



## FCC PART 15.231

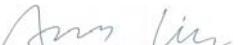
# TEST REPORT

For

**Hangzhou Hamaton Tyre Valves Co., Ltd.**

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

**FCC ID: Z27HTS2A315**

<b>Report Type:</b> Original Report	<b>Product Type:</b> TPMS Sensor
<b>Test Engineer:</b> <u>Ares Liu</u> 	
<b>Report Number:</b> <u>R2SH130130051-00A</u>	
<b>Report Date:</b> <u>2013-03-20</u>	
<b>Reviewed By:</b> <u>Ivan Cao</u>  <u>EMC Leader</u>	
<b>Test Laboratory:</b> Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 <a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a>	

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

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Hangzhou Hamaton Tyre Valves Co., Ltd.*'s product, model number: *JDI-1001 (FCC ID: Z27HTS2A315)* (the "EUT") in this report is a *TPMS Sensor*, which was measured approximately: 6.5 cm (L) x 5.5 cm (W) x 1.5 cm (H), rated input voltage: DC 3V from battery.

*Note: the series product, model JDI-1001, DVT-1001, PRO-1, DVT-1006, PRO-6, DVT-1007, PRO-7, are electrically identical, and the difference between them please refers to the attached declaration letter.*

*We selected Model : JDI-1001, DVT-1006, DVT-1007 for measurement and test , the sample serial number: 130130051-1001,130130051-1006,130130051-1007 (Assigned by BACL, Dongguan). The EUT was received on 2013-02-27.*

### 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**

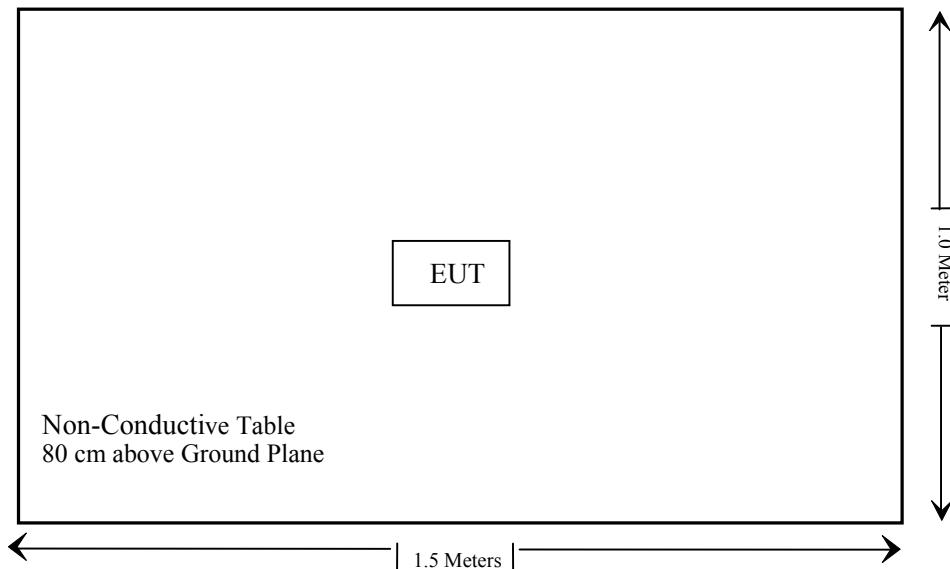
### **Justification**

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	N/A*
§15.205, §15.209, §15.231 (e)	Radiated Emissions	Compliance
§15.231 (c)	20dB Bandwidth Testing	Compliance
§15.231 (e)	Deactivation Testing	Compliance

Note: N/A \* 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.

**Result:** Compliant.

The EUT has an internal antenna soldered on the PCB, which complied with §15.203. Please refer to the EUT Internal photos.

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

### Measurement Uncertainty

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

If  $U_{\text{lab}}$  is less than or equal to  $U_{\text{cisp}}$  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  $U_{\text{lab}}$  is greater than  $U_{\text{cisp}}$  of Table 1, then:

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

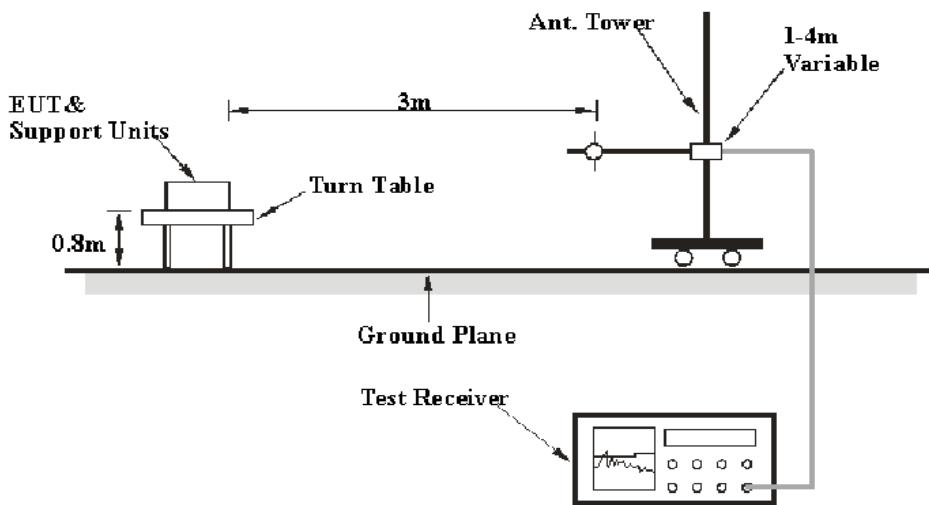
6G~18GHz: 5.23 dB

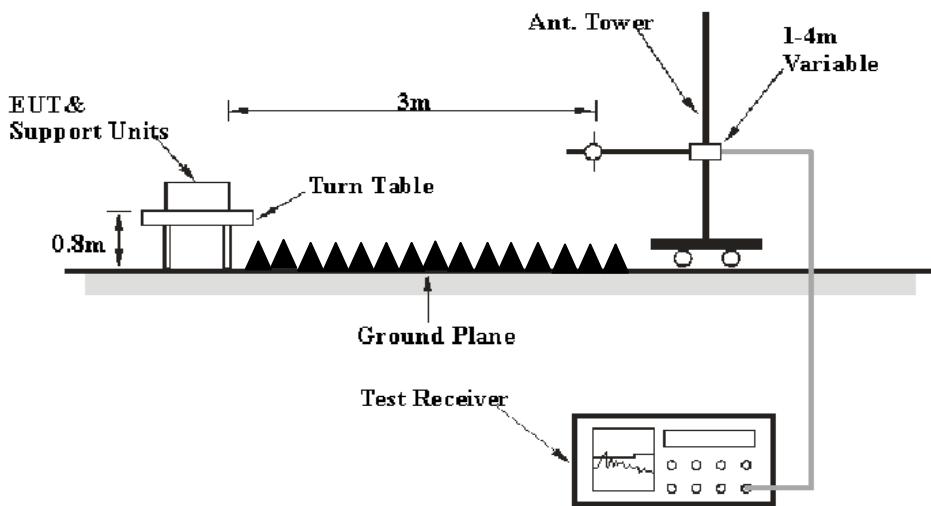
Table 1 – Values of  $U_{\text{cisp}}$

Measurement	$U_{\text{cisp}}$
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 - 2009. 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 4 GHz.

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

<b>Frequency Range</b>	<b>RBW</b>	<b>Video B/W</b>	<b>Detector</b>
30MHz – 1000 MHz	100 kHz	300 kHz	PK
1000 MHz – 4000 MHz	1 MHz	3 MHz	PK

**Test Equipment List and Details**

<b>Manufacturer</b>	<b>Description</b>	<b>Model</b>	<b>Serial Number</b>	<b>Calibration Date</b>	<b>Calibration Due Date</b>
Rohde & Schwarz	EMI Test Receiver	ESCI	100035	2012-05-14	2013-05-13
Sunol Sciences	Hybrid Antennas	JB3	A060611-1	2011-09-06	2013-09-05
HP	Pre-amplifier	8447E	2434A02181	2012-10-08	2013-10-07
R&S	Spectrum Analyzer	FSEM 30	DE31388	2012-03-15	2013-03-14
ETS-LINDGREN	Horn Antenna	3115	000 527 35	2012-09-06	2014-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2013-01-30	2014-01-29

## 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:

**1.76 dB at 1260 MHz in the Horizontal polarization**

## Test Data

### Environmental Conditions

Temperature:	25.6 ° C
Relative Humidity:	62 %
ATM Pressure:	100.8kPa

The testing was performed by Ares Liu on 2013-02-28.

Test mode: Transmitting

### Field Strength(Peak)

Frequency (MHz)	Receiver	Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB $\mu$ V/m)	§15.231	
		Reading (dB $\mu$ V)	Polar (H/V)				Limit (dB $\mu$ V/m)	Margin (dB)
Operating Frequency: 315 MHz								
315	66.54	H	14.42	2.19	0.00	83.15	87.66	4.51
315	49.61	V	14.42	2.19	0.00	66.22	87.66	21.44
630	24.23	H	20.02	3.06	0.00	47.31	67.66	20.35
630	22.36	V	20.02	3.06	0.00	45.44	67.66	22.22
945	28.15	H	23.18	3.72	0.00	55.05	67.66	12.61
945	24.06	V	23.18	3.72	0.00	50.96	67.66	16.70
1260	41.58	H	25.26	2.68	0.00	69.52	74.00	4.48
1260	34.55	V	25.26	2.68	0.00	62.49	74.00	11.51
1575	34.92	H	26.00	3.11	0.00	64.02	74.00	9.98
1575	31.25	V	26.00	3.11	0.00	60.35	74.00	13.65
1890	29.97	H	28.07	3.41	0.00	61.46	74.00	12.54
1890	32.02	V	28.07	3.41	0.00	63.51	74.00	10.49
2205	46.59	H	29.95	3.47	27.68	52.33	74.00	21.67
2205	40.67	V	29.95	3.47	27.68	46.41	74.00	27.59
2520	44.96	H	31.57	3.77	27.87	52.44	74.00	21.56
2520	39.11	V	31.57	3.77	27.87	46.59	74.00	27.41
2835	50.02	H	31.13	4.70	27.57	58.29	74.00	15.71
2835	44.14	V	31.13	4.70	27.57	52.41	74.00	21.59
3150	47.35	H	31.14	4.91	27.66	55.74	74.00	18.26
3150	45.25	V	31.14	4.91	27.66	53.64	74.00	20.36

\*Within measurement uncertainty!

## Field Strength (Average)

Frequency (MHz)	Peak Measurement @ 3m (dB $\mu$ V/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dB $\mu$ V/m)	§15.231	
					Limit (dB $\mu$ V/m)	Margin (dB)
Operating Frequency: 315 MHz						
315	83.15	H	-17.28	65.87	67.66	1.79*
315	66.22	V	-17.28	48.94	67.66	18.72
630	47.31	H	-17.28	30.03	47.66	17.63
630	45.44	V	-17.28	28.16	47.66	19.50
945	55.05	H	-17.28	37.77	47.66	9.89
945	50.96	V	-17.28	33.68	47.66	13.98
1260	69.52	H	-17.28	52.24	54.00	1.76 *
1260	62.49	V	-17.28	45.21	54.00	8.79
1575	64.02	H	-17.28	46.74	54.00	7.26
1575	60.35	V	-17.28	43.07	54.00	10.93
1890	61.46	H	-17.28	44.18	54.00	9.82
1890	63.51	V	-17.28	46.23	54.00	7.77
2205	52.33	H	-17.28	35.05	54.00	18.95
2205	46.41	V	-17.28	29.13	54.00	24.87
2520	52.44	H	-17.28	35.16	54.00	18.84
2520	46.59	V	-17.28	29.31	54.00	24.69
2835	58.29	H	-17.28	41.01	54.00	12.99
2835	52.41	V	-17.28	35.13	54.00	18.87
3150	55.74	H	-17.28	38.46	54.00	15.54
3150	53.64	V	-17.28	36.36	54.00	17.64

\*Within measurement uncertainty!

Note:

The maximum duty cycle was the model: JDI-1001, which was declared by manufacturer. Please refer the declaration letter in the last page of the report.

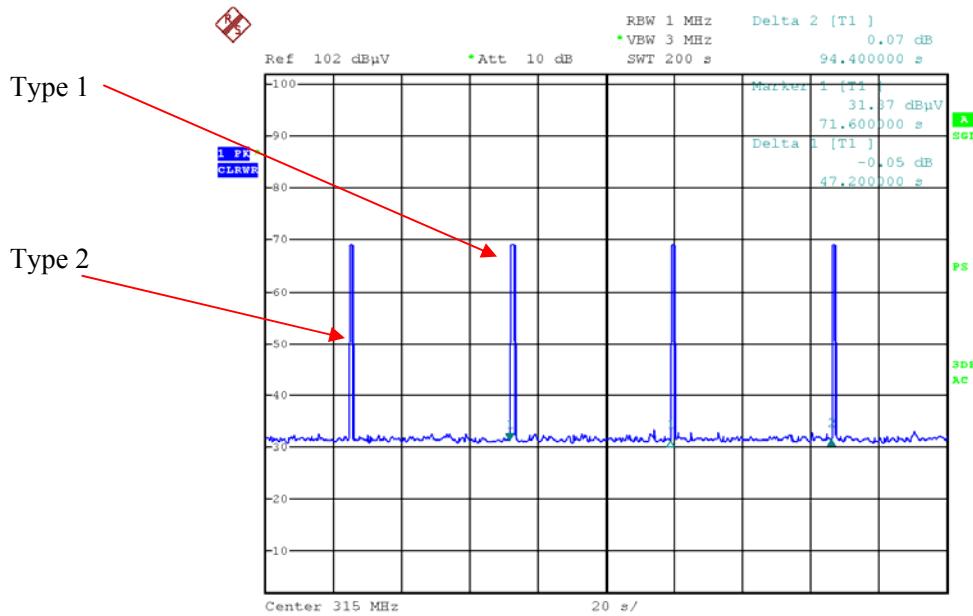
Calculate Average value based on Duty Cycle Correction Factor:

$$\text{Duty cycle} = T_{\text{ON}}/100\text{ms} = (25.8 - 6 \times 0.18 - 30 \times 0.24 - 8 \times 0.48) \text{ms} / 100 \text{ ms} = 13.68\%$$

$$\text{Duty cycle correction factor} = 20 \times \log(\text{duty cycle}) = 20 \times \log(13.68\%) = -17.28 \text{ dB}$$

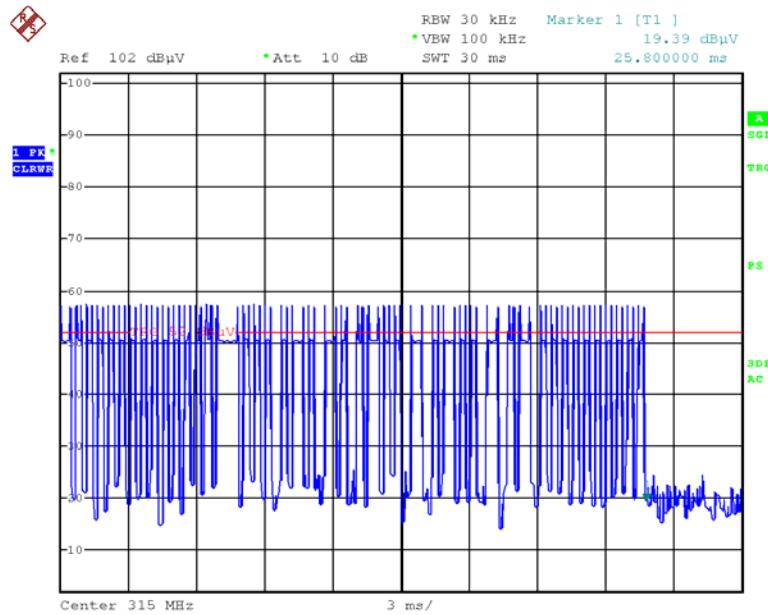
Please refer to following plot.

$$T_{on} + T_{off} + T_{Silent} = 47.2s$$

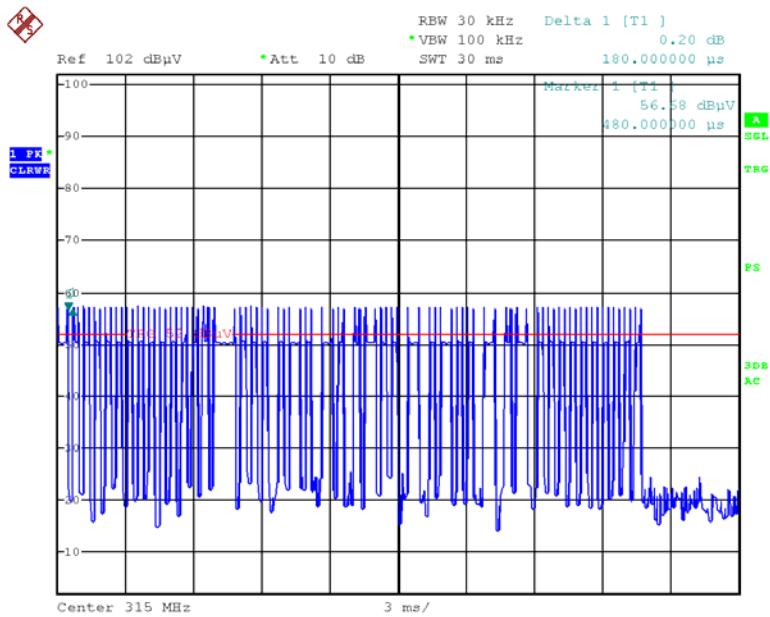


Date: 28.FEB.2013 09:25:09

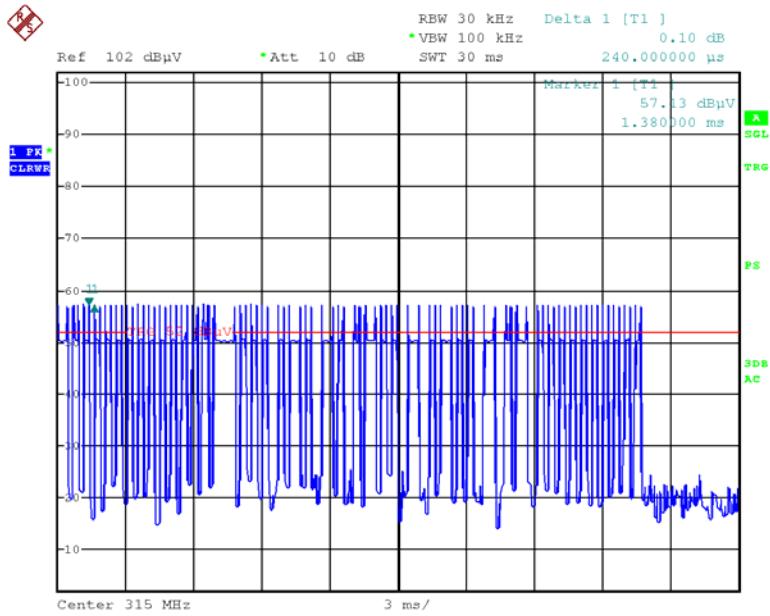
Type 1:  $T_{on} + T_{off} = 25.8\text{ms} < 100\text{ms}$



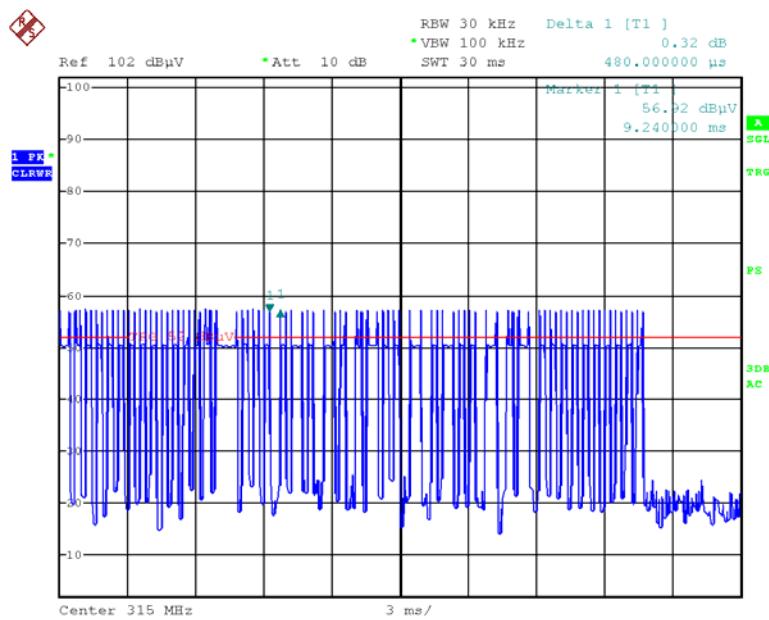
Date: 28.FEB.2013 09:32:14

Type 1: 6 pcs 180us T<sub>off</sub>

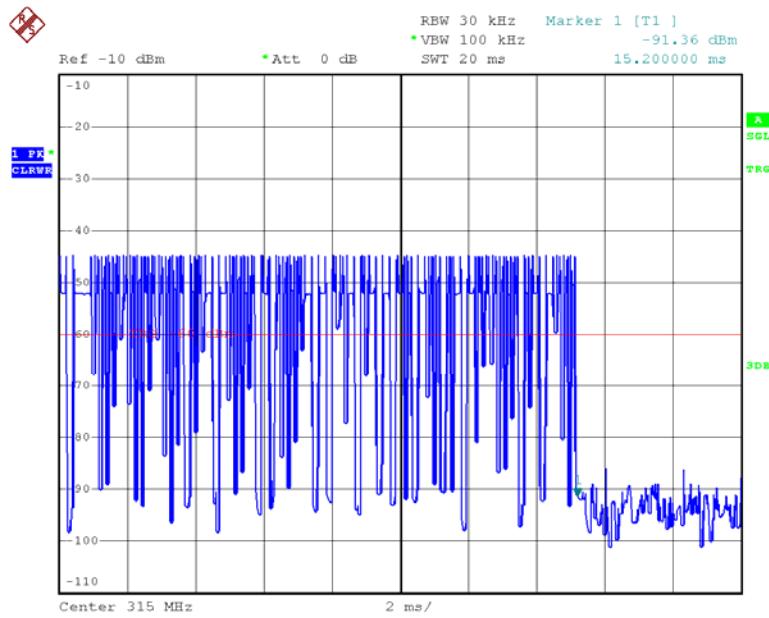
Date: 28.FEB.2013 09:32:31

Type 1: 30 pcs 240us T<sub>off</sub>

Date: 28.FEB.2013 09:32:57

Type 1: 8 pcs 480us T<sub>off</sub>

Date: 28.FEB.2013 09:35:53

Type 2: T<sub>on</sub> + T<sub>off</sub> = 15.2 ms

Date: 13.MAR.2013 10:18:59

## 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
Rohde & Schwarz	Spectrum Analyzer	FSEM 30	1079 8500	2012-10-9	2013-10-8

### 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:	25.6° C
Relative Humidity:	62%
ATM Pressure:	100.8kPa

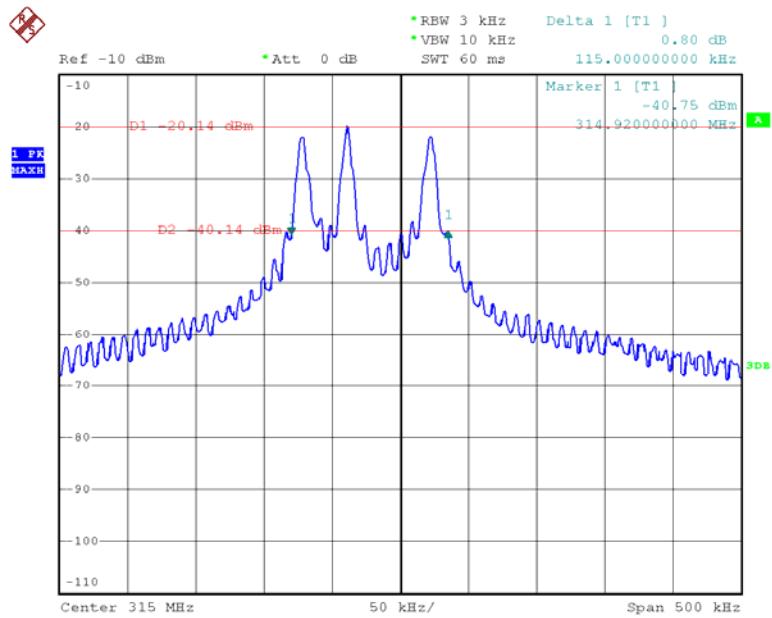
The testing was performed by Ares Liu on 2013-02-28.

Test Mode: Transmitting

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Result
315	155	787.5	Pass

**Note:** Limit = 0.25% \* Center Frequency = 0.25% \* 315 MHz = 0.7875 MHz

**20 dB Bandwidth**

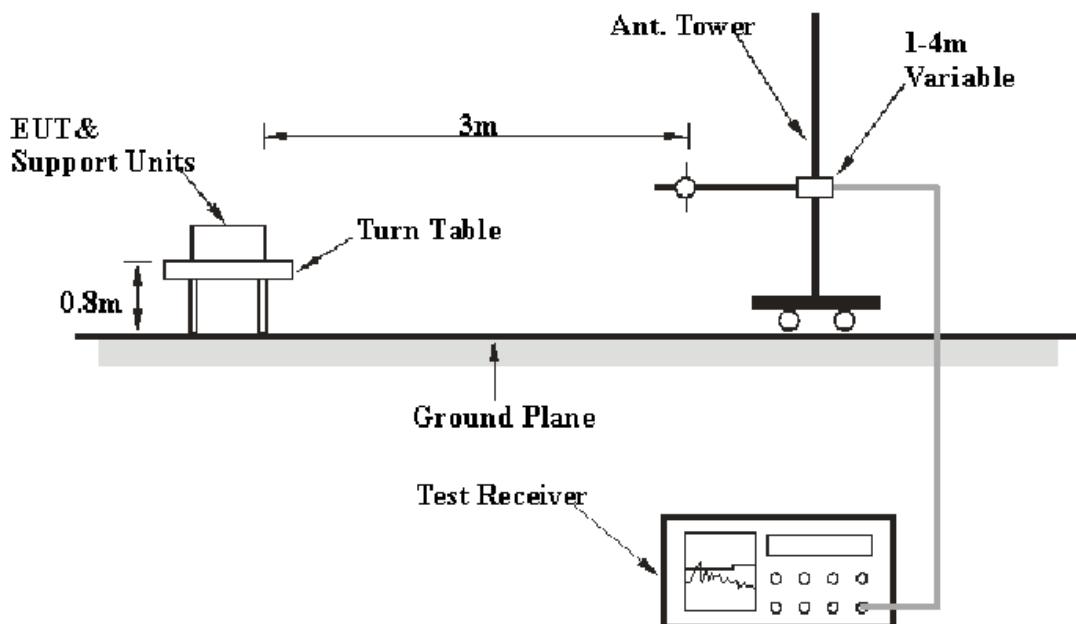
Date: 28.FEB.2013 11:22:35

## 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 - 2009. 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
Rohde & Schwarz	EMI Test Receiver	ESCI	101121	2012-10-8	2013-10-7
Sunol Sciences	Hybrid Antennas	JB3	A060611-1	2011-9-6	2013-9-5
HP	Pre-amplifier	8447E	2434A02181	2012-10-8	2013-10-7

## Test Data

### Environmental Conditions

<b>Temperature:</b>	23.8 ° C~24.5 ° C
<b>Relative Humidity:</b>	54 %~65%
<b>ATM Pressure:</b>	100.1 kPa~100.9kPa

The testing was performed by Ares Liu from 2013-02-27 to 2013-03-20.

Test Mode: Transmitting

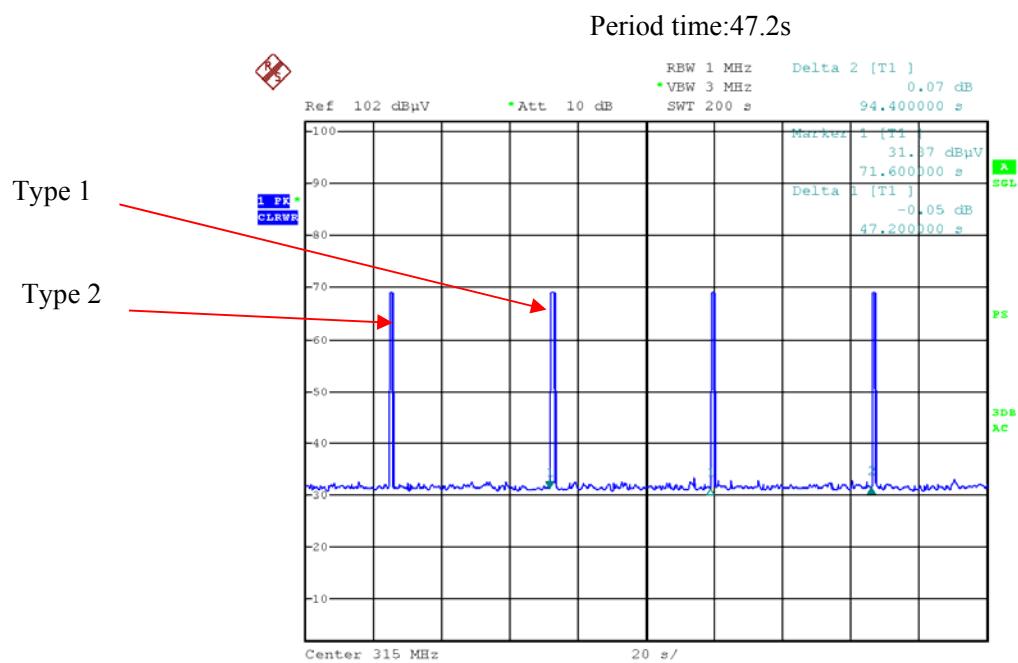
**Test Result:** Compliance. Please refer to following plot.

Model: JDI-1001

Period time	Duration time	Silent time	Silent time Limit	Result
47.2s	25.8ms	47.17s	>10s and >30* Duration time	Pass

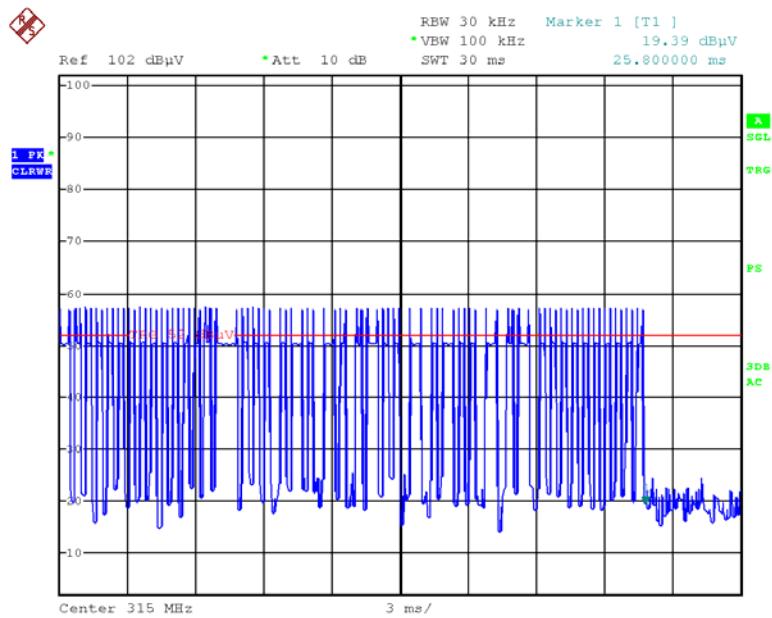
Note: The maximum duration time is 25.8ms, please refer the plots below.

Silent time= Period time- Duration time



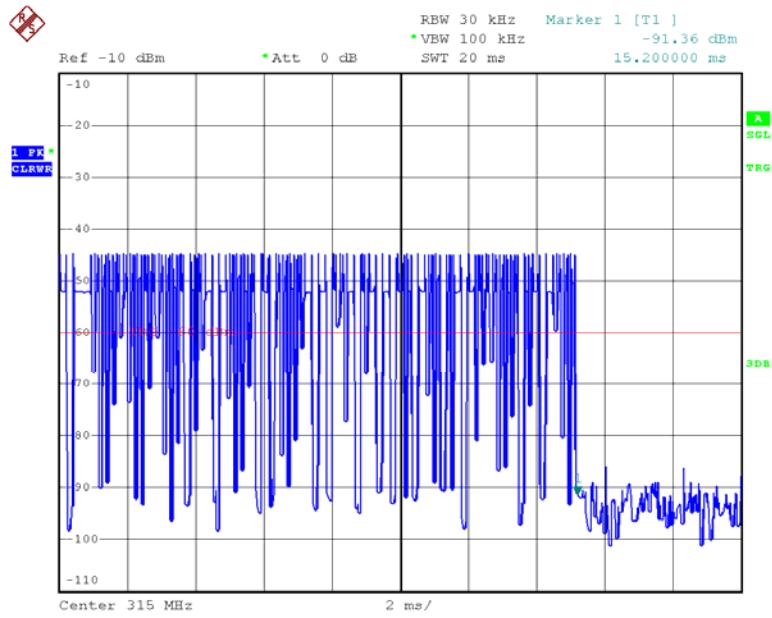
Date: 28.FEB.2013 09:25:09

## Type 1 Duration time:25.8ms



Date: 28.FEB.2013 09:32:14

## Type 2 Duration time:15.2ms



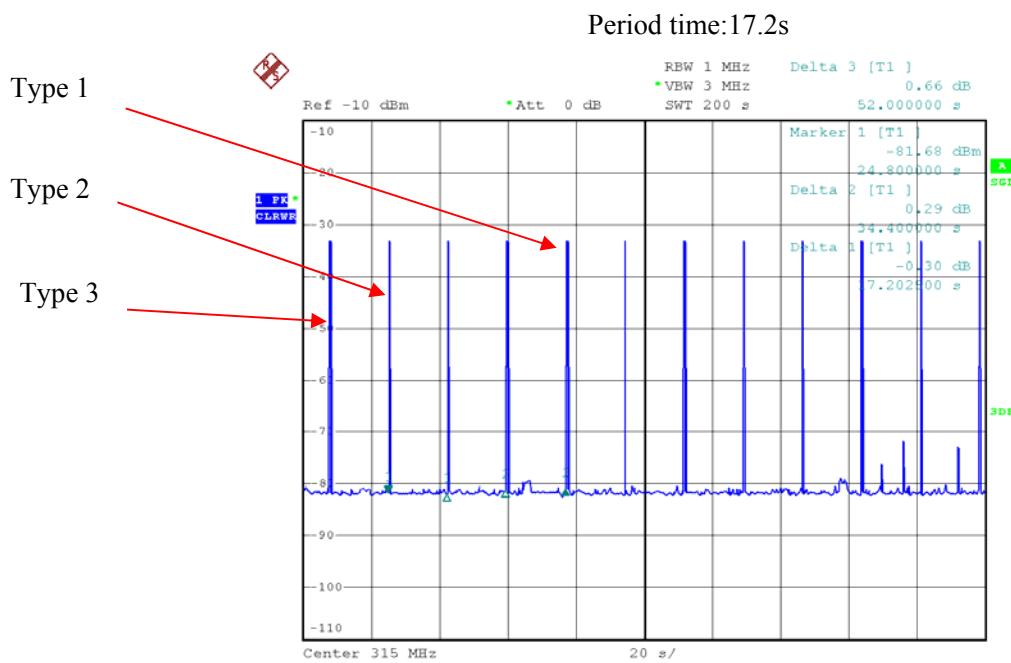
Date: 13.MAR.2013 10:18:59

Model: DVT-1006

Period time	Duration time	Silent time	Silent time Limit	Result
17.2s	15.2ms	17.18s	>10s and >30* Duration time	Pass

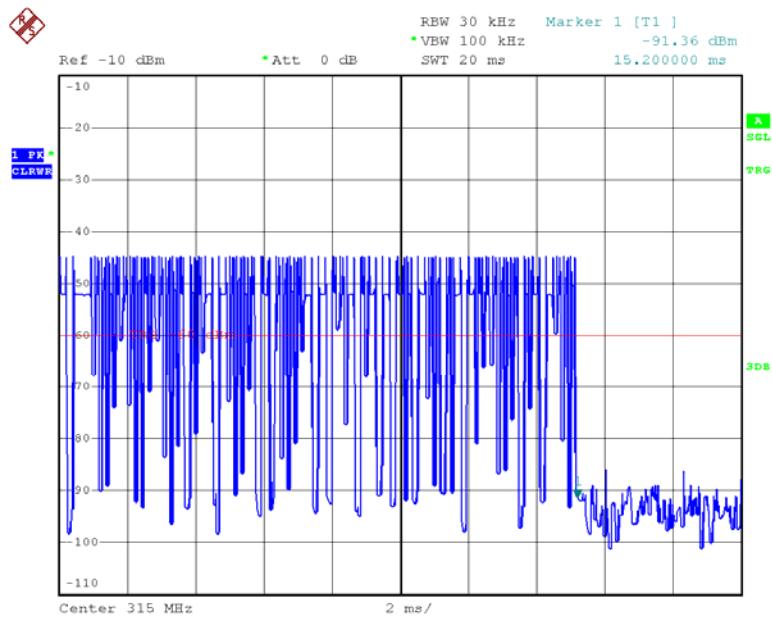
Note: The maximum duration time is 15.2ms, please refer the plots below.

Silent time= Period time- Duration time



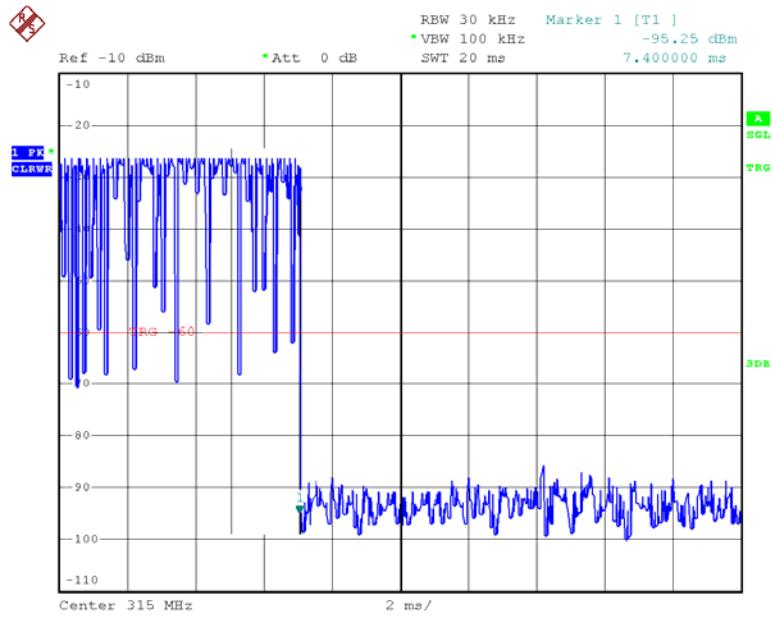
Date: 13.MAR.2013 09:56:36

## Type 1 Duration time:15.2ms



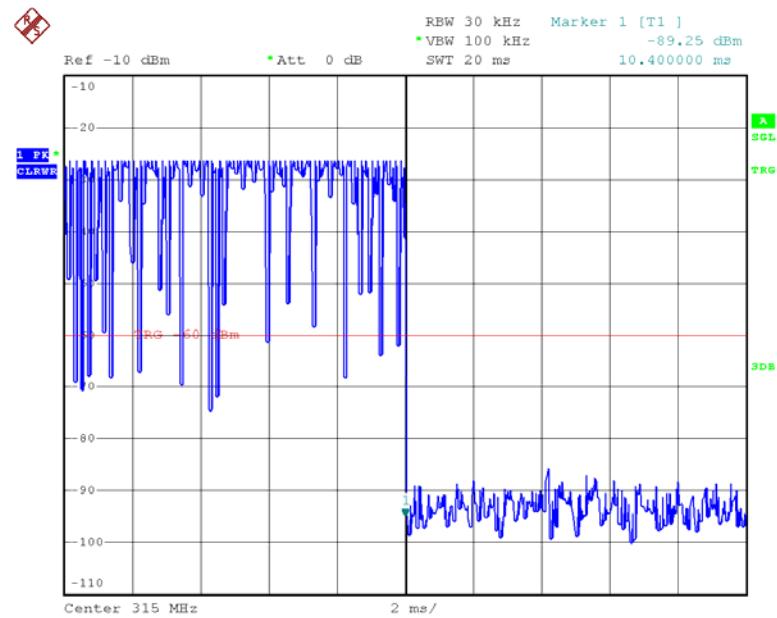
Date: 13.MAR.2013 10:10:50

## Type 2 Duration time:7.4ms



Date: 12.MAR.2013 11:11:48

Type 3 Duration time:10.4ms



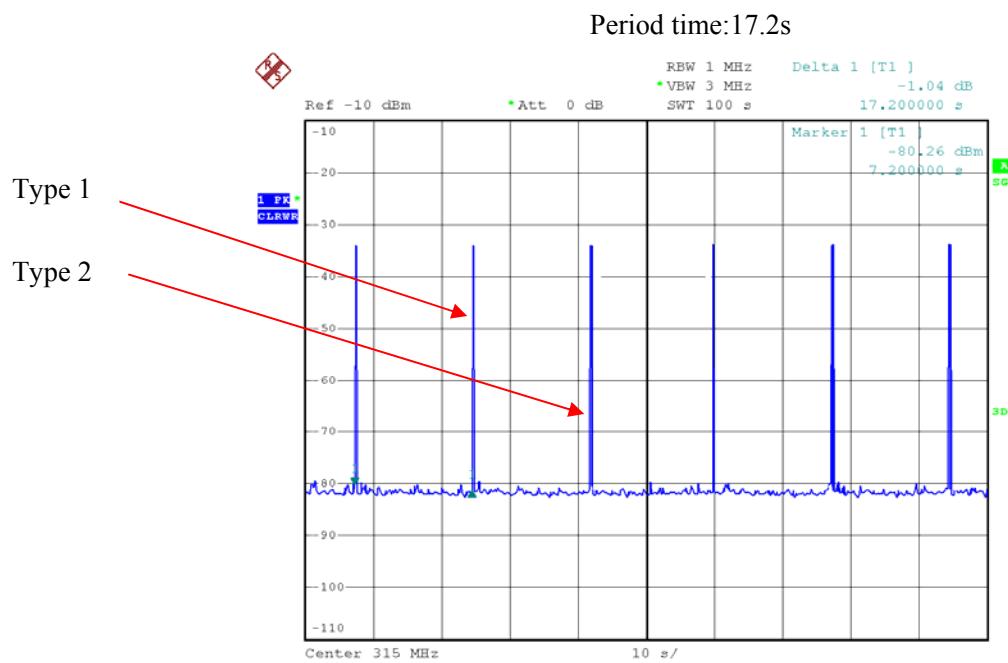
Date: 12.MAR.2013 11:21:48

Model: DVT-1007

Period time	Duration time	Silent time	Silent time Limit	Result
17.2s	15.2ms	17.18s	>10s and >30* Duration time	Pass

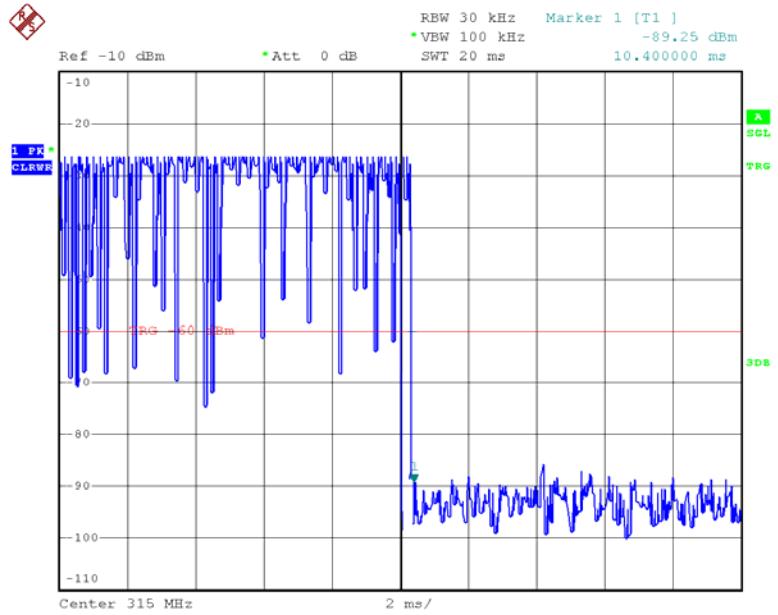
Note: The maximum duration time is 15.2ms, please refer the plots below.

Silent time= Period time- Duration time



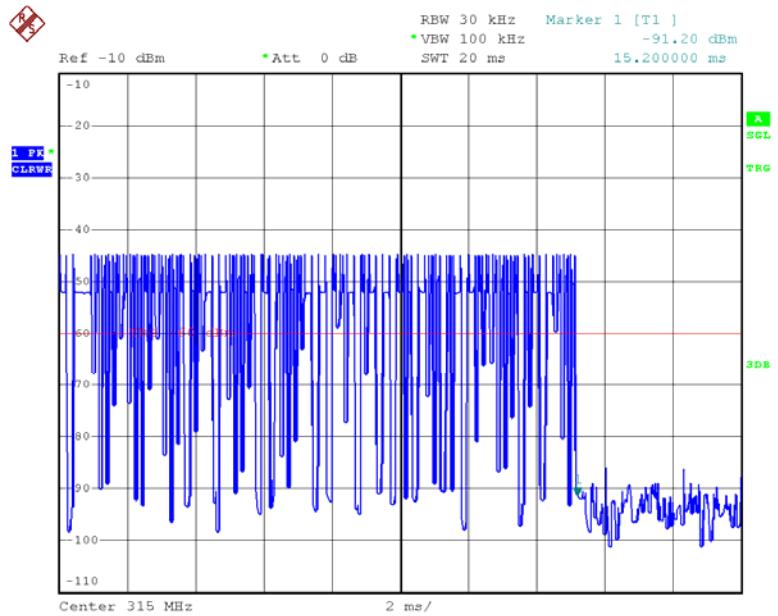
Date: 12.MAR.2013 11:13:39

## Type 1 Duration time: 10.4 ms



Date: 12.MAR.2013 11:48:13

## Type 2 Duration time: 15.2ms



Date: 13.MAR.2013 10:50:50

## DECLARATION LETTER



Hangzhou Hamaton Tyre Valves Co., Ltd.  
12 East Zhenxing Road, Linping, Yuhang, Hangzhou, China  
Tel: 86-571-86159905 Fax: 86-571-86159905

### DECLARATION OF SIMILARITY

Mar 7, 2013

To:  
Bay Area Compliance Laboratories Corp. (Dongguan)  
No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China  
Tel: +86 769 86858888 Fax: +86 769 86858891  
<http://www.baclcorp.com>

Dear Sir or Madam:

We, Hangzhou Hamaton Tyre Valves Co., Ltd., hereby declare that product: TPMS sensor, model(s): JDI-1001, DVT-1001, PRO-1, DVT-1006, PRO-6, DVT-1007, PRO-7, are all with the same hardware design, and electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics. And they were tested by BACL, the results of which are featured in BACL project: R2SH130130051

A description of the differences between the tested model and those that are declared similar areas follows:

JDI-1001, DVT-1001, PRO-1, DVT-1006, PRO-6, DVT-1007, PRO-7, are using different name and may use different housing color and assemble with different valves;

JDI-1001, DVT-1001, PRO-1, DVT-1006, PRO-6, DVT-1007, PRO-7, have different frame structure and modulation in their Radio Frequency signal as following:

For JDI-1001, DVT-1001, Pro-1: frame1 (FSK) + frame2 (ASK) + frame3 (ASK) in one package. The frame width: frame1 is 15ms, frame2 is 26ms, and frame3 is 26ms. Space between packages is 48 seconds. The modulation for frame1 is FSK, frame2 is ASK, and frame3 is ASK;

For DVT-1006, Pro-6: 2\*frames1 (ASK) + 2\*frames2 (FSK) + 2\*frames3 (FSK) + 2\*frames4 (FSK) in one package. The frame width: frame1 is 15ms, frame2 is 7.5ms, frame3 is 10ms, and frame 4 is 10 ms, Space between packages is 17 seconds. The modulation for frame1 is ASK, frame2 is FSK, frame3 is FSK, and frame4 is FSK;

For DVT-1007, Pro-7: 2\*frames1 (FSK) + 2\*frames2 (FSK) + 2\*frames3 (ASK) in one package. The frame width: frame1 is 15ms, frame2 is 10ms, and frame3 is 10ms, Space between packages is 17 seconds. The modulation for frame1 is FSK, frame2 is FSK, and frame3 is ASK.

(Note: ASK and FSK are different modulation set by software.)

Please contact me should there be need for any additional clarification or information.

Best Regards,

Weibo Zhang Quality Supervisor

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