

# FCC Radio Test Report

## FCC ID: 2AMDI-TC88

**Report No.** : TB-FCC154117  
**Applicant** : SHENZHEN TCITY ELECTRONICS CO.,LTD  
**Equipment Under Test (EUT)**  
**EUT Name** : TPMS  
**Model No.** : TC88  
**Serial Model No.** : Please see the page of 4  
**Brand Name** : JUMBER  
**Receipt Date** : 2017-05-31  
**Test Date** : 2017-06-01 to 2017-06-05  
**Issue Date** : 2017-06-06  
**Standards** : FCC Part 15, Subpart C (15.231(e):2016)  
**Test Method** : ANSI C63.10:2013  
**Conclusions** : **PASS**

In the configuration tested, the EUT complied with the standards specified above,  
The EUT technically complies with the FCC requirements

**Test/Witness Engineer** :

WANG SU

**Approved & Authorized** :

Long



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

TB-RF-074-1.0

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# 1. General Information about EUT

## 1.1 Client Information

|                     |   |                                                                                                                                            |
|---------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant</b>    | : | SHENZHEN TCITY ELECTRONICS CO.,LTD                                                                                                         |
| <b>Address</b>      | : | D Building, 4th Floor Yiyuanda Shilong Industry Park, Industrial 2 Road, Shilong Community, Shiyan Street, Baoan District, Shenzhen, China |
| <b>Manufacturer</b> | : | SHENZHEN TCITY ELECTRONICS CO.,LTD                                                                                                         |
| <b>Address</b>      | : | D Building, 4th Floor Yiyuanda Shilong Industry Park, Industrial 2 Road, Shilong Community, Shiyan Street, Baoan District, Shenzhen, China |

## 1.2 General Description of EUT (Equipment Under Test)

|                        |   |                                                                                                                                                                                    |                                                   |
|------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| EUT Name               | : | TPMS                                                                                                                                                                               |                                                   |
| Models No.             | : | TC88, TC18, TC28, TC38, TC58, TC68, TC78, TC88, TC98, TC608, TC618, TC628, TC638, TC658, TC668, TC678, TC688, TC698, TC808, TC818, TC828, TC838, TC858, TC868, TC878, TC888, TC898 |                                                   |
| Model Difference       | : | All these models are identical in the same PCB, layout and electrical circuit, the only difference is appearance.                                                                  |                                                   |
| Product Description    | : | Operation Frequency:                                                                                                                                                               | 433.92 MHz                                        |
|                        |   | Max Out Power:                                                                                                                                                                     | 78.56 dBuV/m (PK Max.)<br>70.82 dBuV/m (AV Max.)  |
|                        |   | Antenna Gain:                                                                                                                                                                      | Integral Antenna(0 dBi) <small>see note 2</small> |
|                        |   | Modulation Type:                                                                                                                                                                   | FSK(1.25Mbps)                                     |
| Power Supply           | : | DC power by button battery.                                                                                                                                                        |                                                   |
| Power Rating           | : | DC 3.0V by button Battery.                                                                                                                                                         |                                                   |
| Connecting I/O Port(S) | : | Please refer to the User's Manual                                                                                                                                                  |                                                   |

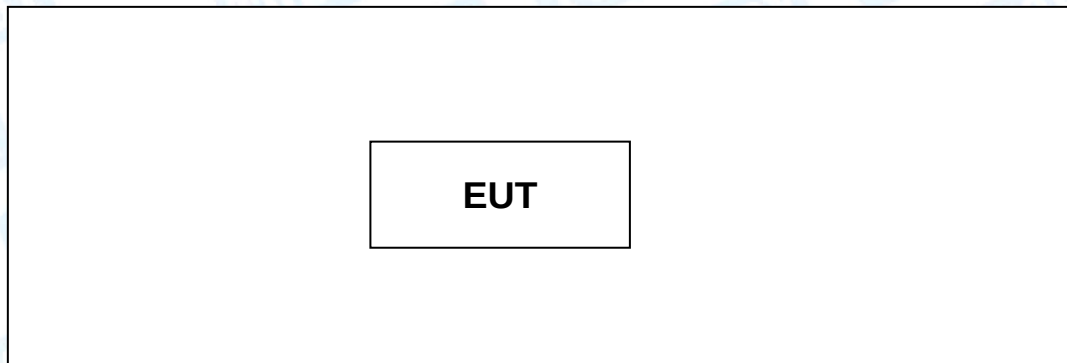
### Note:

- (1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
- (2) Antenna description

| Antenna | Brand | Model Name | Type          | Antenna Gain(dBi) |
|---------|-------|------------|---------------|-------------------|
| 1       | N/A   | N/A        | Integral Ant. | 0                 |

### 1.3 Block Diagram Showing the Configuration of System Tested

#### TX Mode



### 1.4 Description of Support Units

The EUT has been test as an independent unit.

### 1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

| Test Items         | Note                      |
|--------------------|---------------------------|
| Conducted Emission | N/A                       |
| Radiated Emission  | Continuously transmitting |
| Bandwidth          | Continuously transmitting |
| Duty Cycle         | Continuously transmitting |
| Release Time       | Normal Mode               |

**Note:**

- (1) During the testing procedure, the continuously transmitting mode was programmed by the customer.
- (2) The EUT is considered a fixed unit, and it was pre-tested on the positioned of each 3 axis: X axis, Y axis and Z axis. The worst case was found positioned on Z-plane. There for only the test data of this Z-plane were used for radiated emission measurement test.

## 1.6 Description of Test Software Setting

During testing channel& Power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of transmitting mode.

|                              |     |
|------------------------------|-----|
| RF Power Setting in Test SW: | DEF |
|------------------------------|-----|

## 1.7 Measurement Uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %.

| Test Item          | Parameters                           | Expanded Uncertainty ( $U_{Lab}$ ) |
|--------------------|--------------------------------------|------------------------------------|
| Conducted Emission | Level Accuracy:<br>9kHz~150kHz       | $\pm 3.42$ dB                      |
|                    | 150kHz to 30MHz                      | $\pm 3.42$ dB                      |
| Radiated Emission  | Level Accuracy:<br>9kHz to 30 MHz    | $\pm 4.60$ dB                      |
| Radiated Emission  | Level Accuracy:<br>30MHz to 1000 MHz | $\pm 4.40$ dB                      |
| Radiated Emission  | Level Accuracy:<br>Above 1000MHz     | $\pm 4.20$ dB                      |

## 1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

### **CNAS (L5813)**

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

### **FCC List No.: (811562)**

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562.

### **IC Registration No.: (11950A-1)**

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A-1.

## 2. Test Summary

| FCC Part 15 Subpart (15.231(e))                         |                     |          |        |
|---------------------------------------------------------|---------------------|----------|--------|
| Standard Section                                        | Test Item           | Judgment | Remark |
| FCC                                                     |                     |          |        |
| 15.203                                                  | Antenna Requirement | PASS     | N/A    |
| 15.207                                                  | Conducted Emission  | N/A      | N/A    |
| 15.231(e)                                               | Release Time        | PASS     | N/A    |
|                                                         | Radiation Emission  | PASS     | N/A    |
|                                                         | 20 dB Bandwidth     | PASS     | N/A    |
|                                                         | Duty Cycle          | PASS     | N/A    |
| <b>Note:</b> N/A is an abbreviation for Not Applicable. |                     |          |        |

### 3. Test Equipment

| Conducted Emission Test    |                                  |             |            |               |               |
|----------------------------|----------------------------------|-------------|------------|---------------|---------------|
| Equipment                  | Manufacturer                     | Model No.   | Serial No. | Last Cal.     | Cal. Due Date |
| EMI Test Receiver          | Rohde & Schwarz                  | ESCI        | 100321     | Jul. 22, 2016 | Jul. 21, 2017 |
| RF Switching Unit          | Compliance Direction Systems Inc | RSU-A4      | 34403      | Jul. 22, 2016 | Jul. 21, 2017 |
| AMN                        | SCHWARZBECK                      | NNBL 8226-2 | 8226-2/164 | Jul. 22, 2016 | Jul. 21, 2017 |
| LISN                       | Rohde & Schwarz                  | ENV216      | 101131     | Jul. 22, 2016 | Jul. 21, 2017 |
| Radiation Emission Test    |                                  |             |            |               |               |
| Equipment                  | Manufacturer                     | Model No.   | Serial No. | Last Cal.     | Cal. Due Date |
| Spectrum Analyzer          | Agilent                          | E4407B      | MY45106456 | Jul. 22, 2016 | Jul. 21, 2017 |
| EMI Test Receiver          | Rohde & Schwarz                  | ESPI        | 100010/007 | Jul. 22, 2016 | Jul. 21, 2017 |
| Bilog Antenna              | ETS-LINDGREN                     | 3142E       | 00117537   | Mar.25, 2017  | Mar. 24, 2018 |
| Bilog Antenna              | ETS-LINDGREN                     | 3142E       | 00117542   | Mar.25, 2017  | Mar. 24, 2018 |
| Horn Antenna               | ETS-LINDGREN                     | 3117        | 00143207   | Mar.24, 2017  | Mar. 23, 2018 |
| Horn Antenna               | ETS-LINDGREN                     | 3117        | 00143209   | Mar.24, 2017  | Mar. 23, 2018 |
| Loop Antenna               | Laplace instrument               | RF300       | 0701       | Mar.24, 2017  | Mar. 23, 2018 |
| Pre-amplifier              | Sonoma                           | 310N        | 185903     | Mar.25, 2017  | Mar. 24, 2018 |
| Pre-amplifier              | HP                               | 8449B       | 3008A00849 | Mar.25, 2017  | Mar. 24, 2018 |
| Cable                      | HUBER+SUHNER                     | 100         | SUCOFLEX   | Mar. 29, 2017 | Mar. 28, 2018 |
| Positioning Controller     | ETS-LINDGREN                     | 2090        | N/A        | N/A           | N/A           |
| Antenna Conducted Emission |                                  |             |            |               |               |
| Equipment                  | Manufacturer                     | Model No.   | Serial No. | Last Cal.     | Cal. Due Date |
| Spectrum Analyzer          | Agilent                          | E4407B      | MY45106456 | Jul. 22, 2016 | Jul. 21, 2017 |
| EMI Test Receiver          | Rohde & Schwarz                  | ESCI        | 100010/007 | Jul. 22, 2016 | Jul. 21, 2017 |
| Power Meter                | Anritsu                          | ML2495A     | 25406005   | Jul. 22, 2016 | Jul. 21, 2017 |
| Power Sensor               | Anritsu                          | ML2411B     | 25406005   | Jul. 22, 2016 | Jul. 21, 2017 |

## 4. Conducted Emission Test

### 4.1 Test Standard and Limit

#### 4.1.1 Test Standard

FCC 15.207

#### 4.1.2 Test Limit

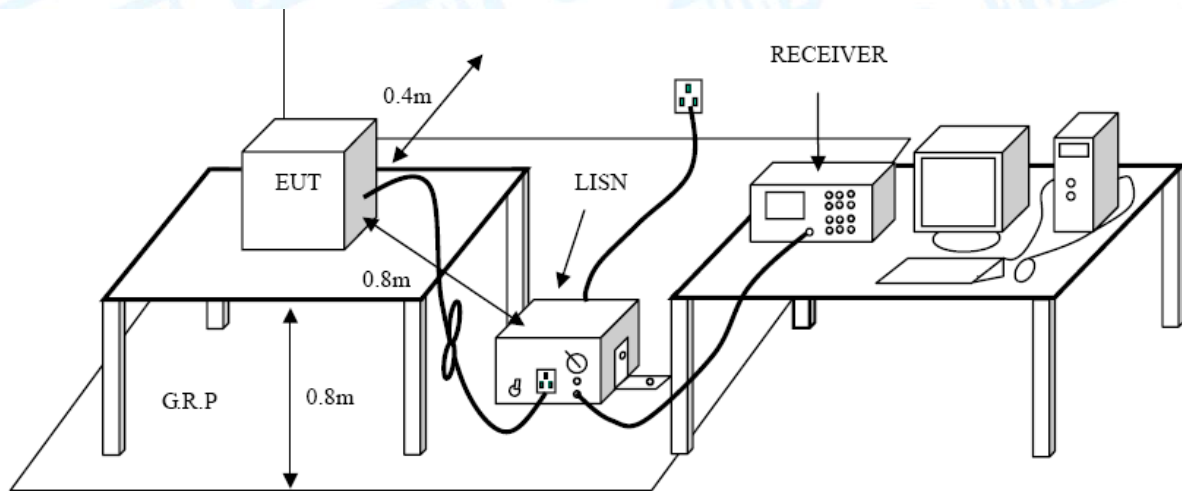
**Conducted Emission Test Limit**

| Frequency     | Maximum RF Line Voltage (dB $\mu$ V) |               |
|---------------|--------------------------------------|---------------|
|               | Quasi-peak Level                     | Average Level |
| 150kHz~500kHz | 66 ~ 56 *                            | 56 ~ 46 *     |
| 500kHz~5MHz   | 56                                   | 46            |
| 5MHz~30MHz    | 60                                   | 50            |

Notes:

- (1) \*Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 4.2 Test Setup



### 4.3 Test Procedure

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis.

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

#### 4.4 Test Data

The EUT is powered by DC battery, no requirement for this test item.

## 5. Radiated Emission Test

### 5.1 Test Standard and Limit

#### 5.1.1 Test Standard

FCC 15.231e

#### 5.1.2 Test Limit

According to FCC 15.231(e) requirement:

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

| Fundamental Frequency (MHz) | Field Strength of Fundamental (microvolt/meter) at 3m | Field Strength of Spurious Emissions (microvolt/meter) at 3m |
|-----------------------------|-------------------------------------------------------|--------------------------------------------------------------|
| 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 formulas for calculating the maximum permitted fundamental field strengths are as follows:

- (1) for the band 130~174 MHz,  $\mu\text{V/m}$  at 3 meters =  $22.7273(F) - 2454.5455$ ;
- (2) for the band 260~470 MHz,  $\mu\text{V/m}$  at 3 meter =  $16.6667(F) - 2833.3333$ .
- (3) The maximum permitted unwanted emissions level is 20 dB below the maximum permitted fundamental level. In addition field strength of any emissions which appear inside of the restriction band shall not exceed the general radiated emissions limits in FCC 15.209.

| Frequency (MHz) | Field Strength (microvolt/meter) | Measurement Distance (meters) |
|-----------------|----------------------------------|-------------------------------|
| 0.009~0.490     | 2400/F(KHz)                      | 300                           |
| 0.490~1.705     | 2400/F(KHz)                      | 30                            |
| 1.705~30.0      | 30                               | 30                            |
| 30~88           | 100                              | 3                             |
| 88~216          | 150                              | 3                             |

|           |     |   |
|-----------|-----|---|
| 216~960   | 200 | 3 |
| Above 960 | 500 | 3 |

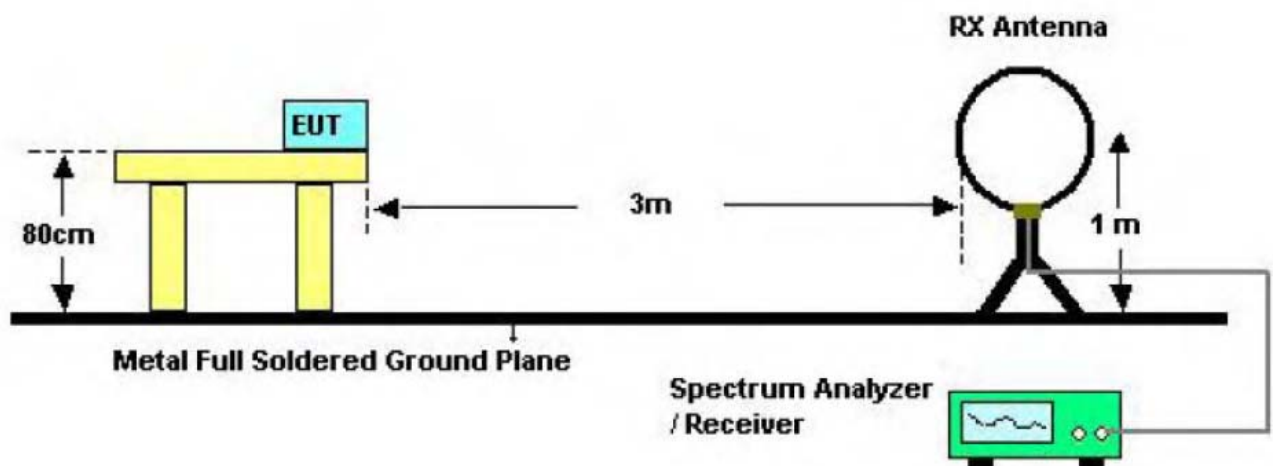
Note:

- (1) The tighter limit applies at the band edges.
- (2) Emission Level(dBuV/m)=20log Emission Level(uV/m)

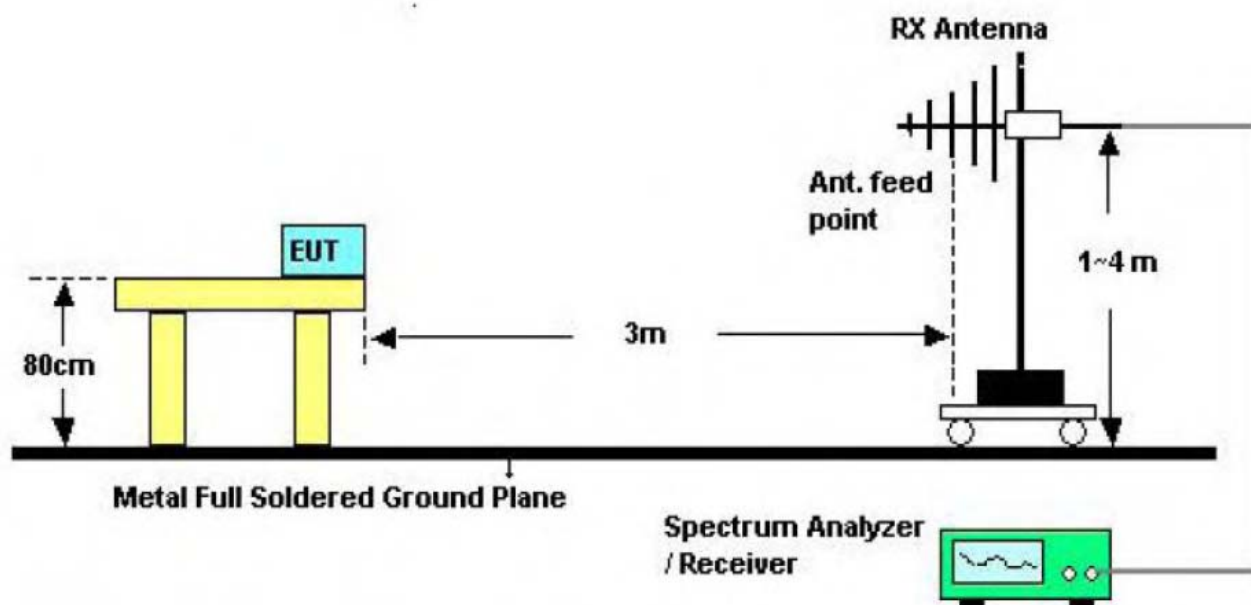
So the field strength of emission limits have been calculated in below table.

| Fundamental Frequency<br>(MHz) | Field Strength of Fundamental<br>(microvolt/meter) at 3m |
|--------------------------------|----------------------------------------------------------|
| 433.92 MHz                     | 72.87 (Average)                                          |
| 433.92 MHz                     | 92.87 (Peak)                                             |

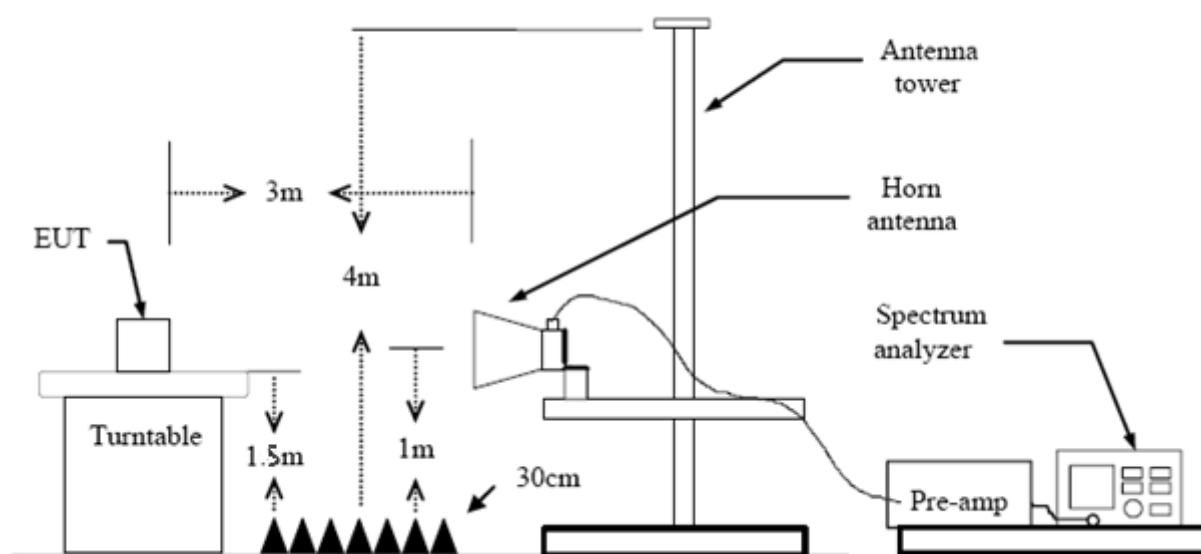
## 5.2 Test Setup



Bellow 30MHz Test Setup



Bellow 1000MHz Test Setup



Above 1GHz Test Setup

### 5.3 Test Procedure

- (1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz. The EUT was placed on a rotating 0.8m high above the ground, the table was rotated 360 degrees to determine the position of the highest radiation.
- (2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m

3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

- (3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
- (4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- (5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
- (6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.
- (7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values.  
Average Values=Peak Values+20log (Duty Cycle)
- (8) For the actual test configuration, please see the test setup photo.

#### 5.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

#### 5.5 Test Data

Test data please refer the following pages.

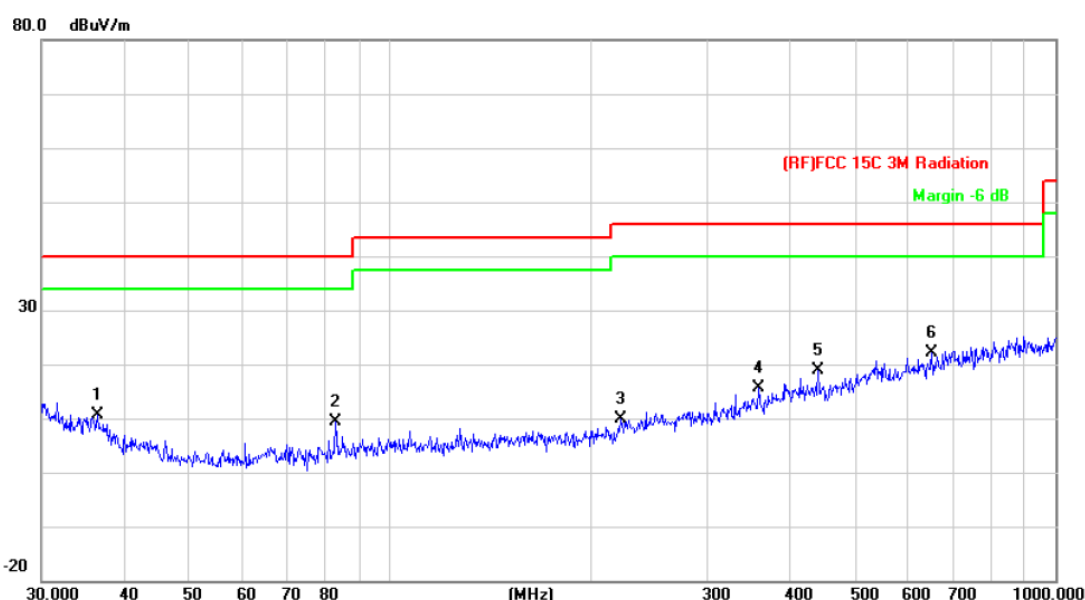
**9 KHz~30 MHz**

From 9 KHz to 30 MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

**Fundamental and Harmonics emissions(30MHz~1GHz)**

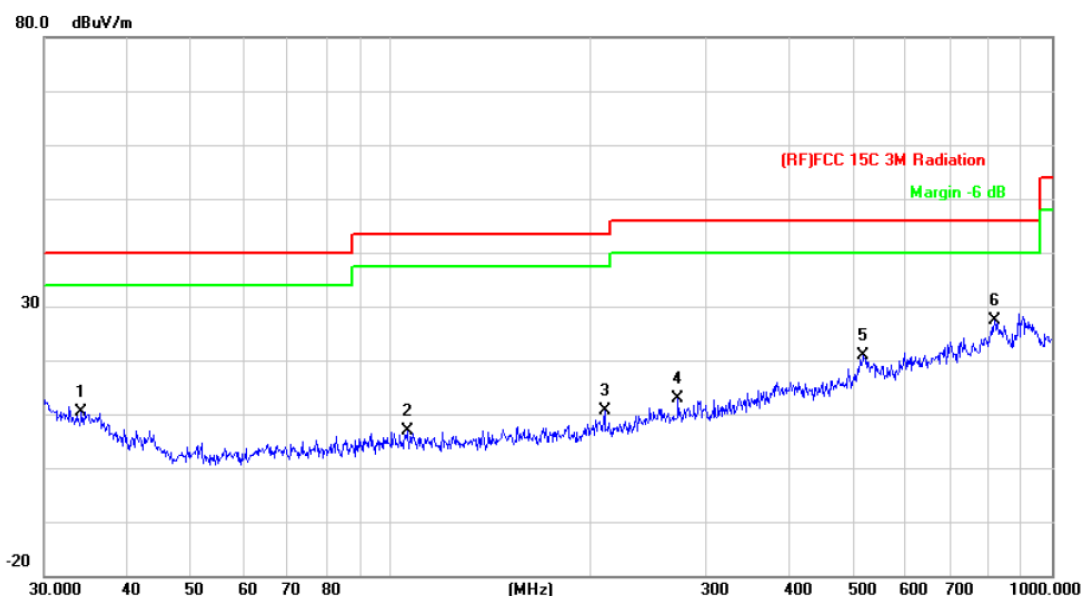
|                      |                                                                                                                    |                           |      |
|----------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------|------|
| <b>EUT:</b>          | TPMS                                                                                                               | <b>Model Name :</b>       | TC88 |
| <b>Temperature:</b>  | 25 °C                                                                                                              | <b>Relative Humidity:</b> | 55%  |
| <b>Test Voltage:</b> | DC 3.0V                                                                                                            |                           |      |
| <b>Ant. Pol.</b>     | Horizontal                                                                                                         |                           |      |
| <b>Test Mode:</b>    | Standby Mode                                                                                                       |                           |      |
| <b>Remark:</b>       | No report for the emission which more than 10 dB below the prescribed limit and the EUT in the worst axis: Z axis. |                           |      |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB/m | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|---------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 36.3814      | 28.74                    | -18.07                    | 10.67                      | 40.00           | -29.33     | peak     |
| 2   |     | 82.9385      | 32.53                    | -23.16                    | 9.37                       | 40.00           | -30.63     | peak     |
| 3   |     | 222.1698     | 28.89                    | -19.02                    | 9.87                       | 46.00           | -36.13     | peak     |
| 4   |     | 357.9287     | 29.65                    | -14.11                    | 15.54                      | 46.00           | -30.46     | peak     |
| 5   |     | 440.1963     | 30.95                    | -12.16                    | 18.79                      | 46.00           | -27.21     | peak     |
| 6   | *   | 651.9417     | 29.93                    | -7.78                     | 22.15                      | 46.00           | -23.85     | peak     |

Emission Level= Read Level+ Correct Factor

|               |                                                                                                                 |                    |      |
|---------------|-----------------------------------------------------------------------------------------------------------------|--------------------|------|
| EUT:          | TPMS                                                                                                            | Model Name :       | TC88 |
| Temperature:  | 25 °C                                                                                                           | Relative Humidity: | 55%  |
| Test Voltage: | DC 3.0V                                                                                                         |                    |      |
| Ant. Pol.     | Vertical                                                                                                        |                    |      |
| Test Mode:    | Standby Mode                                                                                                    |                    |      |
| Remark:       | No report for the emission which more than 10 dB below the prescribed limit the EUT in the worst axis: Z axis.. |                    |      |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB/m | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|---------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 34.1561      | 27.17                    | -16.70                    | 10.47                      | 40.00           | -29.53     | peak     |
| 2   |     | 106.0126     | 28.80                    | -21.85                    | 6.95                       | 43.50           | -36.55     | peak     |
| 3   |     | 210.7860     | 30.22                    | -19.52                    | 10.70                      | 43.50           | -32.80     | peak     |
| 4   |     | 272.2776     | 30.07                    | -17.21                    | 12.86                      | 46.00           | -33.14     | peak     |
| 5   |     | 519.0649     | 30.84                    | -9.96                     | 20.88                      | 46.00           | -25.12     | peak     |
| 6   | *   | 818.8341     | 32.56                    | -5.07                     | 27.49                      | 46.00           | -18.51     | peak     |

Emission Level= Read Level+ Correct Factor

- Note:**
- (1) All Readings are Peak Value.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss
  - (3) The QP measurement was not performed when the peak measured data under the limit of QP detection.

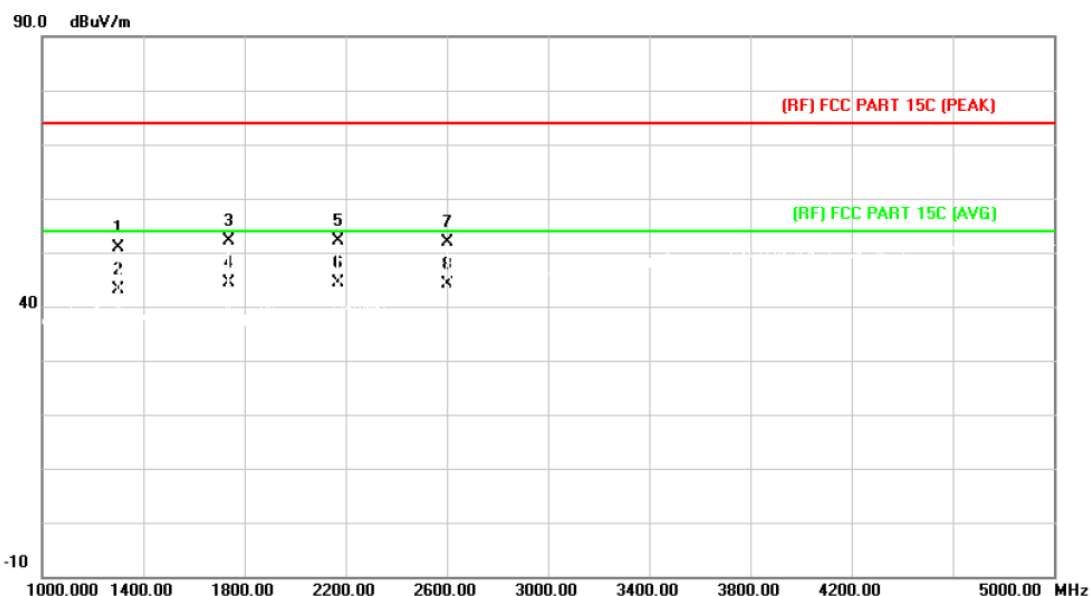
## Fundamental and Harmonics emissions

Below 1G

| EUT:                           |                | TPMS                               |       | Model Name :         |       | TC88       |        |
|--------------------------------|----------------|------------------------------------|-------|----------------------|-------|------------|--------|
| Temperature:                   |                | 25 °C                              |       | Relative Humidity:   |       | 55%        |        |
| Test Voltage:                  |                | DC 3.0V                            |       |                      |       |            |        |
| Test Mode:                     |                | TX Mode                            |       |                      |       |            |        |
| Remark:                        |                | the EUT in the worst axis: Z axis. |       |                      |       |            |        |
| Freq.<br>(MHz)                 | Ant.Pol<br>H/V | Emission Level<br>(dBuV/m)         |       | Limit 3m<br>(dBuV/m) |       | Margin(dB) |        |
|                                |                | PK                                 | AV    | PK                   | AV    | PK         | AV     |
| 434.0651                       | H              | 78.56                              | 70.82 | 92.87                | 72.87 | -22.26     | -2.05  |
| 869.1302                       | H              | 56.72                              | 48.98 | 72.87                | 52.87 | -24.10     | -3.89  |
|                                |                |                                    |       |                      |       |            |        |
| 434.0650                       | V              | 75.69                              | 67.95 | 92.87                | 72.87 | -25.13     | -4.92  |
| 869.1302                       | V              | 50.02                              | 42.28 | 72.87                | 52.87 | -30.80     | -10.59 |
| Average Value= Peak Value-7.74 |                |                                    |       |                      |       |            |        |
| Margin=Emission Level-Limit    |                |                                    |       |                      |       |            |        |

**Above 1G**

|                      |                                                                                                                    |                           |      |
|----------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------|------|
| <b>EUT:</b>          | TPMS                                                                                                               | <b>Model Name :</b>       | TC88 |
| <b>Temperature:</b>  | 25 °C                                                                                                              | <b>Relative Humidity:</b> | 55%  |
| <b>Test Voltage:</b> | DC 3.0V                                                                                                            |                           |      |
| <b>Ant. Pol.</b>     | Horizontal                                                                                                         |                           |      |
| <b>Test Mode:</b>    | TX Mode                                                                                                            |                           |      |
| <b>Remark:</b>       | No report for the emission which more than 10 dB below the prescribed limit and the EUT in the worst axis: Z axis. |                           |      |

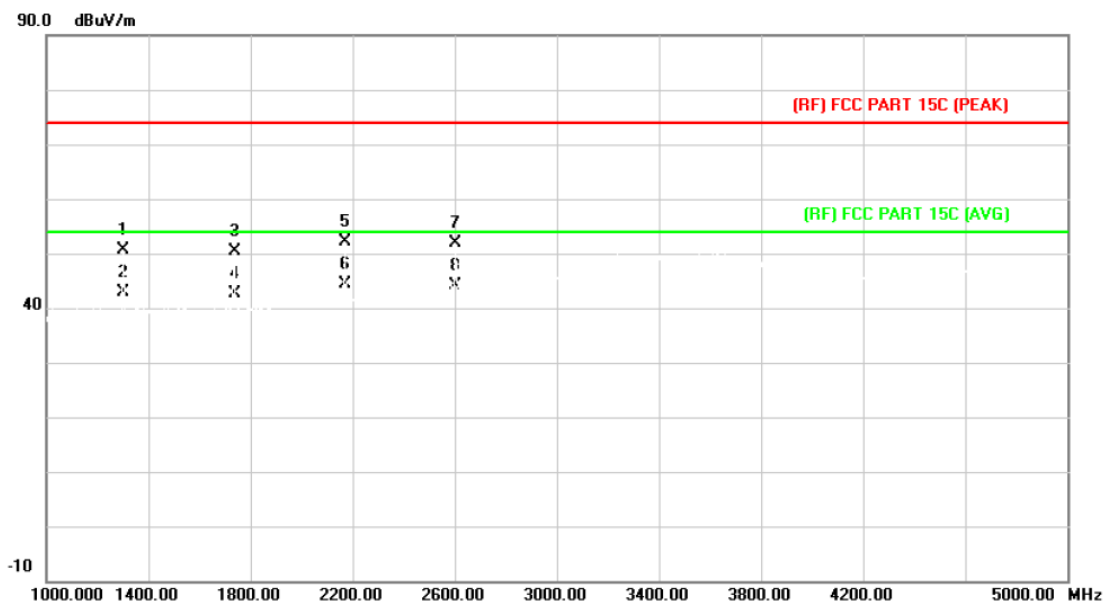


| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB/m | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|---------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 1300.000     | 56.31                    | -5.39                     | 50.92                      | 74.00           | -23.08     | peak     |
| 2   |     | 1300.000     | 48.57                    | -5.39                     | 43.18                      | 54.00           | -10.82     | AVG      |
| 3   |     | 1736.000     | 55.27                    | -3.12                     | 52.15                      | 74.00           | -21.85     | peak     |
| 4   |     | 1736.000     | 47.53                    | -3.12                     | 44.41                      | 54.00           | -9.59      | AVG      |
| 5   |     | 2168.000     | 52.38                    | -0.16                     | 52.22                      | 74.00           | -21.78     | peak     |
| 6   | *   | 2168.000     | 44.64                    | -0.16                     | 44.48                      | 54.00           | -9.52      | AVG      |
| 7   |     | 2604.000     | 49.99                    | 1.85                      | 51.84                      | 74.00           | -22.16     | peak     |
| 8   |     | 2604.000     | 42.25                    | 1.85                      | 44.10                      | 54.00           | -9.90      | AVG      |

**Emission Level= Read Level+ Correct Factor**

**Average Value= Peak Value-7.74**

|                      |                                                                                                                    |                           |      |
|----------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------|------|
| <b>EUT:</b>          | TPMS                                                                                                               | <b>Model Name :</b>       | TC88 |
| <b>Temperature:</b>  | 25 °C                                                                                                              | <b>Relative Humidity:</b> | 55%  |
| <b>Test Voltage:</b> | DC 3.0V                                                                                                            |                           |      |
| <b>Ant. Pol.</b>     | Vertical                                                                                                           |                           |      |
| <b>Test Mode:</b>    | TX Mode                                                                                                            |                           |      |
| <b>Remark:</b>       | No report for the emission which more than 10 dB below the prescribed limit and the EUT in the worst axis: Z axis. |                           |      |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB/m | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|---------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 1300.000     | 56.09                    | -5.39                     | 50.70                      | 74.00           | -23.30     | peak     |
| 2   |     | 1300.000     | 48.35                    | -5.39                     | 42.96                      | 54.00           | -11.04     | AVG      |
| 3   |     | 1736.000     | 53.54                    | -3.12                     | 50.42                      | 74.00           | -23.58     | peak     |
| 4   |     | 1736.000     | 45.80                    | -3.12                     | 42.68                      | 54.00           | -11.32     | AVG      |
| 5   |     | 2168.000     | 52.22                    | -0.16                     | 52.06                      | 74.00           | -21.94     | peak     |
| 6   | *   | 2168.000     | 44.48                    | -0.16                     | 44.32                      | 54.00           | -9.68      | AVG      |
| 7   |     | 2604.000     | 50.08                    | 1.85                      | 51.93                      | 74.00           | -22.07     | peak     |
| 8   |     | 2604.000     | 42.34                    | 1.85                      | 44.19                      | 54.00           | -9.81      | AVG      |

Emission Level= Read Level+ Correct Factor

Average Value=Peak Value-7.74

**Other harmonics emissions are lower than 20dB below the allowable limit.**

- Note:**
- (1) All Readings are Peak Value and AV. And AV is calculated by the following:  
Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.  
Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values.  
Average Values=Peak Values+20log (Duty Cycle)
  - (2) Emission Level= Reading Level + Probe Factor +Cable Loss
  - (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.

**Pulse Desensitization Correction Factor**

Note:

- (1) The Smallest Pulse Width (PW)= 9.96ms
- (2)  $2/PW = 2/9.96 \text{ (ms)} = 0.200 \text{ kHz} < 100 \text{ kHz}$

Because  $2/PW < RBW$ , so the PDCF is not needed.

## 6. Bandwidth

### 6.1 Test Standard and Limit

#### 6.1.1 Test Standard

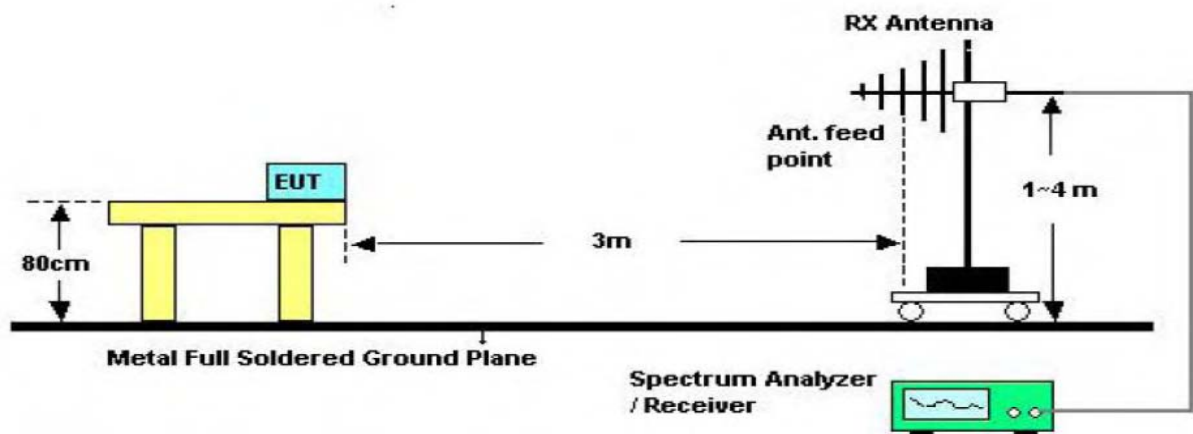
FCC 15.231/RSS 210 Annex 1

#### 6.1.2 Test Limit

The 99% bandwidth of the emissions shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. So the emission bandwidth limits have been calculated in below table.

| Fundamental Frequency | 20 dB Bandwidth Limits (MHz) |
|-----------------------|------------------------------|
| 433.92 MHz            | 1.0848                       |

### 6.2 Test Setup



### 6.3 Test Procedure

- (1) Set Spectrum Analyzer Center Frequency= Fundamental Frequency, RBW=10 kHz, VBW= 30 kHz, Span= 1 MHz.
- (2) Measured the spectrum width with power higher than 20 dB below carrier.

### 6.4 EUT Operating Condition

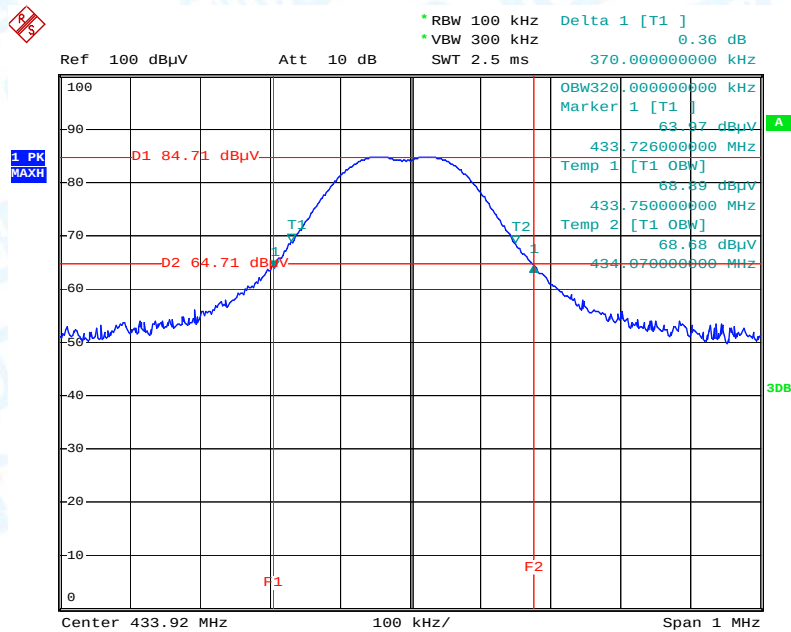
The Equipment Under Test was Programmed to be in continuously transmitting mode.

### 6.5 Test Condition

|                   |   |          |
|-------------------|---|----------|
| Temperature       | : | 25 °C    |
| Relative Humidity | : | 65 %     |
| Pressure          | : | 1010 hPa |
| Test Power        | : | DC 3.0V  |

## 6.6 Test Data

| Frequency (MHz) | 20 dBc Bandwidth (kHz) | Limit (MHz) | Result |
|-----------------|------------------------|-------------|--------|
| 433.92          | 370.00                 | 1.0848      | PASS   |



Date: 2.JUN.2017 19:35:00

## 7. Release Time Measurement

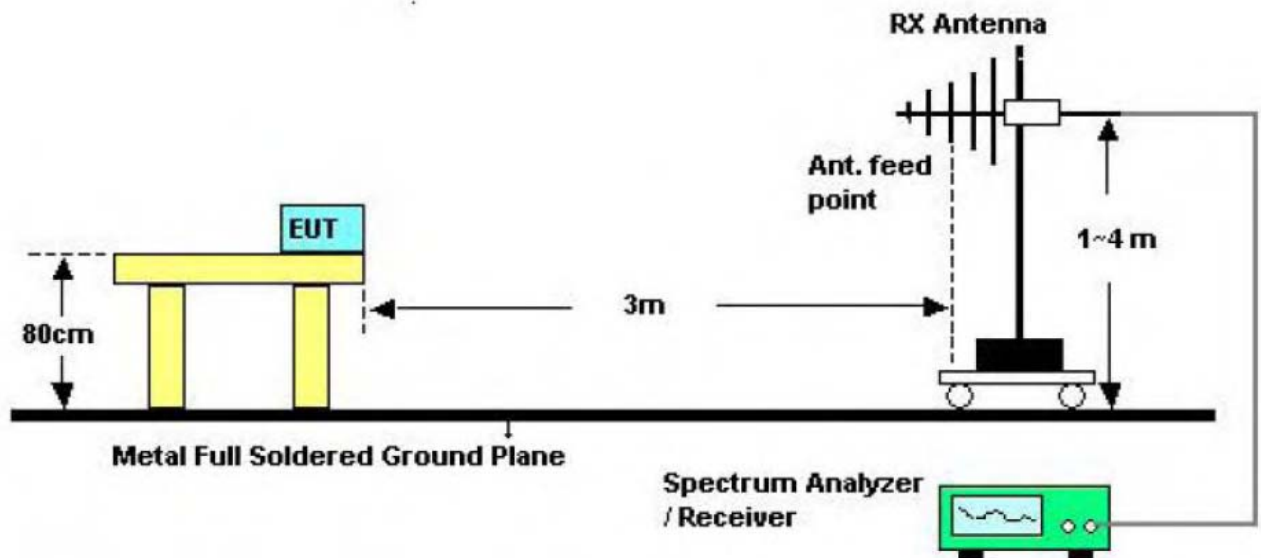
### 7.1 Test Standard and Limit

7.1.1 Test Standard  
FCC 15.231(e)

#### 7.1.2 Test Limit

According to FCC Part 15.231 (e), 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.

### 7.2 Test Setup



### 7.3 Test Procedure

- (1) Setup the EUT as show in the block diagram above.
- (2) Set Spectrum Analyzer Centre Frequency= Fundamental Frequency, RBW=100 kHz, VBW= 300 kHz, Span= 0 Hz.
- (3) Setup the EUT as normal operation and press Transmitter button.
- (4) Set Spectrum Analyzer View, Delta Mark time.

### 7.4 EUT Operating Condition

The EUT was set to work in transmitting mode.

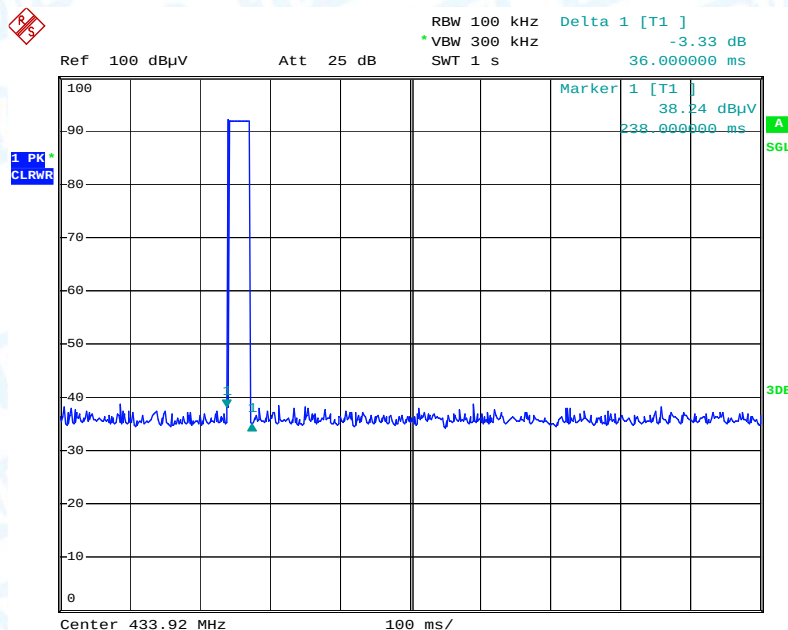
## 7.5 Test Condition

|                   |   |          |
|-------------------|---|----------|
| Temperature       | : | 25 °C    |
| Relative Humidity | : | 65 %     |
| Pressure          | : | 1010 hPa |
| Test Power        | : | DC 3.0V  |

## 7.6 Test Data

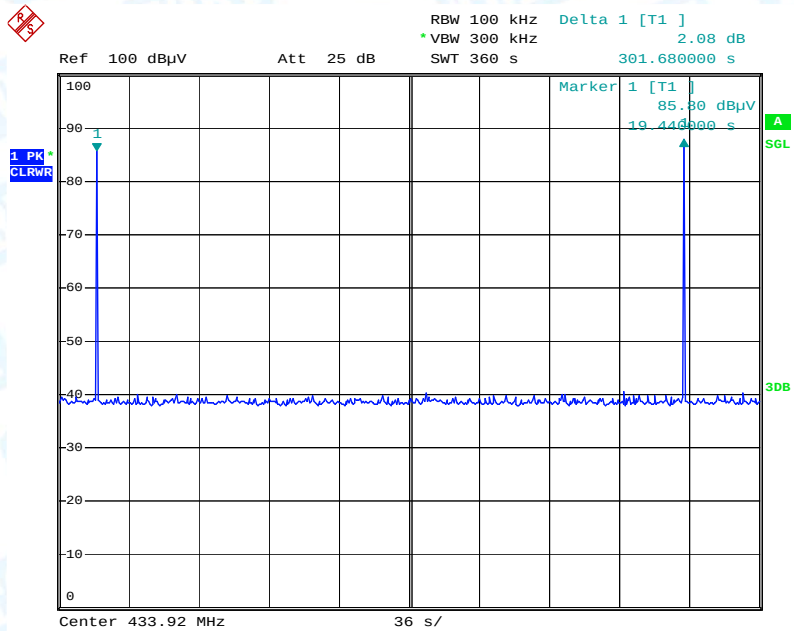
| Release Time<br>(s)  | Limit<br>(s)              | Result |
|----------------------|---------------------------|--------|
| 0.036                | 1                         | PASS   |
| Silent period<br>(s) | Limit<br>(s)              | Result |
| 301.68               | >10s<br>>30* Release Time | PASS   |

**Note: 30\* Release Time=1.08s**



Date: 2.JUN.2017 19:42:58

Silent period



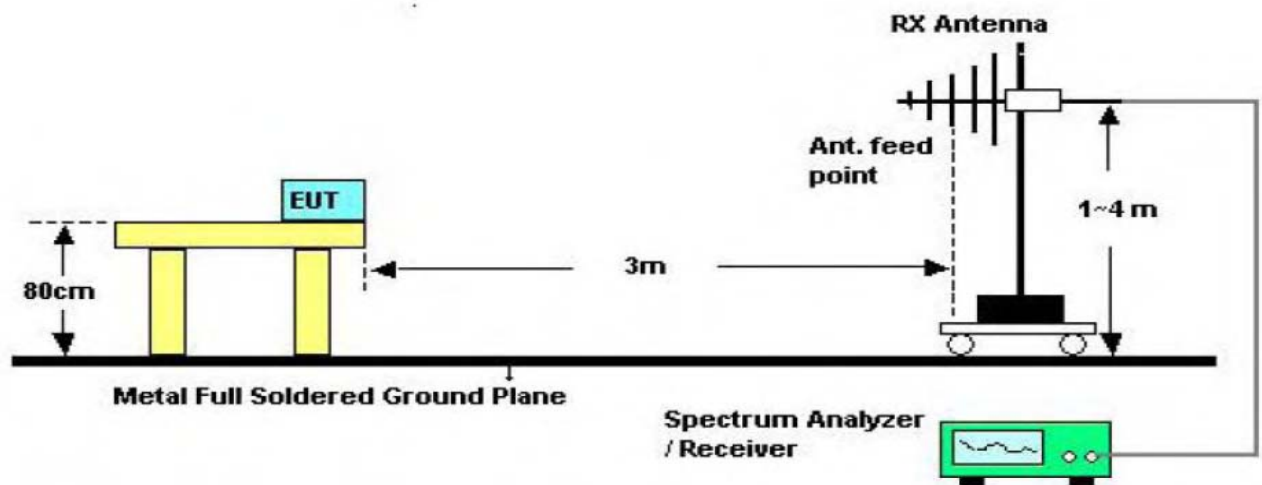
Date: 2.JUN.2017 19:59:17

## 8. Duty Cycle

### 8.1 Test Standard and Limit

5.1.1 Test Standard  
FCC 15.231

### 8.2 Test Setup



### 8.3 Test Procedure

- (1) The EUT was placed on a turntable which is 0.8m above ground plane.
- (2) Set EUT operating in continuous transmitting mode.
- (3) Set the Spectrum Analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth (RBW) to 100 kHz and video bandwidth (VBW) to 300 kHz, Span was set to 0 Hz.
- (4) The Duty Cycle was measured and recorded.

### 8.4 EUT Operating Condition

The EUT was programmed to be in transmitting mode.

### 8.5 Test Condition

|                   |   |          |
|-------------------|---|----------|
| Temperature       | : | 25 °C    |
| Relative Humidity | : | 65 %     |
| Pressure          | : | 1010 hPa |
| Test Power        | : | DC 3.0V  |

## 8.6 Test Data

Please refer the following pages:

**Plot 1:** transmit once in 200ms, and each cycle is 75.20 ms there are two kinds of pulse in each cycle.

**Plot 2:** The large pulse in a time period of 20.88 ms

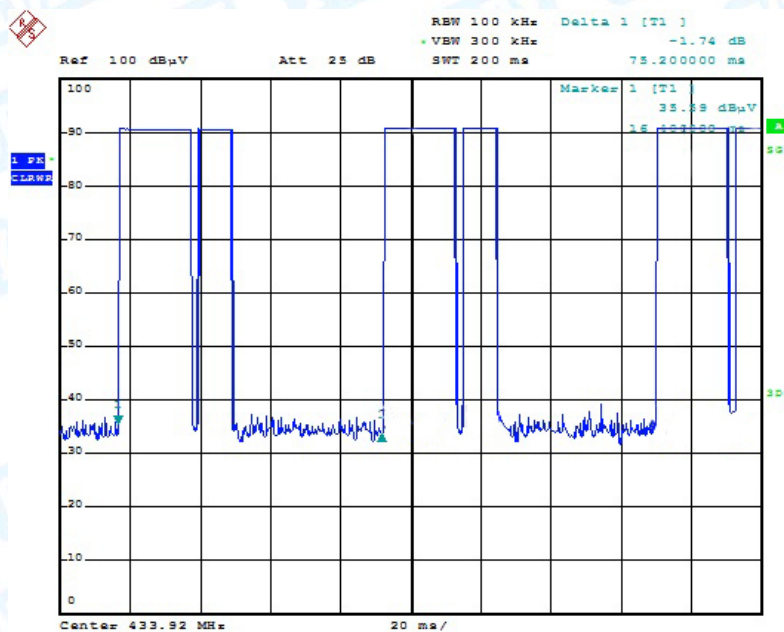
**Plot 3:** The small pulse in a time period of 9.96 ms

**Duty Cycle=ON/Total=(20.88+9.96)/75.20=30.84/75.20=41.01%**

**20 log(Duty Cycle)=-7.74**

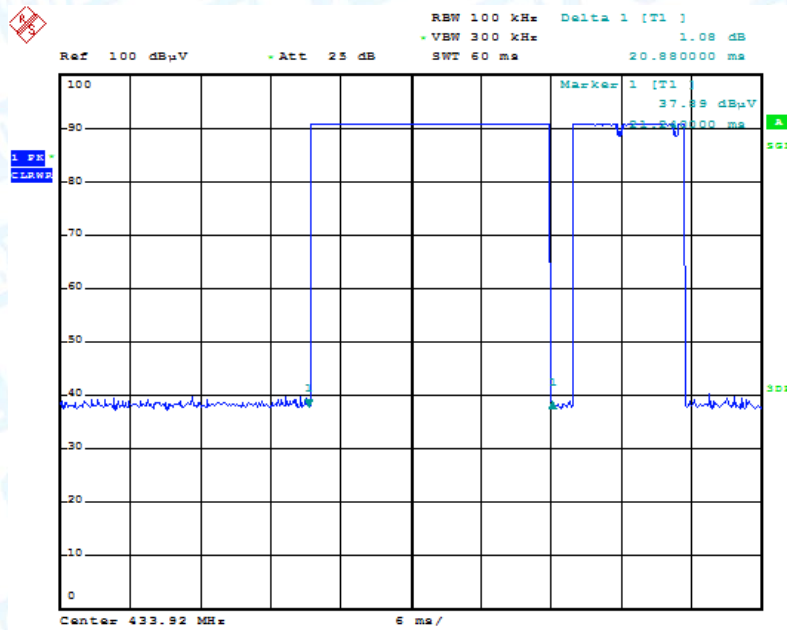
**Average=Peak Value+ 20log(Duty Cycle), AV=PK-7.74**

Plot 1



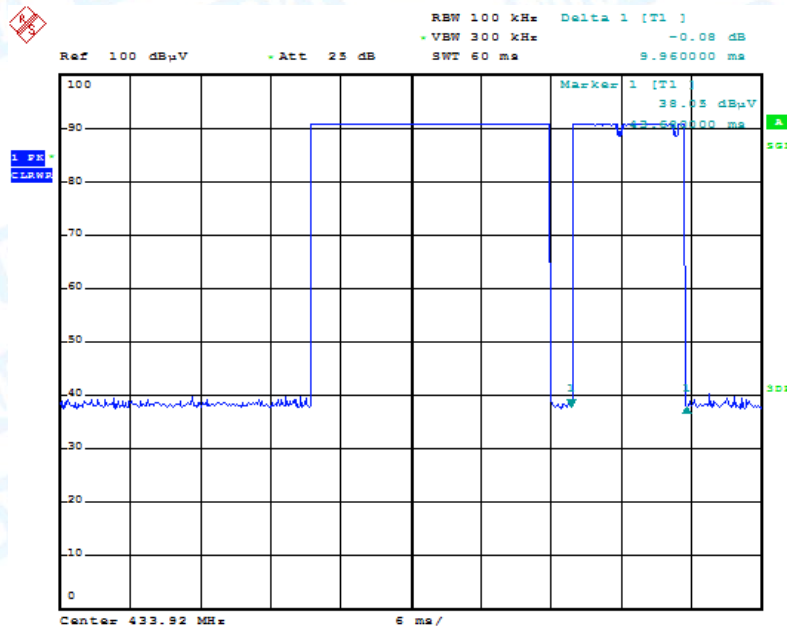
Date: 3.JUN.2017 10:22:36

Plot 2



Date: 3.JUN.2017 15:37:33

**Plot 3**



Date: 3.JUN.2017 15:37:59

## 9. Antenna Requirement

### 9.1 Standard Requirement

#### 9.1.1 Standard

FCC Part 15.203

#### 9.1.2 Requirement

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### 9.2 Antenna Connected Construction

The directional gains of the antenna used for transmitting is 0 dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

#### Result

The EUT antenna is an Integral Antenna. It complies with the standard requirement.

| Antenna Type                                                   |
|----------------------------------------------------------------|
| <input checked="" type="checkbox"/> Permanent attached antenna |
| <input type="checkbox"/> Unique connector antenna              |
| <input type="checkbox"/> Professional installation antenna     |

-----END OF REPORT-----