



## Test Report

Date : 2018-03-15  
No. : HM18010023

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**Applicant:** Gatekeeper Systems (HK) Ltd.  
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay,  
Hong Kong

**Manufacturer:** Gatekeeper Systems (HK) Ltd.  
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay,  
Hong Kong

**Description of Sample(s):** Product: SmartWheel  
Brand Name: Gatekeeper Systems  
Model Number: W-9490  
FCC ID: W3Z-W9490

**Date Sample(s) Received:** 2018-01-11

**Date Tested:** 2018-02-28 to 2018-03-05

**Investigation Requested:** Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10:2013 for FCC Certification.

**Conclusion(s):** The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

**Remark(s):** ---

  
CHEUNG Chi, Kenneth  
Authorized Signatory  
ElectroMagnetic Compatibility Department  
For and on behalf of  
The Hong Kong Standards and Testing Centre Ltd.





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### **1.0 General Details**

#### **1.1 Equipment Under Test [EUT] Description of Sample(s)**

Product: SmartWheel  
Manufacturer: Gatekeeper Systems (HK) Ltd.  
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay, Hong Kong  
Brand Name: Gatekeeper Systems  
Model Number: W-9490  
Rating: CR17450 x 1=3.0Vd.c  
(User is not able to recharge and replace the battery)

#### **1.2 Description of EUT Operation**

The Equipment Under Test (EUT) is SmartWheel (Wheel with remote control lock function) of Gatekeeper Systems (HK) Ltd., which is 2.4GHz transceiver.  
The W-9490 Operational mode transmissions are modulated at FSK (Frequency Shift Keying), with a deviation of 19 kHz (Carson's rule bandwidth about 80 kHz) and MSK (Minimum Shift Keying).  
The EUT was tested under test mode which was set in maximum output power (RF output Power = 0.0 dBm) and transmit continuously.

#### **1.3 Date of Order**

2018-01-11

#### **1.4 Submitted Sample(s):**

2 Samples

#### **1.5 Test Duration**

2018-02-28 to 2018-03-05

#### **1.6 Country of Origin**

China

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### 2.0 Technical Details

#### **2.1 Investigations Requested**

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013 for FCC Certification.

#### **2.2 Test Standards and Results Summary Tables**

| EMISSION<br>Results Summary                               |                  |                  |                     |                                     |                          |
|-----------------------------------------------------------|------------------|------------------|---------------------|-------------------------------------|--------------------------|
| Test Condition                                            | Test Requirement | Test Method      | Class /<br>Severity | Test Result                         |                          |
|                                                           |                  |                  |                     | Pass                                | Fail                     |
| Field Strength of<br>Fundamental &<br>Harmonics Emissions | FCC 47CFR 15.249 | ANSI C63.10:2013 | N/A                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| AC power-line conducted<br>emissions                      | FCC 47CFR 15.207 | ANSI C63.10:2013 | N/A                 | N/A                                 |                          |
| Radiated Emissions                                        | FCC 47CFR 15.209 | ANSI C63.10:2013 | N/A                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Note: N/A - Not Applicable

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### **3.0 Test Results**

#### **3.1 Emission**

##### **3.1.1 Field Strength of Fundamental & Harmonics Emissions**

|                    |                                      |
|--------------------|--------------------------------------|
| Test Requirement:  | FCC 47CFR 15.249                     |
| Test Method:       | ANSI C63.10:2013                     |
| Test Date:         | 2018-02-28                           |
| Mode of Operation: | 1. Tx Mode (FSK)<br>2. Tx Mode (MSK) |

#### **Test Method:**

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber\*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber\*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. In the frequency range of 9kHz to 30MHz, The center of the loop antenna shall be 1 meter above the ground and rotated loop axis for maximum reading. The emissions worst-case are shown in Test Results of the following pages.

Remark: 3 orthogonal axis apply to hand-held device only.

\*: Semi-anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd.  
FCC Test Firm Registration Number 723883  
Designation Number HK0001

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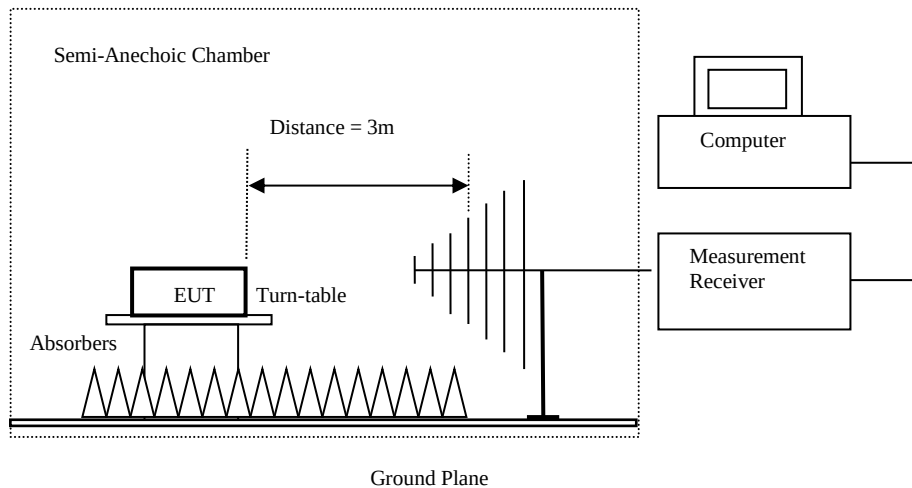
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### **Spectrum Analyzer Setting:**

|                        |                                                  |
|------------------------|--------------------------------------------------|
| 9KHz – 30MHz (Pk & Av) | RBW: 10kHz                                       |
|                        | VBW: 30kHz                                       |
|                        | Sweep: Auto                                      |
|                        | Span: Fully capture the emissions being measured |
|                        | Trace: Max. hold                                 |
| 30MHz – 1GHz (QP)      | RBW: 120kHz                                      |
|                        | VBW: 120kHz                                      |
|                        | Sweep: Auto                                      |
|                        | Span: Fully capture the emissions being measured |
|                        | Trace: Max. hold                                 |
| Above 1GHz (Pk & Av)   | RBW: 3MHz                                        |
|                        | VBW: 3MHz                                        |
|                        | Sweep: Auto                                      |
|                        | Span: Fully capture the emissions being measured |
|                        | Trace: Max. hold                                 |

### **Test Setup:**



Absorbers placed on top of the ground plane are for measurements above 1000MHz only.

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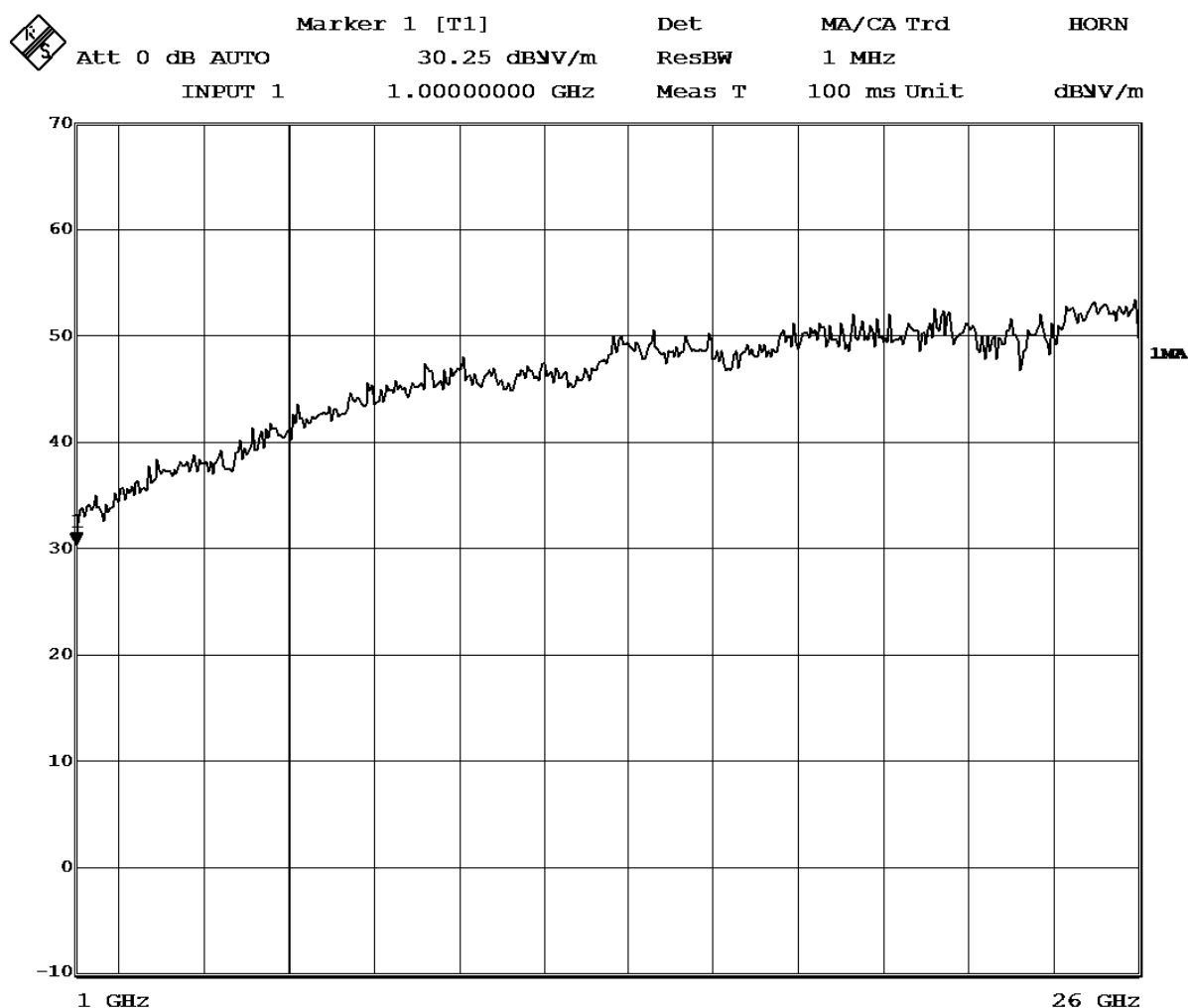
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### Limits for Field Strength of Fundamental & Harmonics Emissions [FCC 47CFR 15.249]:

| Fundamental frequency<br>[MHz] | Field strength of fundamental<br>(millivolts/meter) | Field strength of harmonics<br>(microvolts/meter) |
|--------------------------------|-----------------------------------------------------|---------------------------------------------------|
| 902-928 MHz                    | 50                                                  | 500                                               |
| 2400-2483.5 MHz                | 50                                                  | 500                                               |
| 5725-5875 MHz                  | 50                                                  | 500                                               |
| 24.0-24.25 GHz                 | 250                                                 | 2500                                              |

### Result of TX mode (FSK) (Lowest Channel), (Above 1GHz): Pass



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**Result of TX mode (FSK) (Lowest Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2402.0                                                | 56.7                                                           | 27.9                           | 84.6                        | 16,982.4                  | 500,000           | Vertical            |
| * 4804.0                                              | 12.4                                                           | 32.1                           | 44.5                        | 167.9                     | 5,000             | Vertical            |
| 7206.0                                                | 2.7                                                            | 38.6                           | 41.3                        | 116.1                     | 5,000             | Vertical            |
| 9608.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 5,000             | Vertical            |
| * 12010.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 14412.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 16814.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| * 19216.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 21618.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 24020.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2402.0                                                | 45.2                                                           | 27.9                           | 73.1                        | 4,518.6                   | 50,000            | Vertical            |
| * 4804.0                                              | 1.9                                                            | 32.1                           | 34.0                        | 50.1                      | 500               | Vertical            |
| 7206.0                                                | -1.7                                                           | 38.6                           | 36.9                        | 70.0                      | 500               | Vertical            |
| 9608.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 500               | Vertical            |
| * 12010.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 14412.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 16814.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| * 19216.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 21618.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 24020.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

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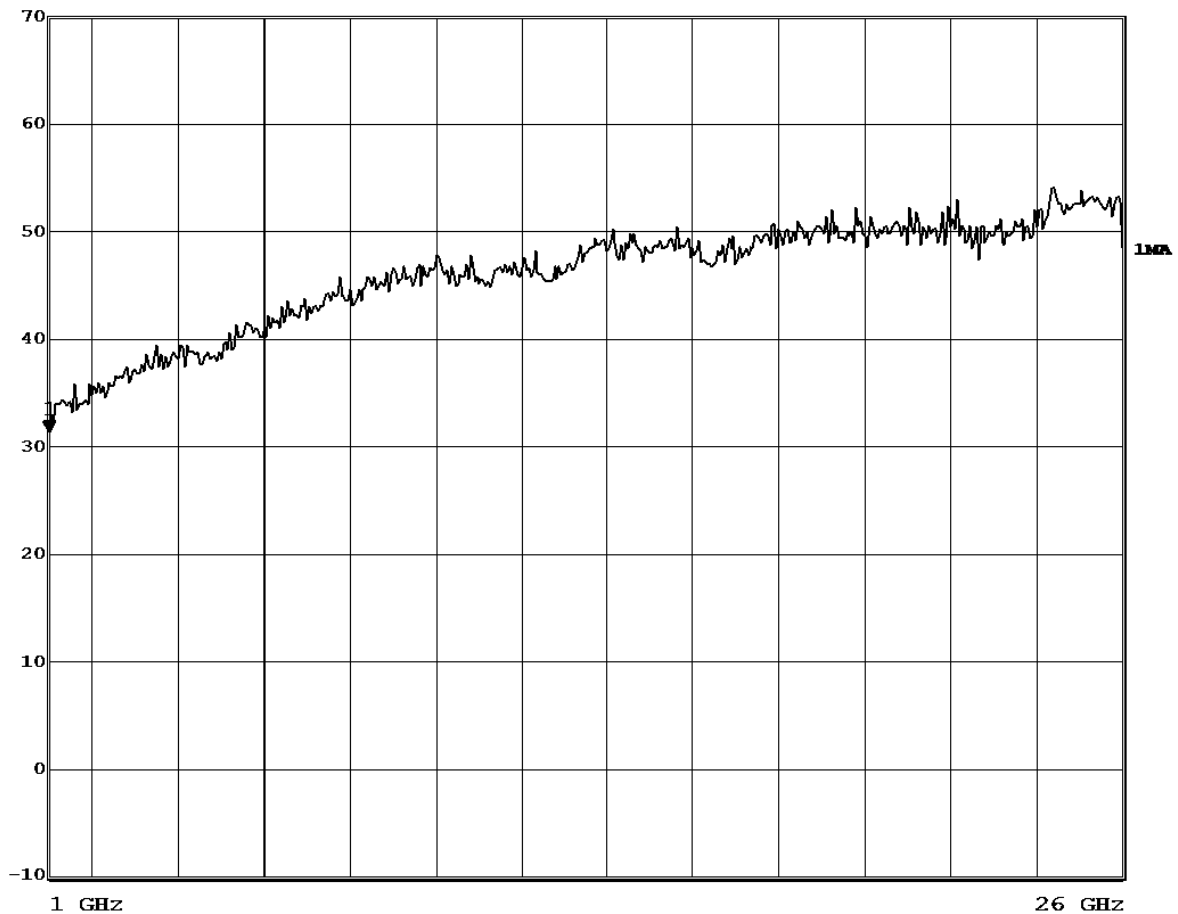
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Result of TX mode (FSK) (Middle Channel), (Above 1GHz): Pass



|               |                |        |             |       |
|---------------|----------------|--------|-------------|-------|
| Att 0 dB AUTO | Marker 1 [T1]  | Det    | MA/CA Trd   | HORN  |
|               | 31.37 dBV/m    | ResBW  | 1 MHz       |       |
| INPUT 1       | 1.00000000 GHz | Meas T | 100 ms Unit | dBV/m |



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**Result of TX mode (FSK) (Middle Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2440.0                                                | 56.1                                                           | 27.9                           | 84.0                        | 15,848.9                  | 500,000           | Vertical            |
| * 4880.0                                              | 8.7                                                            | 32.1                           | 40.8                        | 109.6                     | 5,000             | Vertical            |
| * 7320.0                                              | 2.3                                                            | 38.6                           | 40.9                        | 110.9                     | 5,000             | Vertical            |
| 9760.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 5,000             | Vertical            |
| * 12200.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 14640.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 17080.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| * 19520.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 21960.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 24400.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2440.0                                                | 45.1                                                           | 27.9                           | 73.0                        | 4,466.8                   | 50,000            | Vertical            |
| * 4880.0                                              | 1.9                                                            | 32.1                           | 34.0                        | 50.1                      | 500               | Vertical            |
| * 7320.0                                              | -0.7                                                           | 38.6                           | 37.9                        | 78.5                      | 500               | Vertical            |
| 9760.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 500               | Vertical            |
| * 12200.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 14640.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 17080.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| * 19520.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 21960.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 24400.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

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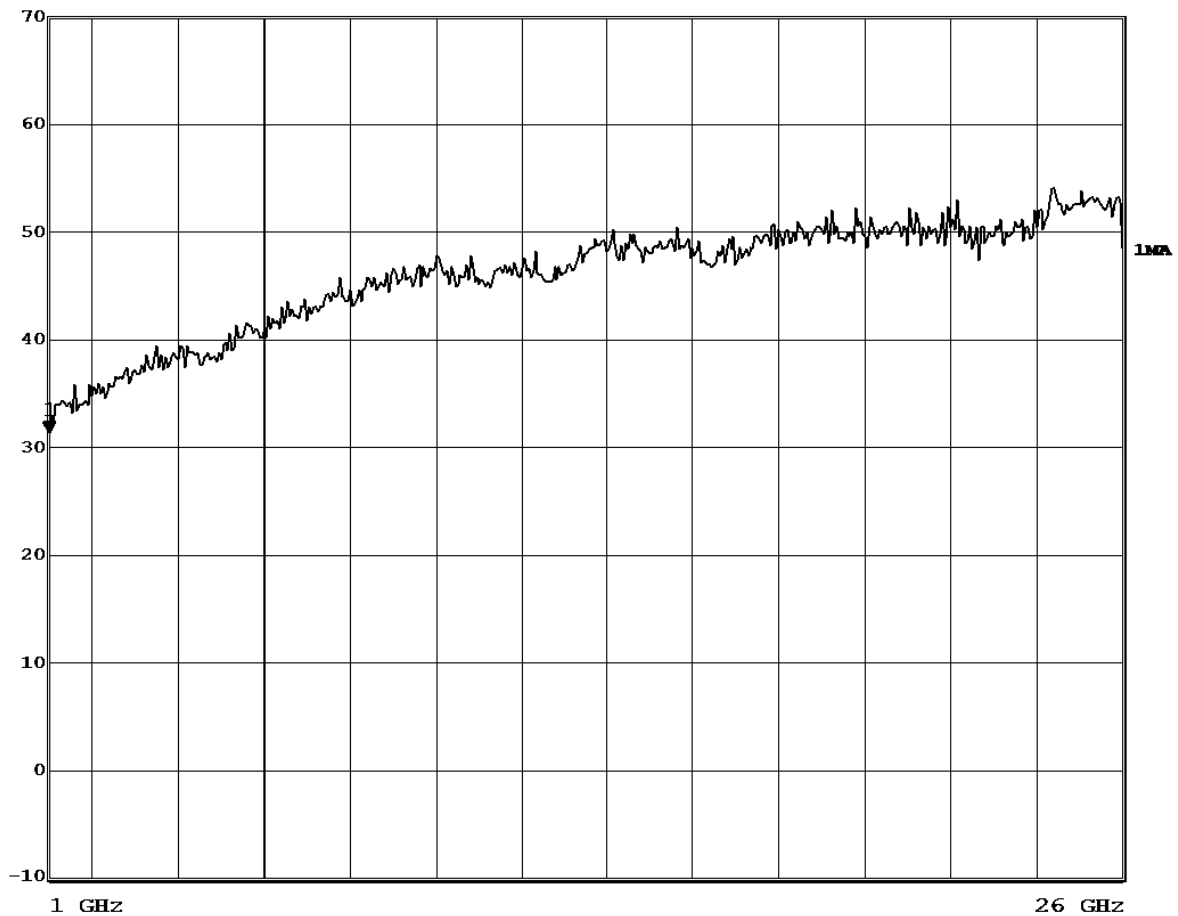
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Result of TX mode (FSK) (Highest Channel), (Above 1GHz): Pass



|               |                |        |             |       |
|---------------|----------------|--------|-------------|-------|
| Att 0 dB AUTO | Marker 1 [T1]  | Det    | MA/CA Trd   | HORN  |
|               | 31.37 dBV/m    | ResBW  | 1 MHz       |       |
| INPUT 1       | 1.00000000 GHz | Meas T | 100 ms Unit | dBV/m |



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**Result of TX mode (FSK) (Highest Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                      |                                   |                                |                        |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------------|-----------------------------------|--------------------------------|------------------------|---------------------|
| Peak Value                                            |                                                                |                                      |                                   |                                |                        |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dB $\mu$ V/m                          | Correction<br>Factor<br>dB $\mu$ V/m | Field<br>Strength<br>dB $\mu$ V/m | Field<br>Strength<br>$\mu$ V/m | Limit @3m<br>$\mu$ V/m | E-Field<br>Polarity |
| 2480.0                                                | 55.8                                                           | 27.9                                 | 83.7                              | 15,310.9                       | 500,000                | Vertical            |
| * 4960.0                                              | 10.8                                                           | 32.1                                 | 42.9                              | 139.6                          | 5,000                  | Vertical            |
| * 7440.0                                              | 2.4                                                            | 38.6                                 | 41.0                              | 112.2                          | 5,000                  | Vertical            |
| 9920.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                      |                                   |                                | 5,000                  | Vertical            |
| * 12400.0                                             |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |
| 14880.0                                               |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |
| 17360.0                                               |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |
| * 19840.0                                             |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |
| 22320.0                                               |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |
| 24800.0                                               |                                                                |                                      |                                   |                                | 5,000                  | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                      |                                   |                                |                        |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------------|-----------------------------------|--------------------------------|------------------------|---------------------|
| Average Value                                         |                                                                |                                      |                                   |                                |                        |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dB $\mu$ V/m                          | Correction<br>Factor<br>dB $\mu$ V/m | Field<br>Strength<br>dB $\mu$ V/m | Field<br>Strength<br>$\mu$ V/m | Limit @3m<br>$\mu$ V/m | E-Field<br>Polarity |
| 2480.0                                                | 35.4                                                           | 27.9                                 | 63.3                              | 1,462.2                        | 50,000                 | Vertical            |
| * 4960.0                                              | 1.1                                                            | 32.1                                 | 33.2                              | 45.7                           | 500                    | Vertical            |
| * 7440.0                                              | -0.4                                                           | 38.6                                 | 38.2                              | 81.3                           | 500                    | Vertical            |
| 9920.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                      |                                   |                                | 500                    | Vertical            |
| * 12400.0                                             |                                                                |                                      |                                   |                                | 500                    | Vertical            |
| 14880.0                                               |                                                                |                                      |                                   |                                | 500                    | Vertical            |
| 17360.0                                               |                                                                |                                      |                                   |                                | 500                    | Vertical            |
| * 19840.0                                             |                                                                |                                      |                                   |                                | 500                    | Vertical            |
| 22320.0                                               |                                                                |                                      |                                   |                                | 500                    | Vertical            |
| 24800.0                                               |                                                                |                                      |                                   |                                | 500                    | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

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## Test Report

Date : 2018-03-15  
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Result of TX mode (MSK) (Lowest Channel), (Above 1GHz): Pass



Att 0 dB AUTO

INPUT 1

Det

MA/CA Trd

HORN

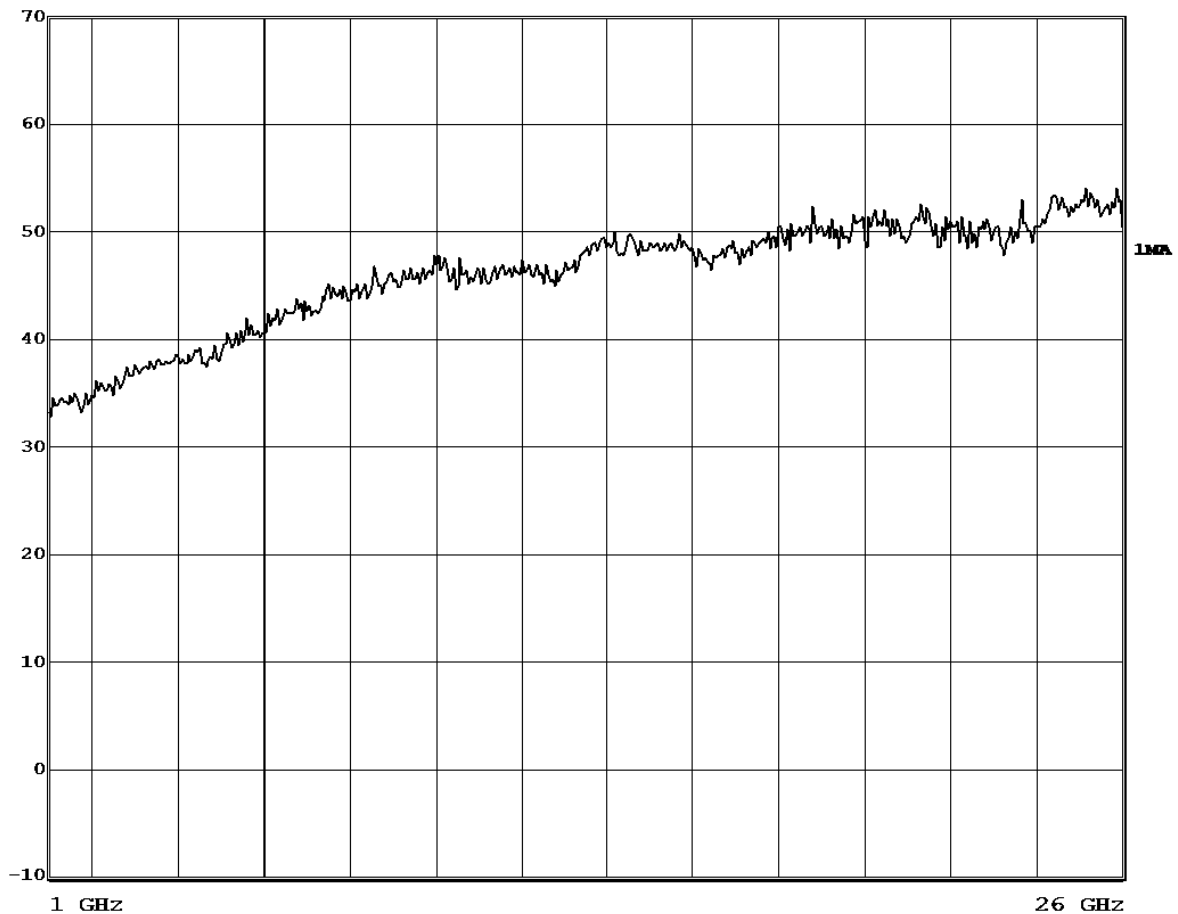
ResBW

1 MHz

Meas T

100 ms Unit

dBV/m



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## Test Report

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**Result of TX mode (MSK) (Lowest Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2401.0                                                | 57.9                                                           | 27.9                           | 85.8                        | 19,498.4                  | 500,000           | Vertical            |
| * 4802.0                                              | 11.2                                                           | 32.1                           | 43.3                        | 146.2                     | 5,000             | Vertical            |
| 7203.0                                                | 2.7                                                            | 38.6                           | 41.3                        | 116.1                     | 5,000             | Vertical            |
| 9604.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 5,000             | Vertical            |
| * 12005.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 14406.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 16807.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| * 19208.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 21609.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 24010.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2401.0                                                | 45.8                                                           | 27.9                           | 73.7                        | 4,841.7                   | 50,000            | Vertical            |
| * 4802.0                                              | 1.9                                                            | 32.1                           | 34.0                        | 50.1                      | 500               | Vertical            |
| 7203.0                                                | -1.3                                                           | 38.6                           | 37.3                        | 73.3                      | 500               | Vertical            |
| 9604.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 500               | Vertical            |
| * 12005.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 14406.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 16807.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| * 19208.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 21609.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 24010.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

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## Test Report

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Result of TX mode (MSK) (Middle Channel), (Above 1GHz): Pass



Att 0 dB AUTO

INPUT 1

Det

MA/CA Trd

HORN

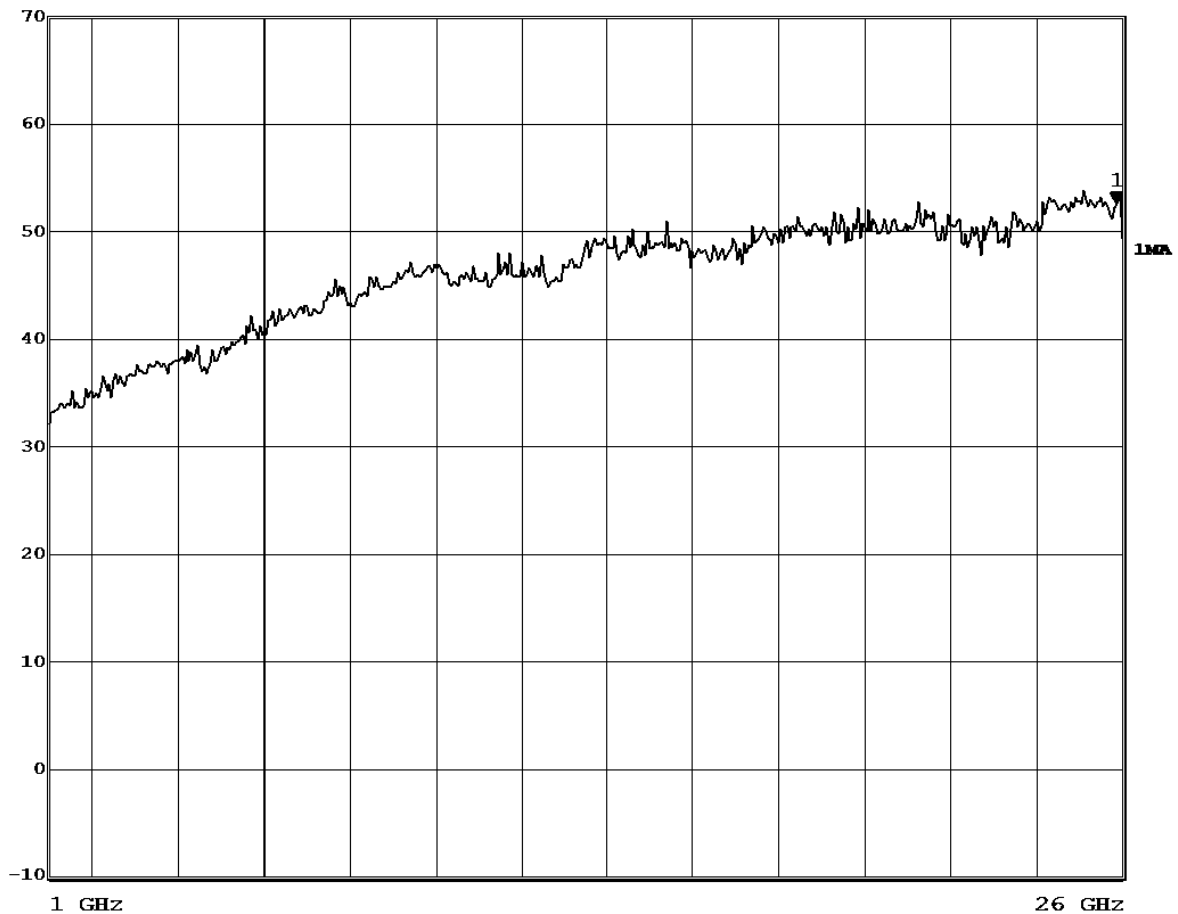
ResBW

1 MHz

Meas T

100 ms Unit

dBμV/m



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**Result of TX mode (MSK) (Middle Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2442.0                                                | 57.8                                                           | 27.9                           | 85.7                        | 19,275.2                  | 500,000           | Vertical            |
| * 4884.0                                              | 10.8                                                           | 32.1                           | 42.9                        | 139.6                     | 5,000             | Vertical            |
| * 7326.0                                              | 2.2                                                            | 38.6                           | 40.8                        | 109.6                     | 5,000             | Vertical            |
| 9768.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 5,000             | Vertical            |
| * 12210.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 14652.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 17094.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| * 19536.0                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 21978.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 24420.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2442.0                                                | 38.4                                                           | 27.9                           | 66.3                        | 2,065.4                   | 50,000            | Vertical            |
| * 4884.0                                              | 2.3                                                            | 32.1                           | 34.4                        | 52.5                      | 500               | Vertical            |
| * 7326.0                                              | -1.2                                                           | 38.6                           | 37.4                        | 74.1                      | 500               | Vertical            |
| 9768.0                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 500               | Vertical            |
| * 12210.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 14652.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 17094.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| * 19536.0                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 21978.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 24420.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.



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Result of TX mode (MSK) (Highest Channel), (Above 1GHz): Pass



Att 0 dB AUTO

INPUT 1

Det

MA/CA Trd

HORN

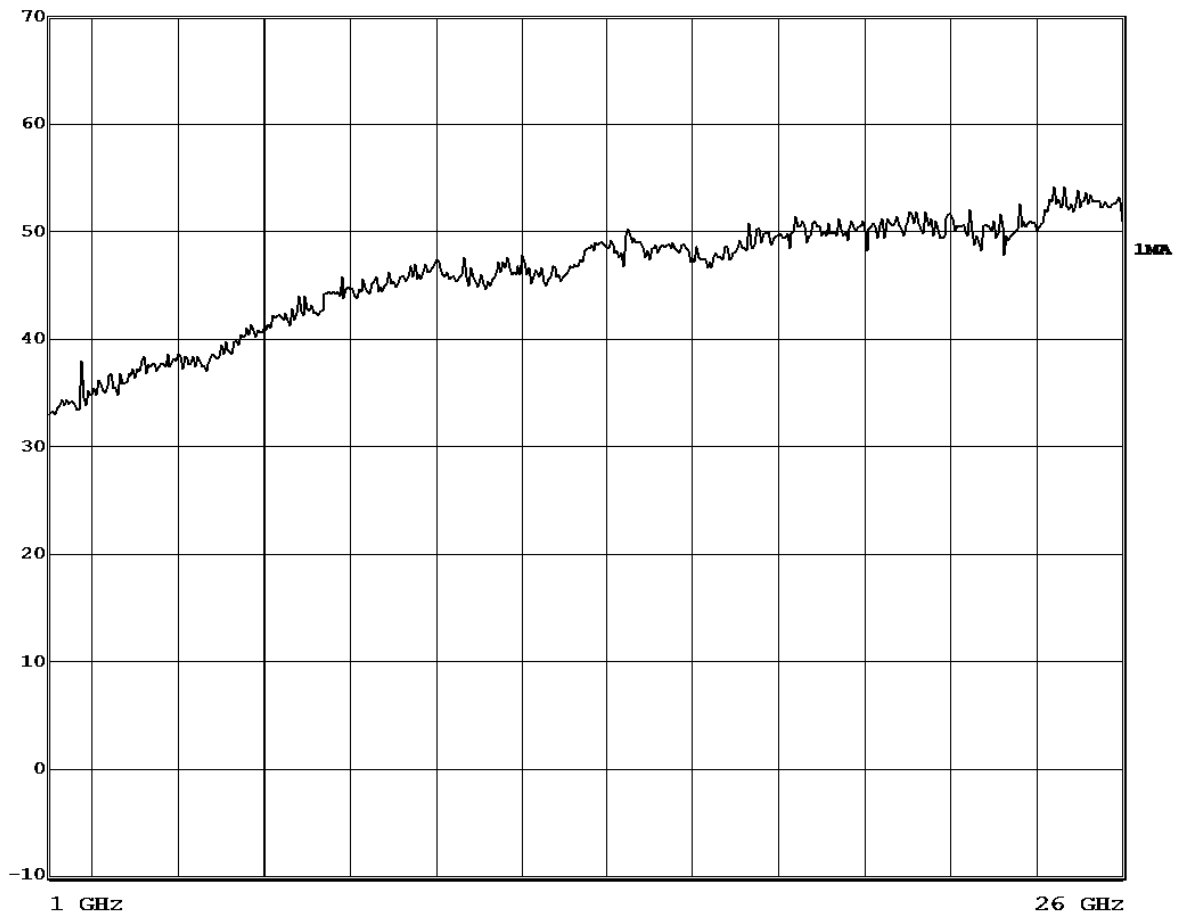
ResBW

1 MHz

Meas T

100 ms Unit

dBV/m



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**Result of TX mode (MSK) (Highest Channel), (Above 1GHz): Pass**

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2481.1                                                | 57.6                                                           | 27.9                           | 85.5                        | 18,836.5                  | 500,000           | Vertical            |
| * 4962.2                                              | 11.4                                                           | 32.1                           | 43.5                        | 149.6                     | 5,000             | Vertical            |
| * 7443.3                                              | 2.4                                                            | 38.6                           | 41.0                        | 112.2                     | 5,000             | Vertical            |
| 9924.4                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 5,000             | Vertical            |
| * 12405.5                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 14886.6                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 17367.7                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| * 19848.8                                             |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 22329.9                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |
| 24811.0                                               |                                                                |                                |                             |                           | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                                                |                                |                             |                           |                   |                     |
|-------------------------------------------------------|----------------------------------------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                                                |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m                                | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2481.1                                                | 46.8                                                           | 27.9                           | 74.7                        | 5,432.5                   | 50,000            | Vertical            |
| * 4962.2                                              | 1.7                                                            | 32.1                           | 33.8                        | 49.0                      | 500               | Vertical            |
| * 7443.3                                              | -0.9                                                           | 38.6                           | 37.7                        | 76.7                      | 500               | Vertical            |
| 9924.4                                                | Emissions detected are more than<br>20 dB below the FCC Limits |                                |                             |                           | 500               | Vertical            |
| * 12405.5                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 14886.6                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 17367.7                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| * 19848.8                                             |                                                                |                                |                             |                           | 500               | Vertical            |
| 22329.9                                               |                                                                |                                |                             |                           | 500               | Vertical            |
| 24811.0                                               |                                                                |                                |                             |                           | 500               | Vertical            |

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

\*: Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Calculated measurement uncertainty : 9kHz to 30MHz 2.4dB  
30MHz to 18GHz 5.0dB  
18GHz – 26.5Hz: 5.24dB

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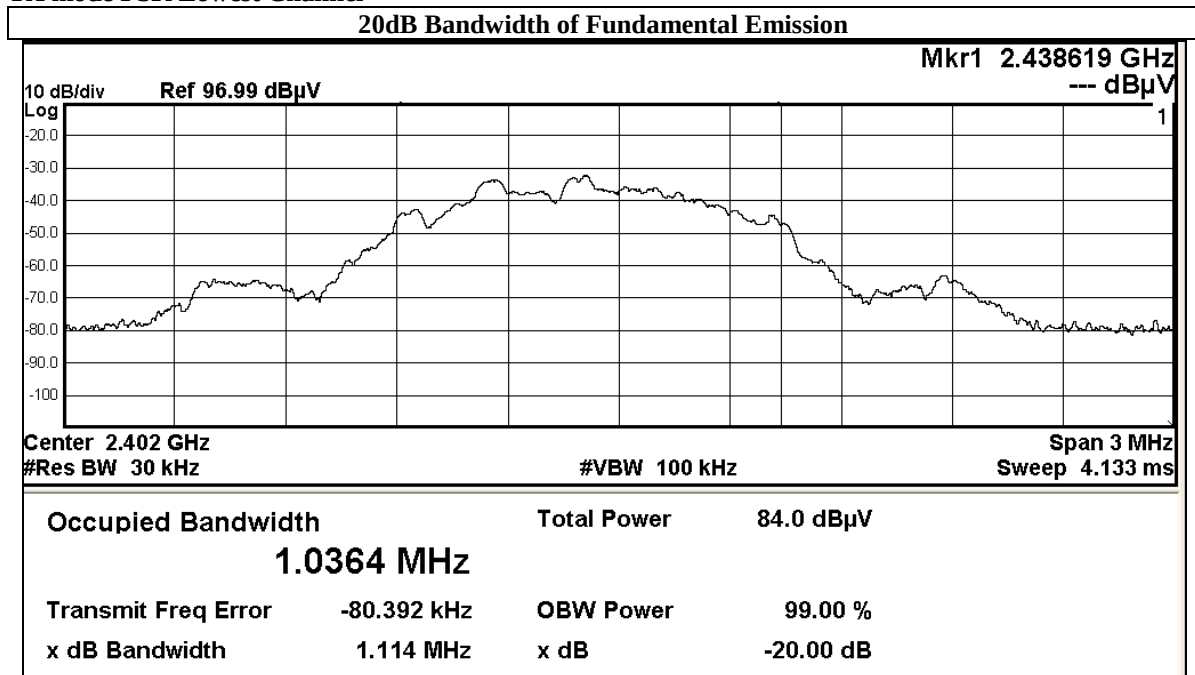
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**Limits for 20dB Bandwidth of Fundamental Emission:**

| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
|--------------------------|-------------------------|
| 2402.0                   | 1.11                    |

**TX mode FSK Lowest Channel**



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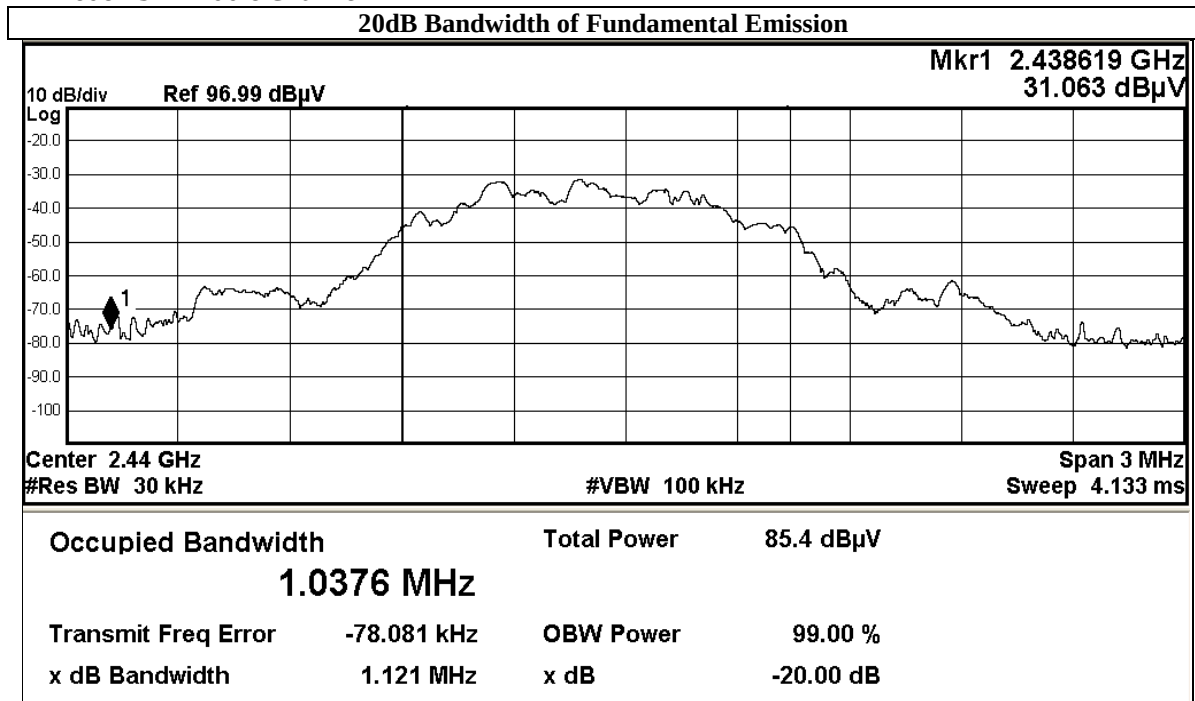
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|                          |                         |
|--------------------------|-------------------------|
| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
| 2440.0                   | 1.12                    |

### TX mode FSK Middle Channel



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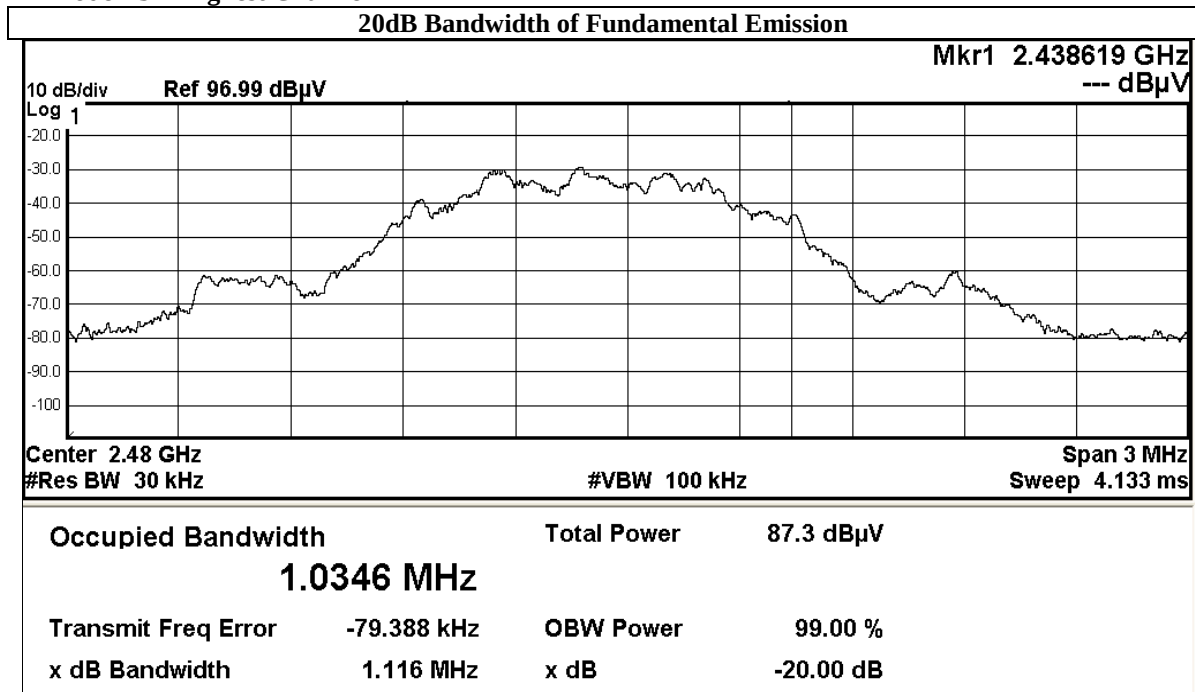
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|                          |                         |
|--------------------------|-------------------------|
| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
| 2480.0                   | 1.12                    |

### TX mode FSK Highest Channel



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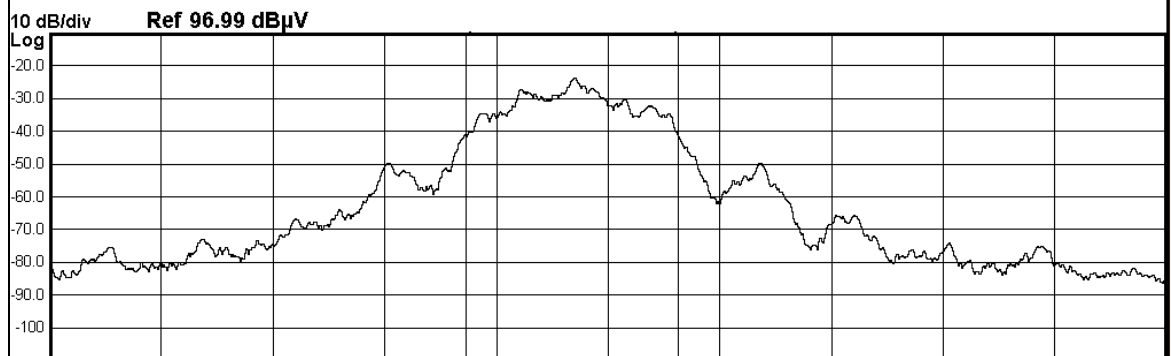
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| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
|--------------------------|-------------------------|
| 2401.0                   | 0.600                   |

TX mode MSK Lowest Channel

### 20dB Bandwidth of Fundamental Emission



Center 2.401 GHz

#Res BW 30 kHz

#VBW 100 kHz

Span 3 MHz

Sweep 4.133 ms

Occupied Bandwidth

566.27 kHz

Total Power

89.2 dBμV

Transmit Freq Error

-96.552 kHz

OBW Power

99.00 %

x dB Bandwidth

600.2 kHz

x dB

-20.00 dB

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## Test Report

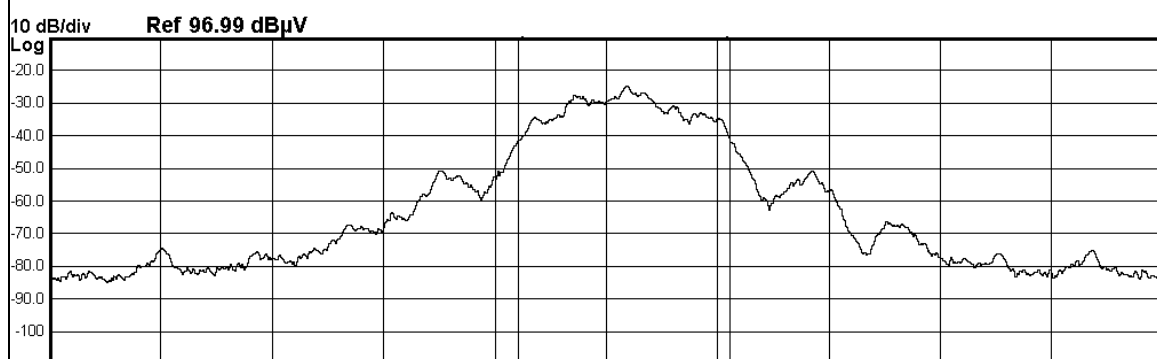
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| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
|--------------------------|-------------------------|
| 2442.0                   | 0.604                   |

TX mode MSK Middle Channel

### 20dB Bandwidth of Fundamental Emission



Center 2.442 GHz  
#Res BW 30 kHz

#VBW 100 kHz

Span 3 MHz  
Sweep 4.133 ms

|                     |             |           |           |
|---------------------|-------------|-----------|-----------|
| Occupied Bandwidth  | Total Power | 89.0 dBμV |           |
| <b>565.15 kHz</b>   |             |           |           |
| Transmit Freq Error | 50.145 kHz  | OBW Power | 99.00 %   |
| x dB Bandwidth      | 604.5 kHz   | x dB      | -20.00 dB |

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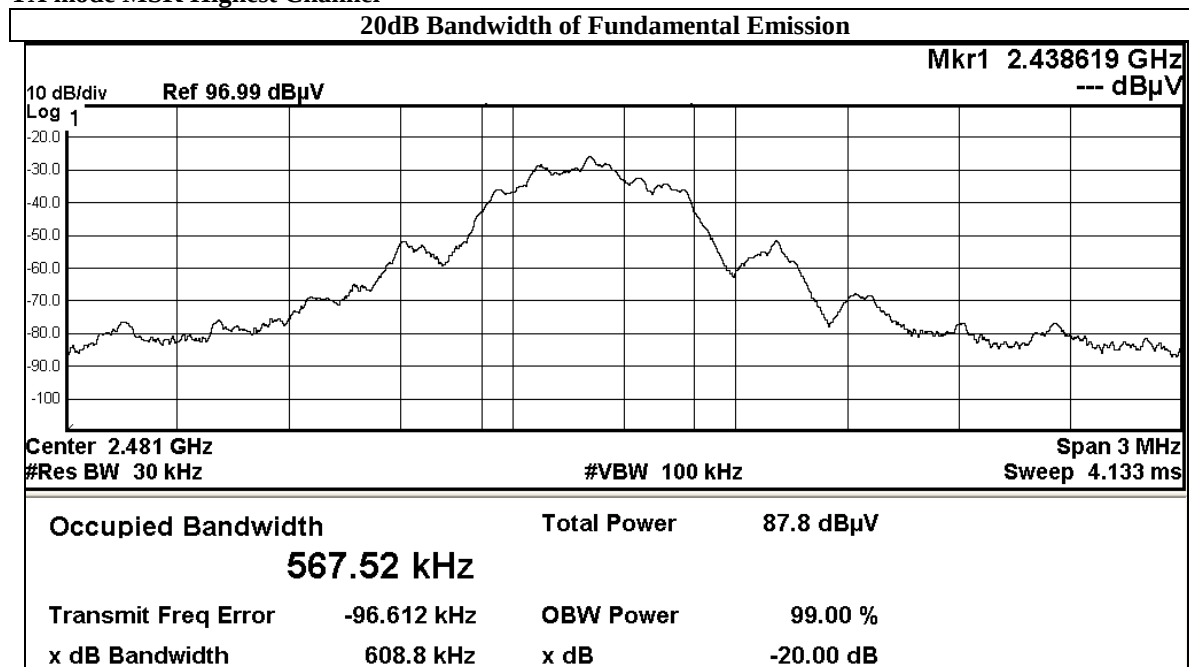
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|                          |                         |
|--------------------------|-------------------------|
| Frequency Range<br>[MHz] | 20dB Bandwidth<br>[MHz] |
| 2481.1                   | 0.609                   |

### TX mode MSK Highest Channel



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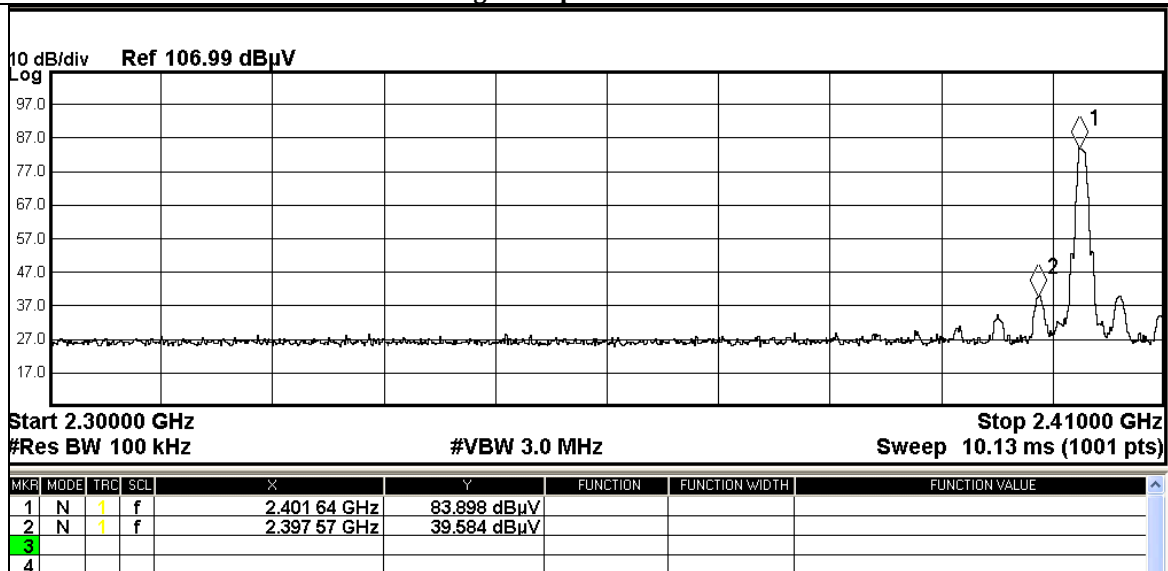
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### Band Edge Measurement:

#### TX mode FSK

| Frequency Range<br>[MHz]     | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|------------------------------|------------------------------------------------------------|
| 2400MHz – Lowest Fundamental | 44.3                                                       |

### Band Edge Compliance Measurement



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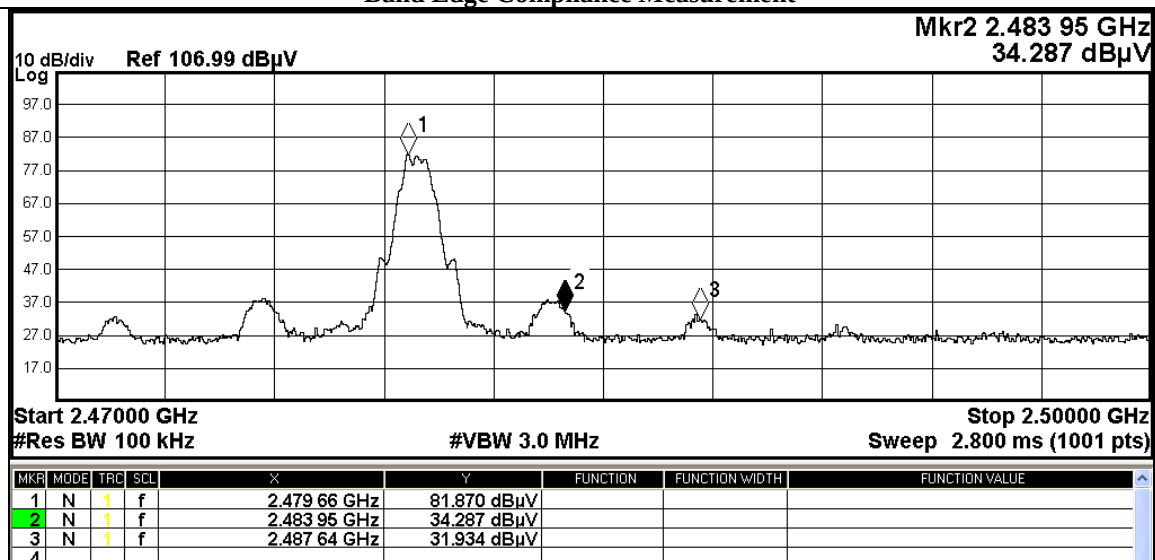
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### Band Edge Measurement:

#### TX mode FSK

| Frequency Range<br>[MHz]        | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|---------------------------------|------------------------------------------------------------|
| Highest Fundamental – 2483.5MHz | 47.6                                                       |

#### Band Edge Compliance Measurement



### Result of TX mode FSK, Band-edge measurement: PASS

| Field Strength of Fundamental and Harmonics Emissions |                                 |                                |                             |                           |                   |                     |
|-------------------------------------------------------|---------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                 |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2397.6                                                | 12.7                            | 27.6                           | 40.3                        | 103.5                     | 5,000             | Vertical            |
| 2487.6                                                | 10.4                            | 28.0                           | 38.4                        | 83.2                      | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                 |                                |                             |                           |                   |                     |
|-------------------------------------------------------|---------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                 |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2397.6                                                | 2.4                             | 27.6                           | 30.0                        | 31.6                      | 500               | Vertical            |
| 2487.6                                                | 1.8                             | 28.0                           | 29.8                        | 30.9                      | 500               | Vertical            |

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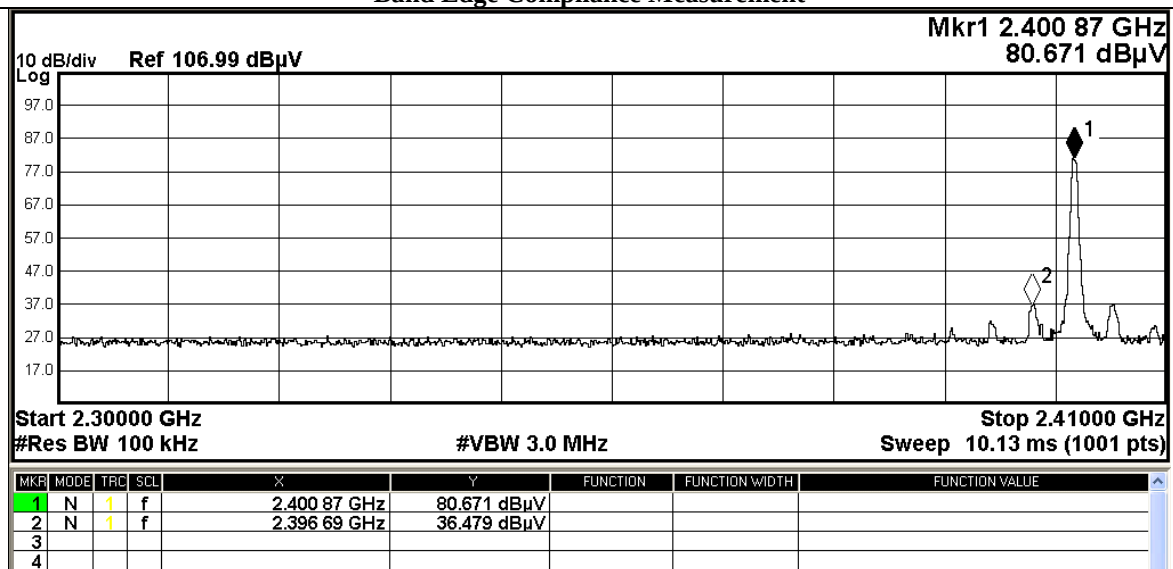
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### Band Edge Measurement:

#### TX mode MSK

| Frequency Range<br>[MHz]     | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|------------------------------|------------------------------------------------------------|
| 2400MHz – Lowest Fundamental | 44.2                                                       |

### Band Edge Compliance Measurement



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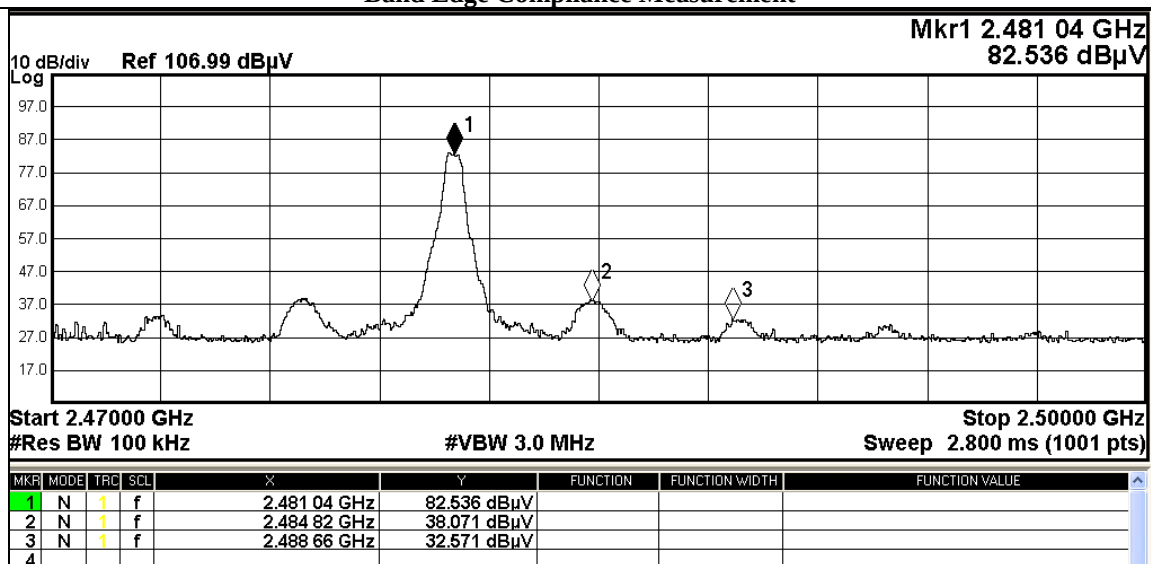
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### Band Edge Measurement:

#### TX mode MSK

| Frequency Range<br>[MHz]        | Radiated Emission Attenuated below the Fundamental<br>[dB] |
|---------------------------------|------------------------------------------------------------|
| Highest Fundamental – 2483.5MHz | 44.5                                                       |

#### Band Edge Compliance Measurement



### Result of TX mode MSK, Band-edge measurement: PASS

| Field Strength of Fundamental and Harmonics Emissions |                                 |                                |                             |                           |                   |                     |
|-------------------------------------------------------|---------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Peak Value                                            |                                 |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2396.7                                                | 11.5                            | 27.9                           | 39.4                        | 93.3                      | 5,000             | Vertical            |
| 2488.7                                                | 6.4                             | 28.0                           | 34.4                        | 52.5                      | 5,000             | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                 |                                |                             |                           |                   |                     |
|-------------------------------------------------------|---------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Average Value                                         |                                 |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 2396.7                                                | 2.4                             | 27.9                           | 30.3                        | 32.7                      | 500               | Vertical            |
| 2488.7                                                | 2.1                             | 28.0                           | 30.1                        | 32.0                      | 500               | Vertical            |

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### Limits for Radiated Emissions [FCC 47 CFR 15.209]:

| Frequency Range<br>[MHz] | Quasi-Peak Limits<br>[μV/m] |
|--------------------------|-----------------------------|
| 0.009-0.490              | 2400/F (kHz)                |
| 0.490-1.705              | 24000/F (kHz)               |
| 1.705-30                 | 30                          |
| 30-88                    | 100                         |
| 88-216                   | 150                         |
| 216-960                  | 200                         |
| Above960                 | 500                         |

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

### Result of Tx mode (MSK), (9kHz – 30MHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

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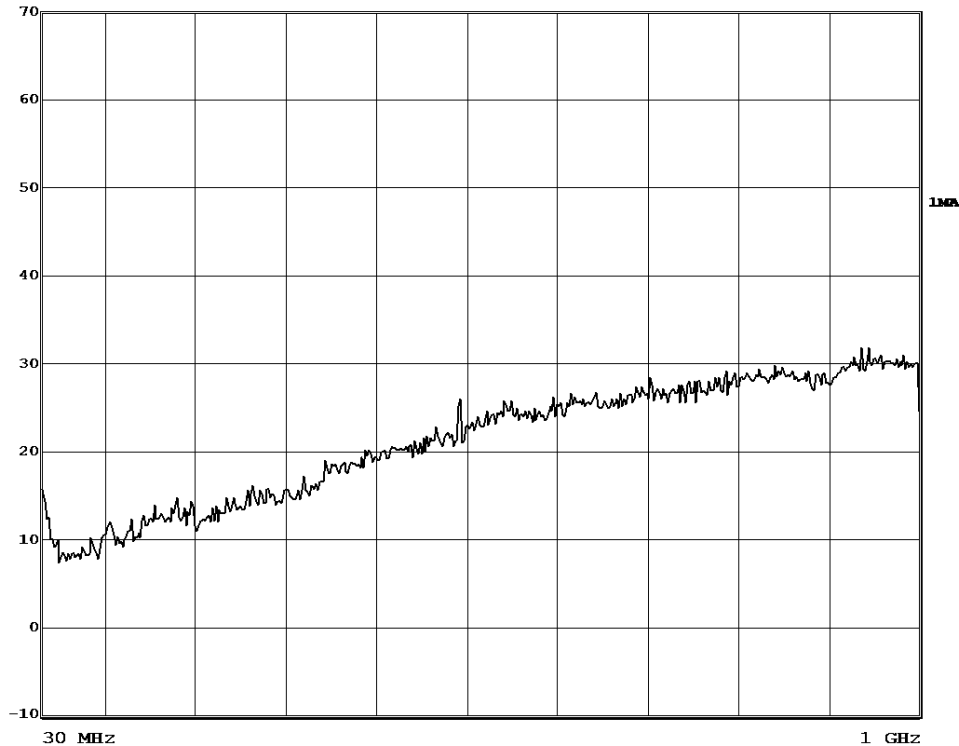
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**Result of Tx mode (MSK), (30MHz – 1GHz): PASS**



Att 0 dB AUTO  
Preamp INPUT 2

Det MA/QP Trd 3143B-H  
ResBW 120 kHz  
Meas T 100 ms Unit dBμV/m



| Field Strength of Fundamental and Harmonics Emissions |                                 |                                |                             |                           |                   |                     |
|-------------------------------------------------------|---------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|---------------------|
| Quasi-Peak Value                                      |                                 |                                |                             |                           |                   |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dBμV/m | Correction<br>Factor<br>dBμV/m | Field<br>Strength<br>dBμV/m | Field<br>Strength<br>μV/m | Limit @3m<br>μV/m | E-Field<br>Polarity |
| 78.4                                                  | 1.6                             | 6.8                            | 8.4                         | 2.6                       | 100               | Vertical            |
| 103.7                                                 | 1.6                             | 8.5                            | 10.1                        | 3.2                       | 150               | Horizontal          |
| 211.4                                                 | 2.3                             | 11.2                           | 13.5                        | 4.7                       | 150               | Horizontal          |
| 257.2                                                 | 0.7                             | 13.0                           | 13.7                        | 4.8                       | 200               | Horizontal          |
| 383.3                                                 | 5.0                             | 16.7                           | 21.7                        | 12.2                      | 200               | Horizontal          |
| 477.5                                                 | 4.2                             | 18.5                           | 22.7                        | 13.6                      | 200               | Horizontal          |

Remarks: Tx mode was tested in both FSK and MSK modulation, MSK modulation was the worst case found in Tx mode.

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**Result of Receiver mode, (9kHz – 30MHz): PASS**

Emissions detected are more than 20 dB below the Limits

**Result of Receiver mode, (30MHz – 1GHz): PASS**

Emissions detected are more than 20 dB below the Limits

**Result of Receiver mode, (1GHz – 18GHz): PASS**

| Field Strength of Fundamental and Harmonics Emissions |                                       |                                      |                                   |                                |                        |                     |
|-------------------------------------------------------|---------------------------------------|--------------------------------------|-----------------------------------|--------------------------------|------------------------|---------------------|
| Peak Value                                            |                                       |                                      |                                   |                                |                        |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dB $\mu$ V/m | Correction<br>Factor<br>dB $\mu$ V/m | Field<br>Strength<br>dB $\mu$ V/m | Field<br>Strength<br>$\mu$ V/m | Limit @3m<br>$\mu$ V/m | E-Field<br>Polarity |
| 2442.0                                                | 3.2                                   | 27.9                                 | 31.1                              | 35.9                           | 5,000                  | Vertical            |

| Field Strength of Fundamental and Harmonics Emissions |                                       |                                      |                                   |                                |                        |                     |
|-------------------------------------------------------|---------------------------------------|--------------------------------------|-----------------------------------|--------------------------------|------------------------|---------------------|
| Average Value                                         |                                       |                                      |                                   |                                |                        |                     |
| Frequency<br>MHz                                      | Measured<br>Level @3m<br>dB $\mu$ V/m | Correction<br>Factor<br>dB $\mu$ V/m | Field<br>Strength<br>dB $\mu$ V/m | Field<br>Strength<br>$\mu$ V/m | Limit @3m<br>$\mu$ V/m | E-Field<br>Polarity |
| 2442.0                                                | 0.4                                   | 27.9                                 | 28.3                              | 26.0                           | 500                    | Vertical            |

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz  
Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : (9kHz – 30MHz): 2.4dB  
(30MHz – 1GHz): 5.0dB  
(1GHz - 18GHz): 5.0dB  
(18GHz – 26GHz): 5.24dB

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### Appendix A

#### LIST OF MEASUREMENT EQUIPMENT

##### Radiated Emission

| EQP NO. | DESCRIPTION                                     | MANUFACTURER                | MODEL NO. | SERIAL NO. | LAST CAL   | DUE CAL    |
|---------|-------------------------------------------------|-----------------------------|-----------|------------|------------|------------|
| EM215   | MULTIDEVICE CONTROLLER                          | EMCO                        | 2090      | 00024676   | N/A        | N/A        |
| EM217   | ELECTRIC POWERED<br>TURNTABLE                   | EMCO                        | 2088      | 00029144   | N/A        | N/A        |
| EM218   | ANECHOIC CHAMBER                                | ETS-LINDGREN                | FACT-3    | --         | 2017/04/24 | 2018/04/24 |
| EM356   | ANTENNA<br>POSITIONING TOWER                    | ETS-LINDGREN                | 2171B     | 00150346   | N/A        | N/A        |
| EM355   | BICONILOG ANTENNA                               | ETS-LINDGREN                | 3143B     | 00201783   | 2017/03/15 | 2019/03/15 |
| EM229   | EMI TEST RECEIVER                               | R&S                         | ESIB40    | 100248     | 2017/06/01 | 2018/06/01 |
| EM299   | DOUBLE-RIDGED WAVEGUIDE<br>HORN ANTENNA         | ETS-LINDGREN                | 3115      | 00114120   | 2016/04/27 | 2018/04/27 |
| EM300   | PYRAMIDAL STANDARD GAIN<br>HORN ANTENNA         | ETS-LINDGREN                | 3160-09   | 00130130   | 2016/05/13 | 2018/05/13 |
| EM302   | PRECISION OMNIDIRECTIONAL<br>DIPOLE (1 – 6GHZ)  | SEIBERSDORF<br>LABORATORIES | POD 16    | 161806/L   | 2016/05/11 | 2018/05/11 |
| EM303   | PRECISION OMNIDIRECTIONAL<br>DIPOLE (6 – 18GHZ) | SEIBERSDORF<br>LABORATORIES | POD 618   | 6181908/L  | 2016/05/11 | 2018/05/11 |
| EM353   | LOOP ANTENNA                                    | ETS_LINDGREN                | 6502      | 00206533   | 2016/03/16 | 2018/03/16 |

#### Remarks:

CM Corrective Maintenance  
N/A Not Applicable or Not Available  
TBD To Be Determined

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### Appendix B

#### Photographs of EUT

Front View of the product



Rear View of the product



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### Photographs of EUT

**Inner Circuit Top View**



**Inner Circuit Bottom View**



**Inner View of the product**



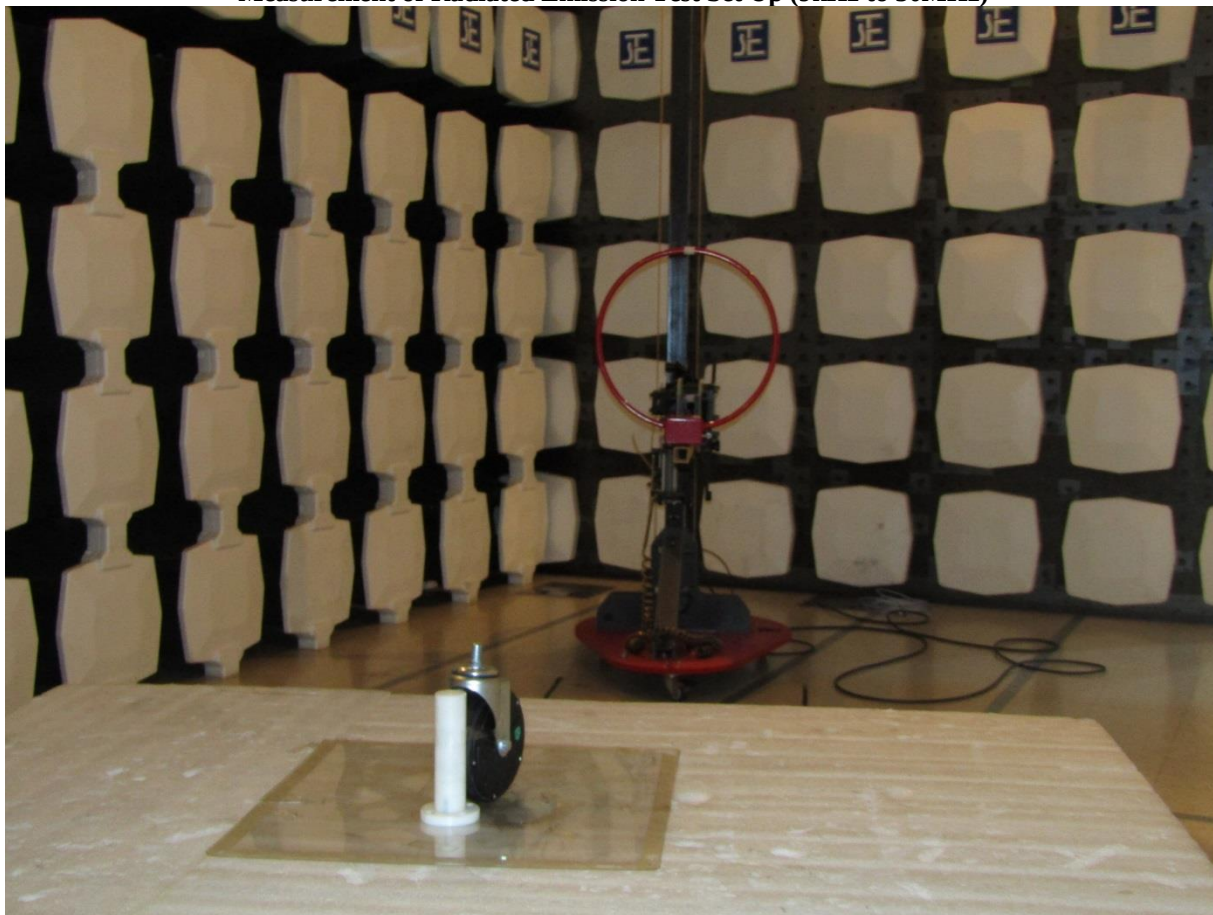
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### Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)



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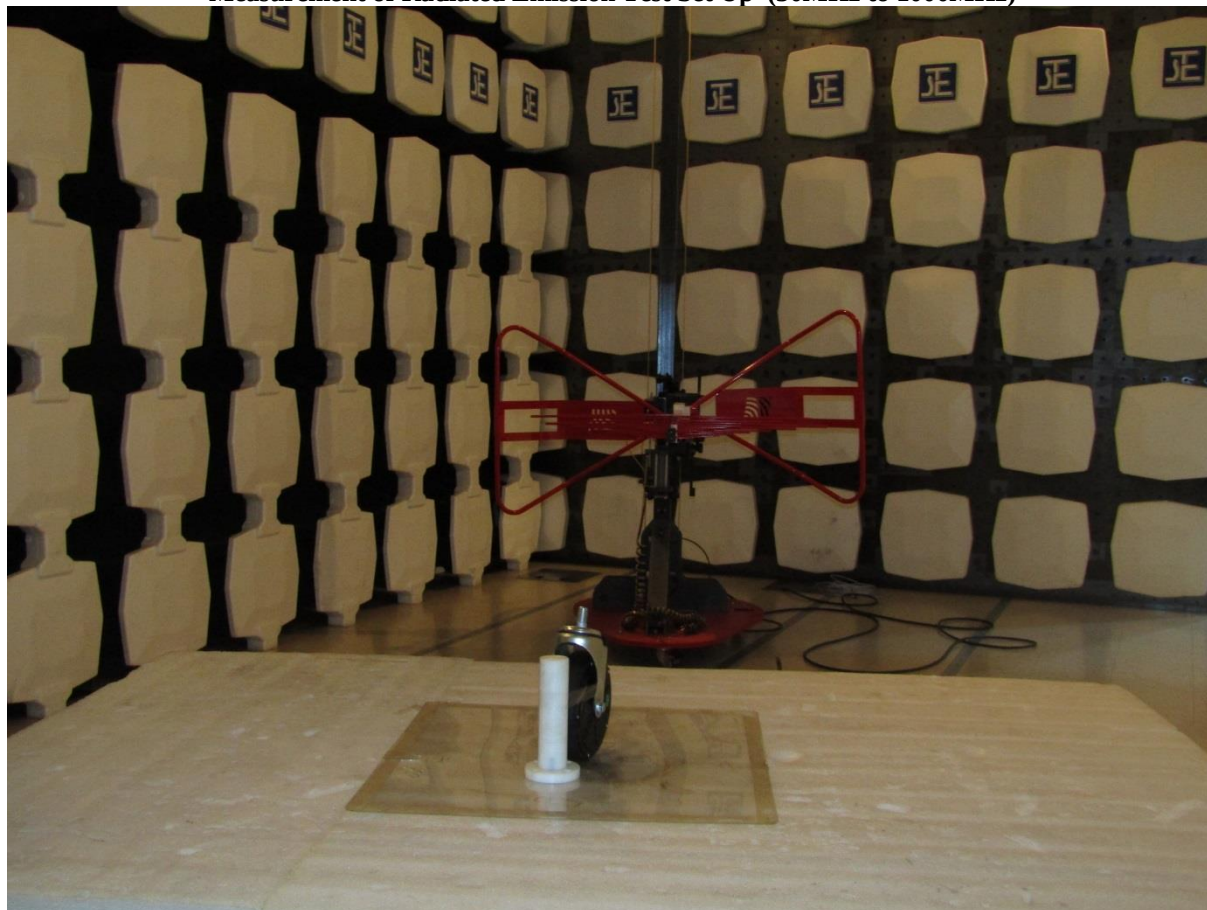
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### Photographs of EUT

Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



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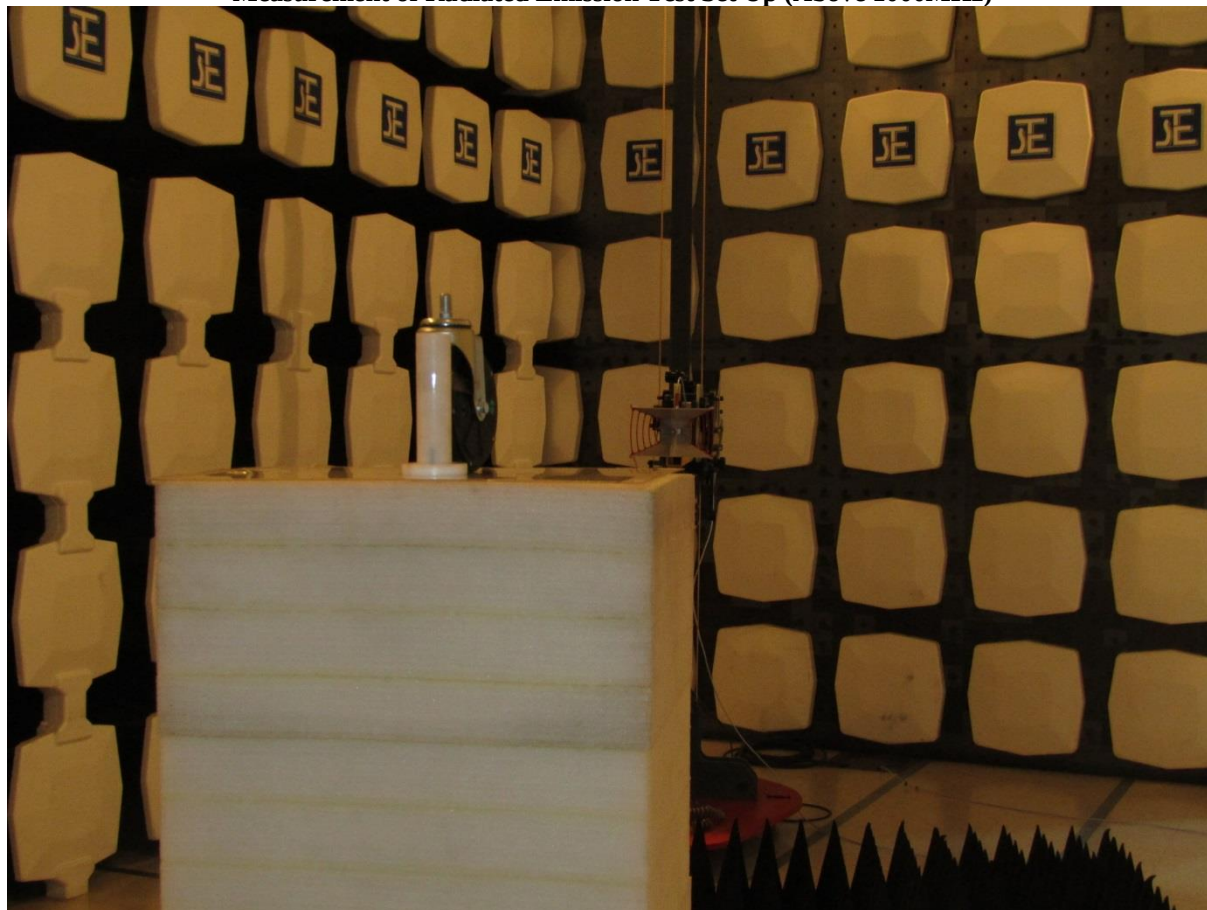
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### Photographs of EUT

**Measurement of Radiated Emission Test Set Up (Above 1000MHz)**



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