

***FCC Part 15***  
***EMI TEST REPORT***  
  
*of*

E.U.T. : Tire Pressure Monitor System

FCC ID : XB4OERSX2BCD

MODEL : OERSX2

Working Frequency : 433.92 MHz

*for*

APPLICANT : ORO-TEK CO., LTD

ADDRESS : 1F., NO.21, LN. 510, JHONGJHENG RD.,  
FONGYUAN CITY, TAICHUNG  
COUNTY 42059, TAIWAN

Test Performed by

**ELECTRONICS TESTING CENTER, TAIWAN**

NO.34, LIN 5, DINGFU TSUEN, LINKOU SHIANG  
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Report Number : 10-12-RBF-042-01

## TEST REPORT CERTIFICATION

Applicant : ORO-TEK CO., LTD  
1F., NO.21, LN. 510, JHONGJHENG RD., FONGYUAN CITY,  
TAICHUNG COUNTY 42059, TAIWAN

Manufacturer : ORO-TEK CO., LTD  
1F., NO.21, LN. 510, JHONGJHENG RD., FONGYUAN CITY,  
TAICHUNG COUNTY 42059, TAIWAN

Description of EUT :

- a) Type of EUT : Tire Pressure Sensor
- b) Trade Name : ORO-TEK
- c) Model No. : OERSX2
- d) FCC ID : XB4OERSX2BCD
- e) Working Frequency : 433.92 MHz
- f) Power Supply : DC 3V

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C (2009)

I HEREBY CERTIFY THAT; The data shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003) and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note : 1. The results of the testing report relate only to the items tested.  
2. The testing report shall not be reproduced except in full, without the written approval of ETC.

Issued Date : Jan. 17, 2011

Test Engineer : Vincent Chang  
( Vincent Chang, Engineer )

Check By : Charles Wang  
( Charles Wang, Supervisor )

Approve & Authorized Signer : Will Yauo  
Will Yauo, Manager  
EMC Dept. II of ELECTRONICS  
TESTING CENTER, TAIWAN

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## 1. GENERAL INFORMATION

### 1.1 Product Description

- a) Type of EUT : Tire Pressure Sensor
- b) Trade Name : ORO-TEK
- c) Model No. : OERSX2
- d) FCC ID : XB4OERSX2BCD
- e) Working Frequency : 433.92MHz
- f) Power Supply : DC 3V

### 1.2 Characteristics of Device:

This device is the transmitter (external valve sensor) of a tire pressure monitor system. This unit is placed onto Tire Valve System as Transmitting Sensor. Its power is supplied by a 3V Lithium Battery.

### 1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in chapter 13 of ANSI C63.4 (2003).

The Transmitter under test was operated continuously in its normal operating mode for the purpose of the measurements. In order to secure the continuous operation of the device under test, rewiring in the circuit was done by the manufacturer so as to affect its intended operation.

The receiving antenna polarized horizontally was varied from 1 to 4 meters and the wooden turntable was rotated through 360 degrees to obtain the highest reading on the field strength meter or on the display of the spectrum analyzer. And also, each emission was to be maximized by changing the orientation of the Transmitter under test.

In order to determining the average value during one pulse train of the radiated power generated from the Transmitter under test, the encoded wave form in the time domain was used.

### 1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at NO.34, LIN 5, DINGFU TSUEN, LINKOU SHIANG TAIPEI COUNTY, TAIWAN, 24442, R.O.C.

This site has been fully described in a report submitted to your office, and accepted in a letter dated Aug. 05, 2008.

## 2. DEFINITION AND LIMITS

### 2.1 Definition

Intentional radiator:

A device that intentionally generates and emits radio frequency energy by radiation or induction.

### 2.2 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

| MHz               | MHz                   | MHz           | GHz         |
|-------------------|-----------------------|---------------|-------------|
| 0.090 - 0.110     | 16.42-16.423          | 399.9-410     | 4.5-5.15    |
| 0.495 - 0.505 **  | 16.69475 - 16.69525   | 608-614       | 5.35-5.46   |
| 2.1735 - 2.1905   | 16.80425 - 16.80475   | 960-1240      | 7.25-7.75   |
| 4.125-4.128       | 25.5-25.67            | 1300-1427     | 8.025-8.5   |
| 4.17725-4.17775   | 37.5-38.25            | 1435-1626.5   | 9.0-9.2     |
| 4.20725-4.20775   | 73-74.6               | 1645.5-1646.5 | 9.3-9.5     |
| 6.215-6.218       | 74.8-75.2             | 1660-1710     | 10.6-12.7   |
| 6.26775-6.26825   | 108-121.94            | 1718.8-1722.2 | 13.25-13.4  |
| 6.31175-6.31225   | 123-138               | 2200-2300     | 14.47-14.5  |
| 8.291-8.294       | 149.9-150.05          | 2310-2390     | 15.35-16.2  |
| 8.362-8.366       | 156.52475 - 156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.37625-8.38675   | 156.7-156.9           | 2655-2900     | 22.01-23.12 |
| 8.41425-8.41475   | 162.0125-167.17       | 3260-3267     | 23.6-24.0   |
| 12.29-12.293      | 167.72-173.2          | 3332-3339     | 31.2-31.8   |
| 12.51975-12.52025 | 240-285               | 3345.8-3358   | 36.43-36.5  |
| 12.57675-12.57725 | 322-335.4             | 3360-4400     | Above 38.6  |
| 13.36-13.41       |                       |               |             |

Remark “\*\*”: Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

### 2.3 Limitation

#### (1) Conducted Emission Limits:

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that 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 150kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency<br>MHz | Quasi Peak<br>dB μ V | Average<br>dB μ V |
|------------------|----------------------|-------------------|
| 0.15 - 0.5       | 66-56*               | 56-46*            |
| 0.5 - 5.0        | 56                   | 46                |
| 5.0 - 30.0       | 60                   | 50                |

- Decreases with the logarithm of the frequency

**(2) Radiated Emission Limits :**

According to 15.231(a), Periodic operation in the band 40.66-40.70 MHz and above 70 MHz, except as shown in paragraph 15.231(e), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

| Frequency Band (MHz) | Field strength of Fundamental (uV/m) | Field strength of Spurious (uV/m) |
|----------------------|--------------------------------------|-----------------------------------|
| 40.66-40.70          | 2250                                 | 225                               |
| 70-130               | 1250                                 | 125                               |
| 130-174              | *1,250 to 3,750                      | *125 to 375                       |
| 174-260              | 3750                                 | 375                               |
| 260-470              | *3,750 to 12,500                     | *375 to 1250                      |
| Above 470            | 12500                                | 1250                              |

\* Linear interpolations.

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

| Frequency Band (MHz) | Field strength of Fundamental (uV/m) | Field strength of Spurious (uV/m) |
|----------------------|--------------------------------------|-----------------------------------|
| 40.66-40.70          | 1,000                                | 100                               |
| 70-130               | 500                                  | 50                                |
| 130-174              | *500 to 1,500                        | *50 to 150                        |
| 174-260              | 1,500                                | 150                               |
| 260-470              | *1,500 to 5,000                      | *150 to 500                       |
| Above 470            | 5,000                                | 500                               |

\* Linear interpolations

Field strength limits are at the distance of 3 meters, emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209, as following table:

| Other Frequencies (MHz) | Field Strength of Fundamental |                                     |
|-------------------------|-------------------------------|-------------------------------------|
|                         | $\mu\text{V}/\text{meter}$    | $\text{dB}\mu\text{V}/\text{meter}$ |
| 30 - 88                 | 100                           | 40.0                                |
| 88 - 216                | 150                           | 43.5                                |
| 216 - 960               | 200                           | 46.0                                |
| Above 960               | 500                           | 54.0                                |

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

### **(3) Limit of transmission time**

According to 15.231(a),

- 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.
- 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.
- 4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.
- 5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmission are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

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.

## **2.4 Labeling Requirement**

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## **2.5 User Information**

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### 3 SYSTEM TEST CONFIGURATION

#### 3.1 Justification

All measurement were intentional to maximum the emissions from EUT by varying the connection cables, therefore, the test result is sure to meet the applicable requirement.

#### 3.2 Devices for Tested System

| Device                 | Manufacture   | Model / FCC ID.         | Description |
|------------------------|---|-------------------------|-------------|
| Tire Pressure Sensor * | 1F., NO.21, LN. 510,<br>JHONGJHENG RD.,<br>FONGYUAN CITY,<br>TAICHUNG COUNTY 42059,<br>TAIWAN | OERSX2/<br>XB4OERSX2BCD | ---         |

Remark “\*” means equipment under test.



## **4. RADIATED EMISSION MEASUREMENT**

### **4.1 Applicable Standard**

For periodic operation intentional radiator, the radiated emission shall comply with § 15.231(e).

### **4.2 Measurement Procedure**

#### **A. Preliminary Measurement For Portable Devices**

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

#### **B. Final Measurement**

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

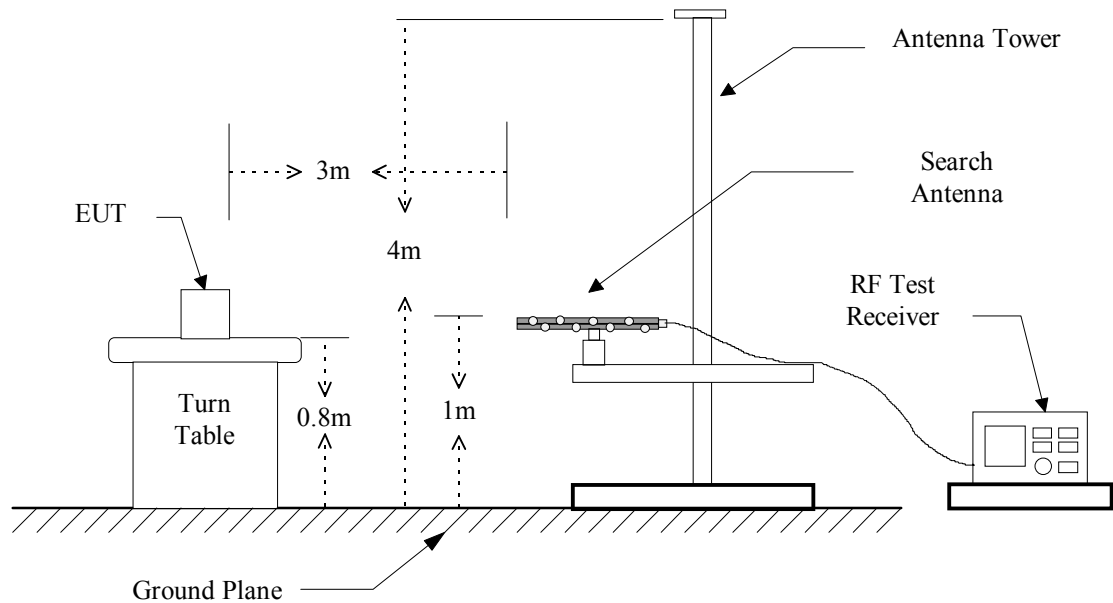
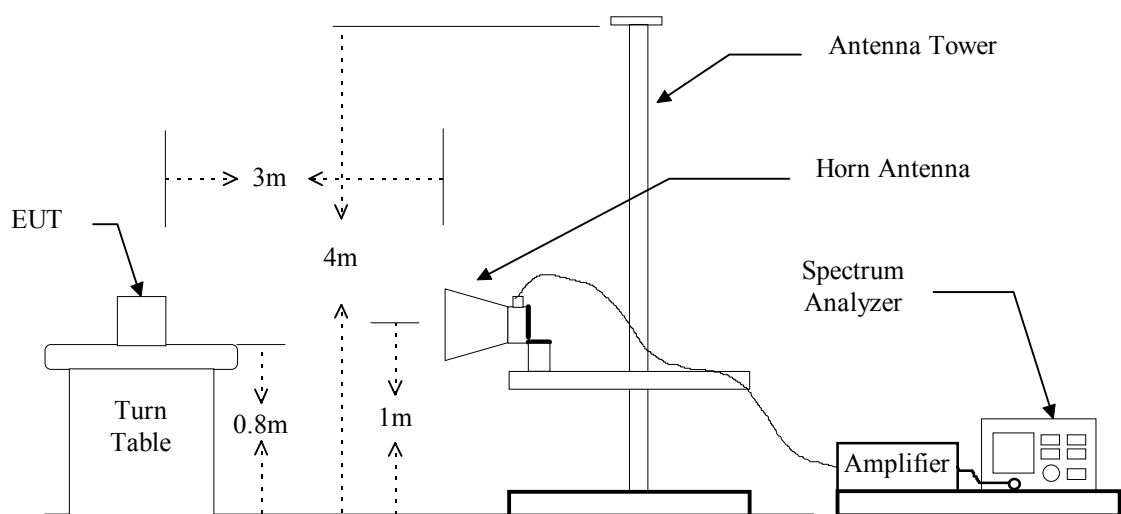


Figure 2 : Frequencies measured above 1 GHz configuration



### 4.3 Test Data

#### A. Fundanmental and Harmonic

Operation : Transmitting; EUT put on table horizontally  
Mode

Test Date : Dec. 21, 2010 Temperature : 18 °C Humidity 65 %

| Frequency<br>(MHz) | Ant<br>Pol<br>H/V | Reading<br>(dBuV)<br>Peak | Factor<br>(dB) |       | Result @3m<br>(dBuV/m) |      | Limit @3m<br>(dBuV/m) |      | Margin<br>(dB) | Table<br>Degree<br>(Deg.) | Ant.<br>High<br>(m) |
|--------------------|-------------------|---------------------------|----------------|-------|------------------------|------|-----------------------|------|----------------|---------------------------|---------------------|
|                    |                   |                           | C              | D     | Peak                   | Ave. | Peak                  | Ave. |                |                           |                     |
| 433.990            | H                 | 76.0                      | -5.5           | -20.0 | 70.5                   | 50.5 | 92.8                  | 72.8 | -22.3          | 62                        | 1.50                |
| 867.980            | H                 | 56.5                      | 2.3            | -20.0 | 58.8                   | 38.8 | 72.8                  | 52.8 | -14.0          | 75                        | 1.50                |
| *1301.970          | V                 | ---                       | -8.4           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| *1735.960          | H/V               | ---                       | -6.1           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| 2169.950           | H/V               | ---                       | -4.0           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| *2603.940          | H/V               | ---                       | -2.4           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| 3037.930           | H/V               | ---                       | -1.1           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| 3471.920           | H/V               | ---                       | -0.1           | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| 3905.910           | H/V               | ---                       | 1.6            | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |
| 4339.900           | H/V               | ---                       | 2.0            | -20.0 | ---                    | ---  | 74.0                  | 54.0 | ---            | ---                       | ---                 |

Note :

1. Factor C means “corrected”, and that includes antenna factor, cable loss, amplifier gain (if any). And Factor D means “Duty”, that is for calculating the average value and derived from section 3.6 in this test report.
2. Peak Result = Reading + C. Factor  
Ave. Result = Peak Value + D Factor
3. “\*” means the frequency fall in the restricted frequency band, and the limit of emission is referred to FCC class B
4. The limit for spurious emissions refers to FCC§15.231.
5. The expanded uncertainty of the radiated emission tests is 3.53 dB.

*If the measured frequencies fall in the restricted frequency band, the limit employed is § 15.209 general requirement when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function, no duty factor applied.*

**B. Other Emission**

a) Emission frequencies below 1 GHz

Operation Mode : Transmitting; EUT put on table horizontallyTest Date : Dec. 21, 2010 Temperature : 18 °C Humidity: 65 %

| Frequency<br>(MHz) | Ant-Pol<br>H/V | Meter<br>Reading<br>(dBuV) | Corrected<br>Factor<br>(dB) | Result<br>@3m<br>(dBuV/m) | Limit<br>@3m<br>(dBuV/m) | Margin<br>(dB) | Table<br>Degree<br>(Deg.) | Ant.<br>High<br>(m) |
|--------------------|----------------|----------------------------|-----------------------------|---------------------------|--------------------------|----------------|---------------------------|---------------------|
| 37.14              | V              | 4.9                        | 13.3                        | 18.2                      | 40.0                     | -21.8          | 178                       | 1.0                 |
| 121.41             | H              | 6.7                        | 12.9                        | 19.6                      | 43.5                     | -23.9          | 89                        | 1.5                 |
| 139.45             | H              | 8.4                        | 14.0                        | 22.4                      | 43.5                     | -21.1          | 76                        | 1.5                 |
| 175.61             | H              | 8.7                        | 15.9                        | 24.6                      | 43.5                     | -18.9          | 93                        | 1.5                 |
| 182.14             | H              | 10.1                       | 16.6                        | 26.7                      | 43.5                     | -16.8          | 92                        | 1.5                 |
| 192.41             | V              | 11.2                       | 17.8                        | 29.0                      | 43.5                     | -14.5          | 175                       | 1.0                 |

Note :

1. Remark "---" means that the emission level is too low to be measured.
2. The expanded uncertainty of the radiated emission tests is 3.53 dB.

b) Emission frequencies above 1 GHz

Radiated emission frequencies above 1 GHz to 5 GHz were too low to be measured with a pre-amplifier of 35 dB.

#### 4.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

And the average value is

$$\text{Average} = \text{Peak Value} + \text{Duty Factor}$$

*Note : If the measured frequencies are fall in the restricted frequency band, the limit employed must be quasi peak value when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function.*

#### 4.5 Activate Time

The EUT will transmit automatically. The duration of each transmission is 10ms and the silent period between transmissions is 29.88 seconds which is greater than 30 times the duration of the transmission (30\*10=300ms) and is also greater than 10 seconds. This operation complies with the requirement of 15.231(e).

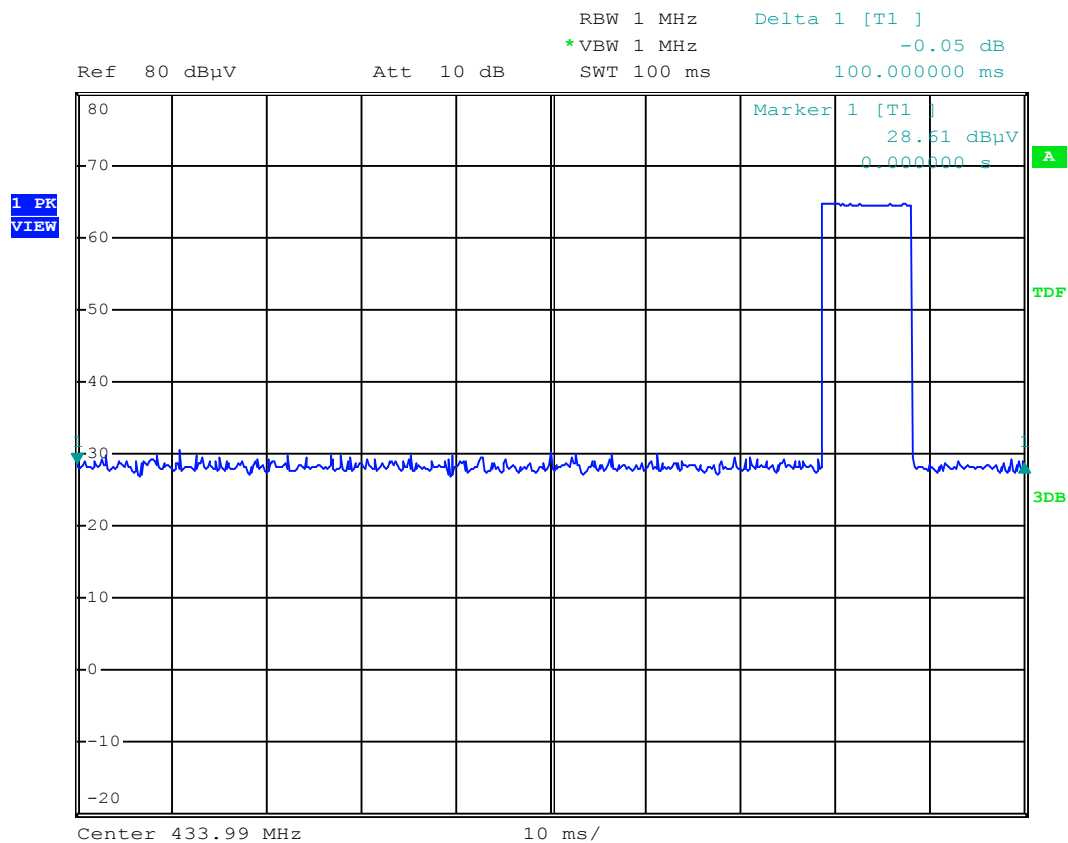
#### 4.6 Calculation of Duty Factor

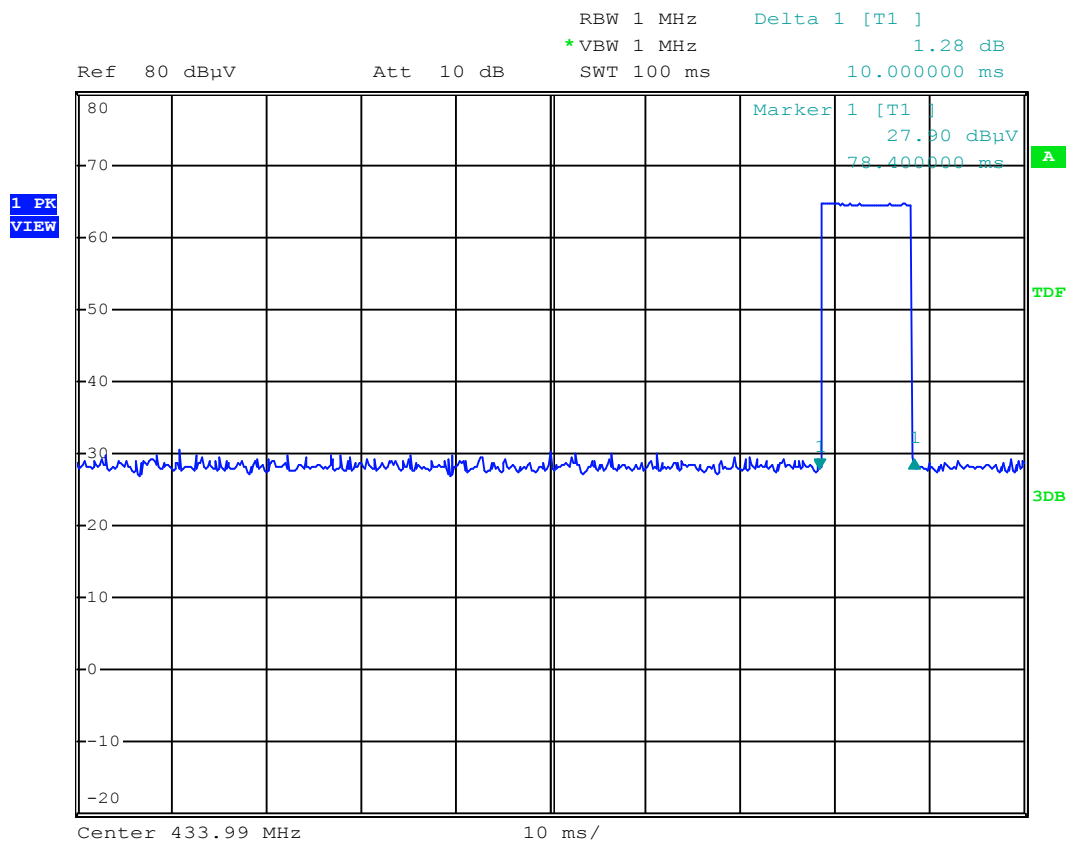
The duty factor is calculated with following formula :

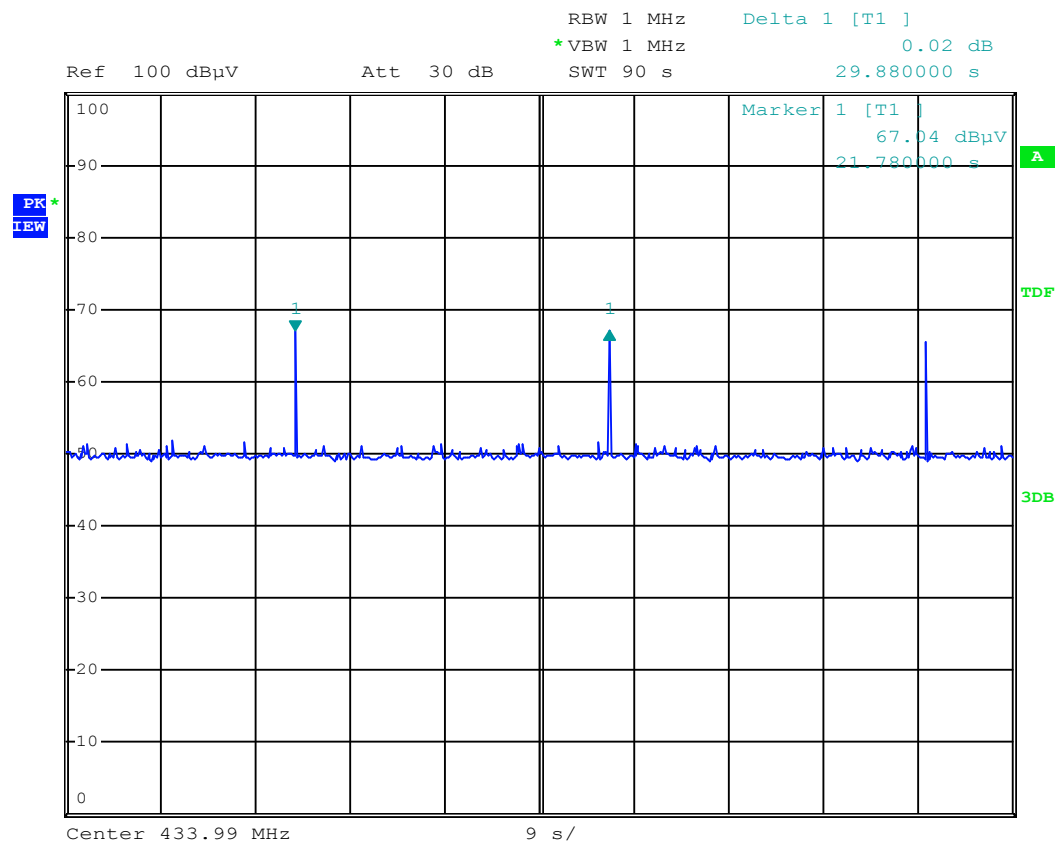
$$20\log \frac{\text{Total Duty}}{\text{Period of Pulse Train}}$$

433.92 MHz

$$\text{Duty Factor} = 20\log \frac{10\text{ms}}{100\text{ms}} = -20\text{dB}$$









#### 4.7 Radiated Test Equipment

| Equipment             | Manufacturer    | Model No. | Calibration Date | Next Cal. Date |
|-----------------------|-----------------|-----------|------------------|----------------|
| Test Receiver         | Rohde & Schwarz | ESCI      | 2010/02/03       | 2011/02/02     |
| Spectrum              | Advantest       | R3162     | 2010/03/01       | 2011/02/28     |
| Bi-Log Antenna        | Schaffner       | CBL 6111  | 2010/05/21       | 2011/05/20     |
| Log-periodic Antenna  | EMCO            | 3146      | 2010/10/11       | 2011/10/10     |
| Biconical Antenna     | EMCO            | 3110      | 2010/09/10       | 2011/09/09     |
| Double Ridged Antenna | EMCO            | 3115      | 2010/05/11       | 2011/05/10     |
| Amplifier             | HP              | 8449B     | 2010/12/15       | 2011/12/14     |
| Amplifier             | HP              | 83051A    | 2010/05/13       | 2011/05/12     |
| Amplifier             | HP              | 8447D     | 2010/05/10       | 2011/05/09     |
| Spectrum              | Rohde & Schwarz | FSP40     | 2010/09/17       | 2011/09/16     |

#### 4.8 Measuring Instrument Setup

Explanation of measuring instrument setup in frequency band measured is as following :

| Frequency Band (MHz) | Instrument        | Function   | Resolution bandwidth | Video Bandwidth |
|----------------------|-------------------|------------|----------------------|-----------------|
| 30 to 1000           | RF Test Receiver  | Quasi-Peak | 120 kHz              | N/A             |
|                      | Spectrum Analyzer | Peak       | 100 kHz              | 100 kHz         |
| Above 1000           | Spectrum Analyzer | Peak       | 1 MHz                | 1 MHz           |
|                      | Spectrum Analyzer | Average    | 1 MHz                | 10 Hz           |

#### 4.9 Radiated Measurement Photos



## 5. BANDWIDTH OF EMISSION

### 5.1 Applicable Standard Plot Graphic of Bandwidth

Per FCC rule §15.231(c), the permitted emission bandwidth is no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

### 5.2 Bandwidth Test Equipment

| Equipment | Manufacturer    | Model No. | Calibration Date | Next Cal. Date |
|-----------|-----------------|-----------|------------------|----------------|
| Spectrum  | Rohde & Schwarz | FSP40     | 2010/09/17       | 2011/09/16     |

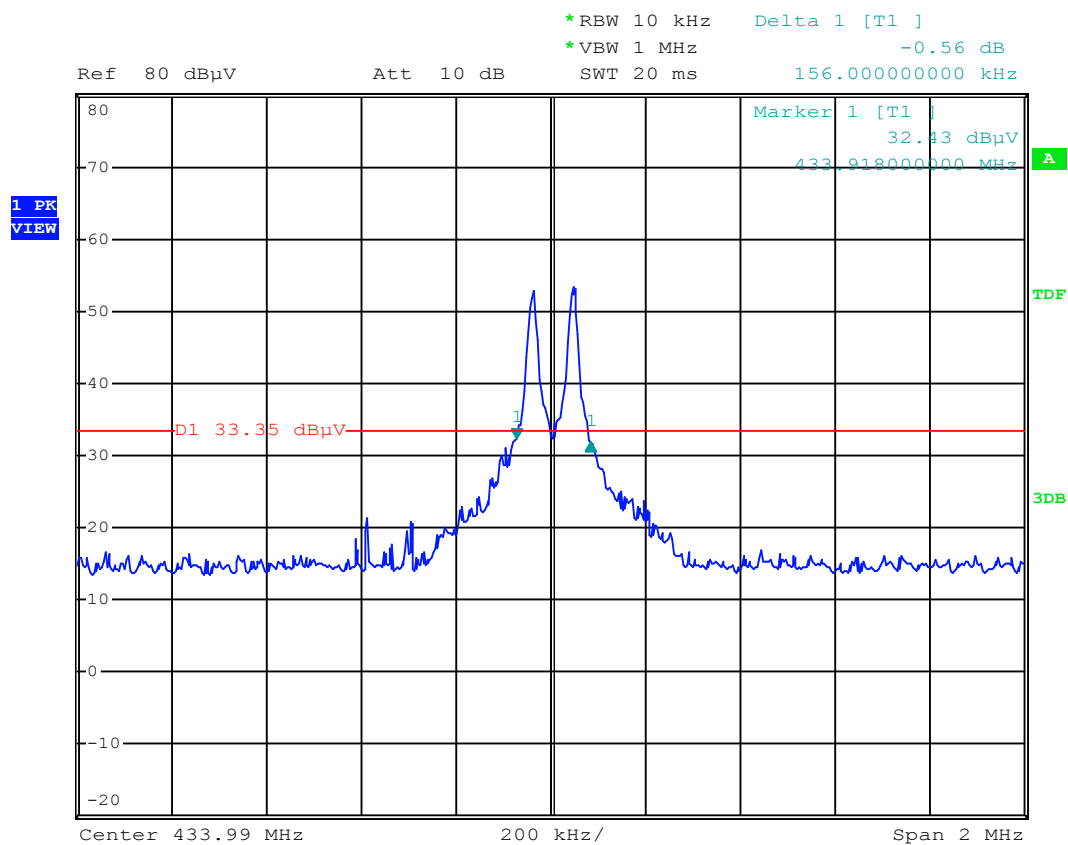
### 5.3 Plot Graphic of Bandwidth

The emission bandwidth limit for this transmitter is

$$433.99 \text{ MHz} * 0.25\% = 1084.975 \text{ kHz}$$

$$20 \text{ dB bandwidth} = 156 \text{ kHz}$$

**Test Result: 156 kHz < 1084.975 kHz.**



## **6. CONDUCTED EMISSION MEASUREMENT**

### **6.1 Description**

This EUT is excused from investigation of conducted emission, for it is powered by DC 3V battery only. According to §15.207 (d), measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

## **7 ANTENNA REQUIREMENT**

### **7.1 Standard Applicable**

According to §15.203, 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.

### **7.2 Antenna Construction**

The antenna is permanently integrated on RF Board, no consideration of replacement.  
Please see photos submitted in Exhibit B.