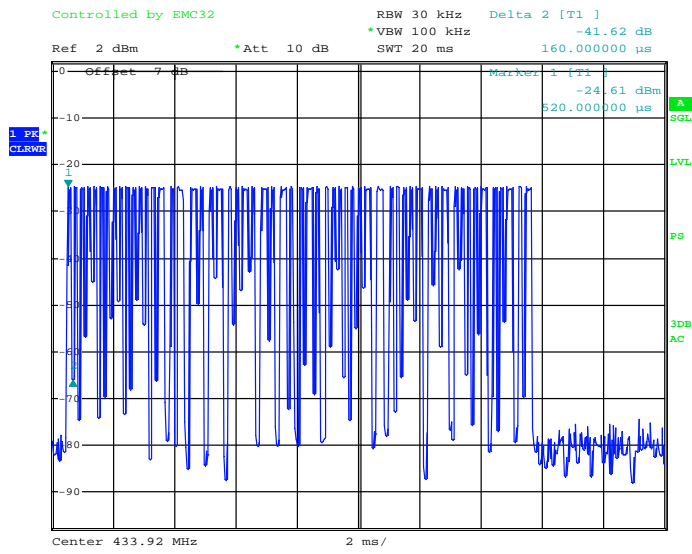
Please refer to following plot.

Three Group pulse in a Duration time



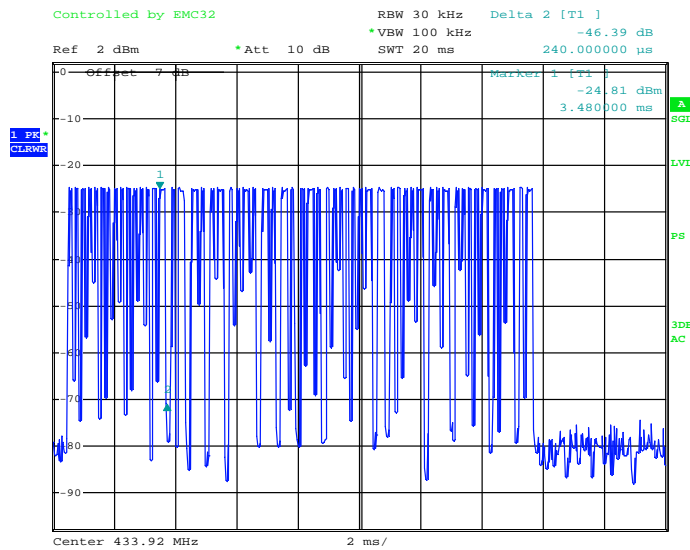
Date: 28.AUG.2015 10:51:08

33pcs 160 us pulse in a group



Date: 28.AUG.2015 11:12:23

20pcs 240 us pulse in a group



Date: 28.AUG.2015 11:12:49

§15.231(c) - 20dB 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
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2014-09-16	2015-09-16

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that 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 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Yao on 2015-07-30

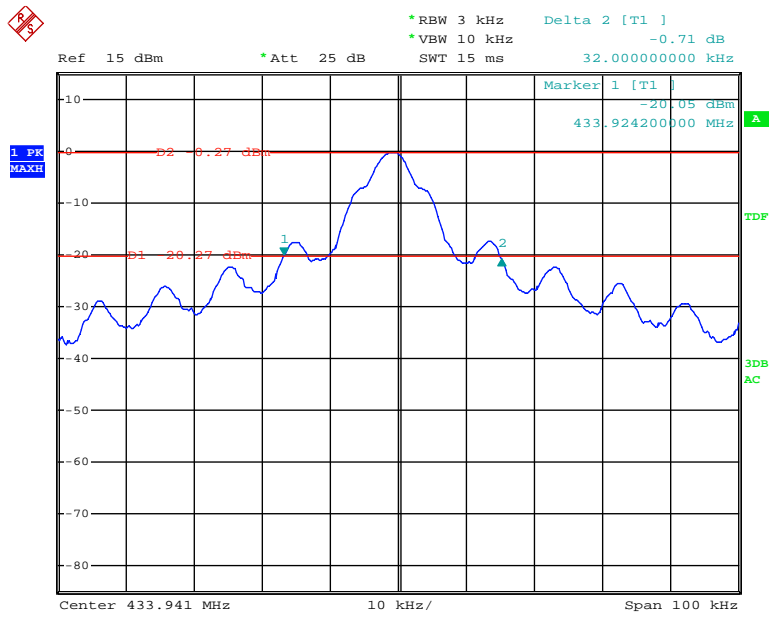
Test Mode: Transmitting

Please refer to following table and plot.

Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	32	1084.8	Pass

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

20 dB Bandwidth



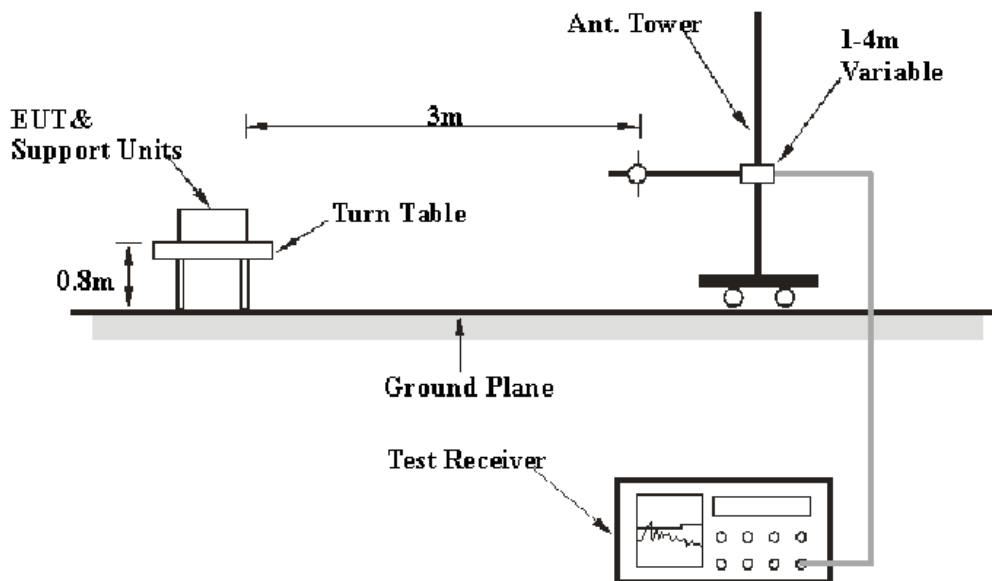
Date: 30.JUL.2015 10:13:30

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.

EUT Setup



The deactivation test was performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4 - 2014. The specification used was the FCC 15.231(e) limits.

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	330	171377	2014-09-16	2015-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2014-09-16	2015-09-16
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2014-09-12	2015-09-12
ETS	Horn Antenna	3115	6229	2014-09-12	2015-09-12
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2014-09-16	2015-09-16
Mini	Pre-amplifier	ZVA-183-S+	857001418	2014-09-16	2015-09-16
champrotek	Chamber	Chamber A	1#	2014-09-17	2015-09-17
R&S	Auto test Software	EMC32	V 09.10.0	-	-
BACL	RF cable	KS-LAB-A01	KS-LAB-A01	2015-06-16	2015-12-15
BACL	RF cable	KS-LAB-A02	KS-LAB-A02	2015-06-16	2015-12-15

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

Test Data

Environmental Conditions

Temperature:	26 °C
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Matt Yao on 2015-08-28

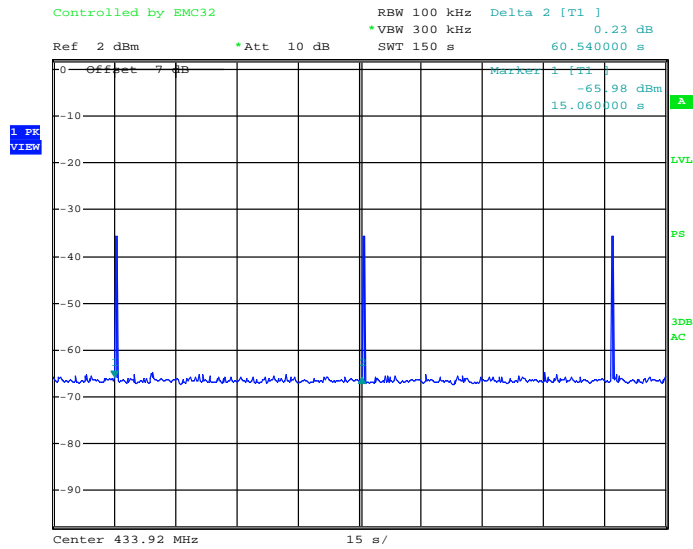
Test Mode: Transmitting

Please refer to following table and plot.

Period time	Duration time	Silent time	Silent time Limit	Result
60.54s	Less than 100ms	More than 60.44s	>10s and >30* Duration time	Pass

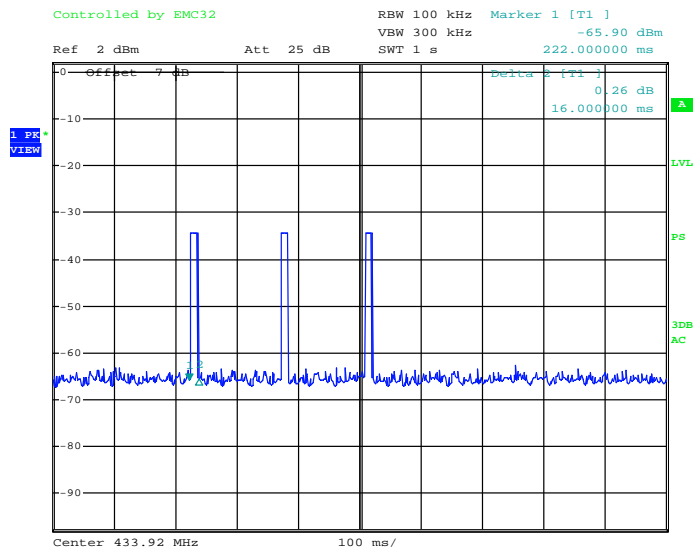
Note: Silent time= Period time- Duration time

Period time = 60.54s



Date: 28.AUG.2015 09:54:20

Duration Time Less than 100ms



Date: 28.AUG.2015 11:55:20

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