FCC PART 15.231

TEST REPORT

For

Shenzhen Autel Intelligent Tech. Co., Ltd.

East Gate, the 1st Floor of SZICC Bldg., Chaguang Road 1089, Xili Town, Nanshan District, Shenzhen, China

FCC ID: WQ8301A315

Report Type:	**Product Type:**
Original Report	Universal Tire Pressure Monitoring Sensor

Test Engineer:	Gardon Zhang
Report Number:	RSZ130930003-00
Report Date:	2013-11-13
Reviewed By:	Alvin Huang RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Shenzhen Autel Intelligent Tech.Co., Ltd's* product, model number: *88900 (FCC ID: WQ8301A315)* (or the "EUT") in this report was an *Universal Tire Pressure Monitoring Sensor*, which was measured approximately: 5.2 cm (L) x 2.9 cm (W) x 2.2 cm (H), rated input voltage: DC 3V button cell.

**All measurement and test data in this report was gathered from production sample serial number: 1309109 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2013-09-30.*

Objective

This 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 C63.4-2009.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, 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 - 2009, 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. (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.

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 December 06, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

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 a typical fashion (as normally used by a typical user).

Two operator mode:

Mode 1: When the vehicle speed is below 20 km/hour or it is stationary, MX-SENSOR will recognize that the signal receiver of the vehicle is in sleep or in low power consumption status. Only when the tire is leak or flat, or MX-SENSOR is activated by activation tools, will MX-SENSOR send separately signal once. There are 12 frames of ASK data and 3 frames of FSK data in the signal. The 12 frames of ASK signal is used to wake the receiver up while the FSK signal includes the information of tire pressure, temperature, etc

This mode belongs to 15.231

Mode 2: MX-SENSOR will identify the vehicle is driving only if the speed is over 20 km/hour. Meanwhile, it will send FSK signal. MX-SENSOR will send 3 frames of FSK data once every 15s.

This mode belongs to 15.231(e)

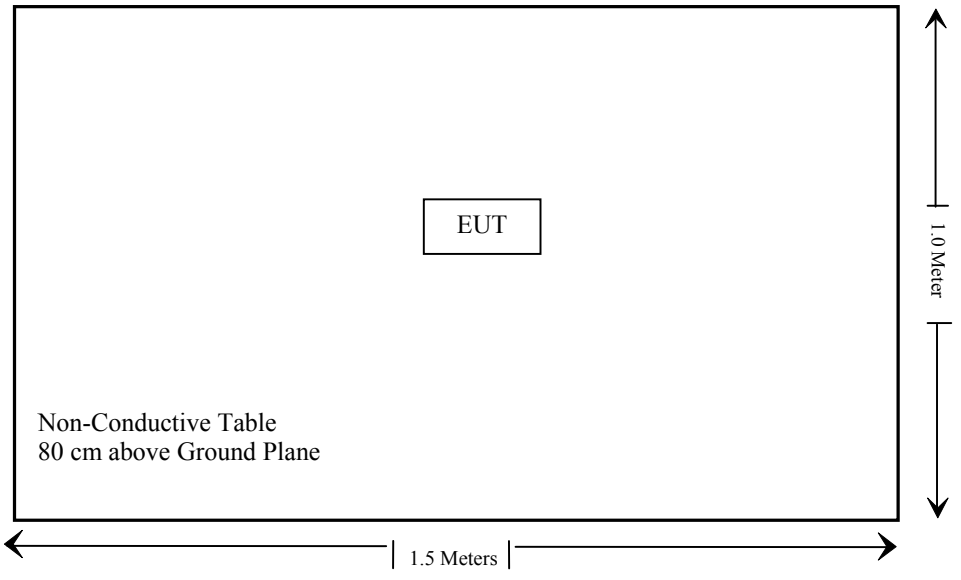
Special Accessories

The special accessories were provided by manufacture.

Equipment Modifications

No modification was made to the EUT 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 (b), §15.231(e)	Radiated Emissions	Compliance
§15.231 (c)	20dB Emission Bandwidth	Compliance
§15.231 (a)(2)	Deactivation	Compliance
§15.231 (e)	Transmission Time, Silent period	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 Connector Construction

The EUT has one integral antenna arrangement, which was permanently attached and the gain was -4dBi, fulfill the requirement of this section. Please refer to EUT photos.

Result: Compliant.

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

Applicable Standard

FCC §15.205, §15.209, §15.231 (b) , §15.231 (e)

According to FCC §15.231(b), 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	2250	225
70-130	1250	125
130-174	1250 to 3750**	125 to 375**
174-260	3750	375
260-470	3750 to 12500**	375 to 1250**
Above 470	12500	1250

*Linear interpolations.

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

According to §15.231 (e), intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field Strength of Fundamental (Microvolts /meter)	Field Strength of spurious emissions (Microvolts /meter)
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500**	50 to 150**
174-260	1500	150
260-470	1500 to 5000**	150 to 500**
Above 470	5000	500

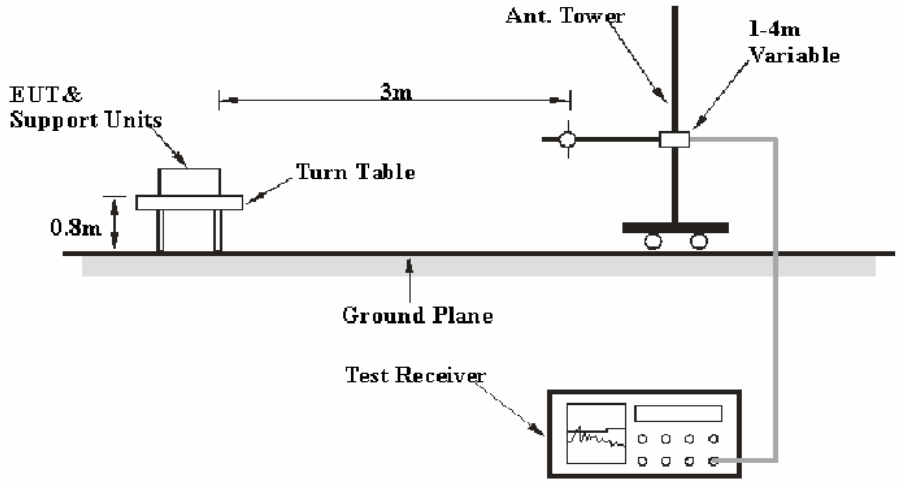
**Linear interpolations.

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

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.

EUT Setup



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:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK

Test Procedure

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

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak detection mode above 1 GHz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2013-09-17	2014-09-17
HP	Amplifier	8447E	1937A01046	2013-09-30	2014-09-30
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2011-11-28	2014-11-27
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2012-11-24	2013-11-23
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2013-04-03	2014-04-03
Sunol Sciences	Horn Antenna	DRH-118	A052304	2011-12-01	2014-11-30

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

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 5.8 dB means the emission is 5.8 dB 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 FCC §15.205, §15.209, §15.231 (e), with the worst margin reading of:

4.82 dB at **3150.0 MHz** in the **Vertical** polarization

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level is in compliance 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:	24~26 ℃
Relative Humidity:	50~56 %
ATM Pressure:	100.1~101.1 kPa

The testing was performed by Gardon Zhang from 2013-09-17 to 2013-11-13.

Test mode: Transmitting

Mode 1 (ASK & FSK):

30 MHz - 4 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.231(b)/205/209		
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dBµV/m)	Margin (dB)	Comment
315	62.47	PK	203	1.0	H	16.0	78.47	95.62	9.19	Fundamental
315	54.58	PK	311	1.6	V	16.0	70.58	95.62	17.08	Fundamental
1260.0	36.48	PK	256	1.6	H	0.16	36.64	75.62	31.02	Harmonic
1260.0	37.62	PK	303	1.7	V	0.16	37.78	75.62	29.88	Harmonic
2205.0	56.69	PK	71	1.6	H	4.40	61.09	74.00	12.91	Harmonic
2205.0	51.63	PK	305	1.6	V	4.40	56.03	74.00	17.97	Harmonic
2520.0	54.29	PK	339	1.6	H	7.59	61.88	75.62	5.78	Harmonic
2520.0	49.90	PK	44	1.6	V	7.59	57.49	75.62	10.17	Harmonic
2835.0	53.46	PK	50	1.3	H	8.56	62.02	74.00	11.98	Harmonic
2835.0	52.02	PK	156	1.6	V	8.56	60.58	74.00	13.42	Harmonic
3150.0	50.88	PK	107	1.6	H	9.43	60.31	75.62	7.35	Harmonic
3150.0	53.41	PK	116	1.3	V	9.43	62.84	75.62	4.82	Harmonic

Field Strength of Average Emission							
Frequency (MHz)	Peak Measurement @3m (dBµV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.231(b)/205/209		
					Limit (dBµV/m)	Margin (dB)	Comment
315	78.47	H	-18.27	60.2	75.62	15.42	Fundamental
315	70.58	V	-18.27	52.31	75.62	23.31	Fundamental
1260.0	36.64	H	-18.27	18.37	55.62	37.25	Harmonic
1260.0	37.78	V	-18.27	19.51	55.62	36.11	Harmonic
2205.0	61.09	H	-18.27	42.82	54.00	11.18	Harmonic
2205.0	56.03	V	-18.27	37.76	54.00	16.24	Harmonic
2520.0	61.88	H	-18.27	43.61	55.62	12.01	Harmonic
2520.0	57.49	V	-18.27	39.22	55.62	16.40	Harmonic
2835.0	62.02	H	-18.27	43.75	54.00	10.25	Harmonic
2835.0	60.58	V	-18.27	42.31	54.00	11.69	Harmonic
3150.0	60.31	H	-18.27	42.04	55.62	13.58	Harmonic
3150.0	62.84	V	-18.27	44.57	55.62	11.05	Harmonic

Calculate Average value based on Duty Cycle correction factor:

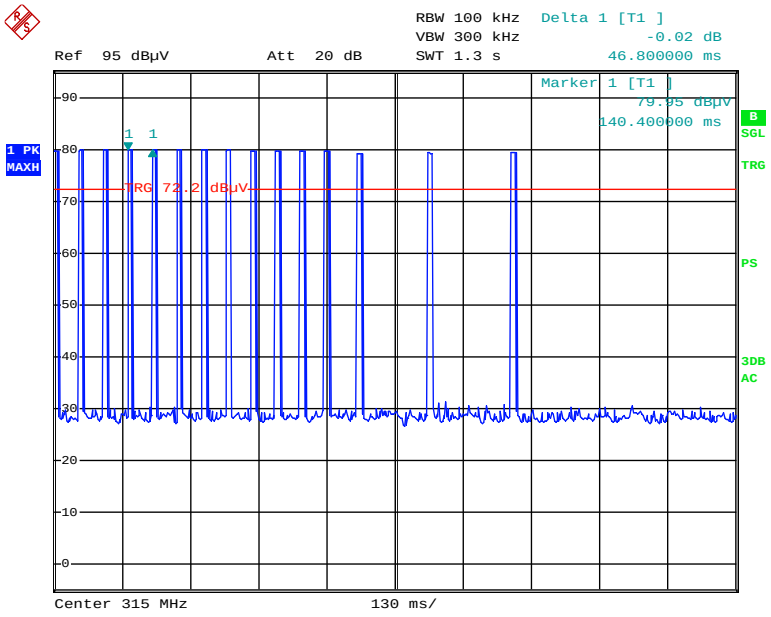
Ton = 16*Pulses=16*0.36ms = 5.76 ms

Tp = 47.2 ms

Duty cycle = Ton/Tp = 5.76/47.2 = 0.122

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.122 = -18.27 dB

Duty Cycle 1



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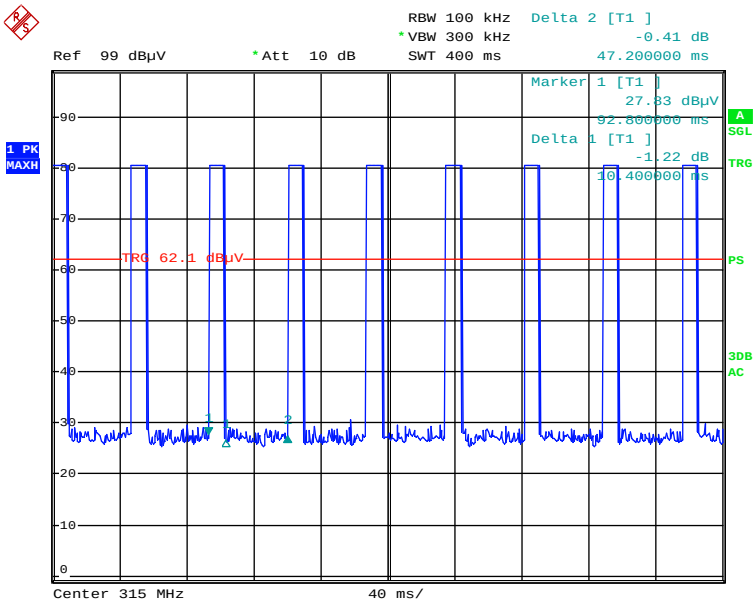
Duty Cycle 2



EUT

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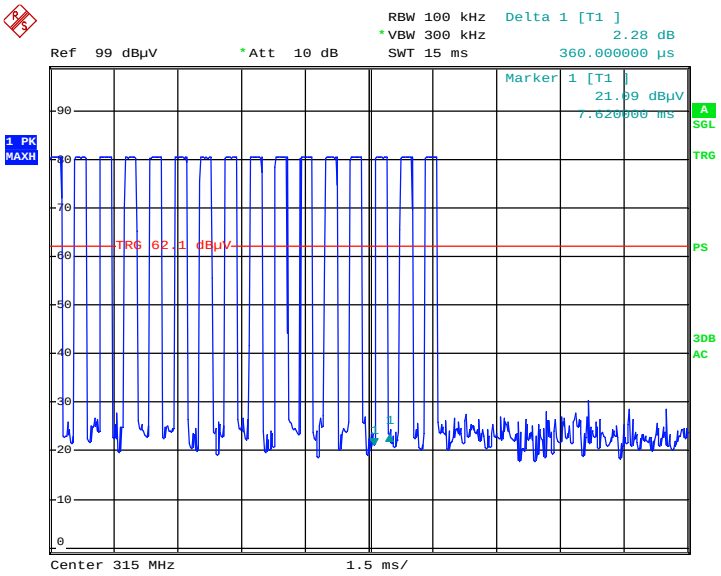
Duty Cycle 3



EUT

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Mode 2 (FSK modulation):

30 MHz - 4 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.231(e)/205/209		
	Reading (dBµV)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dBµV/m)	Margin (dB)	Comment
315	59.54	PK	131	1.0	H	16.0	75.54	87.66	12.12	Fundamental
315	52.80	PK	136	1.4	V	16.0	68.80	87.66	18.86	Fundamental
1260.0	35.26	PK	219	1.5	H	0.16	35.42	74.00	38.58	Harmonic
1260.0	36.44	PK	22	1.7	V	0.16	36.60	74.00	37.40	Harmonic
1575.0	39.87	PK	258	1.4	H	1.70	41.57	74.00	32.43	Harmonic
1575.0	38.92	PK	341	1.2	V	1.70	40.62	74.00	33.38	Harmonic
1890.0	37.27	PK	101	1.3	H	2.63	39.90	74.00	34.10	Harmonic
1890.0	35.54	PK	289	1.2	V	2.63	38.17	74.00	35.83	Harmonic
2205.0	42.48	PK	134	1.2	H	4.40	46.88	74.00	27.12	Harmonic
2205.0	39.11	PK	304	1.5	V	4.40	43.51	74.00	30.49	Harmonic
2520.0	46.19	PK	43	1.4	H	7.59	53.78	74.00	20.22	Harmonic
2520.0	43.44	PK	311	1.4	V	7.59	51.03	74.00	22.97	Harmonic
2835.0	35.42	PK	351	1.6	H	8.56	43.98	74.00	30.02	Harmonic
2835.0	36.57	PK	193	1.4	V	8.56	45.13	74.00	28.87	Harmonic

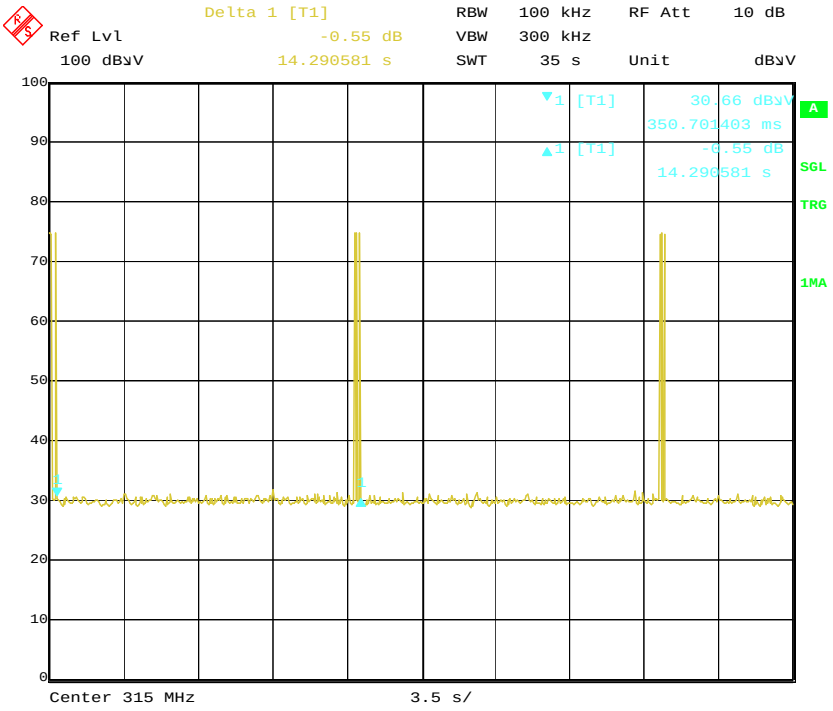
Field Strength of Average Emission							
Frequency (MHz)	Peak Measurement @3m (dBµV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Amplitude (dBµV/m)	FCC Part 15.231(e)/205/209		
					Limit (dBµV/m)	Margin (dB)	Comment
315	75.54	H	-19.69	55.85	67.66	11.81	Fundamental
315	68.80	V	-19.69	49.11	67.66	18.55	Fundamental
1260.0	35.42	H	-19.69	15.73	54.00	38.27	Harmonic
1260.0	36.60	V	-19.69	16.91	54.00	37.09	Harmonic
1575.0	41.57	H	-19.69	21.88	54.00	32.12	Harmonic
1575.0	40.62	V	-19.69	20.93	54.00	33.07	Harmonic
1890.0	39.90	H	-19.69	20.21	54.00	33.79	Harmonic
1890.0	38.17	V	-19.69	18.48	54.00	35.52	Harmonic
2205.0	46.88	H	-19.69	27.19	54.00	26.81	Harmonic
2205.0	43.51	V	-19.69	23.82	54.00	30.18	Harmonic
2520.0	53.78	H	-19.69	34.09	54.00	19.91	Harmonic
2520.0	51.03	V	-19.69	31.34	54.00	22.66	Harmonic
2835.0	43.98	H	-19.69	24.29	54.00	29.71	Harmonic
2835.0	45.13	V	-19.69	25.44	54.00	28.56	Harmonic

Note:

Duty cycle = Ton/Tp = 10.36/100 = 0.1036

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.1036 = -19.69 dB

Duty Cycle 1



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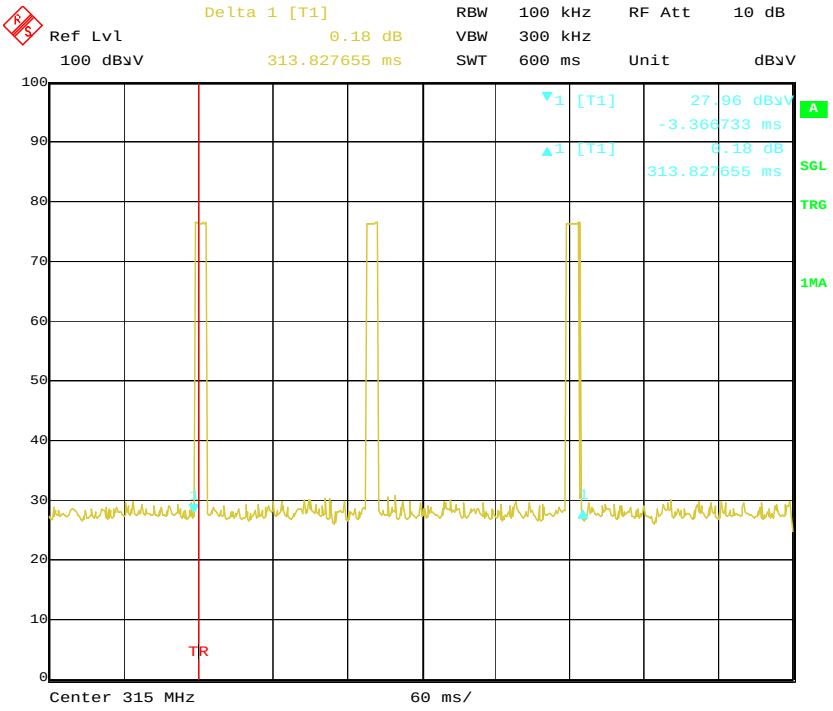
Duty Cycle 2



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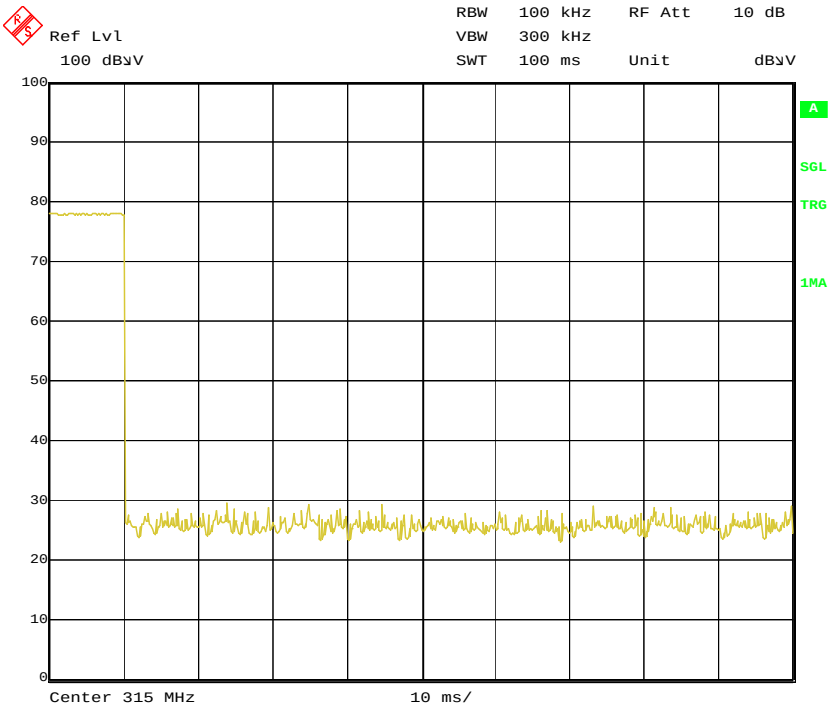
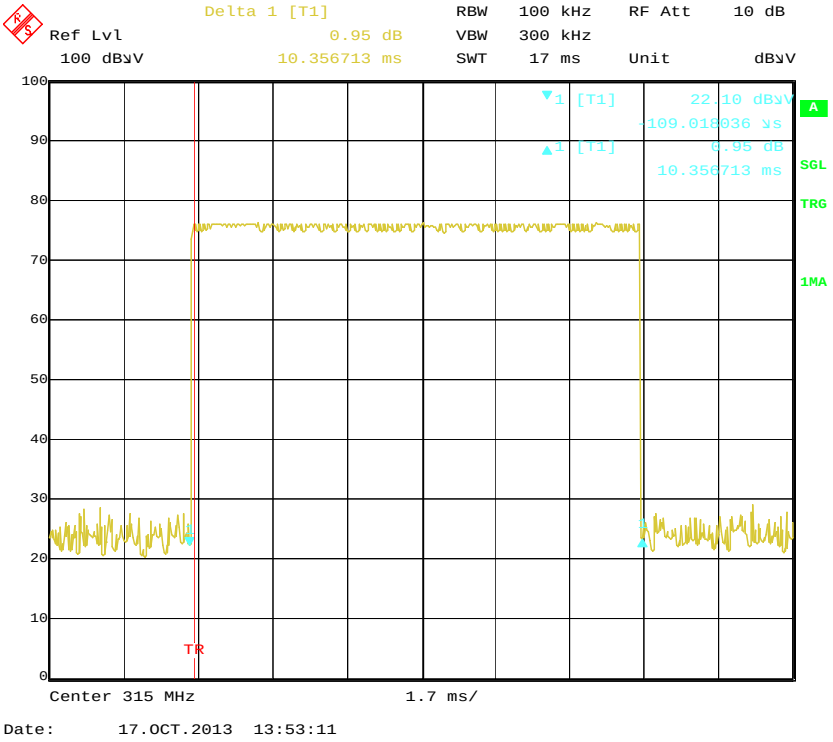
Duty Cycle 3



Duty Cycle 4



FCC §15.231(c) – 20 dB EMISSION BANDWIDTH TESTING

Applicable Standard

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	101122	2013-09-17	2014-09-17

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements, traceable to 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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Gardon Zhang on 2013-10-11 and 2013-11-13.

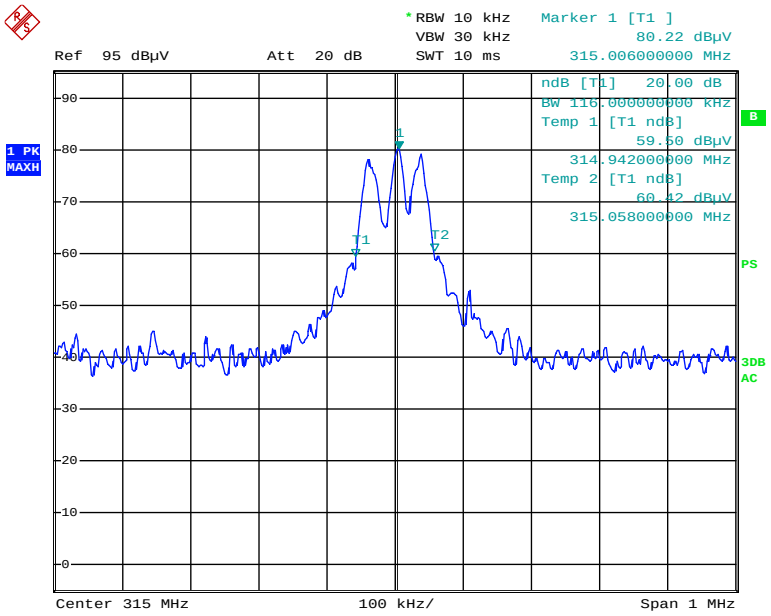
Mode 1: ASK&FSK modulation

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Emission Bandwidth (kHz)	<Limit (kHz)	Result
315	116.0	787.5	Pass

Note: LIMIT = 0.25% * center frequency = 0.25% * 315 MHz = 787.5 kHz
20dB Emission Bandwidth = 116.0 kHz <787.5 kHz

20 dB Emission Bandwidth



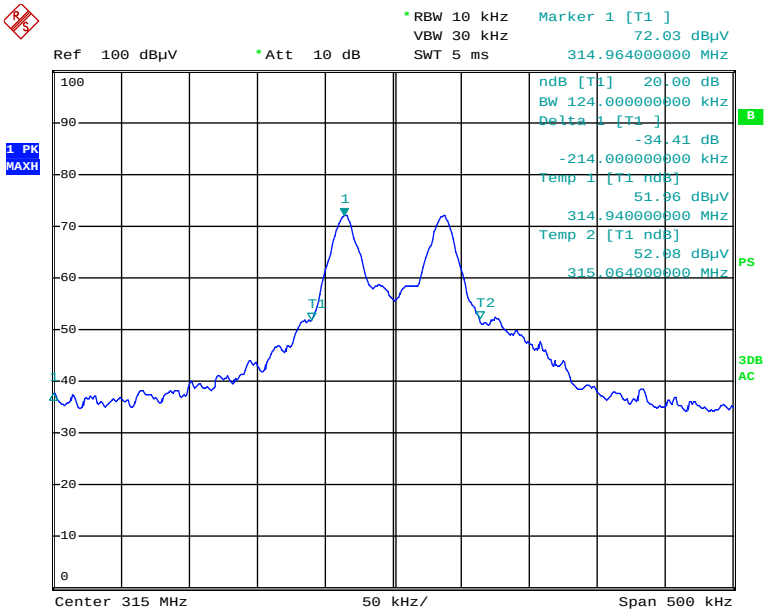
Test Mode 2: FSK modulation

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Emission Bandwidth (kHz)	<Limit (kHz)	Result
315	124.0	787.5	Pass

Note: LIMIT = 0.25% * center frequency = 0.25% * 315 MHz = 787.5 kHz
20dB Emission Bandwidth = 124.0 kHz <787.5 kHz

20 dB Emission Bandwidth



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FCC §15.231(a)(2) - DEACTIVATION TESTING

Applicable Standard

Per FCC §15.231(a) (2), a transmitter activated automatically shall cease transmission within 5 seconds after activation.

Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer=operating frequency.
3. Set the spectrum analyzer as RBW=100k VBW=300k Span=0Hz.
4. Repeat above procedures until all frequency measured was complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2013-09-17	2014-09-17

*** 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

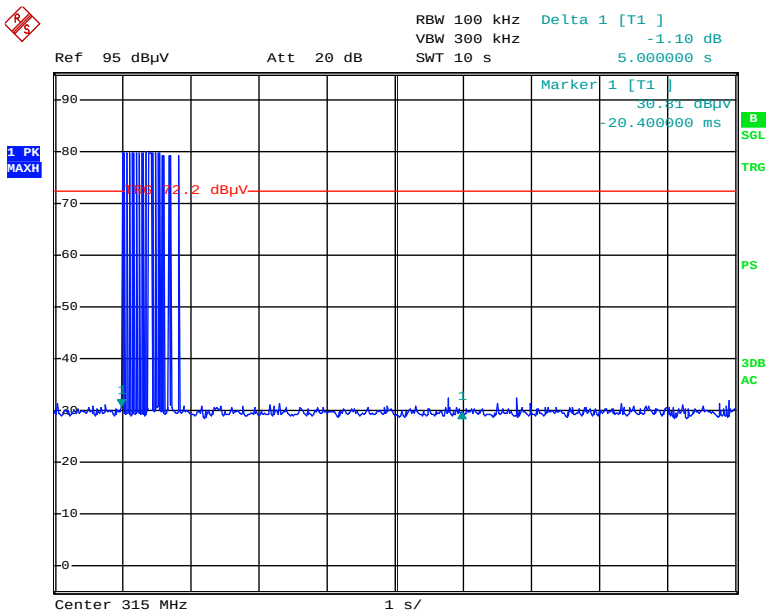
Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	55 %
ATM Pressure:	100.1 kPa

The testing was performed by Gardon Zhang on 2013-11-13.

Mode 1(ASK&FSK modulation):

Test Result: Compliant, please refer to following plot



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FCC §15.231(e) – TRANSMISSION AND SILENT PERIOD TESTING

Applicable Standard

Per FCC §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 Procedure

5. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
6. Set center frequency of spectrum analyzer=operating frequency.
7. Set the spectrum analyzer as RBW=100kHz, VBW=300kHz, Span=0Hz.
8. Repeat above procedures until all frequency measured was complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2012-11-24	2013-11-23

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

Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Gardon Zhang on 2013-10-17.

Test Mode: Transmitting

Deactivation

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

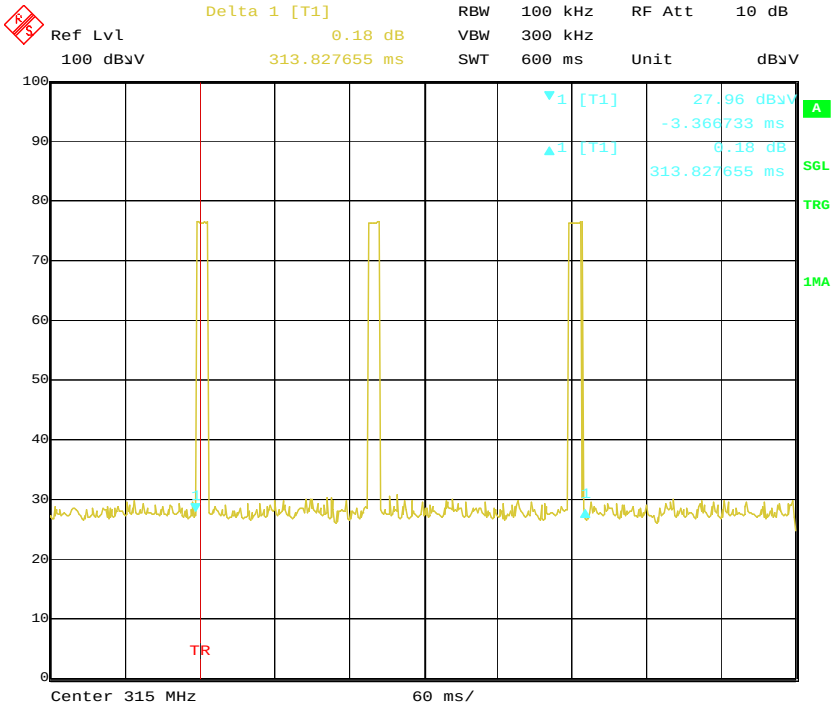
Silent period

Silent period (s)	Limit (s)	Result
14.01 s	> 10 s	Pass

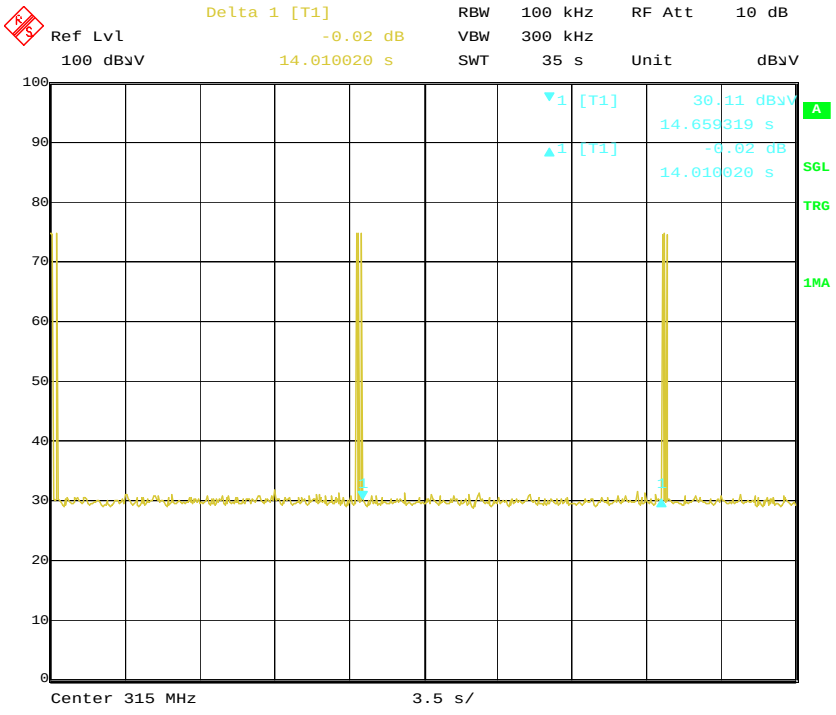
Note: The silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.
The duration time is 0.314 s, 0.314×30 = 9.42 s.

Test Result: Compliant, please refer to following plot

Transmission period



Silent period



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