



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

for

TPMS Sensor

Model: WARDKS

Brand: VALOR/DigiTire/Perfect Equipment/DILL

Test Report Number:

C151210Z03-RP1

Issued for

SHANGHAI BAOLONG AUTOMOTIVE CORPORATION

5500, Shenzhuan Rd., Songjiang District, Shanghai 201619, China

Issued By

Compliance Certification Services (Shenzhen) Inc.

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Issued Date: December 21, 2015

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	December 21, 2015	Initial Issue	ALL	Amzula Chen



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1. TEST RESULT CERTIFICATION

Product	TPMS Sensor
Model	WARDKS
Brand	VALOR/DigiTire/Perfect Equipment/DILL
Tested	December 10~December 16, 2015
Applicant	SHANGHAI BAOLONG AUTOMOTIVE CORPORATION 5500, Shenzhuan Rd., Songjiang District, Shanghai 201619, China
Manufacturer	SHANGHAI BAOLONG AUTOMOTIVE CORPORATION 5500, Shenzhuan Rd., Songjiang District, Shanghai 201619, China

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted
DEVIATION FROM APPLICABLE STANDARD	
None	

We hereby certify that:

The above equipment was tested by Compliance Certification Services (Shenzhen) Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.209 and Part 15.231.

The test results of this report relate only to the tested sample identified in this report.

Approved by:

Reviewed by:

Sunday Hu
Supervisor of RF Dept.
Compliance Certification Service (Shenzhen)
Inc.

Ruby Zhang
Supervisor of Report Dept.
Compliance Certification Service (Shenzhen)
Inc.



2. EUT DESCRIPTION

Product	TPMS Sensor
Model	WARDKS
Brand	VALOR/DigiTire/Perfect Equipment/DILL
Model Difference	N/A
Power Supply	DC3V supplied by the battery
Frequency Range	433.92 MHz
Transmit Power	Peak: 73.37dBuV/m (Max.) Average: 57.55dBuV/m (Max.)
Modulation Technique	FSK,ASK
Number of Channels	1 Channel
Antenna Designation	PCB antenna with -2dBi gain (Max)
Temperature Range	-40°C ~ +125°C
Hardware Version	QY1001-01-000BM-V04
Software Version	QY1001-04-000PR-V1.0

Remark: This submittal(s) (test report) is intended for FCC ID: Z9F-WARDKS filing to comply with Section 15.209 and 15.231 of the FCC Part 15, Subpart C Rules.



3. TEST METHODOLOGY

3.1 DESCRIPTION OF TEST MODES

The EUT has been tested under engineering test mode condition and the EUT staying in continuous transmitting mode.

The following test mode(s) were scanned during the preliminary test below 1G:

Test Item	Test mode	Worse mode
Conducted Emission	Not applicable since the EUT supplied by the battery.	☐
Radiated Emission	Mode 1: TX	☒

Above 1G, TX mode with the highest data rate (worst case) are chosen for full testing.



4. FACILITIES AND ACCREDITATIONS

4.1 FACILITIES

All measurement facilities used to collect the measurement data are located at **No.10-1, Mingkeda Logistics Park, No.18, Huanguan South Rd., Guan Lan Town, Baoan District, Shenzhen, China**

The sites are constructed in conformance with the requirements of ANSI C63.10:2013, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

4.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following accreditation body according to ISO/IEC 17025.

USA	A2LA
China	CNAS

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

USA	FCC
Japan	VCCI(C-3478, R-3135, T-652, G-10624)
Canada	INDUSTRY CANADA

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.ccssz.com>

4.3 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Parameter	Uncertainty
Radiated Emission, 30 to 200 MHz Test Site : 966(2)	+/-3.6880dB
Radiated Emission, 200 to 1000 MHz Test Site : 966(2)	+/-3.6695dB
Radiated Emission, 1 to 8 GHz	+/-5.1782dB
Radiated Emission, 8 to 18 GHz	+/-5.2173dB
Conducted Emissions	+/-3.6836dB
Band Width	178kHz
Peak Output Power MU	+/-1.906dB
Band Edge MU	+/-0.182dB
Channel Separation MU	416.178Hz
Duty Cycle MU	0.054ms
Frequency Stability MU	226Hz

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

The measured result is above (below) the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance (non-compliance) is more probable than non-compliance) with the specification limit.



5. SETUP OF EQUIPMENT UNDER TEST

5.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

5.2 SUPPORT EQUIPMENT

No	Equipment	Model	Serial No.	FCC ID	Brand	Data Cable	Power Cord
1.	N/A						

Remark:

Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



6. FCC PART 15.231 REQUIREMENTS

6.1 20 DB BANDWIDTH

LIMIT

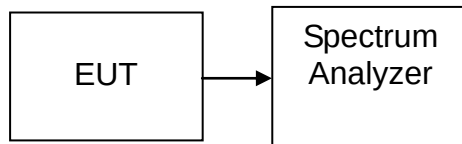
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Last Calibration	Due Calibration
Spectrum Analyzer	Agilent	E4446A	US44300399	03/01/2015	03/01/2016

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The spectrum analyzer center frequency is set to the transmitter frequency. The RBW is set to 10 kHz and VBW is set 30kHz.

TEST RESULTS

No non-compliance noted.

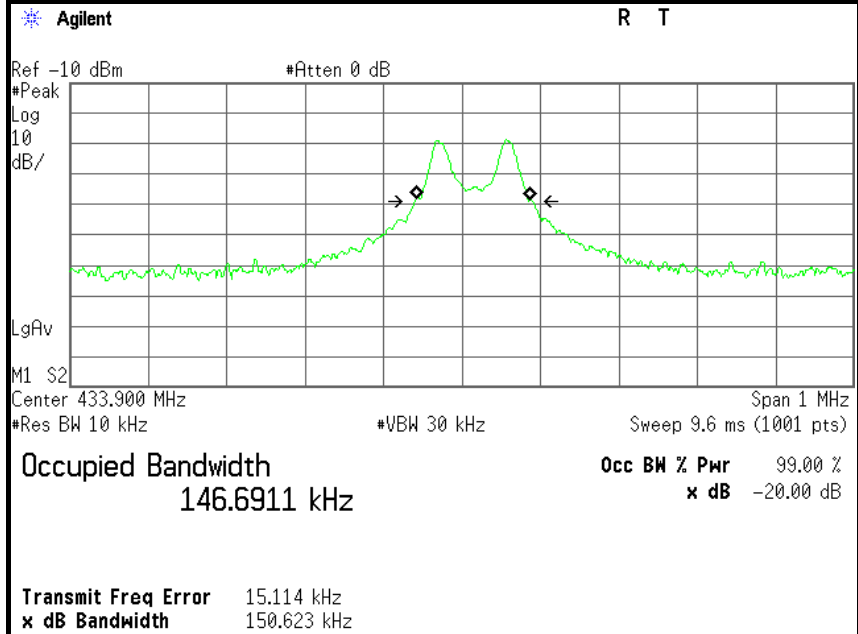
Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (MHz)	Result
433.92	150.6230	1.0848	PASS



Test Plot

20dB Bandwidth





6.2 LIMIT OF TRANSMISSION TIME

LIMIT

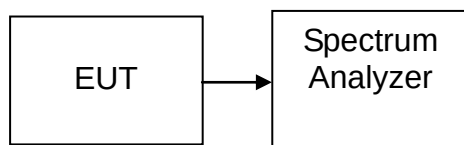
According to 15.231 (e) Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the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

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Last Calibration	Due Calibration
Spectrum Analyzer	Agilent	E4446A	US44300399	03/01/2015	03/01/2016
Spectrum Analyzer	R&S	FSU	200409	10/25/2015	10/24/2016

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The spectrum analyzer center frequency is set to the transmitter frequency. The RBW and VBW are set to 1MHz.

TEST RESULTS

No non-compliance noted

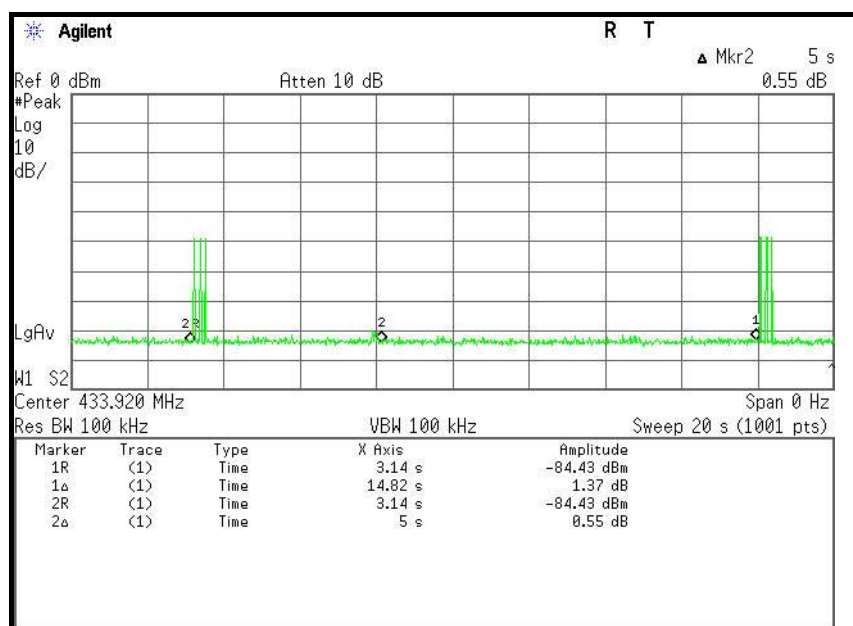
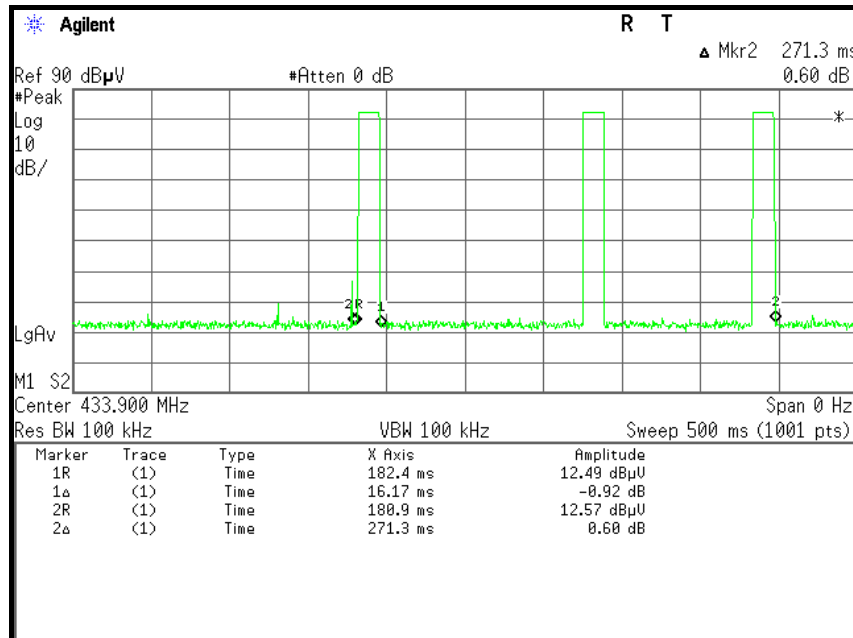
Test Data

Frequency (MHz)	Transmission Time (s)	Limit (s)	Result
433.92	0.271	1	Pass

Frequency (MHz)	Silent Period (s)	Limit (s)	Result
433.92	14.549	10	Pass



Test Plot





6.3 DUTY CYCLE

LIMIT

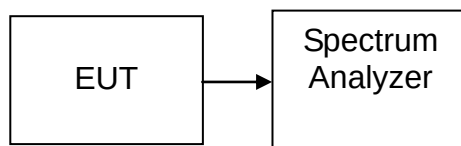
Nil (No dedicated limit specified in the Rules)

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Last Calibration	Due Calibration
Spectrum Analyzer	Agilent	E4446A	US44300399	02/28/2015	02/27/2016

Remark: Each piece of equipment is scheduled for calibration once a year.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz, Adjust Sweep = 20ms
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted

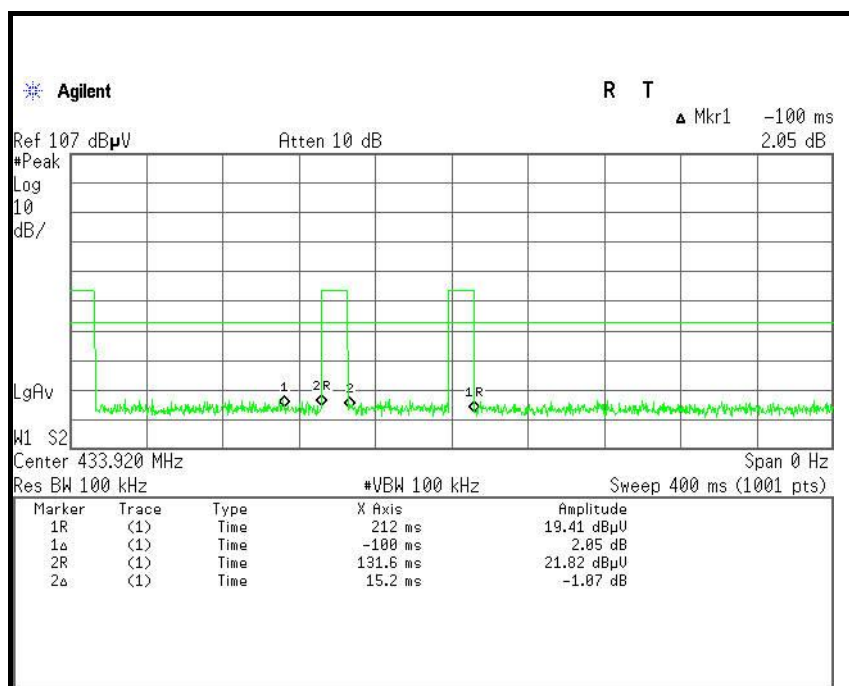
Test Data

Duty Cycle Correction Factor = $20 \times \log(1/x) = 20 \times \log(1/0.304) = 10.34\text{dB}$

【 $x=15.2 \times 2/100=0.304$ 】



Test Plot





6.4 RADIATED EMISSIONS

LIMIT

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 emission (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500 ¹	50 to 150 ¹
174-260	1,500	150
260-470	1,500 to 5,000 ¹	150 to 500 ¹
Above 470	5,000	500

1. ** linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$; for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

2. In the above emission table, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength ($\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

**MEASUREMENT EQUIPMENT USED**

Radiated Emission Test Site 966 (2)					
Name of Equipment	Manufacturer	Model Number	Serial Number	Last Calibration	Due Calibration
PSA Series Spectrum Analyzer	Agilent	E4446A	US44300399	02/28/2015	02/27/2016
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	02/28/2015	02/27/2016
Amplifier	MITEQ	AM-1604-3000	1123808	03/18/2015	03/18/2016
High Noise Amplifier	Agilent	8449B	3008A01838	02/28/2015	02/27/2016
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170-497	02/28/2015	02/27/2016
Bilog Antenna	SCHAFFNER	CBL6143	5082	02/28/2015	02/27/2016
Horn Antenna	SCHWARZBECK	BBHA9120	D286	02/28/2015	02/27/2016
Loop Antenna	A、R、A	PLA-1030/B	1029	09/25/2015	09/24/2016
Turn Table	N/A	N/A	N/A	N.C.R	N.C.R
Controller	Sunol Sciences	SC104V	022310-1	N.C.R	N.C.R
Controller	CT	N/A	N/A	N.C.R	N.C.R
Temp. / Humidity Meter	Anymetre	JR913	N/A	02/28/2015	02/27/2016
Antenna Tower	SUNOL	TLT2	N/A	N.C.R	N.C.R
Test S/W	FARAD	LZ-RF / CCS-SZ-3A2			

Remark: Each piece of equipment is scheduled for calibration once a year.

TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m or 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz:

(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO

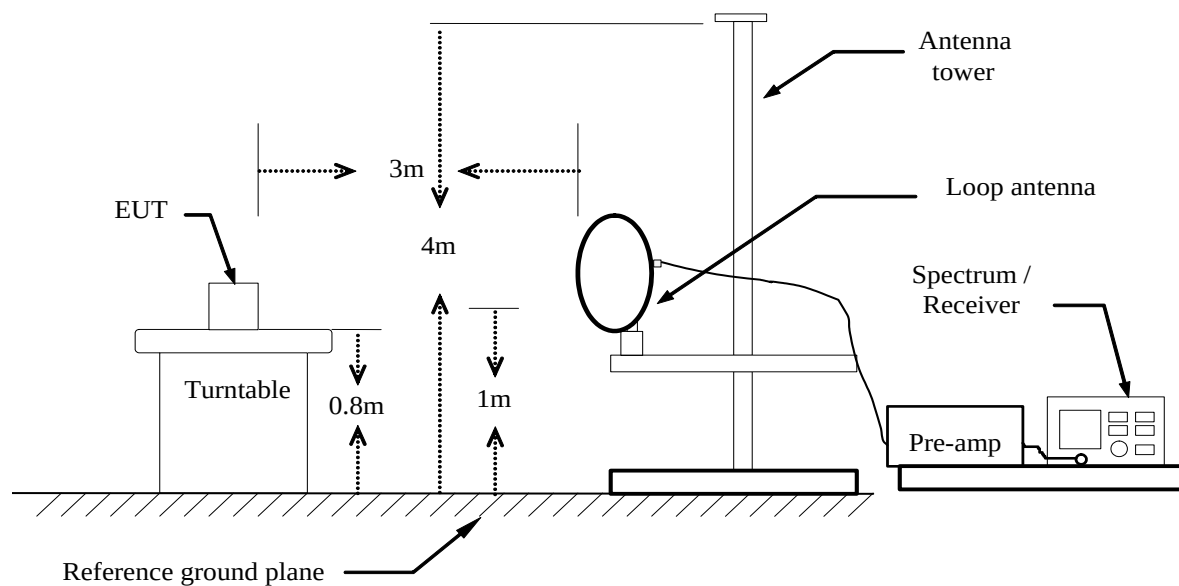
(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO

7. Repeat above procedures until the measurements for all frequencies are complete.

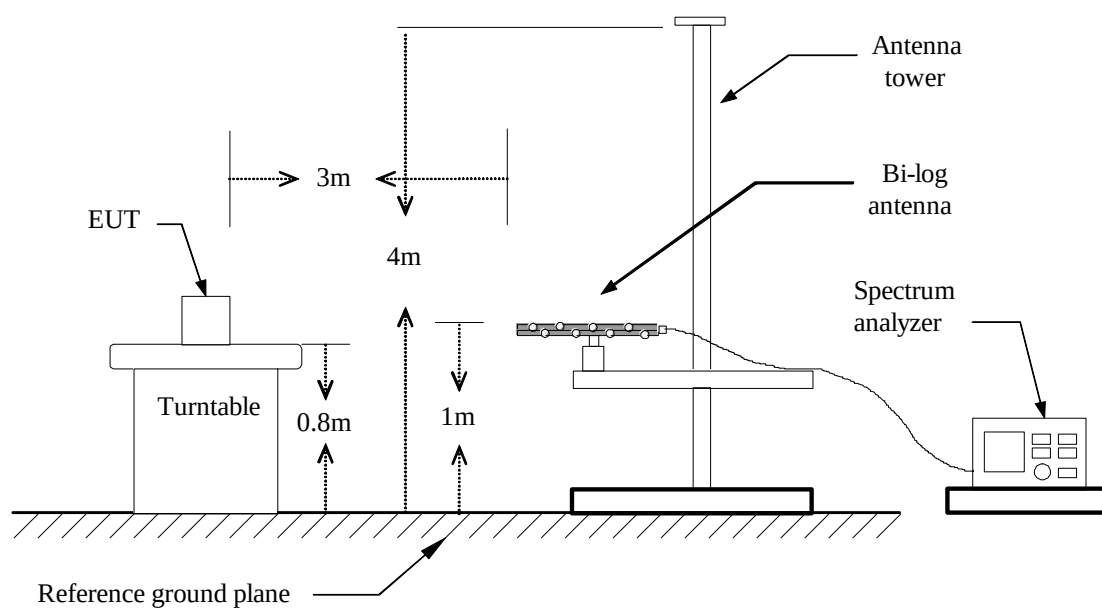


TEST CONFIGURATION

Below 30MHz

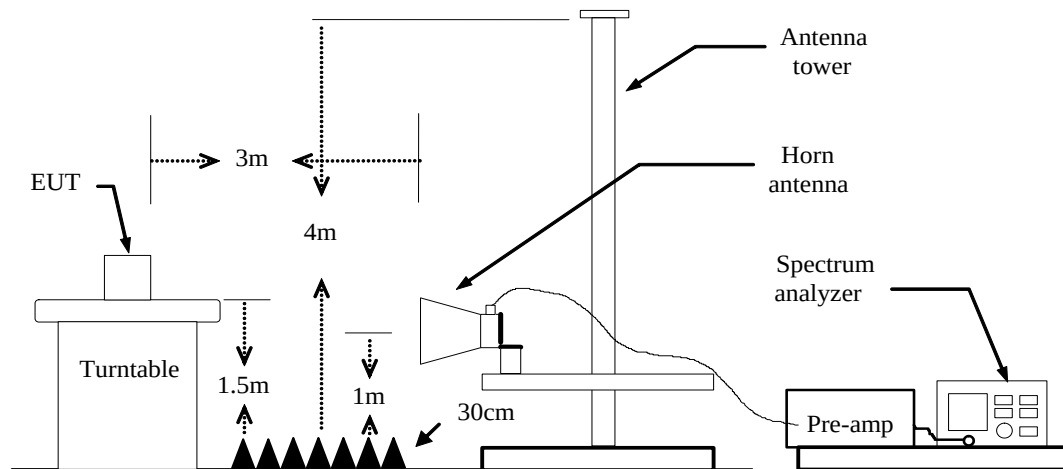


Below 1 GHz





Above 1 GHz



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

DATA SAMPLE

Below 1GHz

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
XXX.XXXX	37.47	-16.41	21.06	40.00	-18.94	V	QP

Above 1GHz

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
XXXX.XXXX	55.54	4.56	60.10	74.00	-13.90	V	Peak
XXXX.XXXX	29.66	4.56	34.22	54.00	-19.78	V	AVG

Frequency (MHz)	= Emission frequency in MHz
Reading (dBuV)	= Uncorrected Analyzer / Receiver reading
Correction Factor (dB/m)	= Antenna factor + Cable loss – Amplifier gain
Result (dBuV/m)	= Reading (dBuV) + Corr. Factor (dB/m)
Limit (dBuV/m)	= Limit stated in standard
Margin (dB)	= Result (dBuV/m) – Limit (dBuV/m)
Q.P.	= Quasi-peak Reading
Peak	= Peak Reading
AVG	= Average Reading

**TEST RESULTS**

Operation Mode: TX

Test Date: December 15, 2015

Temperature: 24°C

Tested by: Jack Chen

Humidity: 52 % RH

Polarity: Ver. / Hor.

Fundamental:

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
433.92	82.56	-9.19	73.37	92.87	-19.50	V	Peak
433.92	66.74	-9.19	63.03	72.87	-9.84	V	AVG
433.92	79.42	-9.19	70.23	92.87	-22.64	H	Peak
433.92	63.60	-9.19	59.89	72.87	-12.98	H	AVG

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
39.7000	45.33	-11.25	34.08	40.00	-5.92	V	QP
61.0400	51.19	-13.43	37.76	40.00	-2.24	V	QP
157.0700	40.44	-11.79	28.65	43.50	-14.85	V	QP
278.3200	38.68	-9.77	28.91	46.00	-17.09	V	QP
369.5000	37.11	-8.79	28.32	46.00	-17.68	V	QP
868.0800	30.20	-2.49	27.71	46.00	-18.29	V	QP
61.0400	51.28	-13.43	37.85	40.00	-2.15	H	QP
131.8500	38.60	-12.39	26.21	43.50	-17.29	H	QP
157.0700	38.61	-11.79	26.82	43.50	-16.68	H	QP
214.3000	34.38	-11.20	23.18	43.50	-20.32	H	QP
758.4700	27.01	-3.46	23.55	46.00	-22.45	H	QP
868.0800	36.22	-2.49	33.73	46.00	-12.27	H	QP

Remark: AVG = peak - duty factor**Remark:** No emission found between lowest internal used/generated frequency to 30MHz.**Remark:**

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.

**Above 1 GHz**

Operation Mode: TX **Test Date:** December 15, 2015
Temperature: 24°C **Humidity:** 52 % RH
Tested by: Jack Chen

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Pole (V/H)	Remark
1492.000	48.06	-6.89	41.17	74.00	-32.83	V	peak
2020.000	46.41	-4.89	41.52	74.00	-32.48	V	peak
2604.000	42.18	-2.07	40.11	74.00	-33.89	V	peak
3004.000	42.64	-1.35	41.29	74.00	-32.71	V	peak
3488.000	40.93	-0.54	40.39	74.00	-33.61	V	peak
3892.000	41.11	1.13	42.24	74.00	-31.76	V	peak
1068.000	46.62	-8.29	38.33	74.00	-35.67	H	peak
1748.000	47.14	-6.38	40.76	74.00	-33.24	H	peak
2168.000	42.72	-4.08	38.64	74.00	-35.36	H	peak
2604.000	44.24	-2.07	42.17	74.00	-31.83	H	peak
3296.000	41.27	-0.86	40.41	74.00	-33.59	H	peak
3784.000	39.98	0.68	40.66	74.00	-33.34	H	peak

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Spectrum setting:
 - a. Spectrum Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.
 - b. AVG=peak- duty factor.



6.5 POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

MEASUREMENT EQUIPMENT USED

Conducted Emission Test Site					
Name of Equipment	Manufacturer	Model Number	Serial Number	Last Calibration	Due Calibration
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	02/28/2015	02/27/2016
LISN(EUT)	ROHDE&SCHWARZ	ENV216	101543-WX	02/28/2015	02/27/2016
LISN	EMCO	3825/2	8901-1459	02/28/2015	02/27/2016
Temp. / Humidity Meter	VICTOR	HTC-1	N/A	02/28/2015	02/27/2016
Test S/W	FARAD	EZ-EMC/ CCS-3A1-CE			

Remark: Each piece of equipment is scheduled for calibration once a year.

TEST CONFIGURATION

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

Not applicable (Since the EUT is powered by battery)