



## RADIO TEST REPORT

Report No.: STS2302125W02

Issued for

Shenzhen HAC Telecom Technology Co., LTD

Fl 9, Block A, Bldg 1, Shenzhen International Innovation  
Valley, Xingke 1st Street, Nanshan, Shenzhen, China

|                         |                         |
|-------------------------|-------------------------|
| <b>Product Name:</b>    | Pulse reader for Elster |
| <b>Brand:</b>           |                         |
| <b>Model Number:</b>    | WRW-E1                  |
| <b>Series Model(s):</b> | N/A                     |
| <b>FCC ID:</b>          | WMUHAC-WRW-E1           |
| <b>Test Standard:</b>   | FCC Part 15.249         |

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**TEST RESULT CERTIFICATION**

**Applicant's Name** .....: Shenzhen HAC Telecom Technology Co., LTD  
**Address** .....: Fl 9, Block A, Bldg 1, Shenzhen International Innovation Valley, Xingke 1st Street, Nanshan, Shenzhen, China  
**Manufacturer's Name** .....: Shenzhen HAC Telecom Technology Co., LTD  
**Address** .....: Fl 9, Block A, Bldg 1, Shenzhen International Innovation Valley, Xingke 1st Street, Nanshan, Shenzhen, China

**Product Description**

**Product Name** .....: Pulse reader for Elster

**Brand** .....:



**Model Number** .....: WRW-E1

**Series Model(s)** .....: N/A

**Test Standards** .....: FCC Part15.249

**Test Procedure** .....: ANSI C63.10-2013

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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**Date of Test** .....:

**Date of receipt of test item** .....: 21 Feb. 2023

**Date of performance of tests** .....: 21 Feb. 2023 ~ 30 Mar. 2023

**Date of Issue** .....: 30 Mar. 2023

**Test Result** .....: **Pass**

Testing Engineer :

(Chris Chen)

Technical Manager :

(Sean She)

Authorized Signatory :

(Bovey Yang)





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### Revision History

| Rev. | Issue Date   | Report NO.    | Effect Page | Contents      |
|------|--------------|---------------|-------------|---------------|
| 00   | 30 Mar. 2023 | STS2302125W02 | ALL         | Initial Issue |
|      |              |               |             |               |



## 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

| <b>FCC Part 15.249 , Subpart C</b> |                               |          |        |
|------------------------------------|-------------------------------|----------|--------|
| Standard Section                   | Test Item                     | Judgment | Remark |
| 15.207                             | Conducted Emission            | N/A      |        |
| 15.203                             | Antenna Requirement           | Pass     |        |
| 15.249                             | Radiated Spurious Emission    | Pass     |        |
| 15.249                             | Radiated Band Edge Emission   | Pass     |        |
| 15.249                             | Field Strength of fundamental | Pass     |        |
| 15.215(c)                          | 20dB Bandwidth                | Pass     |        |

NOTE:

- (1) 'N/A' denotes test is not applicable in this Test Report.
- (2) All tests are according to ANSI C63.10-2013.



## 1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD

Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

A2LA Certificate No.: 4338.01

## 1.2 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 %**.

| No. | Item                              | Uncertainty          |
|-----|-----------------------------------|----------------------|
| 1   | RF output power, conducted        | $\pm 1.197\text{dB}$ |
| 2   | Unwanted Emissions, conducted     | $\pm 2.896\text{dB}$ |
| 3   | All emissions, radiated 9K-30MHz  | $\pm 3.84\text{dB}$  |
| 4   | All emissions, radiated 30M-1GHz  | $\pm 3.94\text{dB}$  |
| 5   | All emissions, radiated 1G-6GHz   | $\pm 4.59\text{dB}$  |
| 6   | All emissions, radiated>6G        | $\pm 5.22\text{dB}$  |
| 7   | Conducted Emission (9KHz-150KHz)  | $\pm 2.14\text{dB}$  |
| 8   | Conducted Emission (150KHz-30MHz) | $\pm 2.54\text{dB}$  |



## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF THE EUT

|                         |  |  |                      |                |                  |      |               |                 |                     |      |
|-------------------------|--|--|----------------------|----------------|------------------|------|---------------|-----------------|---------------------|------|
| Product Name            | Pulse reader for Elster  |  |                      |                |                  |      |               |                 |                     |      |
| Brand                   |   |  |                      |                |                  |      |               |                 |                     |      |
| Model Number            | WRW-E1   |  |                      |                |                  |      |               |                 |                     |      |
| Series Model(s)         | N/A  |  |                      |                |                  |      |               |                 |                     |      |
| Model Difference        | N/A  |  |                      |                |                  |      |               |                 |                     |      |
| Product Description     | <p>The EUT is a Pulse reader for Elster.</p> <table border="1"><tr><td>Operation Frequency:</td><td>903.3-926.8MHz</td></tr><tr><td>Modulation Type:</td><td>GFSK</td></tr><tr><td>Antenna Type:</td><td>Helical Antenna</td></tr><tr><td>Antenna Gain(Peak):</td><td>0dBi</td></tr></table> <p>Based on the application, features, or specification exhibited in User Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User Manual.</p> |  | Operation Frequency: | 903.3-926.8MHz | Modulation Type: | GFSK | Antenna Type: | Helical Antenna | Antenna Gain(Peak): | 0dBi |
| Operation Frequency:    | 903.3-926.8MHz   |  |                      |                |                  |      |               |                 |                     |      |
| Modulation Type:        | GFSK   |  |                      |                |                  |      |               |                 |                     |      |
| Antenna Type:           | Helical Antenna  |  |                      |                |                  |      |               |                 |                     |      |
| Antenna Gain(Peak):     | 0dBi   |  |                      |                |                  |      |               |                 |                     |      |
| Channel List            | Please refer to the Note 3.  |  |                      |                |                  |      |               |                 |                     |      |
| Battery                 | <p>Rated Voltage:3.6V<br/>Charge Limit Voltage: Not rechargeable<br/>Capacity: 4000mAh</p>   |  |                      |                |                  |      |               |                 |                     |      |
| Hardware version number | HAC-MLW2   |  |                      |                |                  |      |               |                 |                     |      |
| Software version number | N/A  |  |                      |                |                  |      |               |                 |                     |      |
| Connecting I/O Port(s)  | Please refer to the Note 1.  |  |                      |                |                  |      |               |                 |                     |      |

#### Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.
2. The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report. Due to the incorrect antenna information, a series of problems such as the accuracy of the test results will be borne by the customer.



3.

| Channel List |                 |         |                 |         |                 |
|--------------|-----------------|---------|-----------------|---------|-----------------|
| Channel      | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 01           | 903.3           | 28      | 911.3           | 55      | 919.4           |
| 02           | 903.5           | 29      | 911.6           | 56      | 919.7           |
| 03           | 903.8           | 30      | 911.9           | 57      | 920             |
| 04           | 904.1           | 31      | 912.2           | 58      | 920.3           |
| 05           | 904.4           | 32      | 912.5           | 59      | 920.6           |
| 06           | 904.7           | 33      | 912.8           | 60      | 920.9           |
| 07           | 905             | 34      | 913.1           | 61      | 921.2           |
| 08           | 905.3           | 35      | 913.4           | 62      | 921.5           |
| 09           | 905.6           | 36      | 913.7           | 63      | 921.8           |
| 10           | 905.9           | 37      | 914             | 64      | 922.1           |
| 11           | 906.2           | 38      | 914.3           | 65      | 922.4           |
| 12           | 906.5           | 39      | 914.6           | 66      | 922.7           |
| 13           | 906.8           | 40      | 914.9           | 67      | 923             |
| 14           | 907.1           | 41      | 915.2           | 68      | 923.3           |
| 15           | 907.4           | 42      | 915.5           | 69      | 923.6           |
| 16           | 907.7           | 43      | 915.8           | 70      | 923.9           |
| 17           | 908             | 44      | 916.1           | 71      | 924.2           |
| 18           | 908.3           | 45      | 916.4           | 72      | 924.5           |
| 19           | 908.6           | 46      | 916.7           | 73      | 924.8           |
| 20           | 908.9           | 47      | 917             | 74      | 925.1           |
| 21           | 909.2           | 48      | 917.3           | 75      | 925.4           |
| 22           | 909.5           | 49      | 917.6           | 76      | 925.7           |
| 23           | 909.8           | 50      | 917.9           | 77      | 926             |
| 24           | 910.1           | 51      | 918.2           | 78      | 926.3           |
| 25           | 910.4           | 52      | 918.5           | 79      | 926.8           |
| 26           | 910.7           | 53      | 918.8           |         |                 |
| 27           | 911             | 54      | 919.1           |         |                 |



## 2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions

Each of these EUT operation mode(s) or test configuration mode(s) mentioned below was evaluated respectively.

| Pretest Mode | Description       | Data/Modulation |
|--------------|-------------------|-----------------|
| Mode 1       | TX CH01(903.3MHz) | GFSK            |
| Mode 2       | TX CH41(915.2MHz) | GFSK            |
| Mode 3       | TX CH79(926.8MHz) | GFSK            |

Note:

(1) All above mode have been measurement, only worst data was reported.

(2) We have been tested for all available U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V,50/60Hz is shown in the report.

## For AC Conducted Emission

| Test Case             |                     |
|-----------------------|---------------------|
| AC Conducted Emission | Mode 4 : Keeping TX |

## 2.3 TEST SOFTWARE AND POWER LEVEL

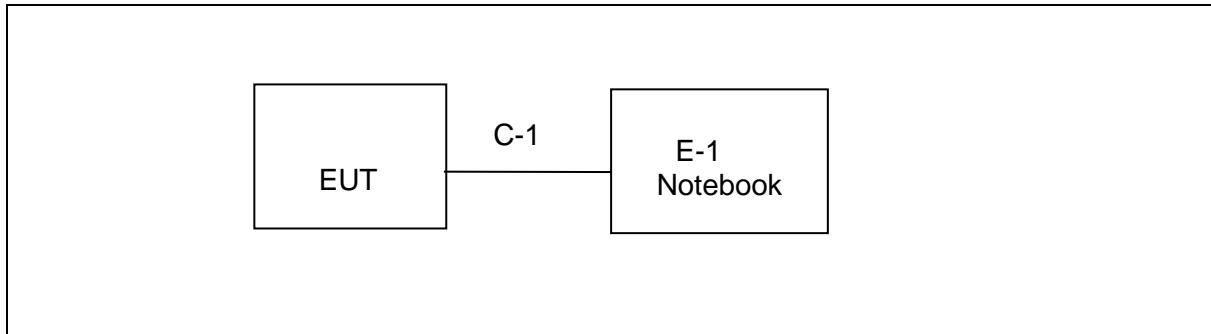
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

| RF Function | Type                             | Mode Or Modulation type | ANT Gain(dBi) | Power Class | Software For Testing                                  |
|-------------|----------------------------------|-------------------------|---------------|-------------|---|
| Other SRD   | 903.3MHz<br>915.2MHz<br>926.8MHz | GFSK                    | 0             | Default     | The EUT has signal transmission when it is powered on |

## 2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

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.

Radiated Spurious Emission Test





## 2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

### Necessary accessories

| Item | Equipment | Mfr/Brand | Model/Type No. | Length | Note |
|------|-----------|-----------|----------------|--------|------|
| N/A  | N/A       | N/A       | N/A            | N/A    | N/A  |
|      |           |           |                |        |      |
|      |           |           |                |        |      |
|      |           |           |                |        |      |

### Support units

| Item | Equipment | Mfr/Brand | Model/Type No. | Length | Note |
|------|-----------|-----------|----------------|--------|------|
| E-1  | Notebook  | LENOVO    | Think Pad E470 | N/A    | N/A  |
| C-1  | USB Cable | N/A       | N/A            | 150cm  | NO   |
|      |           |           |                |        |      |
|      |           |           |                |        |      |

#### Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.



## 2.6 EQUIPMENTS LIST FOR ALL TEST ITEMS

| RF Radiation Test Equipment |                  |                    |                 |                  |                  |
|-----------------------------|------------------|--------------------|-----------------|------------------|------------------|
| Kind of Equipment           | Manufacturer     | Type No.           | Serial No.      | Last Calibration | Calibrated Until |
| Temperature & Humidity      | SW-108           | SuWei              | N/A             | 2023.03.03       | 2024.03.02       |
| Pre-Amplifier(0.1M-3GHz)    | EM               | EM330              | 060665          | 2022.07.04       | 2023.07.03       |
| Pre-Amplifier (1G-18GHz)    | SKET             | LNPA-01018G-45     | SK2018080901    | 2022.09.29       | 2023.09.28       |
| 18GHz-40GHz Filter          | XINGBO           | XBLBQ-GTA44        | 22062003-1      | 2023.03.06       | 2024.03.05       |
| Pre-mplifier(18G-40G)       | SKET             | LNPA_1840-50       | SK2018101801    | 2023.03.06       | 2024.03.05       |
| Positioning Controller      | MF               | MF-7802            | MF-780208587    | N/A              | N/A              |
| Signal Analyzer             | R&S              | FSV 40-N           | 101823          | 2022.09.29       | 2023.09.28       |
| Switch Control Box          | N/A              | N/A                | N/A             | N/A              | N/A              |
| Filter Box                  | BALUN Technology | SU319E             | BL-SZ1530051    | N/A              | N/A              |
| Active loop Antenna         | ZHINAN           | ZN30900C           | 16035           | 2023.02.28       | 2024.02.27       |
| Bilog Antenna               | TESEQ            | CBL6111D           | 34678           | 2022.09.30       | 2024.09.29       |
| Horn Antenna                | SCHWARZBECK      | BBHA 9120D         | 02014           | 2021.10.11       | 2023.10.10       |
| Horn Antenna                | A-INFOMW         | LB-180400-KF       | J211020657      | 2021.09.28       | 2023.09.27       |
| Antenna Mast                | MF               | MFA-440H           | N/A             | N/A              | N/A              |
| Turn Table                  | EM               | SC100_1            | 60531           | N/A              | N/A              |
| AC Power Source             | APC              | KDF-11010G         | F214050035      | N/A              | N/A              |
| DC Power Supply             | Zhaoxin          | RXN 605D           | 20R605D11010081 | N/A              | N/A              |
| Test SW                     | EZ-EMC           | Ver.STSLAB-03A1 RE |                 |                  |                  |
| Conduction Test equipment   |                  |                    |                 |                  |                  |
| Kind of Equipment           | Manufacturer     | Type No.           | Serial No.      | Last calibration | Calibrated until |
| Test Receiver               | R&S              | ESCI               | 101427          | 2022.09.29       | 2023.09.28       |
| LISN                        | R&S              | ENV216             | 101242          | 2022.09.28       | 2023.09.27       |
| LISN                        | EMCO             | 3810/2NM           | 23625           | 2022.09.28       | 2023.09.27       |
| Temperature & Humidity      | HH660            | Mieo               | N/A             | 2022.09.30       | 2023.09.29       |
| Test SW                     | EZ-EMC           | Ver.STSLAB-03A1 CE |                 |                  |                  |
| RF Connected Test           |                  |                    |                 |                  |                  |
| Kind of Equipment           | Manufacturer     | Type No.           | Serial No.      | Last calibration | Calibrated until |
| Signal Analyzer             | Agilent          | N9020A             | MY51510623      | 2023.03.01       | 2024.02.28       |
| Temperature & Humidity      | HH660            | Mieo               | N/A             | 2022.09.30       | 2023.09.29       |



### 3. EMC EMISSION TEST

#### 3.1 CONDUCTED EMISSION MEASUREMENT

##### 3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 15.249 limit in the table below has to be followed.

| FREQUENCY (MHz) | Quasi-peak | Average   |
|-----------------|------------|-----------|
| 0.15 -0.5       | 66 - 56 *  | 56 - 46 * |
| 0.50 -5.0       | 56.00      | 46.00     |
| 5.0 -30.0       | 60.00      | 50.00     |

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of “ \* ” marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

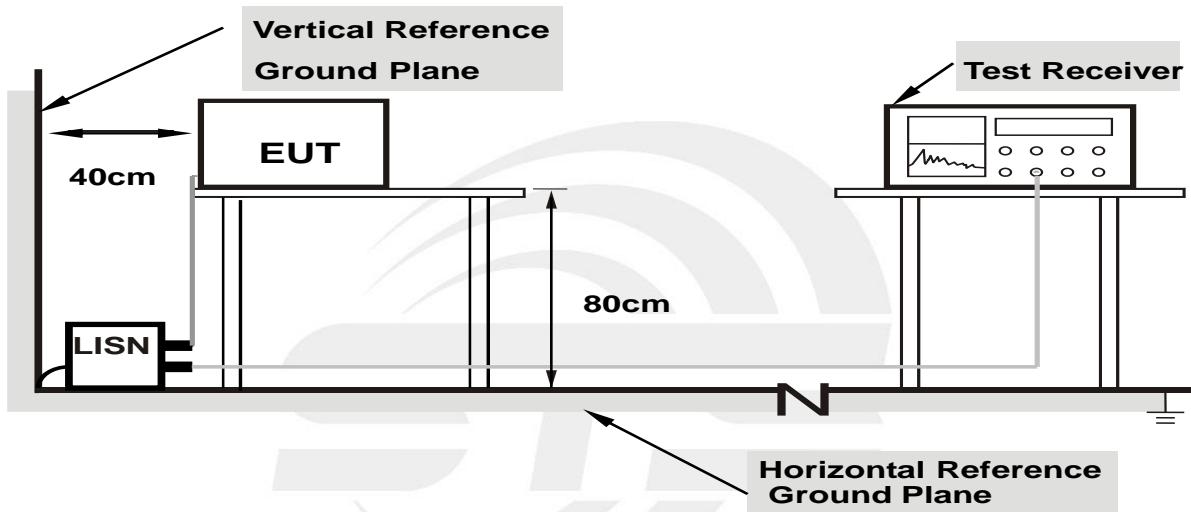
The following table is the setting of the receiver

| Receiver Parameters | Setting  |
|---------------------|----------|
| Attenuation         | 10 dB    |
| Start Frequency     | 0.15 MHz |
| Stop Frequency      | 30 MHz   |
| IF Bandwidth        | 9 kHz    |

### 3.1.2 TEST PROCEDURE

- a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical 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.
- b. 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.
- c. 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.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

### 3.1.3 TEST SETUP



**Note: 1. Support units were connected to second LISN.  
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes**

### 3.1.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

### 3.1.5 TEST RESULT

|               |       |                    |       |
|---------------|-------|--------------------|-------|
| Temperature:  | --(C) | Relative Humidity: | --%RH |
| Test Voltage: | N/A   | Phase:             | L/N   |
| Test Mode:    | N/A   |                    |       |

Note: EUT cannot be powered by battery and is not applicable.



## 3.2 RADIATED EMISSION MEASUREMENT

### 3.2.1 RADIATED EMISSION LIMITS

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on Part 15.249 and the Part 15.209(a) limit in the table below has to be followed.

Standard FCC 15.209

| Frequencies<br>(MHz) | Field Strength<br>(micorvolts/meter)                              | Measurement Distance<br>(meters) |
|----------------------|---|----------------------------------|
| 0.009~0.490          | 2400/F(KHz)   | 300                              |
| 0.490~1.705          | 24000/F(KHz)  | 30                               |
| 1.705~30.0           | 30  | 30                               |
| 30~88                | 100   | 3                                |
| 88~216               | 150   | 3                                |
| 216~960              | 200   | 3                                |
| 960~1000             | 500   | 3                                |
| Above 1000           | Other:74.0 dB( $\mu$ V)/m (Peak)<br>54.0 dB( $\mu$ V)/m (Average) | 3                                |

Standard FCC 15.249

| Frequency of Emission<br>(MHz) | Field Strength of<br>fundamental<br>(millivolts /meter) | Field Strength of<br>Harmonics<br>(microvolts/meter) |
|--------------------------------|---|--|
| 900~928                        | 50  | 500  |
| 2400~2483.5                    | 50  | 500  |
| 5725~5875                      | 50  | 500  |
| 24000~242500                   | 250   | 2500   |

Notes:

- (1) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.



In case the emission fall within the restricted band specified on 15.209 limit in the followed

. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits below 1000 MHz shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

In case the emission fall within the restricted band specified on 15.209 limit in the followed

1. The field strength of fundamental and harmonic emissions, measured at 3 m, shall not exceed 50 mV/m and 0.5 mV/m respectively.

The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

2. Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in 15.209, whichever is less stringent.

NOTE:

(1)The limit for radiated test was performed according to 15.209.

(2)Emission level (dB<sub>u</sub>V/m)=20log Emission level (uV/m).

#### LIMITS OF RESTRICTED FREQUENCY BANDS

| Spectrum Parameter               | Setting               |
|----------------------------------|-----------------------|
| Detector                         | Peak/AV               |
| Attenuation                      | Auto                  |
| Start Frequency                  | 1000 MHz              |
| Stop Frequency                   | 10th carrier harmonic |
| RB (emission in restricted band) | >20BW                 |
| VB (emission in restricted band) | =3xRB                 |



| Receiver Parameter     | Setting                              |
|------------------------|--------------------------------------|
| Attenuation            | Auto                                 |
| Start ~ Stop Frequency | 9kHz~90kHz / RB 200Hz for PK & AV    |
|                        | 90kHz~110kHz / RB 200Hz for QP       |
|                        | 110kHz~490kHz / RB 200Hz for PK & AV |
|                        | 490kHz~30MHz / RB 9kHz for QP        |
|                        | 30MHz~1000MHz / RB 120kHz for QP     |

### 3.2.2 TEST PROCEDURE

- a. The measuring distance of 3m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation(Below 1GHz)
- b. The measuring distance of 3m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation(Above 1GHz)
- c. The height of the test antenna shall vary between 1m to 4m. Both horizontal and vertical polarization of the antenna are set to make the measurement.
- d. The initial step in collecting radiated emission data is a receive peak detector mode. Pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. All readings are peak unless otherwise stated QP in column of Note. Peak denoted that the Peak reading compliance with the QP limits and then QP Mode measurement didn't perform (Below 1GHz)
- f. All readings are Peak mode value unless otherwise stated AVG in column of Note. If the Peak mode measured value compliance with the Peak limits and lower than AVG Limits, the EUT shall be deemed to meet Peak & AVG limits and then only Peak mode was measured, but AVG mode didn't perform.(Above 1GHz)
- g. For the actual test configuration, please refer to the related Item –EUT Test Photos.

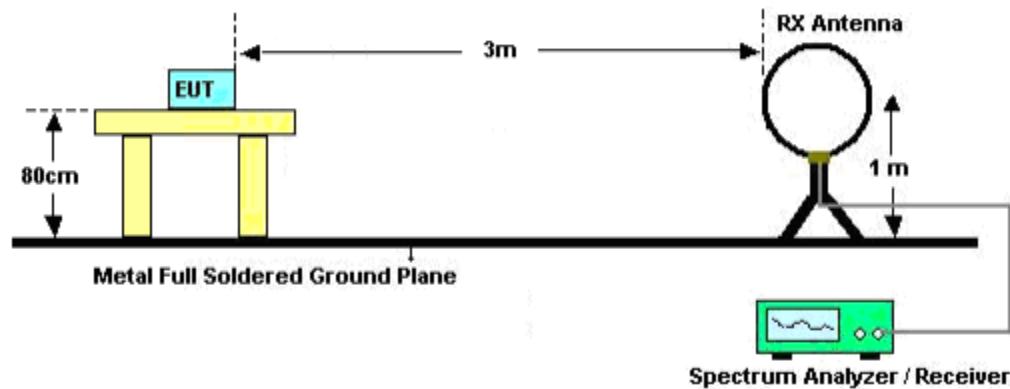
Note: Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

### 3.2.3 DEVIATION FROM TEST STANDARD

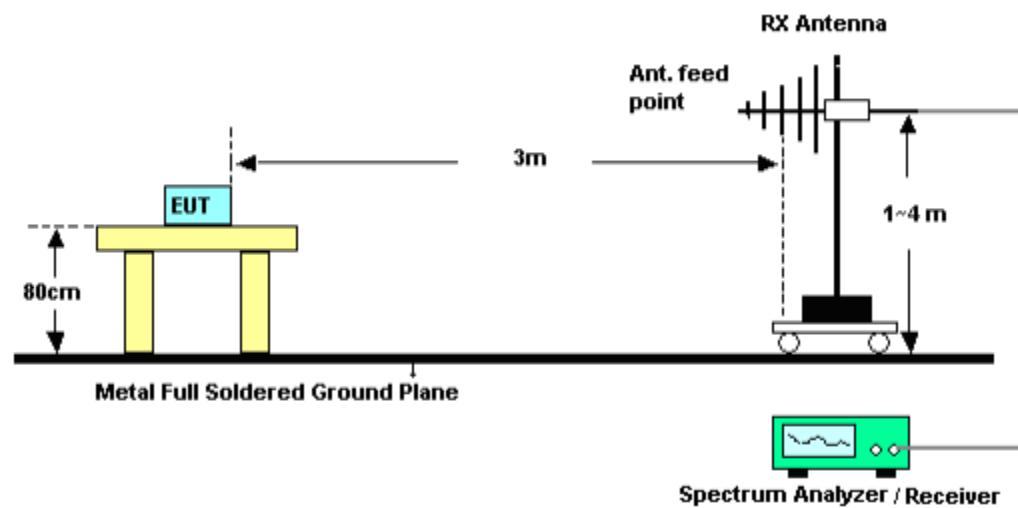
No deviation

### 3.2.4 TEST SETUP

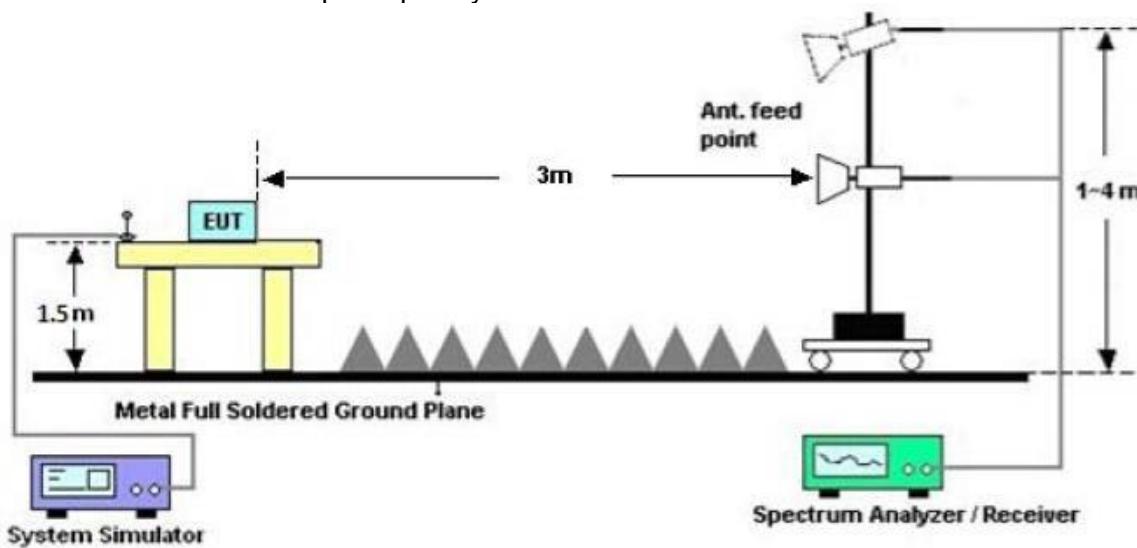
#### (A) Radiated Emission Test-Up Frequency Below 30MHz



#### (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



#### (C) Radiated Emission Test-Up Frequency Above 1GHz





### 3.2.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

Margin=PL-PK L or AL- AV L; Margin only shown the worst case.

Where

PR = Peak Reading

AR = Average Reading

PL = Peak Level

AL = Average Level

AF = Antenna Factor

PK L = Peak Limit

AV L = AV Limit

For example

| Frequency<br>(MHz) | PR<br>(dB $\mu$ V/m) | AR<br>(dB $\mu$ V/m) | AF<br>(dB) | PL<br>(dB $\mu$ V/m) | AL<br>(dB $\mu$ V/m) | PK L<br>(dB $\mu$ V/m) | AV L<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|--------------------|----------------------|----------------------|------------|----------------------|----------------------|------------------------|------------------------|----------------|
| 2178               | 40.23                | 30.31                | 9.83       | 50.06                | 40.14                | 74.00                  | 54.00                  | -13.86         |



### 3.2.6 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

Below 30 MHz

|               |         |                    |       |
|---------------|---------|--------------------|-------|
| Temperature:  | 23.1(C) | Relative Humidity: | 60%RH |
| Test Voltage: | DC 3.6V | Polarization:      | ---   |
| Test Mode:    | TX Mode |                    |       |

| Freq.<br>(MHz) | Reading<br>(dB <sub>UV</sub> /m) | Limit<br>(dB <sub>UV</sub> /m) | Margin<br>(dB) | State |
|----------------|----------------------------------|--------------------------------|----------------|-------|
| --             | --                               | --                             | --             | P/F   |
| --             | --                               | --                             | --             | PASS  |
| --             | --                               | --                             | --             | PASS  |

#### NOTE:

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

Distance extrapolation factor = $40 \log(\text{specific distance}/\text{test distance})$ (dB);  
Limit line = specific limits(dB<sub>UV</sub>) + distance extrapolation factor.

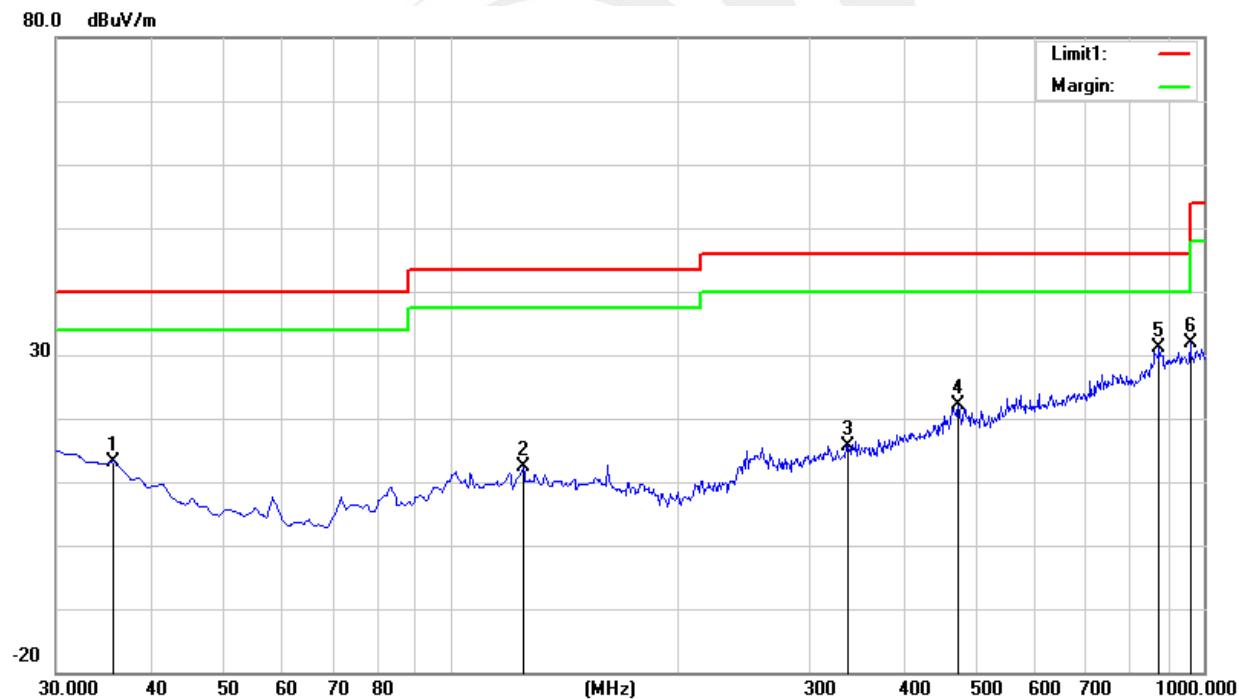
## Between 30MHz – 1000 MHz Radiation Spurious

|               |                                |                    |            |
|---------------|--------------------------------|--------------------|------------|
| Temperature:  | 23.1(C)                        | Relative Humidity: | 60%RH      |
| Test Voltage: | DC 3.6V                        | Phase:             | Horizontal |
| Test Mode:    | Mode 1/2/3 (Mode 1 worst mode) |                    |            |

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-------------------------|--------------------|-------------------|----------------|--------|
| 1   | 35.8200            | 29.16             | -15.91                  | 13.25              | 40.00             | -26.75         | peak   |
| 2   | 125.0600           | 30.62             | -18.22                  | 12.40              | 43.50             | -31.10         | peak   |
| 3   | 337.4900           | 29.24             | -13.49                  | 15.75              | 46.00             | -30.25         | peak   |
| 4   | 472.3200           | 31.14             | -8.92                   | 22.22              | 46.00             | -23.78         | peak   |
| 5   | 873.9000           | 31.60             | -0.58                   | 31.02              | 46.00             | -14.98         | peak   |
| 6   | 959.2600           | 30.11             | 1.75                    | 31.86              | 46.00             | -14.14         | peak   |

## Remark:

- Margin = Result (Result =Reading + Factor )–Limit
- Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



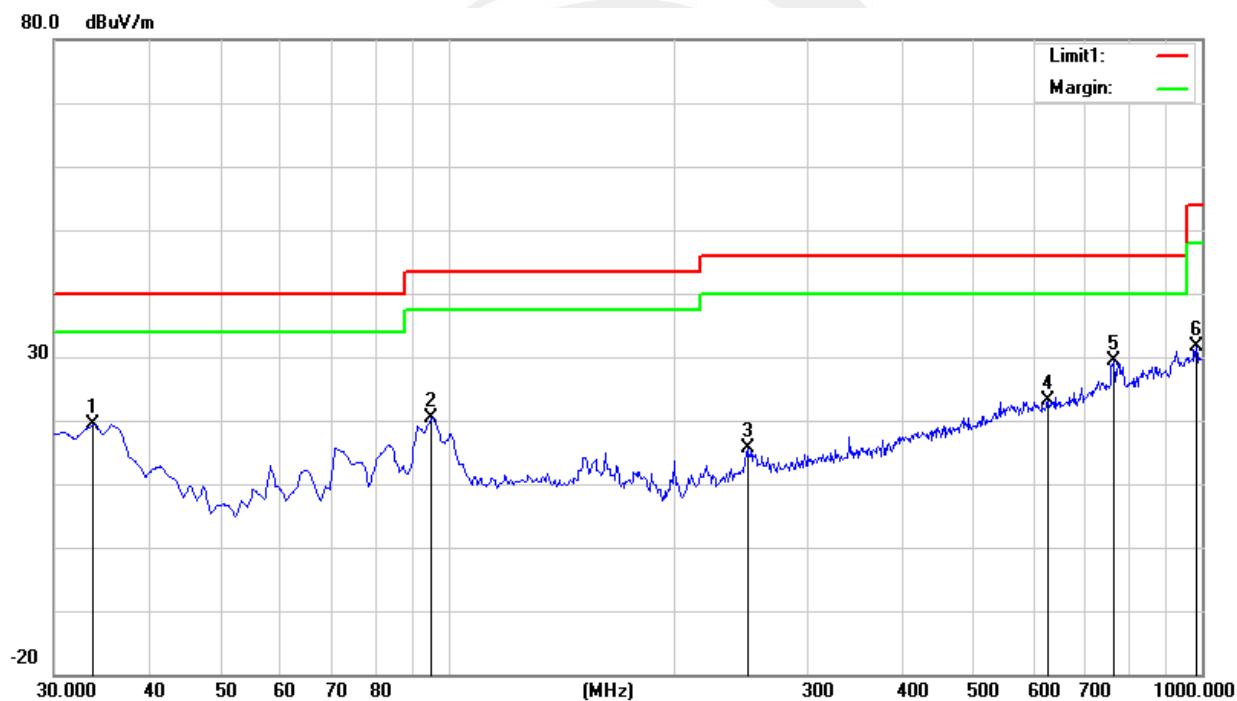


|               |                                |                    |          |
|---------------|--------------------------------|--------------------|----------|
| Temperature:  | 23.1(C)                        | Relative Humidity: | 60%RH    |
| Test Voltage: | DC 3.6V                        | Phase:             | Vertical |
| Test Mode:    | Mode 1/2/3 (Mode 1 worst mode) |                    |          |

| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>Factor(dB/m) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|-------------------------|--------------------|-------------------|----------------|--------|
| 1   | 33.8800            | 34.17             | -14.80                  | 19.37              | 40.00             | -20.63         | peak   |
| 2   | 94.9900            | 41.12             | -20.78                  | 20.34              | 43.50             | -23.16         | peak   |
| 3   | 250.1900           | 31.84             | -16.10                  | 15.74              | 46.00             | -30.26         | peak   |
| 4   | 626.5500           | 28.43             | -5.19                   | 23.24              | 46.00             | -22.76         | peak   |
| 5   | 764.2900           | 31.52             | -2.24                   | 29.28              | 46.00             | -16.72         | peak   |
| 6   | 983.5100           | 29.22             | 2.46                    | 31.68              | 54.00             | -22.32         | peak   |

## Remark:

1. Margin = Result (Result =Reading + Factor )–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain





Above 1G Radiation Spurious

## 903.30MHz

## PK

| Frequency | Meter Reading  | Detector   | Amplifier | Loss | Antenna Factor | Orrected Factor | Corrected Amplitude | FCC Part 15.249/15.209/205 |        | RX Antenna Polar |
|-----------|----------------|------------|-----------|------|----------------|-----------------|---------------------|----------------------------|--------|------------------|
|           |                |            |           |      |                |                 |                     | Limit                      | Margin |                  |
| (MHz)     | (dB $\mu$ V/m) | (PK/QP/AV) | (dB)      | (dB) | (dB/m)         | (dB)            | (dB $\mu$ V/m)      | (dB $\mu$ V/m)             | (dB)   | (H/V)            |
| 1804.64   | 68.92          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 53.73               | 74                         | -20.27 | H                |
| 1804.64   | 67.98          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 52.79               | 74                         | -21.21 | V                |
| 2706.86   | 59.41          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 46.14               | 74                         | -27.86 | H                |
| 2706.86   | 57.73          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 44.46               | 74                         | -29.54 | V                |
| 3609.35   | 41.78          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 38.10               | 74                         | -35.90 | H                |
| 3609.35   | 41.75          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 38.07               | 74                         | -35.93 | V                |

## 915.20MHz

## PK

| Frequency | Meter Reading  | Detector   | Amplifier | Loss | Antenna Factor | Orrected Factor | Corrected Amplitude | FCC Part 15.249/15.209/205 |        | RX Antenna Polar |
|-----------|----------------|------------|-----------|------|----------------|-----------------|---------------------|----------------------------|--------|------------------|
|           |                |            |           |      |                |                 |                     | Limit                      | Margin |                  |
| (MHz)     | (dB $\mu$ V/m) | (PK/QP/AV) | (dB)      | (dB) | (dB/m)         | (dB)            | (dB $\mu$ V/m)      | (dB $\mu$ V/m)             | (dB)   | (H/V)            |
| 1830.31   | 68.74          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 53.55               | 74                         | -20.45 | H                |
| 1830.31   | 68.13          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 52.94               | 74                         | -21.06 | V                |
| 2745.82   | 59.14          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 45.87               | 74                         | -28.13 | H                |
| 2745.82   | 57.58          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 44.31               | 74                         | -29.69 | V                |
| 3660.86   | 41.57          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 37.89               | 74                         | -36.11 | H                |
| 3660.86   | 41.94          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 38.26               | 74                         | -35.74 | V                |

## 926.80MHz

## PK

| Frequency | Meter Reading  | Detector   | Amplifier | Loss | Antenna Factor | Orrected Factor | Corrected Amplitude | FCC Part 15.249/15.209/205 |        | RX Antenna Polar |
|-----------|----------------|------------|-----------|------|----------------|-----------------|---------------------|----------------------------|--------|------------------|
|           |                |            |           |      |                |                 |                     | Limit                      | Margin |                  |
| (MHz)     | (dB $\mu$ V/m) | (PK/QP/AV) | (dB)      | (dB) | (dB/m)         | (dB)            | (dB $\mu$ V/m)      | (dB $\mu$ V/m)             | (dB)   | (H/V)            |
| 1855.70   | 68.57          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 53.38               | 74                         | -20.62 | H                |
| 1855.70   | 67.80          | PK         | 45.10     | 4.91 | 25.00          | -15.19          | 52.61               | 74                         | -21.39 | V                |
| 2783.58   | 59.05          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 45.78               | 74                         | -28.22 | H                |
| 2783.58   | 57.54          | PK         | 44.10     | 5.03 | 25.80          | -13.27          | 44.27               | 74                         | -29.73 | V                |
| 3711.30   | 41.62          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 37.94               | 74                         | -36.06 | H                |
| 3711.30   | 41.76          | PK         | 43.80     | 6.72 | 33.40          | -3.68           | 38.08               | 74                         | -35.92 | V                |

Note: The peak value is less than the AV limit, so AV data does not need to be tested.



## Duty cycle



| Ton ( ms ) | Tp ( ms ) | Duty Factor |
|------------|-----------|-------------|
| 104        | 1000      | -19.66      |

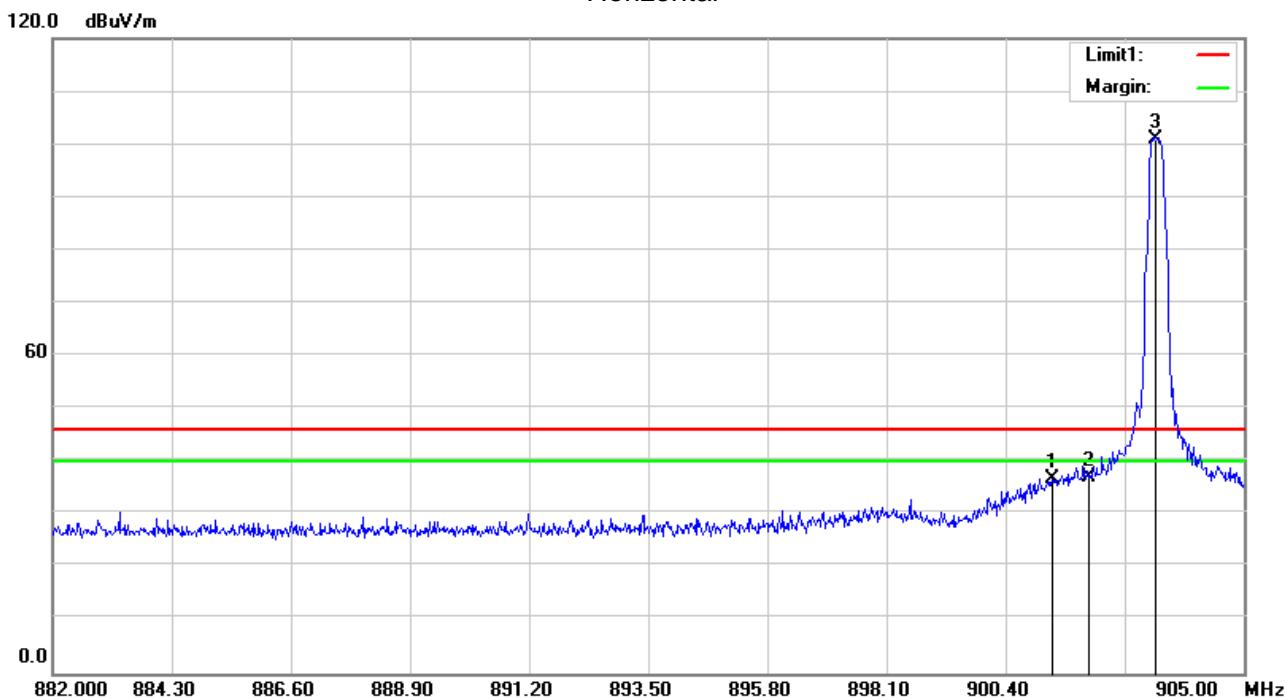
Note: Duty Factor=20\*LOG10 (Ton/Tp)



(Radiation Band edge)

## Low channel

Horizontal



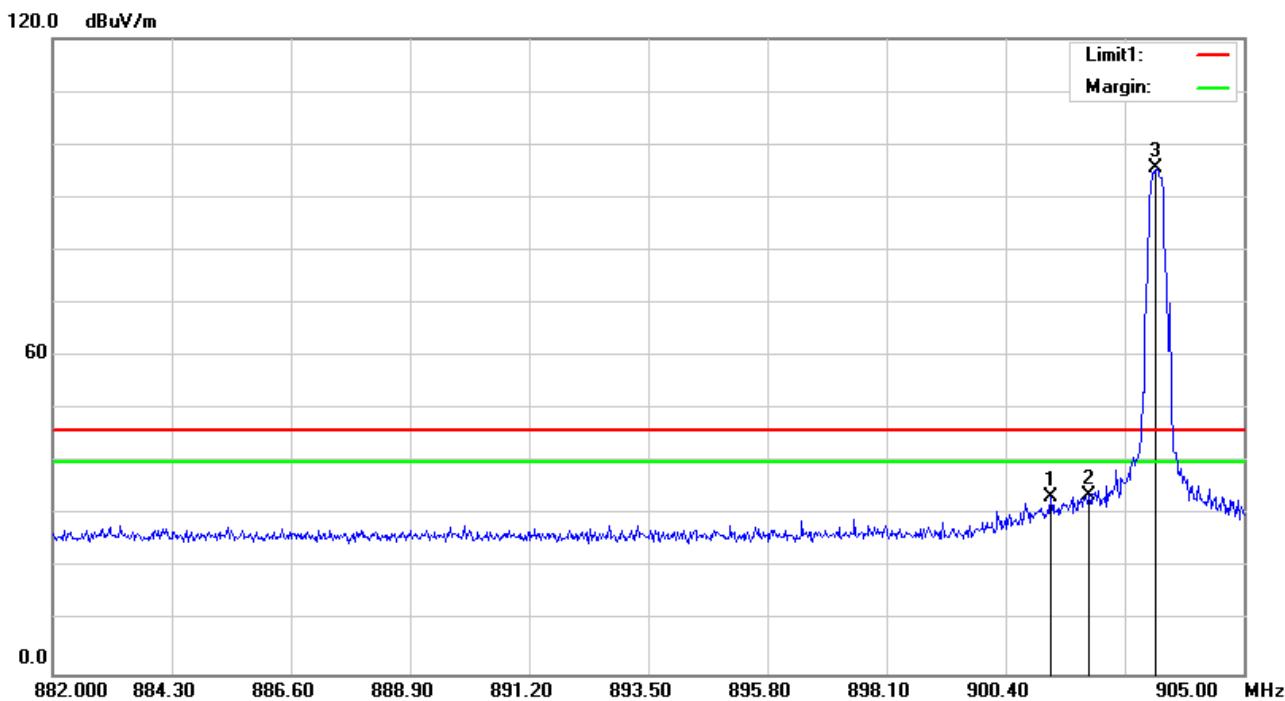
| No. | Frequency | Reading | Correct      | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 1   | 901.2970  | 37.26   | -0.41        | 36.85    | 46.00    | -9.15  | peak   |
| 2   | 902.0000  | 37.40   | -0.40        | 37.00    | 46.00    | -9.00  | peak   |

## Fundamental Frequency

| No. | Frequency | Reading | Correct      | Duty cycle   | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 3   | 903.3000  | 101.38  | -0.37        | -            | 101.01   | 114      | -12.99 | peak   |
| 4   | 903.3000  | 101.38  | -0.37        | -19.66       | 81.35    | 94       | -12.65 | AVG    |



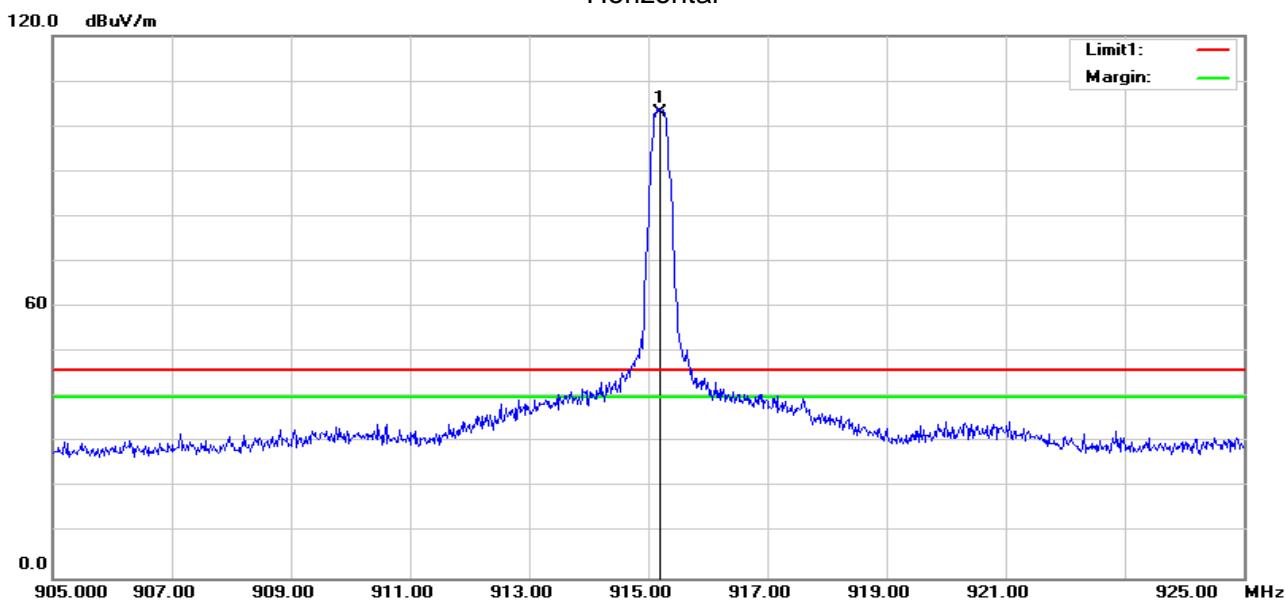
Vertical



| No. | Frequency | Reading | Correct      | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 1   | 901.2740  | 33.96   | -0.41        | 33.55    | 46.00    | -12.45 | peak   |
| 2   | 902.0000  | 34.23   | -0.40        | 33.83    | 46.00    | -12.17 | peak   |

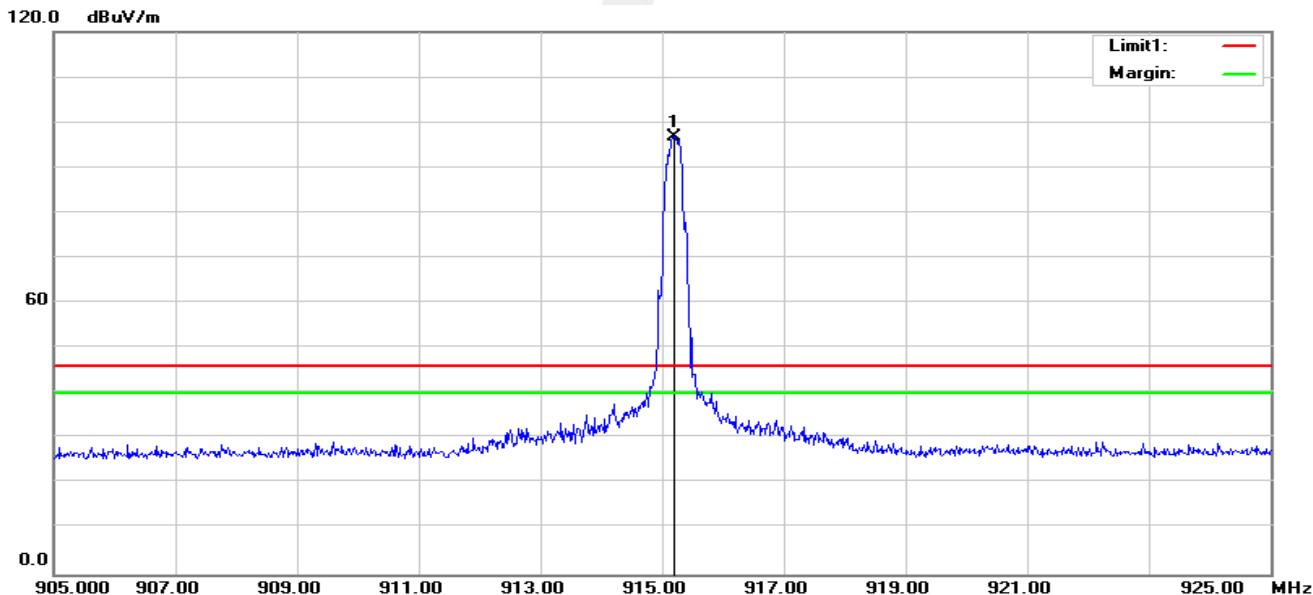
#### Fundamental Frequency

| No. | Frequency | Reading | Correct      | Duty cycle   | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 3   | 903.3000  | 95.91   | -0.37        | -            | 95.54    | 114      | -18.46 | peak   |
| 4   | 903.3000  | 95.91   | -0.37        | -19.66       | 75.88    | 94       | -18.12 | AVG    |

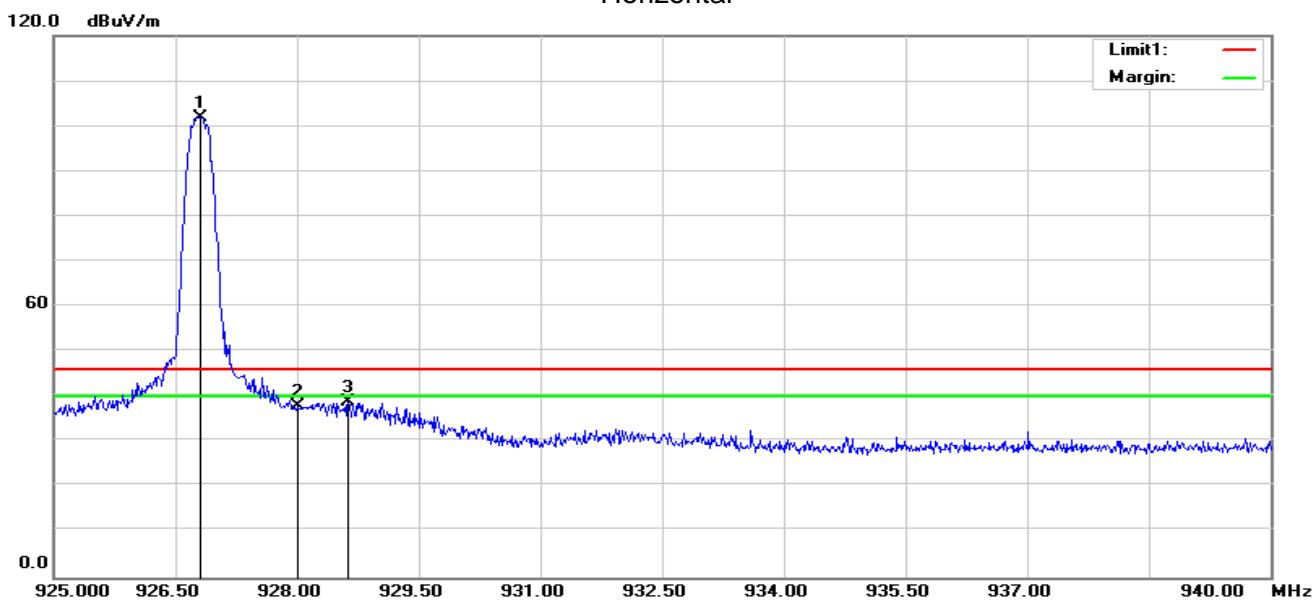
**Mid channel**  
Horizontal

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Duty cycle Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|----------------------|-------------------------|-----------------|----------------|-------------|--------|
| 1   | 915.2000        | 103.28         | -0.10                | -                       | 103.18          | 114            | -10.82      | peak   |
| 2   | 915.2000        | 103.28         | -0.10                | -19.66                  | 83.52           | 94             | -10.48      | AVG    |

## Vertical



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Duty cycle Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|----------------------|-------------------------|-----------------|----------------|-------------|--------|
| 1   | 915.2000        | 96.78          | -0.10                | -                       | 96.68           | 114            | -17.32      | peak   |
| 2   | 915.2000        | 96.78          | -0.10                | -19.66                  | 77.02           | 94             | -16.98      | AVG    |

**High channel**  
Horizontal

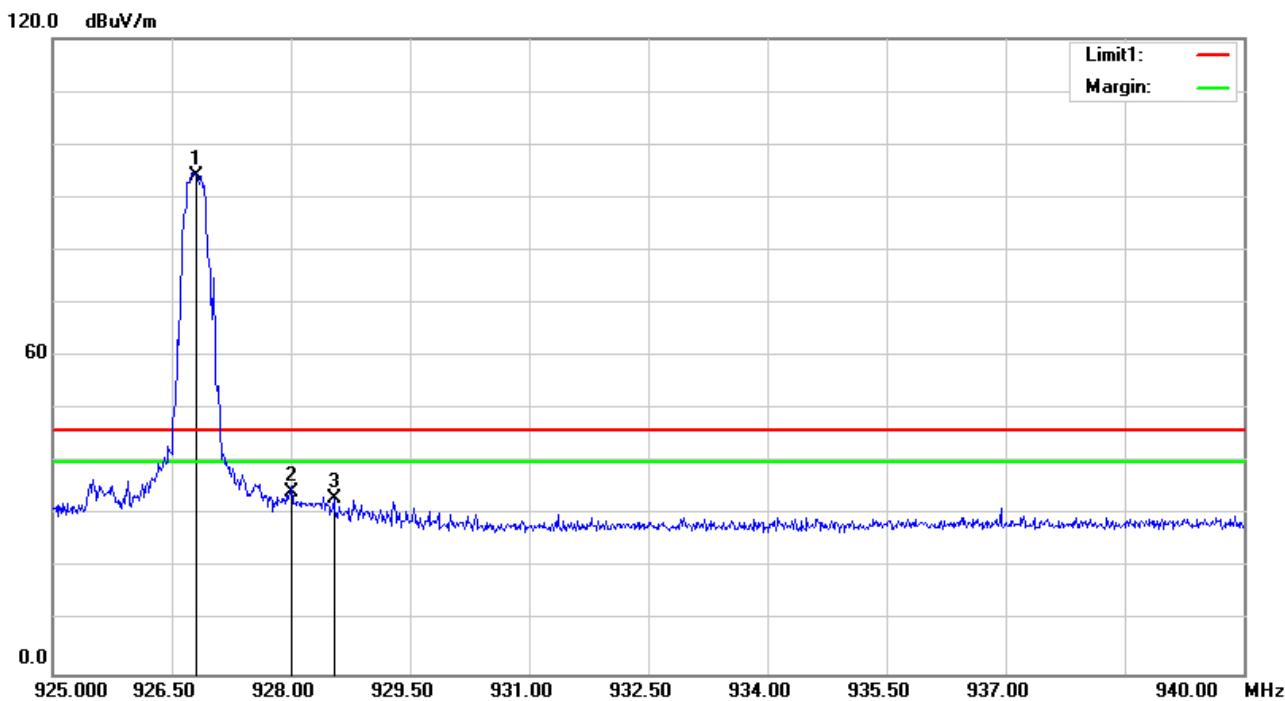
| No. | Frequency | Reading | Correct      | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 2   | 928.0000  | 37.45   | 0.43         | 37.88    | 46.00    | -8.12  | peak   |
| 3   | 928.6300  | 38.30   | 0.46         | 38.76    | 46.00    | -7.24  | peak   |

**Fundamental Frequency**

| No. | Frequency | Reading | Correct      | Duty cycle   | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 1   | 926.8000  | 101.60  | 0.36         | -            | 101.96   | 114      | -12.04 | peak   |
| 4   | 926.8000  | 101.60  | 0.36         | -19.66       | 82.3     | 94       | -11.7  | AVG    |



Vertical



| No. | Frequency | Reading | Correct      | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 2   | 928.0000  | 33.83   | 0.43         | 34.26    | 46.00    | -11.74 | peak   |
| 3   | 928.5400  | 32.71   | 0.46         | 33.17    | 46.00    | -12.83 | peak   |

#### Fundamental Frequency

| No. | Frequency | Reading | Correct      | Duty cycle   | Result   | Limit    | Margin | Remark |
|-----|-----------|---------|--------------|--------------|----------|----------|--------|--------|
|     | (MHz)     | (dBuV)  | Factor(dB/m) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB)   |        |
| 1   | 926.8000  | 93.77   | 0.36         | -            | 94.13    | 114      | -19.87 | peak   |
| 4   | 926.8000  | 93.77   | 0.36         | -19.66       | 74.47    | 94       | -19.53 | AVG    |

Note: AV result=Reading+Correct Factor+Duty cycle Factor

## 4. BANDWIDTH TEST

### 4.1 TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting : RBW= 1% to 5% OBW,  $VBW \geq RBW$ , Sweep time = Auto.

### 4.2 TEST SETUP



### 4.3 EUT OPERATION CONDITIONS

TX mode.

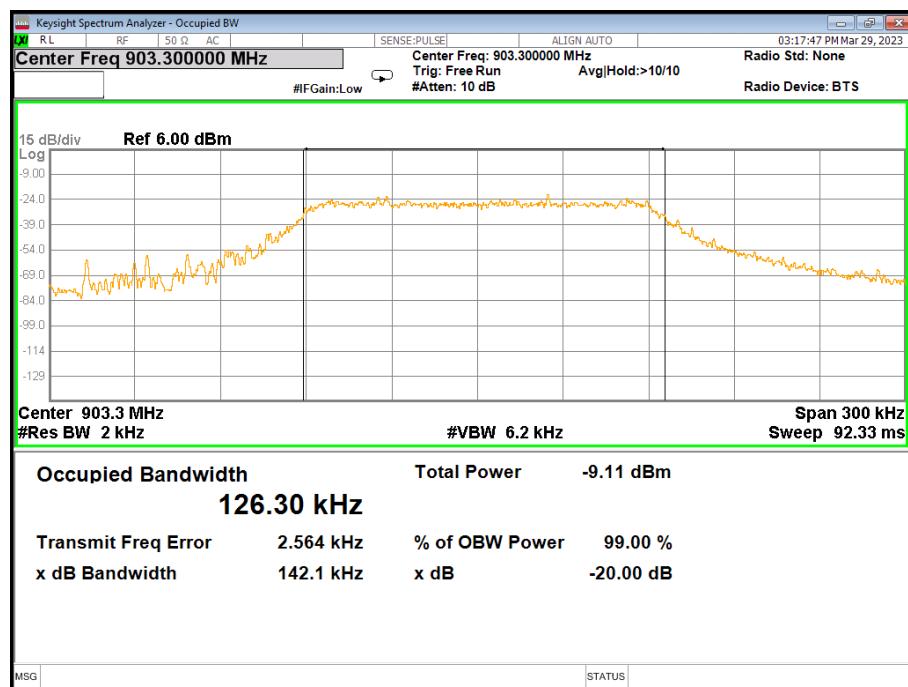


#### 4.4 TEST RESULTS

|               |         |                    |     |
|---------------|---------|--------------------|-----|
| Temperature:  | 25 °C   | Relative Humidity: | 50% |
| Test Voltage: | DC 3.6V |                    |     |

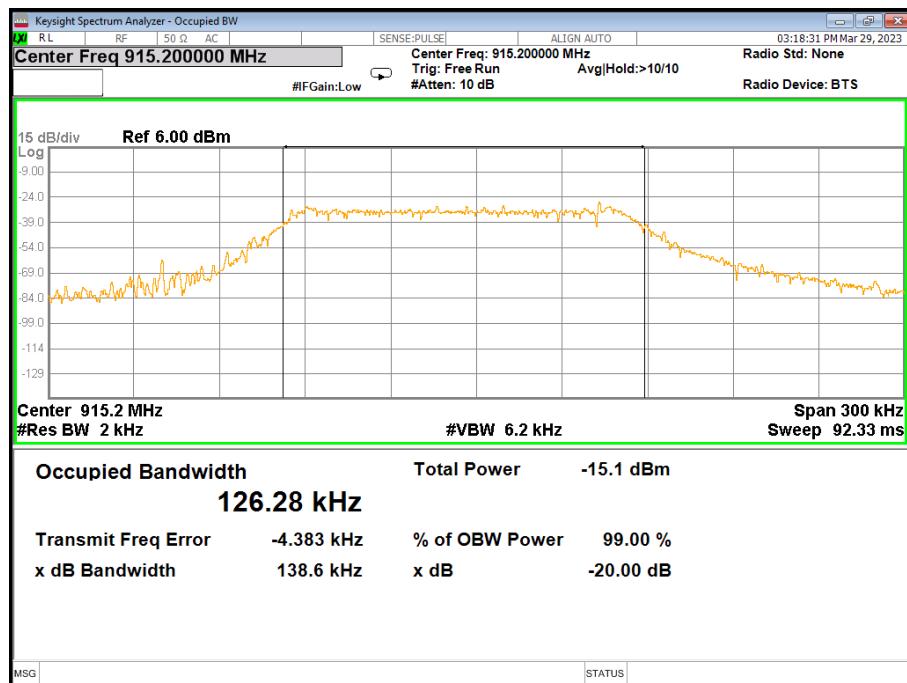
| Test Channel | Frequency(MHz) | 20 dB Bandwidth(KHz) | 99% Bandwidth(KHz) |
|--------------|----------------|----------------------|--------------------|
| CH01         | 903.3          | 142.1                | 126.30             |
| CH41         | 915.2          | 138.6                | 126.28             |
| CH79         | 926.8          | 136.6                | 125.90             |

#### Low Channel

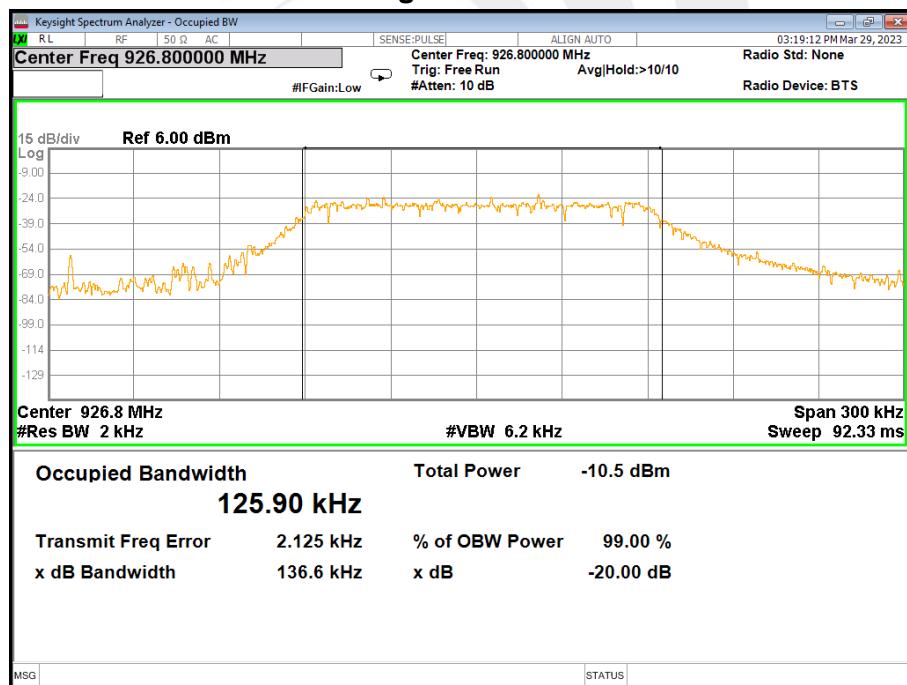




### Mid Channel



### High Channel





## 5. ANTENNA REQUIREMENT

### 5.1 STANDARD REQUIREMENT

According to the FCC Part 15 Paragraph 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.

### 5.2 EUT ANTENNA

The EUT antenna is Helical Antenna. It conforms to the standard requirements.





## APPENDIX- PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

\*\*\*\*\*END OF THE REPORT\*\*\*\*\*

