

# MEASUREMENT REPORT

## FCC PART 15 Subpart C Section 231

Report No.: S2021033082150101

Issue Date: 05-11-2021

**Applicant:** DIAS Automotive Electronic Systems Co., Ltd.  
**Address:** Building 5. Lane 33. Jin Ji Road Pudong Shanghai  
**FCC ID:** 2ALJETPS4-1  
**Product:** Tire pressure sensor  
**Model No.:** TPS4.1  
**FCC Rule Part(s):** FCC Part 15 Subpart C Section 231  
**Test Procedure(s):** ANSI C63.10:2013  
**Result:** Pass  
**Test Date:** April 19 ~ 27, 2021

Compiled By

*Line chen*

(Line Chen)  
Senior Test Engineer

Approved By

*Kerry Zhou*

(Kerry Zhou)  
Engineer Manager



The test results relate only to the samples tested

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10:2013. Test results reported herein relate only to the item(s) tested.

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The test report must not be used by the client to claim product certifications, approval, or endorsement by NVLAP, NIST or any agency of U.S. Government.

### Revision History

| Report No.        | Version | Description | Issue Date |
|-------------------|---------|-------------|------------|
| S2021033082150101 | Rev. 01 | /           | 05-11-2021 |
|                   |         |             |            |

## TABLE OF CONTENTS

|                                                     |           |
|-----------------------------------------------------|-----------|
| <b>1. TEST RESULT SUMMARY.....</b>                  | <b>4</b>  |
| <b>2. GENERAL DESCRIPTION OF EUT.....</b>           | <b>5</b>  |
| 2.1. APPLICANT.....                                 | 5         |
| 2.2. MANUFACTURER.....                              | 5         |
| 2.3. FACTORY.....                                   | 5         |
| 2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST..... | 5         |
| <b>3. LABORATORY AND ACCREDITATIONS.....</b>        | <b>6</b>  |
| 3.1. LABORATORY.....                                | 6         |
| 3.2. ACCREDITATIONS.....                            | 6         |
| 3.3. MEASUREMENT UNCERTAINTY.....                   | 6         |
| <b>4. LIST OF USED TEST EQUIPMENT AT GRGT.....</b>  | <b>7</b>  |
| <b>5. RADIATED SPURIOUS EMISSIONS.....</b>          | <b>8</b>  |
| 5.1. LIMITS.....                                    | 8         |
| 5.2. TEST PROCEDURES.....                           | 8         |
| 5.3. TEST SETUP.....                                | 9         |
| 5.4. DATA SAMPLE.....                               | 10        |
| 5.5. TEST RESULTS.....                              | 11        |
| <b>6. 20DB BANDWIDTH.....</b>                       | <b>15</b> |
| 6.1. LIMITS.....                                    | 15        |
| 6.2. TEST PROCEDURES.....                           | 15        |
| 6.3. TEST SETUP.....                                | 15        |
| 6.4. TEST RESULTS.....                              | 15        |
| <b>7. TRANSMISSION TIME.....</b>                    | <b>16</b> |
| 7.1. LIMITS.....                                    | 16        |
| 7.2. TEST PROCEDURES.....                           | 16        |
| 7.3. TEST SETUP.....                                | 16        |
| 7.4. TEST RESULTS.....                              | 16        |

## 1. TEST RESULT SUMMARY

| Section B of FCC Part 15.231   |                            |                           |                   |
|--------------------------------|----------------------------|---------------------------|-------------------|
| Standard                       | Item                       | Limit / Severity          | Result            |
| Part 15, Subpart C<br>(15.231) | Conducted Emissions        | §15.207                   | N/A <sup>1)</sup> |
|                                | Transmission Time          | §15.231<br>§15.231(a) (3) | PASS              |
|                                | 20DB Bandwidth             | §15.231 (c)               | PASS              |
|                                | Radiated Spurious Emission | §15.231(b)                | PASS              |

Note. 1: The EUT was powered by 1\*DC 3V Battery.

## 2. GENERAL DESCRIPTION OF EUT

### 2.1. APPLICANT

Name: DIAS Automotive Electronic Systems Co., Ltd.  
Address: Building 5. Lane 33. Jin Ji Road Pudong Shanghai

### 2.2. MANUFACTURER

Name: DIAS Automotive Electronic Systems Co., Ltd.  
Address: Building 5. Lane 33. Jin Ji Road Pudong Shanghai

### 2.3. FACTORY

Name : DIAS Automotive Electronic Systems Co., Ltd.  
Address : Building 5. Lane 33. Jin Ji Road Pudong Shanghai

### 2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: Tire pressure sensor  
Model No.: TPS4.1  
Trade Name: N/A  
FCC ID: 2ALJETPS4-1  
Power supply: The EUT was powered by 1\*DC 3V Battery  
Frequency Range: 433.92MHz  
Max Antenna gain: Integrated Antenna, 3dBi  
Sample submitting way: ☒ Provided by customer ☐ Sampling  
Type of Modulation: FSK  
Temperature Range: -40°C ~ +85 °C  
Hardware Version: V1.0  
Software Version: V1.0  
Note: N/A

### 3. LABORATORY AND ACCREDITATIONS

#### 3.1. LABORATORY

These measurement tests were performed at the Fangguang Inspection and testing Co.,LTD located at 200 Linghu Avenue, Xinwu District, Wuxi City.

#### 3.2. ACCREDITATIONS

NVLAP LAB CODE: 600222-0

#### 3.3. 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:

|                                                                                |
|--------------------------------------------------------------------------------|
| Radiated Emission Measurement                                                  |
| Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ): 2.72dB |
| 20db Bandwidth                                                                 |
| Measuring Uncertainty for a Level of Confidence of 95% ( $U=2U_c(y)$ ): 1.1dB  |

This uncertainty represents a n expanded uncertainty factor of  $k=2$ .

#### 4. LIST OF USED TEST EQUIPMENT AT GRGT

| Name of Equipment      | Manufacturer  | Model   | Calibration Due |
|------------------------|---------------|---------|-----------------|
| Radiated Emission      |               |         |                 |
| Bi-Log Antenna         | ROHDE&SCHWARZ | HL562E  | 2022-03-30      |
| Broadband Horn Antenna | ROHDE&SCHWARZ | HF907   | 2022-03-30      |
| Preamplifier           | ROHDE&SCHWARZ | SCU-18D | 2022-01-17      |
| EMI Receiver           | ROHDE&SCHWARZ | ESR26   | 2021-04-29      |
| EXA Signal Analyzer    | Keysight      | N9010B  | 2021-05-29      |
| Semi anechoic chamber  | EMC           | EMCCT-3 | 2023-04-07      |
| Thermohygrometer       | Yuhuaze       | HTC-1   | 2022-01-17      |

## 5. RADIATED SPURIOUS EMISSIONS

### 5.1. LIMITS

§15.231(b) In addition to the provisions of §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 (microvolts/meter) | Field strength of spurious emission (microvolts/meter) |
|-----------------------------|--------------------------------------------------|--------------------------------------------------------|
| 40.66-40.70                 | 2,250                                            | 225                                                    |
| 70-130                      | 1,250                                            | 125                                                    |
| 130-174                     | <sup>1</sup> 1,250 to 3,750                      | <sup>1</sup> 125 to 375                                |
| 174-260                     | 3,750                                            | 375                                                    |
| 260-470                     | <sup>1</sup> 3,750 to 12,500                     | <sup>1</sup> 375 to 1,250                              |
| Above 470                   | 12,500                                           | 1,250                                                  |

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.]

§15.231(b)(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

| Frequency (MHz) | Quasi-peak( $\mu\text{V/m}$ ) | Measurement distance(m) | Quasi-peak(dB $\mu\text{V/m}$ )@distance 3m |
|-----------------|-------------------------------|-------------------------|---------------------------------------------|
| 0.009-0.490     | $2400/F(\text{kHz})$          | 300                     | 53.8~88.5                                   |
| 0.490-1.705     | $24000/F(\text{kHz})$         | 30                      | 43~53.8                                     |
| 1.705-30.0      | 30                            | 30                      | 49.5                                        |
| 30 ~ 88         | 100                           | 3                       | 40                                          |
| 88~216          | 150                           | 3                       | 43.5                                        |
| 216 ~ 960       | 200                           | 3                       | 46                                          |
| Above 960       | 500                           | 3                       | 54                                          |

**NOTE:** (1) The lower limit shall apply at the transition frequencies.

### 5.2. TEST PROCEDURES

- 1) The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

- 6) If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.  
Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

### 5.3. TEST SETUP

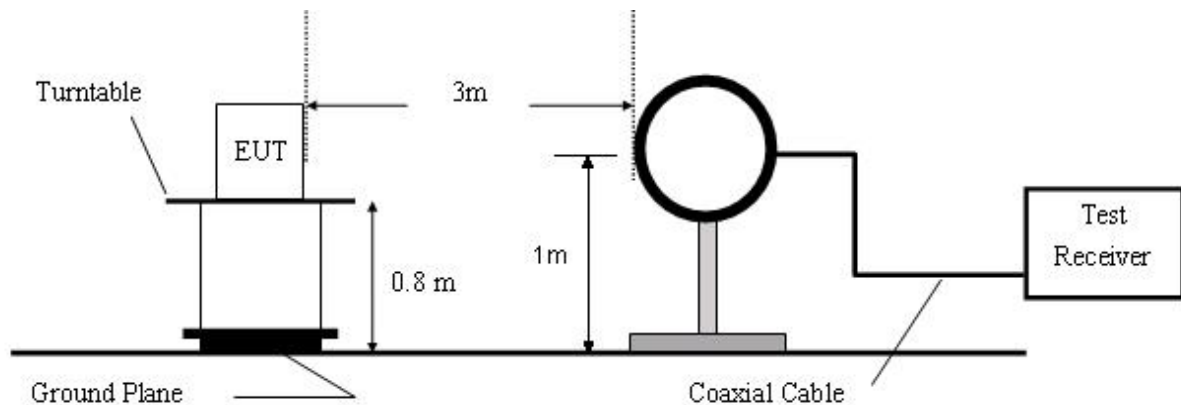


Figure 1. 9KHz to 30MHz radiated emissions test configuration

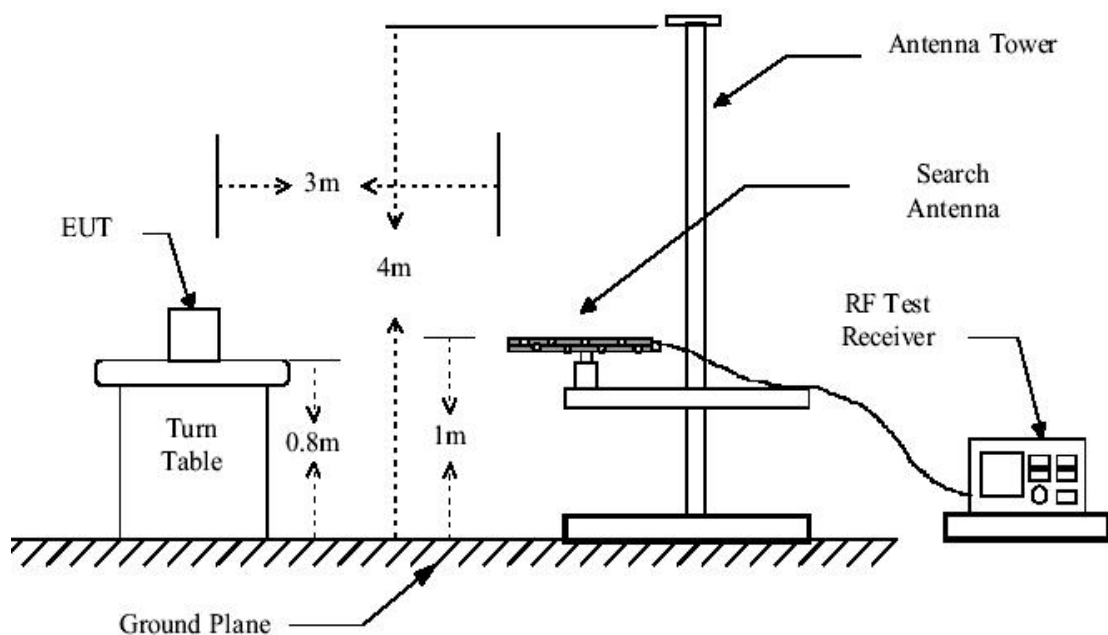


Figure 2. 30MHz to 1GHz radiated emissions test configuration

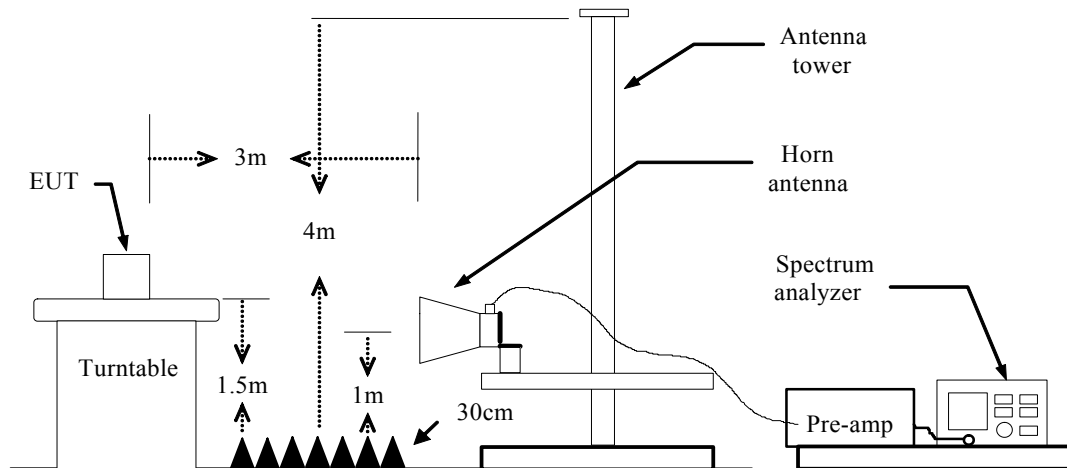


Figure 3. Above 1GHz radiated emissions test configuration

## 5.4. 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                              |

## 5.5. TEST RESULTS

### *Fundamental:*

| Frequency | Reading  | Correct      | Result   | Limit    | Margin | Antenna Pole(V/H) | Remark |
|-----------|----------|--------------|----------|----------|--------|-------------------|--------|
| (MHz)     | (dBuV/m) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |                   |        |
| 433.9200  | 55.21    | 17.00        | 72.21    | 100.83   | -28.62 | V                 | Peak   |
| 433.9200  | 55.21    | 17.00        | 72.21    | 100.83   | -28.62 | H                 | Peak   |

| Frequency | PK Result | Duty Cycle Correction | Result   | Limit    | Margin | Antenna Pole(V/H) | Remark |
|-----------|-----------|-----------------------|----------|----------|--------|-------------------|--------|
| (MHz)     | (dBuV/m)  | Factor(dB)            | (dBuV/m) | (dBuV/m) | (dB)   |                   |        |
| 433.9200  | 72.21     | -10.85                | 61.36    | 80.83    | -19.47 | V                 | AVG    |
| 433.9200  | 72.21     | -10.85                | 61.36    | 80.83    | -19.47 | H                 | AVG    |

Remark:

1.  $AVG = Peak + 20 \log(Duty\ Cycle)$
2. Duty Cycle Correction Factor:  $20 \log(0.29) = -10.85$
3. Duty Cycle= On time/Total time =78/272=29%

## Radiated Spurious Emission

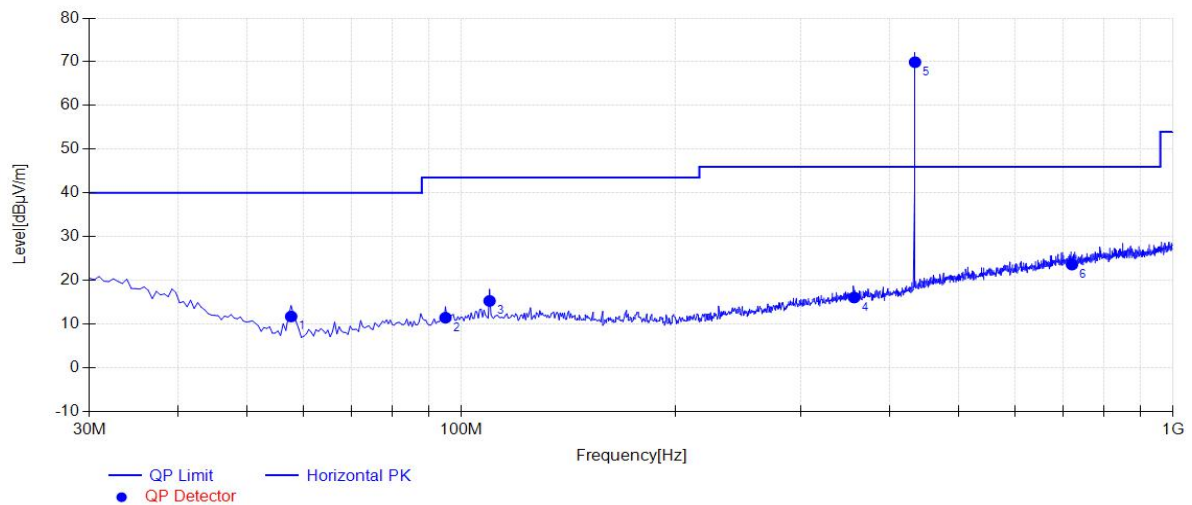
### For 9 kHz to 30MHz

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

30MHz – 1GHz

|              |                      |            |            |
|--------------|----------------------|------------|------------|
| EUT:         | Tire pressure sensor | Polarity:  | Horizontal |
| Mode:        | Normal Operation     | Voltage:   | DC 3V      |
| Environment: | Temp: 25°C; Humi:60% | Test date: | 2021-04-21 |

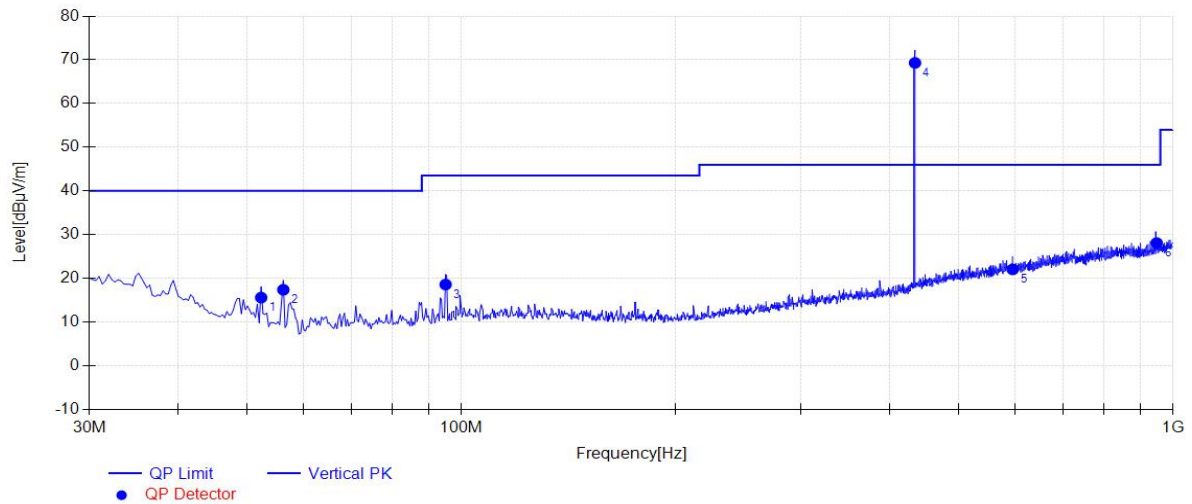
### Test Graph



| Final Data List |             |             |                   |                   |                |             |           |            |
|-----------------|-------------|-------------|-------------------|-------------------|----------------|-------------|-----------|------------|
| NO.             | Freq. [MHz] | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Polarity   |
| 1               | 57.6450     | 7.45        | 11.73             | 40.00             | 28.27          | 200         | 38        | Horizontal |
| 2               | 94.9900     | 10.61       | 11.46             | 43.50             | 32.04          | 200         | 1         | Horizontal |
| 3               | 109.5400    | 11.44       | 15.30             | 43.50             | 28.20          | 100         | 23        | Horizontal |
| 4               | 356.4050    | 15.02       | 16.08             | 46.00             | 29.92          | 200         | 81        | Horizontal |
| 5               | 434.0050    | 17.00       | 69.92             | N/A               | N/A            | 200         | 111       | Horizontal |
| 6               | 721.1250    | 22.15       | 23.61             | 46.00             | 22.39          | 100         | 359       | Horizontal |

|              |                      |            |            |
|--------------|----------------------|------------|------------|
| EUT:         | Tire pressure sensor | Polarity:  | Vertical   |
| Mode:        | Normal Operation     | Voltage:   | DC 3V      |
| Environment: | Temp: 25°C; Humi:60% | Test date: | 2021-04-21 |

### Test Graph



| Final Data List |             |             |                   |                   |                |             |           |          |
|-----------------|-------------|-------------|-------------------|-------------------|----------------|-------------|-----------|----------|
| NO.             | Freq. [MHz] | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1               | 52.3174     | 8.89        | 15.60             | 40.00             | 24.40          | 100         | 55        | Vertical |
| 2               | 56.1987     | 7.84        | 17.40             | 40.00             | 22.60          | 100         | 55        | Vertical |
| 3               | 95.0117     | 10.61       | 18.59             | 43.50             | 24.91          | 100         | 77        | Vertical |
| 4               | 433.9780    | 17.00       | 69.31             | N/A               | N/A            | 100         | 334       | Vertical |
| 5               | 595.3751    | 20.29       | 22.05             | 46.00             | 23.95          | 200         | 88        | Vertical |
| 6               | 948.5729    | 24.64       | 28.09             | 46.00             | 17.91          | 100         | 7         | Vertical |

#### Emission above 1GHz:

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

|              |                      |            |            |
|--------------|----------------------|------------|------------|
| EUT:         | Tire pressure sensor | Polarity:  | Horizontal |
| Mode:        | 433.92 TX            | Voltage:   | DC 3V      |
| Environment: | Temp: 25°C; Humi:60% | Test date: | 2021-04-21 |

| Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
|-------------|----------------|-------------|----------------|-------------|-------------|-----------|----------|
| 2166.4333   | 37.54          | -4.72       | 74.00          | 36.46       | 100         | 132       | PK       |
| 2169.8340   | 27.05          | -4.71       | 54.00          | 26.95       | 100         | 132       | AV       |
| 2809.1618   | 36.79          | -1.80       | 74.00          | 37.21       | 100         | 73        | PK       |
| 2911.1822   | 28.38          | -1.39       | 54.00          | 25.62       | 100         | 178       | AV       |
| 6077.2154   | 43.73          | 7.18        | 74.00          | 30.27       | 100         | 89        | PK       |
| 6124.8250   | 35.76          | 7.30        | 54.00          | 18.24       | 100         | 203       | AV       |

|              |                      |            |            |
|--------------|----------------------|------------|------------|
| EUT:         | Tire pressure sensor | Polarity:  | Vertical   |
| Mode:        | 433.92 TX            | Voltage:   | DC 3V      |
| Environment: | Temp: 25°C; Humi:60% | Test date: | 2021-04-21 |

| Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
|-------------|----------------|-------------|----------------|-------------|-------------|-----------|----------|
| 1734.5469   | 44.20          | -6.63       | 74.00          | 29.80       | 100         | 169       | PK       |
| 1734.5469   | 34.81          | -6.63       | 54.00          | 19.19       | 100         | 169       | AV       |
| 2169.8340   | 33.53          | -4.71       | 54.00          | 20.47       | 100         | 169       | AV       |
| 2169.8340   | 43.78          | -4.71       | 74.00          | 30.22       | 100         | 169       | PK       |
| 2601.7203   | 44.39          | -2.85       | 74.00          | 29.61       | 100         | 169       | PK       |
| 2601.7203   | 34.36          | -2.85       | 54.00          | 19.64       | 100         | 169       | AV       |

## 6. 20DB BANDWIDTH

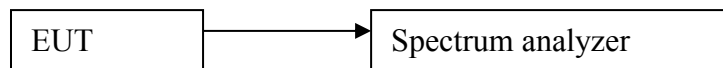
### 6.1. LIMITS

§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. 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.

### 6.2. TEST PROCEDURES

- 1) Set resolution bandwidth (RBW) =2kHz.Set the video bandwidth (VBW)  $\geq 3 \times$  RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 20dB bandwidth value.
- 2) Repeat above procedures until all frequencies measured were complete.

### 6.3. TEST SETUP



### 6.4. TEST RESULTS

Test mode:

| Channel | Frequency(MHz) | Bandwidth (kHz) | Limit (kHz) | Test Result |
|---------|----------------|-----------------|-------------|-------------|
|         | 433.92         | 118.1           | 1084.8      | PASS        |

#### Test Plot



## 7. TRANSMISSION TIME

### 7.1. LIMITS

§15.231 (e) (3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

§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.

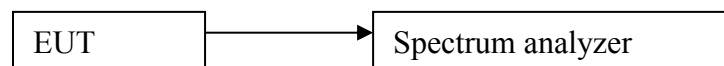
§15.231 (a) for this periodic operation:

- (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
- (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

### 7.2. TEST PROCEDURES

- 1) The spectrum analyzer resolution bandwidth that is  $\leq$ EBW. So we test the Maximum Conducted Output Power —Integrated band power method.
- 2) Set Set the analyzer span = 0Hz. RBW = 1MHz. Set VBW  $\geq$  3 x RBW. Detector = Peak. Sweep = Adjust according to actual conditions.
- 3) Allow the trace to stabilize, record value.

### 7.3. TEST SETUP



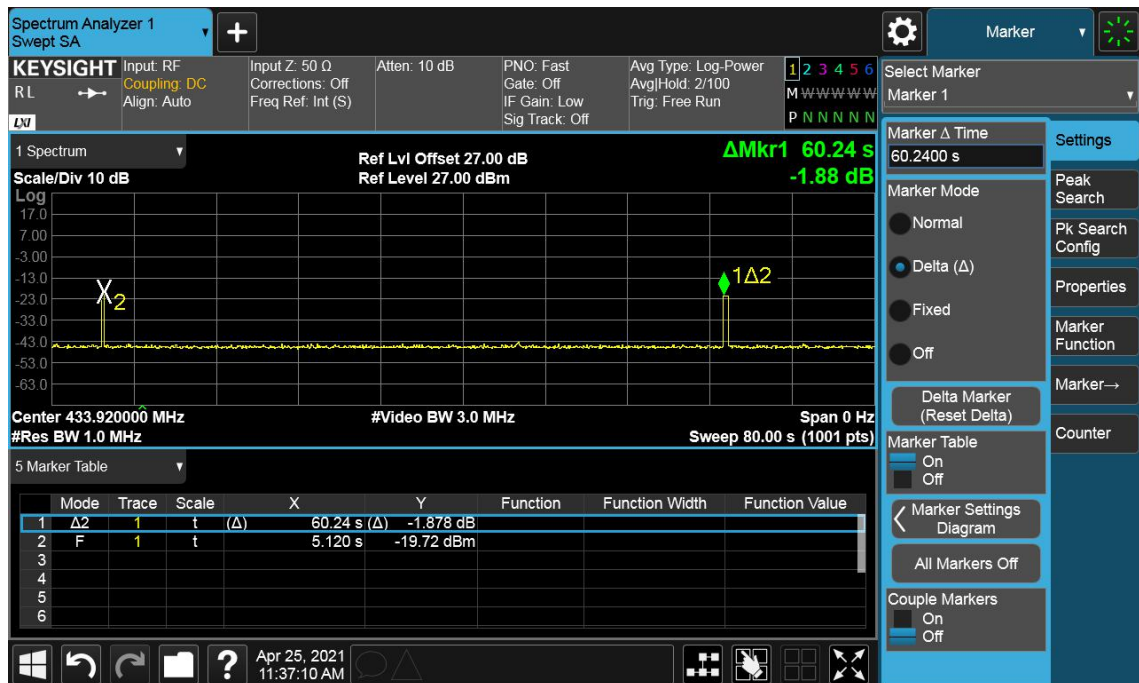
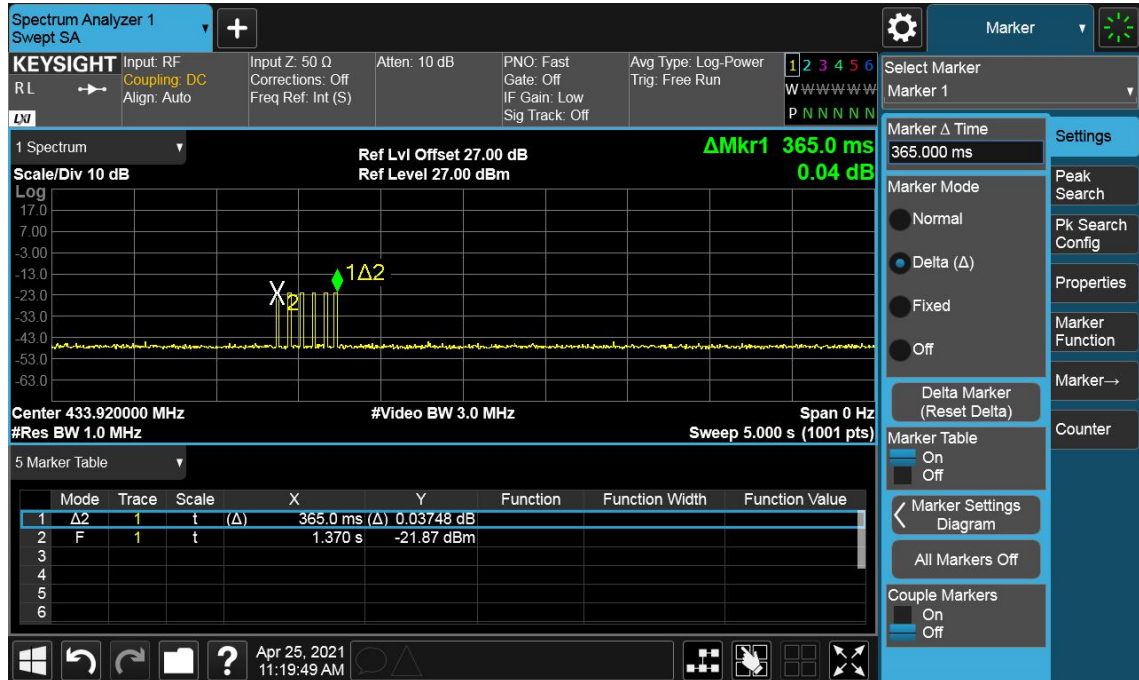
### 7.4. TEST RESULTS

#### Test Data

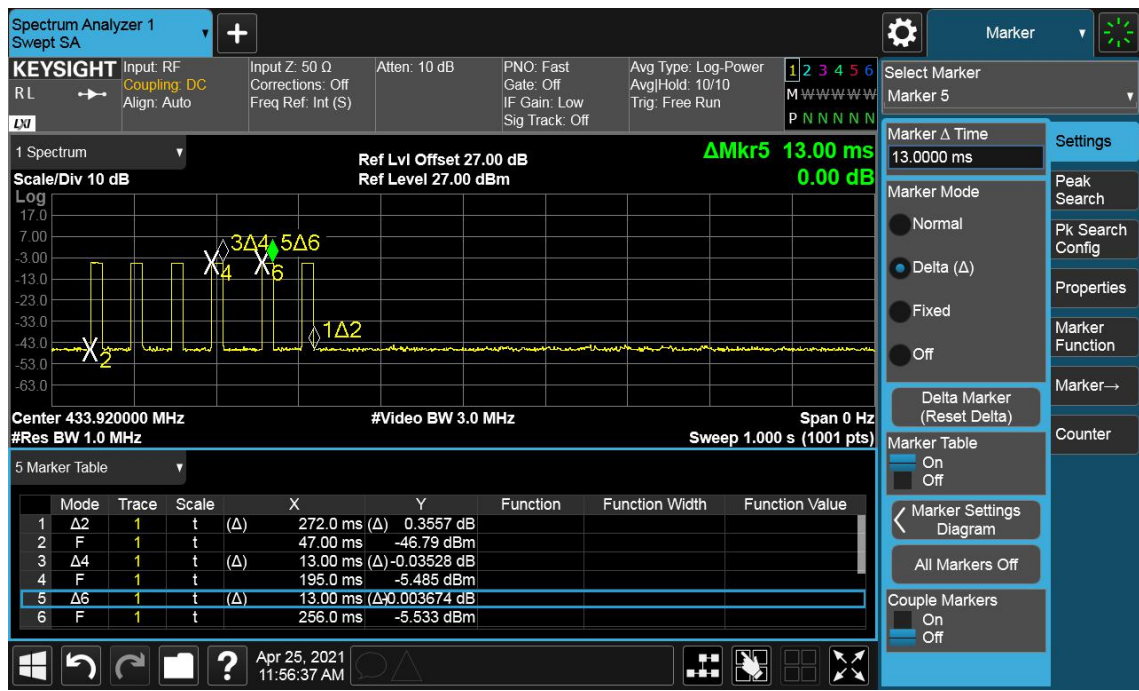
| Frequency (MHz) | Transmission Time (s) | Limit (s) | Result |
|-----------------|-----------------------|-----------|--------|
| 433.92          | 0.365                 | 1         | Pass   |

| Frequency (MHz) | Silent period (s) | Limit (s) | Result |
|-----------------|-------------------|-----------|--------|
| 433.92          | 60.24             | >10       | Pass   |

## Test Plot



### Duty Cycle:



Remark:

1. On time:  $13\text{ms} \times 6 = 78\text{ms}$
2. Duty Cycle = On time/Total time (100ms) =  $78\text{ms}/272\text{ms} = 29\%$

-----This is the last page of the report. -----