FCC PART 15.231

TEST REPORT

For

HAMATON AUTOMOTIVE TECHNOLOGY CO., LTD

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

FCC ID: 2AFH7PHT200

Report Type:	Product Type:
Original Report	TPMS Sensor

Test Engineer:	Chris Wang
Report Number:	RKS160901003-00I
Report Date:	2016-10-20
Reviewed By:	Jesse Huang EMC Manager
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) Chenghu Road,Kunshan Development Zone No.248,Kunshan, Jiangsu, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The HAMATON AUTOMOTIVE TECHNOLOGY CO., LTD's product, model number: HTS-2000, (FCC ID: 2AFH7PHT200) the "EUT" is a TPMS Sensor, The EUT was measured approximately: 72.7mm(L)*53.5 mm(W)* 17.5mm(H). Rated input voltage: DC 3V from battery.

**The product's series model number: S219. The difference between them was explained in the attached declaration letter.*

**All measurement and test data in this report was gathered from production sample serial number: 20160830005.*

(Assigned by BACL Kunshan). The EUT supplied by the applicant was received on 2016-08-30.

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 C63.10-2013.

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)

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 Lab Corp. (Kunshan). 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. (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 C63.10-2013.

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

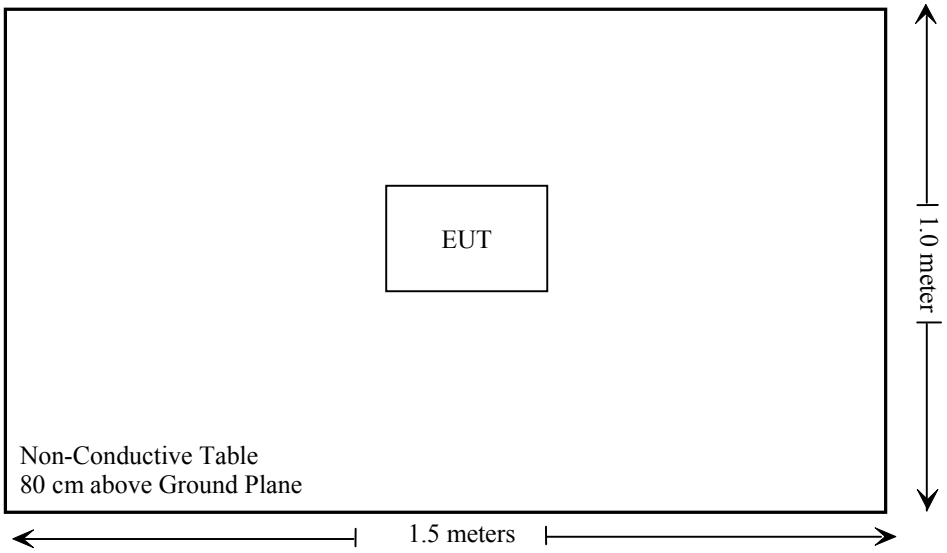
No exercise software.

Equipment Modifications

No modification on the EUT.

Block Diagram of Test Setup

Below 1GHz:



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)	Transmission and Silent Period 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 2dBi, 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)

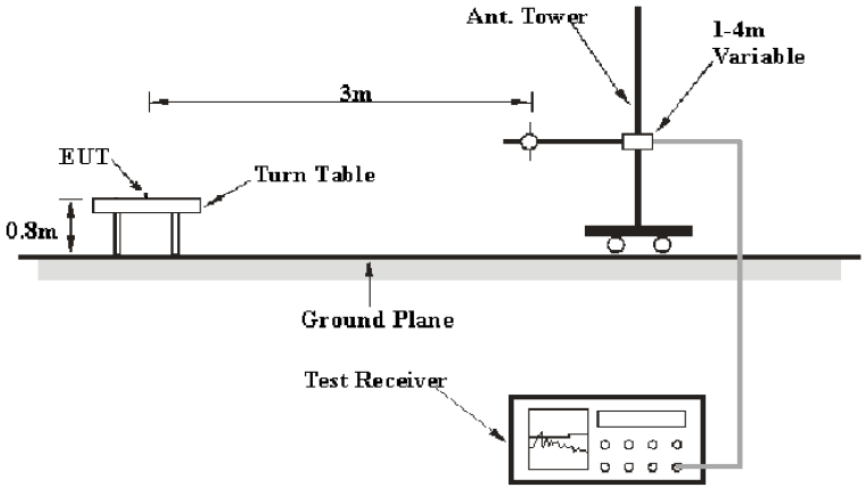
Measurement Uncertainty

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.

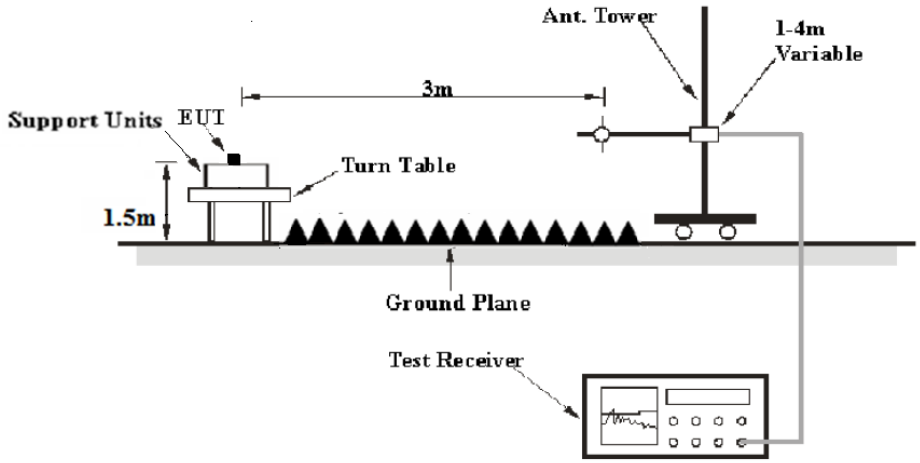
Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Kunshan) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

EUT Setup

Below 1GHz:



Above 1 GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10 - 2013. The specification used was the FCC § 15.209, 15.205 and 15.231.

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 Instrunent	Amplifier	330	171377	2016-09-16	2017-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2015-11-12	2016-11-11
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2016-09-12	2017-09-12
ETS	Horn Antenna	3115	6229	2015-11-07	2016-11-06
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-11-12	2016-11-11
Mini	Pre-amplifier	ZVA-183-S+	857001418	2016-09-16	2017-09-16
champrotek	Chamber	Chamber A	1#	2016-09-17	2017-09-17
R&S	Auto test Software	EMC32	V 09.10.0	-	-
BACL	RF cable	KS-LAB-A01	KS-LAB-A01	2015-12-16	2016-12-15
BACL	RF cable	KS-LAB-A02	KS-LAB-A02	2015-12-16	2016-12-15

*** 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:

Corrected Amplitude = Meter Reading + Antenna Loss + Cable Loss - 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:

Margin = Limit – 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:

6.10dB at **433.92MHz** 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 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Chris Wang on 2016-10-20.
Test mode: FSK & ASK Transmitting

Field Strength (Peak)

Frequency (MHz)	Maximum Reading (dBuV)	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)
433.92	85.73	V	13.7	1.2	25.2	75.43	92.87	17.44
433.92	87.53	H	13.7	1.2	25.2	77.23	92.87	15.64
867.84	50.06	H	18.5	1.8	25.2	45.16	72.87	27.71
867.84	52.51	V	18.5	1.8	25.2	47.61	72.87	25.26
1301.76	41.72	H	22.4	2.4	25.3	41.22	74.00	32.78
1301.76	44.12	V	22.4	2.4	25.3	43.62	74.00	30.38

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(e)	
					Limit (dBμV/m)	Margin (dB)
433.92	75.43	H	-10.46	64.97	72.87	7.90
433.92	77.23	V	-10.46	66.77	72.87	6.10
867.84	45.16	H	-10.46	34.7	52.87	18.17
867.84	47.61	V	-10.46	37.15	52.87	15.72
1301.76	41.22	H	-10.46	30.76	54	23.24
1301.76	43.62	V	-10.46	33.16	54	20.84

Note: All other spurious emissions for above 1GHz are 20dB below the limit.

*Within measurement uncertainty!

Note:
Calculate Average value based on duty cycle correction factor:

Duty cycle=T_{on}/T_P
= 30 ms /100ms
= 0.30

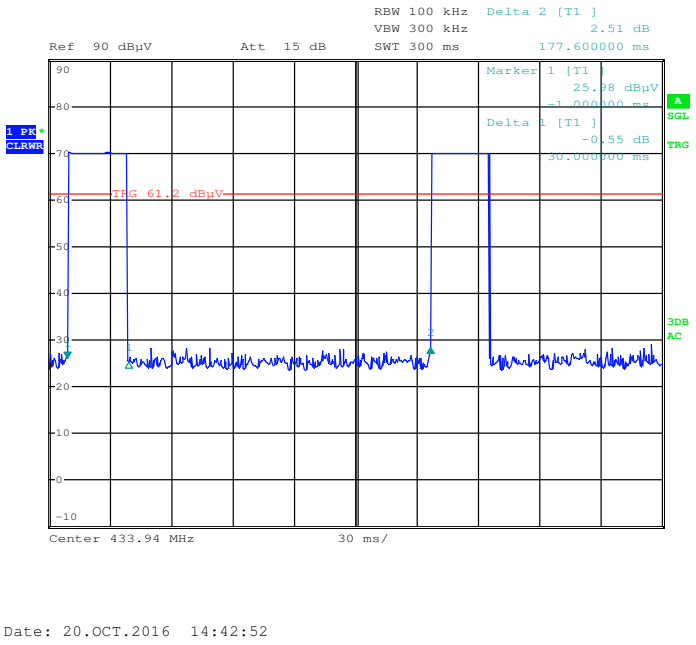
Duty cycle factor= 20*log (duty cycle)
= -10.46dB

So The Max. duty cycle is 30.0%, and duty cycle correction factor is -10.46dB

Average=Peak+ Duty cycle factor

Please refer to the following plot.

Duty cycle

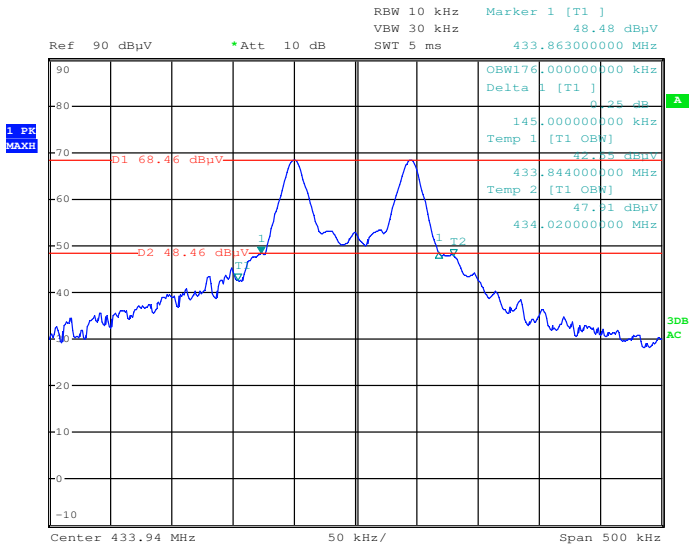


Model	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
FSK & ASK	433.92	145.0	1084.8	Pass

Note: Limit = 0.25% * Center Frequency = 0.25% * 433.92 MHz = 1084.8 kHz
20dB Bandwidth=145.0 kHz<1084.8 kHz

20 dB Bandwidth

Mixed with FSK & ASK:



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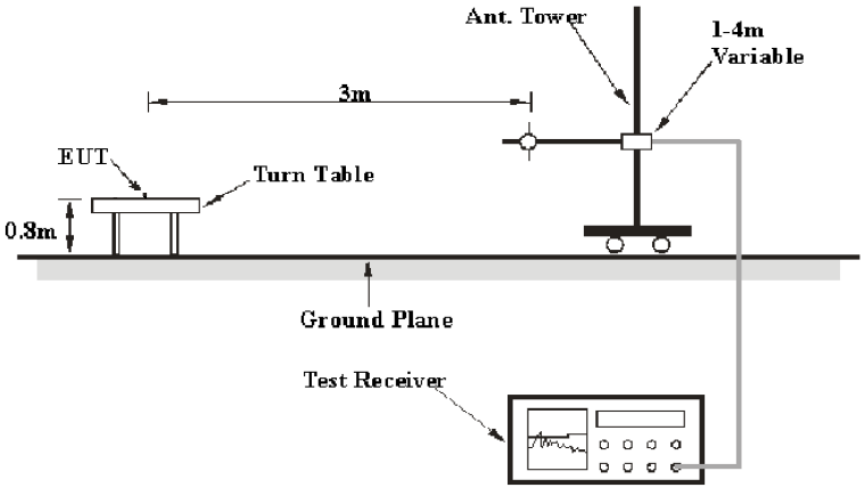
FCC §15.231(e) - Transmission and Silent Period Testing

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

Below 1GHz:



The deactivation test was performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10- 2013. The specification used was the FCC 15.231(e) limits.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrunent	Amplifier	330	171377	2016-09-16	2017-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2015-11-12	2016-11-11
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2016-09-12	2017-09-12
champrotek	Chamber	Chamber A	1#	2016-09-17	2017-09-17
BACL	RF cable	KS-LAB-A02	KS-LAB-A02	2015-12-16	2016-12-15

*** 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 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Chris Wang on 2016-10-19.

Test Mode: Transmitting（mixed with FSK & ASK）

Please refer to following table and plot.

Deactivation

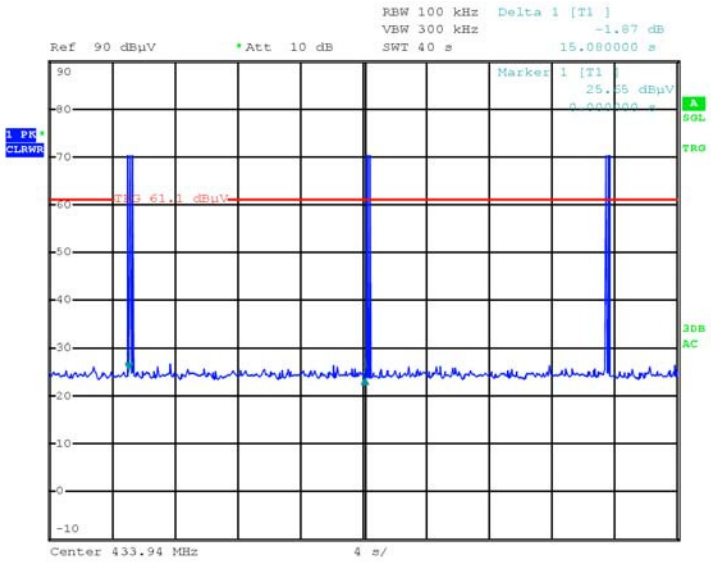
Transmission period (s)	Limit (s)	Result
0.388	< 1	Pass

Silent period

Silent period (s)	Limit (s)	Result
14.692	>11.64	Pass

Note: The silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.
The duration time is 0.388s, 0.388×30 = 11.64s.

Transmission period and Silent period



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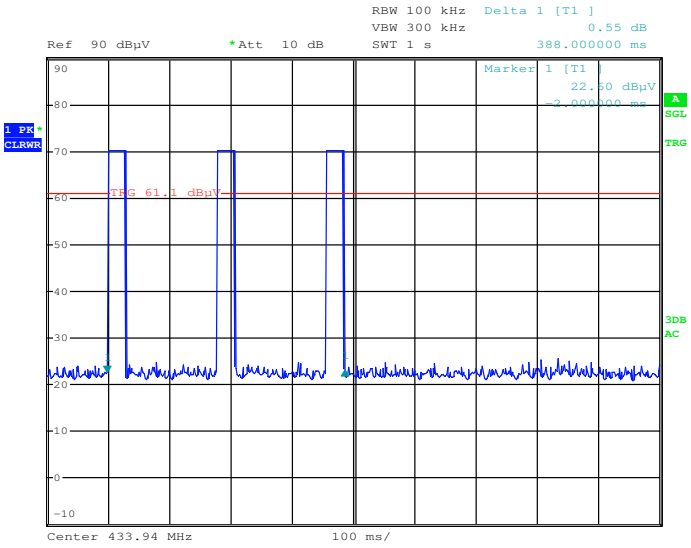

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