



# Electromagnetic Compatibility Test Report

Tests Performed on a TimeKeeping Systems, Inc.

Duress Device, Model DD-0020

Radiometrics Document RP-9829



## Product Detail:

FCC ID: MTD-0020  
IC: 12375A-0020  
Equipment type: Security Device with Transceiver

## Test Standards:

US CFR Title 47, Chapter I, FCC Part 15 Subpart C  
FCC Part 15 CFR Title 47: 2023  
Canada ISED; RSS-210, Issue 10: 2019 as required for Category I Equipment  
IC RSS-GEN Issue 5: 2018

This report concerns: Original Grant for Certification  
FCC Part 15.249

## Tests Performed For:

**TimeKeeping Systems, Inc.**  
30700 Bainbridge Rd.  
Solon, OH 44139

## Test Facility:

**Radiometrics Midwest Corporation**  
12 Devonwood Avenue  
Romeoville, IL 60446-1349  
(815) 293-0772

## Test Date(s):

November 7-10, 2023

## Document RP-9829 Revisions:

| Rev. | Issue Date       | Revised By |
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| 0    | December 4, 2023 |            |
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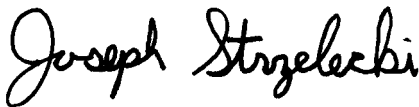


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**1.0 ADMINISTRATIVE DATA**

|                                                                                                                                                                                                                                                                             |                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <i>Equipment Under Test:</i><br>A TimeKeeping Systems, Inc., Duress Device<br>Model: DD-0020 Serial Number:<br>This will be referred to as the EUT in this Report                                                                                                           |                                                                                                        |
| <i>Date EUT Received at Radiometrics:</i><br>October 27, 2023                                                                                                                                                                                                               | <i>Test Date(s):</i><br>November 7-10, 2023                                                            |
| <i>Test Report Written and Authorized By:</i><br>Joseph Strzelecki<br>Senior EMC Engineer                                                                                                                                                                                   | <i>Test Witnessed By:</i><br>The tests were not witnessed by personnel from TimeKeeping Systems, Inc.. |
| <i>Radiometrics' Personnel Responsible for Test:</i><br><br>12/04/2023<br>Date<br>Joseph Strzelecki<br>Senior EMC Engineer<br>NARTE EMC-000877-NE<br><br>Chris D'Alessio<br>EMC Technician | <i>EUT Checked By:</i><br>Joseph Strzelecki<br>Chris D'Alessio<br>Radiometrics                         |

**2.0 TEST SUMMARY AND RESULTS**

The EUT (Equipment Under Test) is a Duress Device, Model DD-0020, manufactured by TimeKeeping Systems, Inc. The detailed test results are presented in a separate section. The following is a summary of the test results.

**Emissions Tests Results**

| Environmental Phenomena       | Frequency Range   | Basic Standard            | Test Result |
|-------------------------------|-------------------|---------------------------|-------------|
| RF Radiated Emissions         | 30-25,000 MHz     | RSS-210 & FCC Part 15.249 | Pass        |
| Conducted Emissions, AC Mains | 0.15 - 30 MHz     | RSS-210 & FCC Part 15.207 | Pass        |
| Occupied Bandwidth Test       | Fundamental Freq. | RSS-GEN & FCC Part 15     | Pass        |

**IEC 17025 Decision Rule:**

The declaration of pass or fail is based on the specifications listed above. The declaration of pass or fail did not consider measurement uncertainty.



## 2.1 RF Exposure Compliance Requirements

Since the average power output is less than 10 mW, the EUT meets the FCC requirement for RF exposure and it is exempt from RSS-102 SAR and RF exposure evaluations. There are no power level adjustments available to the end user. The antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

## 3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

### 3.1 EUT Description

The EUT is a Duress Device, Model DD-0020, manufactured by TimeKeeping Systems, Inc. The EUT was in good working condition during the tests, with no known defects.

#### 3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the printed circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

Since the measurements at the antenna port are used to determine the RF output power, RSS-GEN section 6.8 requires that the effective gain of the products antenna be stated, based on a measurement or on data from the antenna's manufacturer.

## 4.0 TESTED SYSTEM DETAILS

### 4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm or 150 cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. The EUT was tested as a stand-alone device.

Power was supplied with a new battery. There are no external cables

The identification for all equipment, are:

**Tested System Configuration List**

| Item | Description   | Type* | Manufacturer              | Model Number | Serial Number |
|------|---------------|-------|---------------------------|--------------|---------------|
| 1    | Duress Device | E     | TimeKeeping Systems, Inc. | DD-0020      | 004           |

\* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

|                                                                   |                                            |
|-------------------------------------------------------------------|--------------------------------------------|
| Type of modulation including the bit rate and symbol rate         | GFSK at 1Mbps                              |
| Name and version of the test software used to exercise the device | dd12_p7_pendant_FCC_TEST.hex<br>20230919.1 |
| Power settings used for the purpose of exercising the device      | 18                                         |
| Firmware number of the transmitter                                | N/A                                        |



## 4.2 EUT Operating Modes

The transmit mode for all tests was continuous. The continuous mode produces a Duty Cycle of at least 99%.

The EUT was in its normal GFSK modulation during the tests. It was tested as a stand-alone battery powered device, since that is the configuration in the final installation.

## 4.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

## 4.4 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

## 5.0 TEST SPECIFICATIONS

| Document               | Date | Title                                                                                                                 |
|------------------------|------|-----------------------------------------------------------------------------------------------------------------------|
| FCC<br>CFR Title 47    | 2023 | Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices |
| IC RSS-210<br>Issue 10 | 2019 | Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment                        |
| IC RSS-Gen<br>Issue 5  | 2019 | General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)                  |

## 6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

| Document            | Date | Title                                                                                                                                |
|---------------------|------|--------------------------------------------------------------------------------------------------------------------------------------|
| ANSI<br>C63.4-2014  | 2014 | Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI<br>C63.10-2013 | 2013 | American National Standard for Testing Unlicensed Wireless Devices                                                                   |

## 7.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2017 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site ([www.radiomet.com](http://www.radiomet.com)). Radiometrics accreditation status can be verified at A2LA's web site ([www.a2la2.org](http://www.a2la2.org)).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom-made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorbers. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.



Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6-inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC 3124A with a CAB ID of US0224.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSS Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

## 8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

## 9.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

## 10.0 TEST EQUIPMENT TABLE

| RMC ID | Manufacturer  | Description       | Model No. | Serial No. | Frequency Range | Cal Period | Cal Date |
|--------|---------------|-------------------|-----------|------------|-----------------|------------|----------|
| AMP-05 | RMC/Celeritek | Pre-amplifier     | MW110G    | 1001       | 1.0-12GHz       | 12 Mo.     | 01/14/23 |
| AMP-20 | Avantek       | Pre-amplifier     | SF8-0652  | 15221      | 8-18GHz         | 12 Mo      | 06/02/23 |
| AMP-59 | Amplitech     | Pre-amplifier     | APTMP44   | AMP-59     | 18-26 GHz       | 12 Mo.     | 01/10/23 |
| ANT-48 | RMC           | Std. Gain Horn    | HW2020    | 1001       | 18-26.5 GHz     | 24 Mo.     | 11/23/22 |
| ANT-66 | ETS-Lindgren  | Horn Antenna      | 3115      | 62580      | 1.0-18GHz       | 24 Mo.     | 03/16/23 |
| ANT-68 | EMCO          | Log-Periodic Ant. | 93146     | 9604-4456  | 200-1000MHz     | 24 Mo.     | 02/07/22 |
| ANT-80 | AH Systems    | Bicon Antenna     | SAS-540   | 294        | 20-330MHz       | 24 Mo.     | 01/26/23 |
| HPF-06 | Mini-Circuits | High Pass Filter  | VHF-3800+ | 31035      | 3-11 GHz        | 24 Mo.     | 05/23/22 |
| REC-21 | Agilent       | Spectrum Analyzer | E7405A    | MY45118341 | 9Hz-26.5 GHz    | 24 Mo.     | 02/24/22 |
| REC-44 | Agilent       | Spectrum Analyzer | E4440A    | US40420673 | 3Hz-26.5GHz     | 24 Mo.     | 03/31/22 |
| THM-02 | Fluke         | Temp/Humid Meter  | 971       | 93490471   | N/A             | 24 Mo.     | 11/22/22 |

Note: All calibrated equipment is subject to periodic checks.

| Software Company | Test Software Name | Version  | Applicable Tests                               |
|------------------|--------------------|----------|------------------------------------------------|
| Radiometrics     | REREC11D           | 07.21.22 | RF Radiated Emissions (FCC Part 15 & EN 55032) |
| Agilent          | PSA/ESA-E/L/EMC    | 2.4.0.42 | Bandwidth and screen shots                     |



## 11.0 TEST SECTIONS

### 11.1 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

In addition, a high pass filter was used to reduce the fundamental emission. High pass filters were not needed above 10 GHz, since the preamplifiers attenuated the fundamental emission.

The EUT was rotated through three orthogonal axis as per 5.10.1 of ANSI C63.10 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4. Chamber E is located at 12 Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25000 MHz was slowly scanned. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance. The QP and average detectors have a linear response.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

**Radiated Emissions Field Strength Limits**

| Frequency Range (MHz) | Test Distance (meters) | Non-Fundamental Limits |          |
|-----------------------|------------------------|------------------------|----------|
|                       |                        | uV/m                   | dB(uV/m) |
| 30 - 88               | 3                      | 100                    | 40.0     |
| 88 - 216              | 3                      | 150                    | 43.5     |
| 216 - 960             | 3                      | 200                    | 46.0     |
| Above 960             | 3                      | 500                    | 54.0     |

The emission limits shown in the above table are based on measurements using a CISPR quasi-peak detector below 1 GHz. Above 1 GHz, the radiated emission limits are based on measurements employing an average detector. Above 1 GHz peak emissions shall not be more than 20 dB above the average limits.

The fundamental limit is 94 dBuV/m for Average and 114 dBuV/m for peak detection.

#### 11.1.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

$$FS = RA + AF + CF - AG + HPF + PKA$$

Where: FS = Field Strength

RA = Receiver Amplitude



AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

HPF = High pass Filter Loss

PKA = Peak to Average Factor (This is only used for average measurements above 1 GHz)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission.

### 11.1.2 Duty Cycle

In accordance to 7.5 of ANSI C63.10 the following procedures were used.

- a) The EUT was set to the “worst-case” pulse ON time.
- b) The RF output was Coupled to the input of a spectrum analyzer by a “near-field” coupling method. The signal received shall be of sufficient level to trigger adequately the spectrum analyzer sweep display.
- c) The center frequency of the spectrum analyzer was set to the center of the RF signal.
- d) The spectrum analyzer was set for ZERO SPAN.
- e) The sweep time of the analyzer was set to 100 ms and other times to show the duty cycle.
- f) Since the pulse train has a period that exceeds 100 ms, then:
  - 1) The trigger on the spectrum analyzer was set to capture the greatest amount of pulse “ON time” over 100 ms.
  - 2) The 100 ms period that contains the maximum “on time” was found.
  - 3) The duty cycle was determined by dividing the total maximum “ON time” by 100 ms (tON/100 ms).
- h) The duty cycle correction factor was used applying Equation (10) of ANSI C63.10 to the duty cycle determined in the preceding steps.

The width of each pulse is 0.2 mSeconds. There are, at most, 1 pulse per 100mS. This yields an effective duty cycle of 0.2%. The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The transmitter operates for a maximum duration of 0.2 ms in any 100 ms interval.  $20 \log(0.2\text{mSec}/100\text{mSec}) = -54 \text{ dB}$  Peak to Average correction factor.

Since the difference between the peak and the average limits are 20 dB, there is no need to use a correction factor more than 20 dB. Therefore, a 20 dB factor was used.

### 11.1.3 Radiated Emissions Test Results

|               |                                                                            |  |  |  |  |  |  |  |  |  |
|---------------|----------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|
| Test Date     | November 7 to 9, 2023                                                      |  |  |  |  |  |  |  |  |  |
| EUT           | Model: DD-0020 Serial # 004                                                |  |  |  |  |  |  |  |  |  |
| Test Distance | 3 Meters                                                                   |  |  |  |  |  |  |  |  |  |
| Specification | FCC Part 15 Subpart C & RSS-210 Section B.10                               |  |  |  |  |  |  |  |  |  |
| Notes         | Corr. Factors = cable loss - preamp gain                                   |  |  |  |  |  |  |  |  |  |
| Abbreviations | Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP |  |  |  |  |  |  |  |  |  |
| Configuration | The EUT is in the transmit mode with the receiver on                       |  |  |  |  |  |  |  |  |  |

This table includes all emissions except Fundamental, Band edge and harmonics emissions.

| Freq.<br>MHz | Meter<br>Reading<br>dBuV | Dec. | Ant.<br>Pol. | Ant<br>Factor<br>dB/m | Corr.<br>Factors | Dist<br>Fact<br>dB | EUT<br>dBuV/m | Limit<br>dBuV/m | Margin<br>Under<br>Limit dB | Note |
|--------------|--------------------------|------|--------------|-----------------------|------------------|--------------------|---------------|-----------------|-----------------------------|------|
| 36.2         | 11.3                     | P    | H            | 12.1                  | 0.6              | 0.0                | 24.0          | 40.0            | 16.0                        |      |
| 48.4         | 10.8                     | P    | H            | 9.8                   | 0.7              | 0.0                | 21.3          | 40.0            | 18.7                        |      |
| 53.2         | 11.2                     | P    | H            | 9.5                   | 0.8              | 0.0                | 21.5          | 40.0            | 18.5                        |      |

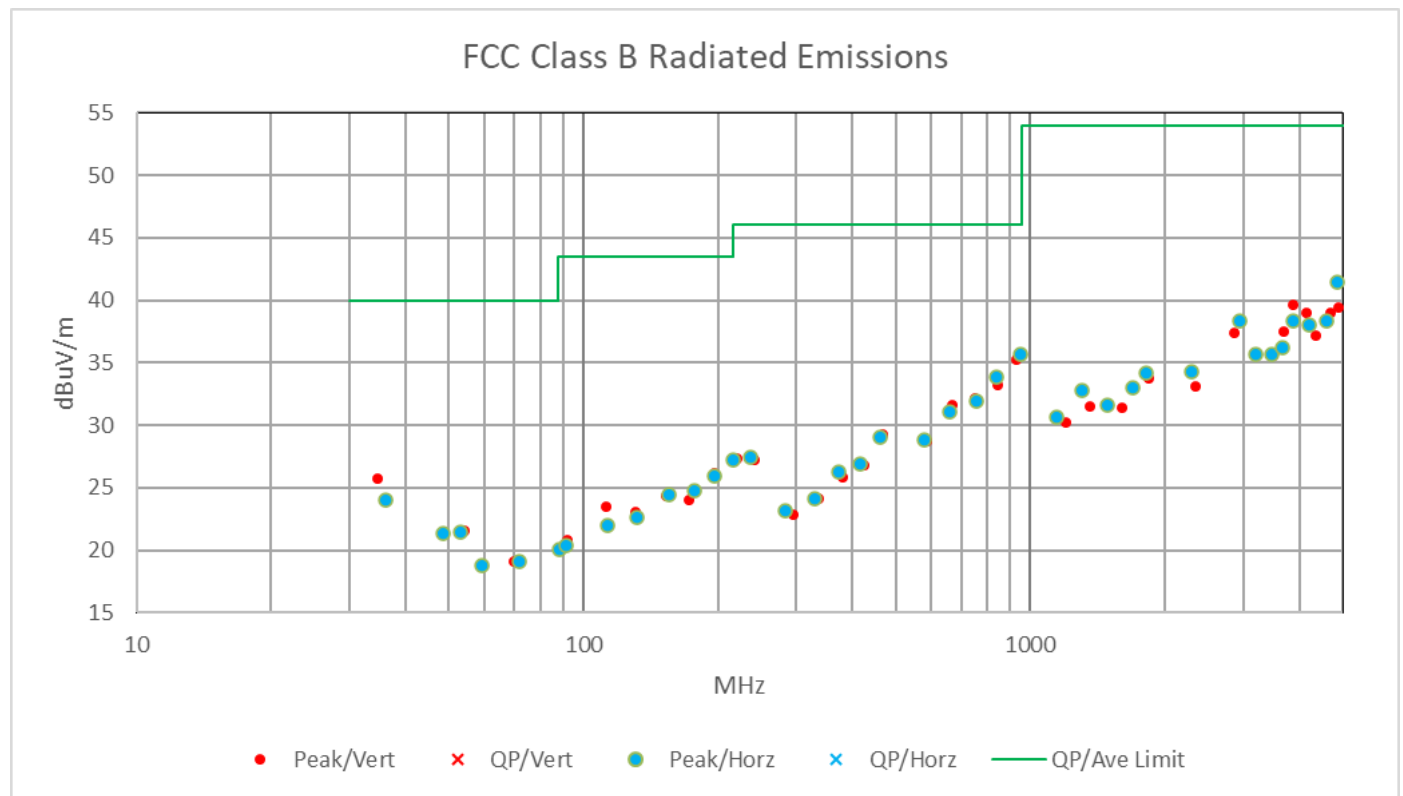


| Freq.<br>MHz | Meter<br>Reading<br>dBuV | Dect. | Ant.<br>Pol. | Ant<br>Factor<br>dB/m | Corr.<br>Factors | Dist<br>Fact<br>dB | EUT<br>dBuV/m | Limit<br>dBuV/m | Margin<br>Under<br>Limit dB | Note |
|--------------|--------------------------|-------|--------------|-----------------------|------------------|--------------------|---------------|-----------------|-----------------------------|------|
| 59.2         | 9.0                      | P     | H            | 9.0                   | 0.8              | 0.0                | 18.8          | 40.0            | 21.2                        |      |
| 71.8         | 9.3                      | P     | H            | 8.9                   | 0.9              | 0.0                | 19.1          | 40.0            | 20.9                        |      |
| 88.4         | 9.7                      | P     | H            | 9.4                   | 1.0              | 0.0                | 20.1          | 43.5            | 23.4                        |      |
| 91.3         | 9.8                      | P     | H            | 9.6                   | 1.0              | 0.0                | 20.4          | 43.5            | 23.1                        |      |
| 113.0        | 9.9                      | P     | H            | 11.0                  | 1.1              | 0.0                | 22.0          | 43.5            | 21.5                        |      |
| 132.2        | 9.3                      | P     | H            | 12.1                  | 1.2              | 0.0                | 22.6          | 43.5            | 20.9                        |      |
| 155.7        | 10.4                     | P     | H            | 12.7                  | 1.4              | 0.0                | 24.5          | 43.5            | 19.0                        |      |
| 177.1        | 10.0                     | P     | H            | 13.3                  | 1.5              | 0.0                | 24.8          | 43.5            | 18.7                        |      |
| 196.6        | 10.3                     | P     | H            | 14.1                  | 1.5              | 0.0                | 25.9          | 43.5            | 17.6                        |      |
| 216.3        | 10.9                     | P     | H            | 14.7                  | 1.6              | 0.0                | 27.2          | 46.0            | 18.8                        |      |
| 237.3        | 10.6                     | P     | H            | 15.1                  | 1.7              | 0.0                | 27.4          | 46.0            | 18.6                        |      |
| 283.7        | 8.1                      | P     | H            | 13.3                  | 1.8              | 0.0                | 23.2          | 46.0            | 22.8                        |      |
| 329.7        | 7.9                      | P     | H            | 14.2                  | 2.0              | 0.0                | 24.1          | 46.0            | 21.9                        |      |
| 373.0        | 9.6                      | P     | H            | 14.6                  | 2.1              | 0.0                | 26.3          | 46.0            | 19.7                        |      |
| 415.7        | 9.0                      | P     | H            | 15.6                  | 2.3              | 0.0                | 26.9          | 46.0            | 19.1                        |      |
| 461.8        | 9.8                      | P     | H            | 16.9                  | 2.4              | 0.0                | 29.1          | 46.0            | 16.9                        |      |
| 581.0        | 7.5                      | P     | H            | 18.6                  | 2.7              | 0.0                | 28.8          | 46.0            | 17.2                        |      |
| 659.0        | 8.0                      | P     | H            | 20.2                  | 2.9              | 0.0                | 31.1          | 46.0            | 14.9                        |      |
| 756.1        | 7.9                      | P     | H            | 20.9                  | 3.1              | 0.0                | 31.9          | 46.0            | 14.1                        |      |
| 840.2        | 8.6                      | P     | H            | 22.0                  | 3.3              | 0.0                | 33.9          | 46.0            | 12.1                        |      |
| 950.8        | 8.8                      | P     | H            | 23.4                  | 3.5              | 0.0                | 35.7          | 46.0            | 10.3                        |      |
| 1142.1       | 39.9                     | P     | H            | 24.7                  | -34.0            | 0.0                | 30.6          | 74.0            | 43.4                        | 1    |
| 1303.3       | 41.9                     | P     | H            | 25.0                  | -34.1            | 0.0                | 32.8          | 74.0            | 41.2                        | 1    |
| 1492.5       | 40.4                     | P     | H            | 25.2                  | -34.0            | 0.0                | 31.6          | 74.0            | 42.4                        | 1    |
| 1700.7       | 40.7                     | P     | H            | 26.3                  | -34.0            | 0.0                | 33.0          | 74.0            | 41.0                        | 1    |
| 1819.8       | 41.1                     | P     | H            | 27.0                  | -33.9            | 0.0                | 34.2          | 74.0            | 39.8                        | 1    |
| 2295.3       | 39.9                     | P     | H            | 28.0                  | -33.6            | 0.0                | 34.3          | 74.0            | 39.7                        | 1    |
| 2934.9       | 41.7                     | P     | H            | 29.7                  | -33.0            | 0.0                | 38.4          | 74.0            | 35.6                        | 1    |
| 3200.2       | 37.4                     | P     | H            | 30.9                  | -32.6            | 0.0                | 35.7          | 74.0            | 38.3                        | 1    |
| 3481.5       | 36.8                     | P     | H            | 31.2                  | -32.3            | 0.0                | 35.7          | 74.0            | 38.3                        | 1    |
| 3672.7       | 36.5                     | P     | H            | 31.9                  | -32.2            | 0.0                | 36.2          | 74.0            | 37.8                        | 1    |
| 3881.9       | 37.5                     | P     | H            | 32.8                  | -32.0            | 0.0                | 38.3          | 74.0            | 35.7                        | 1    |
| 4221.2       | 37.2                     | P     | H            | 32.4                  | -31.6            | 0.0                | 38.0          | 74.0            | 36.0                        | 1    |
| 4592.6       | 36.7                     | P     | H            | 33.1                  | -31.4            | 0.0                | 38.4          | 74.0            | 35.6                        | 1    |
| 4854.9       | 38.8                     | P     | H            | 33.5                  | -30.8            | 0.0                | 41.5          | 74.0            | 32.5                        | 1    |
| 34.6         | 13.0                     | P     | V            | 12.1                  | 0.6              | 0.0                | 25.7          | 40.0            | 14.3                        |      |
| 54.3         | 11.6                     | P     | V            | 9.2                   | 0.8              | 0.0                | 21.6          | 40.0            | 18.4                        |      |
| 69.8         | 9.2                      | P     | V            | 9.0                   | 0.9              | 0.0                | 19.1          | 40.0            | 20.9                        |      |
| 91.9         | 10.2                     | P     | V            | 9.6                   | 1.0              | 0.0                | 20.8          | 43.5            | 22.7                        |      |
| 112.7        | 11.4                     | P     | V            | 11.0                  | 1.1              | 0.0                | 23.5          | 43.5            | 20.0                        |      |
| 131.1        | 9.8                      | P     | V            | 12.1                  | 1.2              | 0.0                | 23.1          | 43.5            | 20.4                        |      |
| 152.8        | 10.3                     | P     | V            | 12.7                  | 1.3              | 0.0                | 24.3          | 43.5            | 19.2                        |      |
| 172.5        | 9.5                      | P     | V            | 13.1                  | 1.4              | 0.0                | 24.0          | 43.5            | 19.5                        |      |
| 197.0        | 10.6                     | P     | V            | 14.1                  | 1.5              | 0.0                | 26.2          | 43.5            | 17.3                        |      |
| 220.9        | 10.9                     | P     | V            | 14.8                  | 1.6              | 0.0                | 27.3          | 46.0            | 18.7                        |      |
| 241.5        | 10.4                     | P     | V            | 15.1                  | 1.7              | 0.0                | 27.2          | 46.0            | 18.8                        |      |
| 295.7        | 7.2                      | P     | V            | 13.7                  | 1.9              | 0.0                | 22.8          | 46.0            | 23.2                        |      |
| 336.0        | 7.8                      | P     | V            | 14.3                  | 2.0              | 0.0                | 24.1          | 46.0            | 21.9                        |      |
| 380.9        | 8.9                      | P     | V            | 14.8                  | 2.1              | 0.0                | 25.8          | 46.0            | 20.2                        |      |
| 423.8        | 8.8                      | P     | V            | 15.7                  | 2.3              | 0.0                | 26.8          | 46.0            | 19.2                        |      |
| 469.2        | 9.8                      | P     | V            | 17.1                  | 2.4              | 0.0                | 29.3          | 46.0            | 16.7                        |      |
| 588.6        | 7.3                      | P     | V            | 18.7                  | 2.7              | 0.0                | 28.7          | 46.0            | 17.3                        |      |
| 669.7        | 8.0                      | P     | V            | 20.7                  | 2.9              | 0.0                | 31.6          | 46.0            | 14.4                        |      |
| 754.8        | 8.1                      | P     | V            | 20.9                  | 3.1              | 0.0                | 32.1          | 46.0            | 13.9                        |      |



| Freq. MHz | Meter Reading dBuV | Dect. | Ant. Pol. | Ant Factor dB/m | Corr. Factors | Dist Fact dB | EUT dBuV/m | Limit dBuV/m | Margin Under Limit dB | Note |
|-----------|--------------------|-------|-----------|-----------------|---------------|--------------|------------|--------------|-----------------------|------|
| 843.8     | 7.8                | P     | V         | 22.1            | 3.3           | 0.0          | 33.2       | 46.0         | 12.8                  |      |
| 932.9     | 8.6                | P     | V         | 23.1            | 3.5           | 0.0          | 35.2       | 46.0         | 10.8                  |      |
| 1200.2    | 39.4               | P     | V         | 24.9            | -34.1         | 0.0          | 30.2       | 74.0         | 43.8                  | 1    |
| 1361.4    | 40.6               | P     | V         | 25.0            | -34.1         | 0.0          | 31.5       | 74.0         | 42.5                  | 1    |
| 1606.6    | 39.9               | P     | V         | 25.5            | -34.0         | 0.0          | 31.4       | 74.0         | 42.6                  | 1    |
| 1847.8    | 40.7               | P     | V         | 27.0            | -33.9         | 0.0          | 33.8       | 74.0         | 40.2                  | 1    |
| 2343.3    | 38.6               | P     | V         | 28.1            | -33.6         | 0.0          | 33.1       | 74.0         | 40.9                  | 1    |
| 2863.9    | 41.0               | P     | V         | 29.4            | -33.0         | 0.0          | 37.4       | 74.0         | 36.6                  | 1    |
| 3169.2    | 37.7               | P     | V         | 30.8            | -32.7         | 0.0          | 35.8       | 74.0         | 38.2                  | 1    |
| 3497.5    | 36.7               | P     | V         | 31.2            | -32.3         | 0.0          | 35.6       | 74.0         | 38.4                  | 1    |
| 3704.7    | 37.6               | P     | V         | 32.1            | -32.2         | 0.0          | 37.5       | 74.0         | 36.5                  | 1    |
| 3877.9    | 38.9               | P     | V         | 32.8            | -32.1         | 0.0          | 39.6       | 74.0         | 34.4                  | 1    |
| 4160.2    | 38.3               | P     | V         | 32.4            | -31.7         | 0.0          | 39.0       | 74.0         | 35.0                  | 1    |
| 4353.4    | 36.1               | P     | V         | 32.6            | -31.5         | 0.0          | 37.2       | 74.0         | 36.8                  | 1    |
| 4704.7    | 36.8               | P     | V         | 33.3            | -31.1         | 0.0          | 39.0       | 74.0         | 35.0                  | 1    |
| 4893.9    | 36.6               | P     | V         | 33.5            | -30.7         | 0.0          | 39.4       | 74.0         | 34.6                  | 1    |

Judgment: Passed by 10.3 dB



**Fundamental and Harmonic Emissions FCC 15.249; Three axis**

|                                             | Tx   | Spectrum Analyzer Readings dBuV |      |      |      |                         |      |      |      |              | EUT         | Peak    | Ave  | Peak   | Ave | Margin      |
|---------------------------------------------|------|---------------------------------|------|------|------|-------------------------|------|------|------|--------------|-------------|---------|------|--------|-----|-------------|
| hrm                                         | Freq | Peak                            |      |      |      | Ave                     |      |      |      | Corr.        | Emission    | Tot. FS |      | Limit  |     | Under       |
| #                                           | MHz  | Vertical Polarization           |      |      |      | Horizontal Polarization |      |      |      | Fact<br>dB/m | Freq<br>MHz | dBuV/m  |      | dBuV/m |     | Limit<br>dB |
|                                             |      | X                               | Y    | Z    | Max  | X                       | Y    | Z    | Max  |              |             |         |      |        |     |             |
| 1                                           | 2402 | 65.1                            | 73.9 | 76.1 | 56.1 | 66.7                    | 73.9 | 73.1 | 53.9 | 33.9         | 2402.0      | 110.0   | 90.0 | 114    | 94  | 4.0         |
| BE                                          | 2402 | 40.9                            | 41.6 | 45.9 | 25.9 | 41.2                    | 44.6 | 40.5 | 24.6 | 5.0          | 2400.0      | 50.9    | 30.9 | 74     | 54  | 23.1        |
| 2                                           | 2402 | 68.5                            | 65.4 | 58.1 | 48.5 | 65.1                    | 53.6 | 63.7 | 45.1 | 3.3          | 4804.0      | 71.8    | 51.8 | 74     | 54  | 2.2         |
| 3                                           | 2402 | 61.0                            | 60.4 | 57.6 | 41.0 | 59.2                    | 55.8 | 60.6 | 40.6 | 7.9          | 7206.0      | 68.9    | 48.9 | 74     | 54  | 5.1         |
| 4                                           | 2402 | 53.1                            | 51.3 | 49.1 | 33.1 | 47.5                    | 44.6 | 43.9 | 27.5 | 12.1         | 9608.0      | 65.2    | 45.2 | 74     | 54  | 8.8         |
| 1                                           | 2426 | 64.8                            | 70.2 | 75.0 | 55.0 | 65.2                    | 74.3 | 66.4 | 54.3 | 34.0         | 2426.0      | 109.0   | 89.0 | 114    | 94  | 5.0         |
| 2                                           | 2426 | 58.7                            | 65.5 | 55.3 | 45.5 | 59.7                    | 53.1 | 68.1 | 48.1 | 3.7          | 4852.0      | 71.8    | 51.8 | 74     | 54  | 2.2         |
| 3                                           | 2426 | 46.0                            | 51.4 | 58.8 | 38.8 | 47.7                    | 52.0 | 59.9 | 39.9 | 8.1          | 7278.0      | 68.0    | 48.0 | 74     | 54  | 6.0         |
| 4                                           | 2426 | 49.6                            | 48.3 | 45.4 | 29.6 | 46.8                    | 45.9 | 50.0 | 30.0 | 13.1         | 9704.0      | 63.1    | 43.1 | 74     | 54  | 10.9        |
| 1                                           | 2480 | 65.2                            | 69.6 | 74.1 | 54.1 | 66.8                    | 73.9 | 68.0 | 53.9 | 34.1         | 2480.0      | 108.2   | 88.2 | 114    | 94  | 5.8         |
| BE                                          | 2480 | 38.4                            | 36.6 | 37.8 | 23.9 | 41.0                    | 38.7 | 37.8 | 24.3 | 5.2          | 2483.5      | 46.2    | 29.5 | 74     | 54  | 24.5        |
| 2                                           | 2480 | 58.7                            | 67.2 | 59.5 | 47.2 | 58.3                    | 55.2 | 68.0 | 48.0 | 3.6          | 4960.0      | 71.6    | 51.6 | 74     | 54  | 2.4         |
| 3                                           | 2480 | 55.8                            | 58.9 | 59.9 | 39.9 | 45.0                    | 57.5 | 61.6 | 41.6 | 8.4          | 7440.0      | 70.0    | 50.0 | 74     | 54  | 4.0         |
| 4                                           | 2480 | 52.2                            | 49.6 | 45.8 | 32.2 | 44.6                    | 45.7 | 49.4 | 29.4 | 13.5         | 9920.0      | 65.7    | 45.7 | 74     | 54  | 8.3         |
| Column numbers (see below for explanations) |      |                                 |      |      |      |                         |      |      |      |              |             |         |      |        |     |             |
| 1                                           | 2    | 3                               | 4    | 5    | 6    | 7                       | 8    | 9    | 10   | 11           | 12          | 13      | 14   | 15     | 16  | 17          |

Column #1. hrm = Harmonic; BE = Band Edge emissions

Column #2. Frequency of Transmitter.

Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #6. Average Reading based on peak reading reduced by the Duty cycle correction

Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #10. Average Reading based on peak reading reduced by the Duty cycle correction

Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor

Column #12. Frequency of Tested Emission

Column #13. Highest peak field strength at listed frequency.

Column #14. Highest Average field strength at listed frequency.

Column #15. Peak Limit.

Column #16. Average Limit.

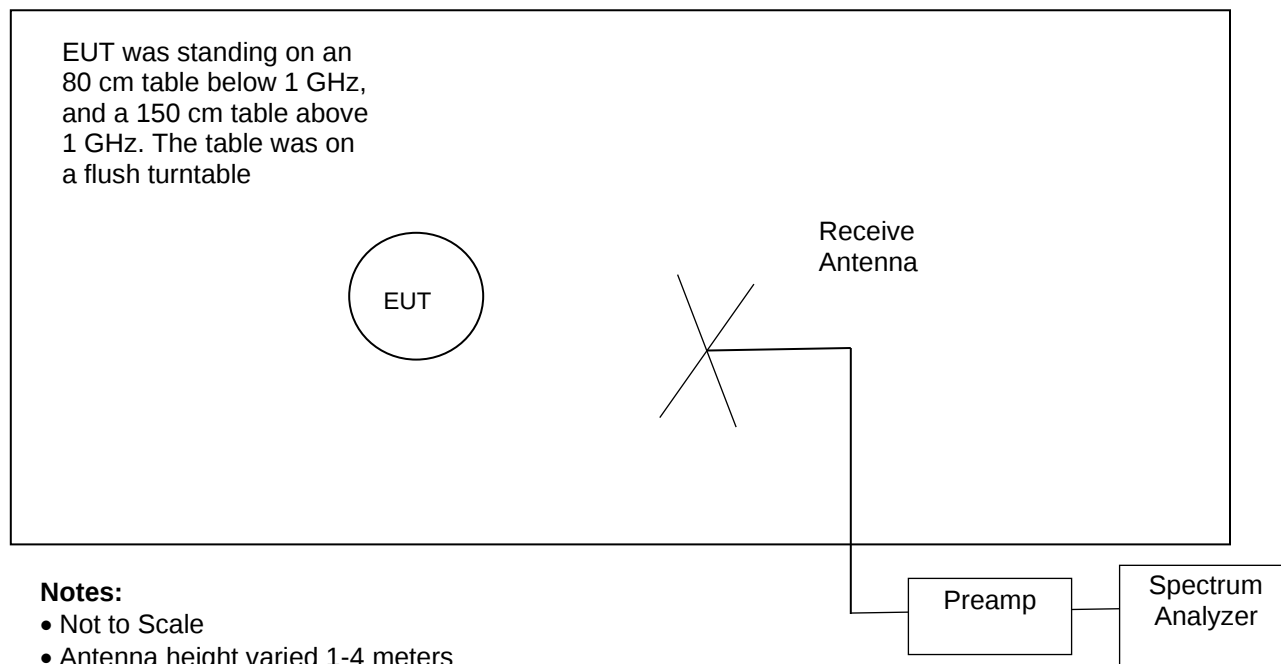
Column #17. The margin (last column) is the worst-case margin under the peak or average limits for that row.

Overall Judgment: Passed by at least 10 dB

No other Emissions were detected from 30 to 25,000 MHz within 10 dB of the limits.

**Figure 1. Drawings of Radiated Emissions Setup**

Chamber E, anechoic

**Notes:**

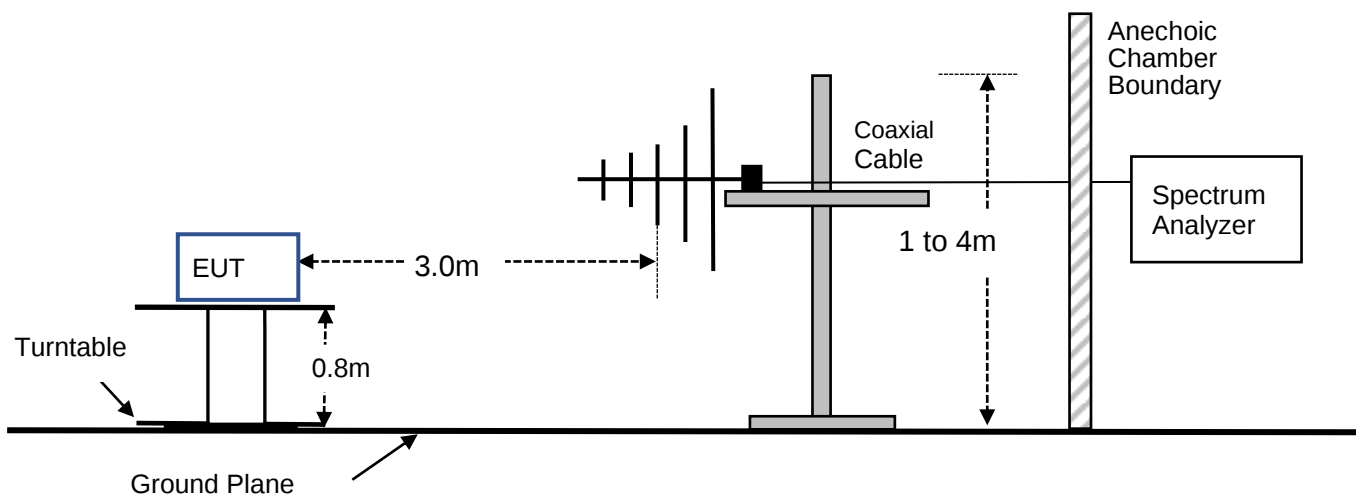
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

| Frequency Range | Receive Antenna | Pre-Amplifier | Spectrum Analyzer | High Pass Filter |
|-----------------|-----------------|---------------|-------------------|------------------|
| 30 to 200 MHz   | ANT-80          | None          | REC-21            | None*            |
| 200 to 1000 MHz | ANT-68          | None          | REC-21            | None*            |
| 1 to 10 GHz     | ANT-66          | AMP-05        | REC-21            | HPF-06           |
| 10 to 18 GHz    | ANT-66          | AMP-20        | REC-21            | None*            |

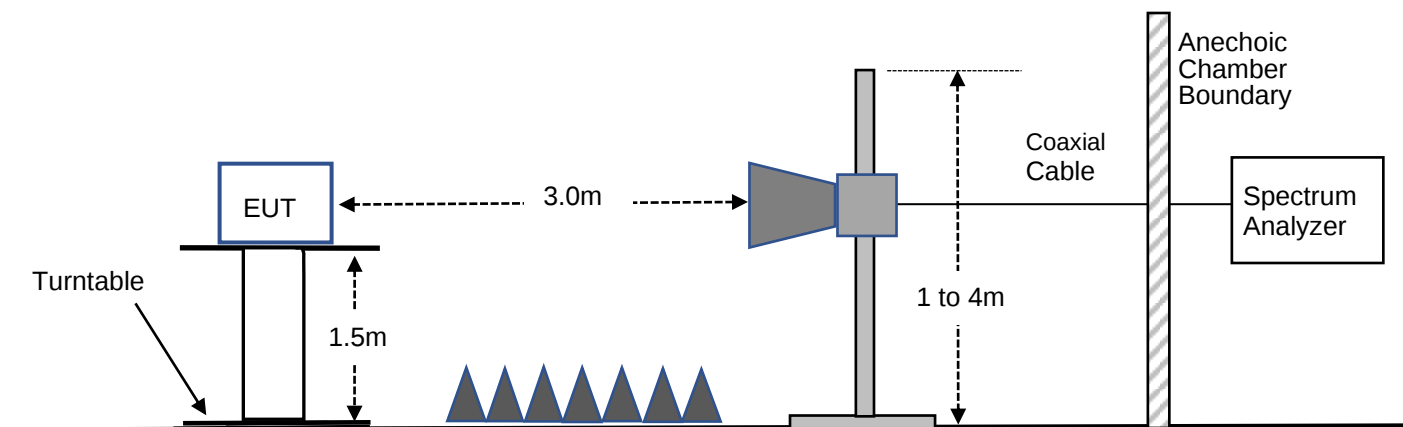
\* A high pass filter was not needed since the fundamental frequency was outside of the amplifiers pass band.



**Radiated Emissions Test Setup for Frequencies from 30MHz to 1000MHz (Side View)**



**Radiated Emissions Test Setup for Frequencies over 1000MHz (Side View)**





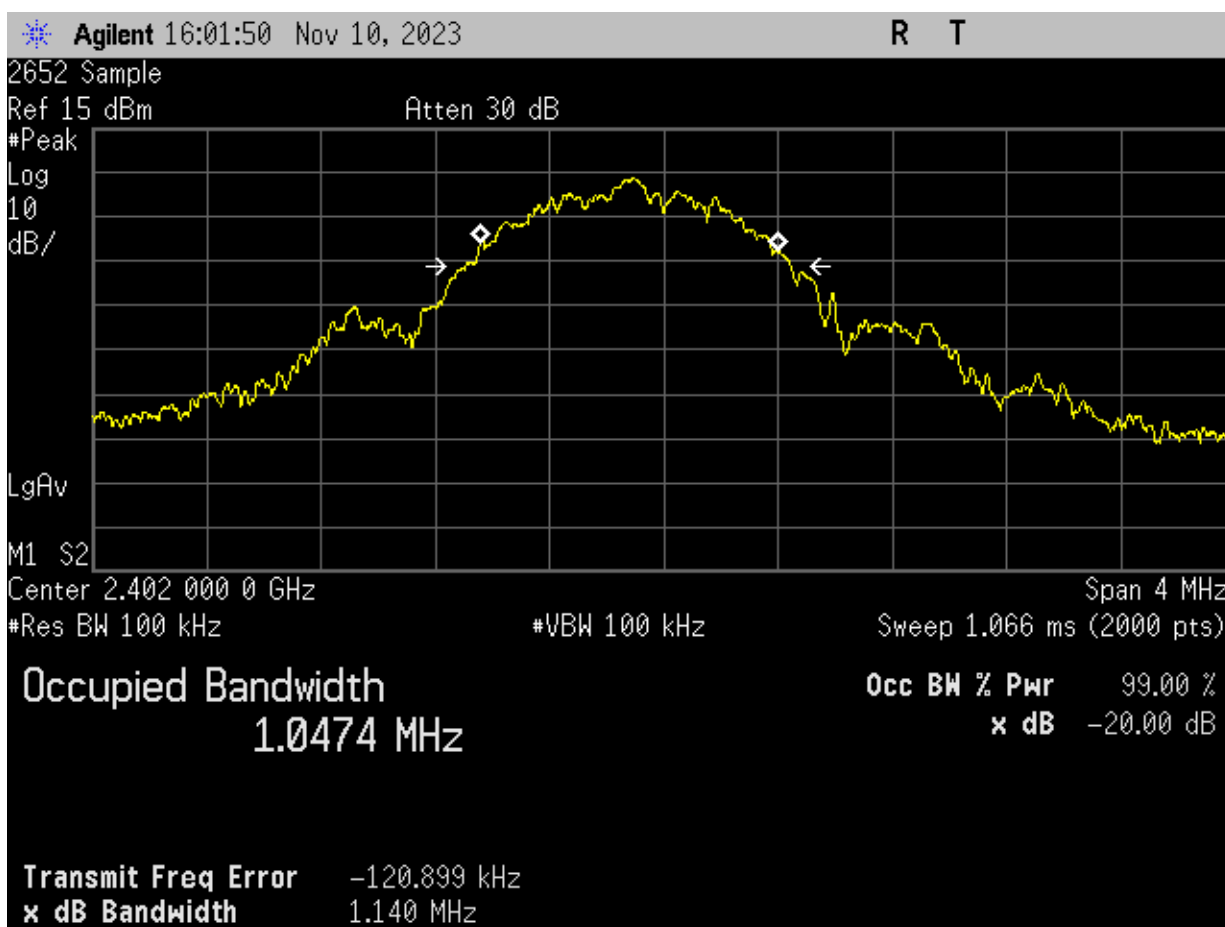
## 11.2 Occupied Bandwidth Data

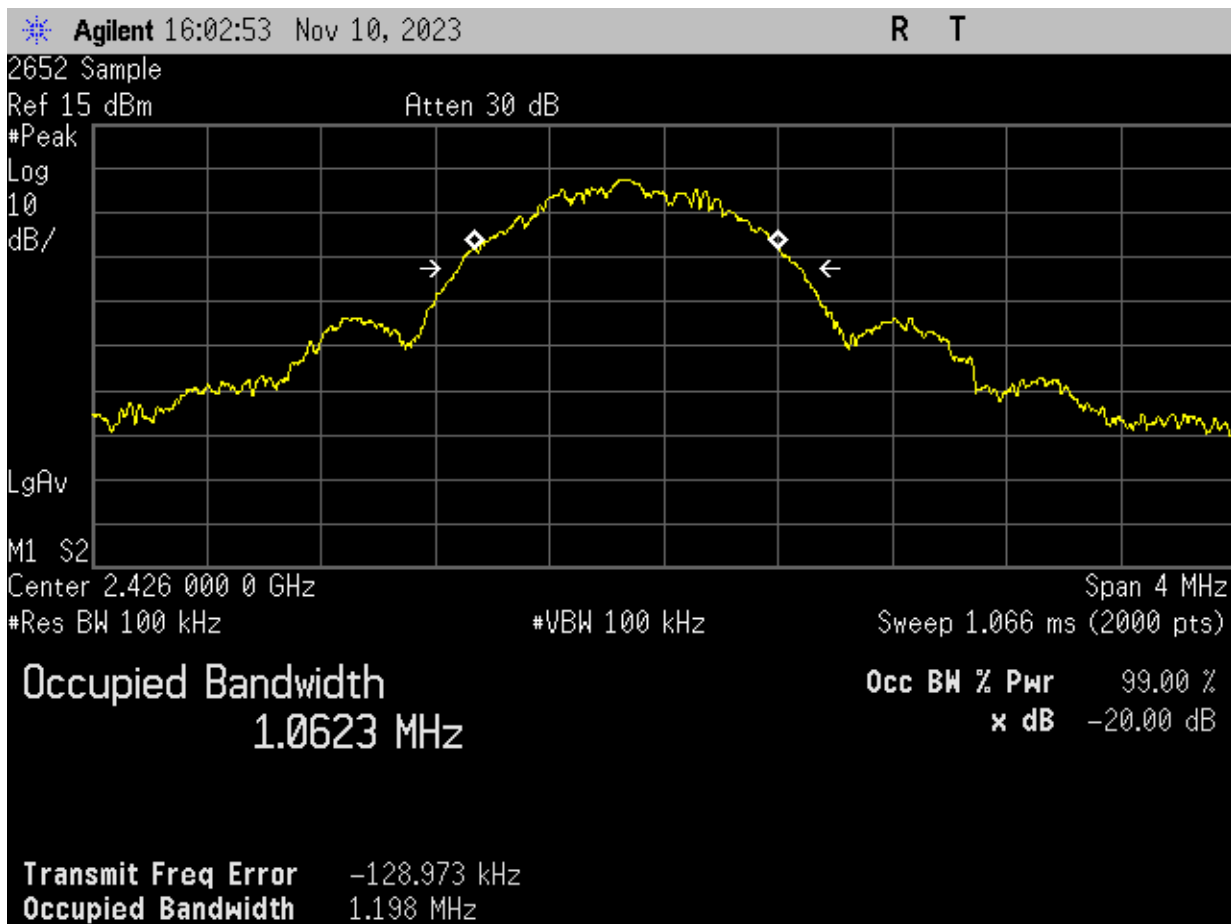
The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission. The plots of the occupied bandwidth for the EUT are supplied on the following pages.

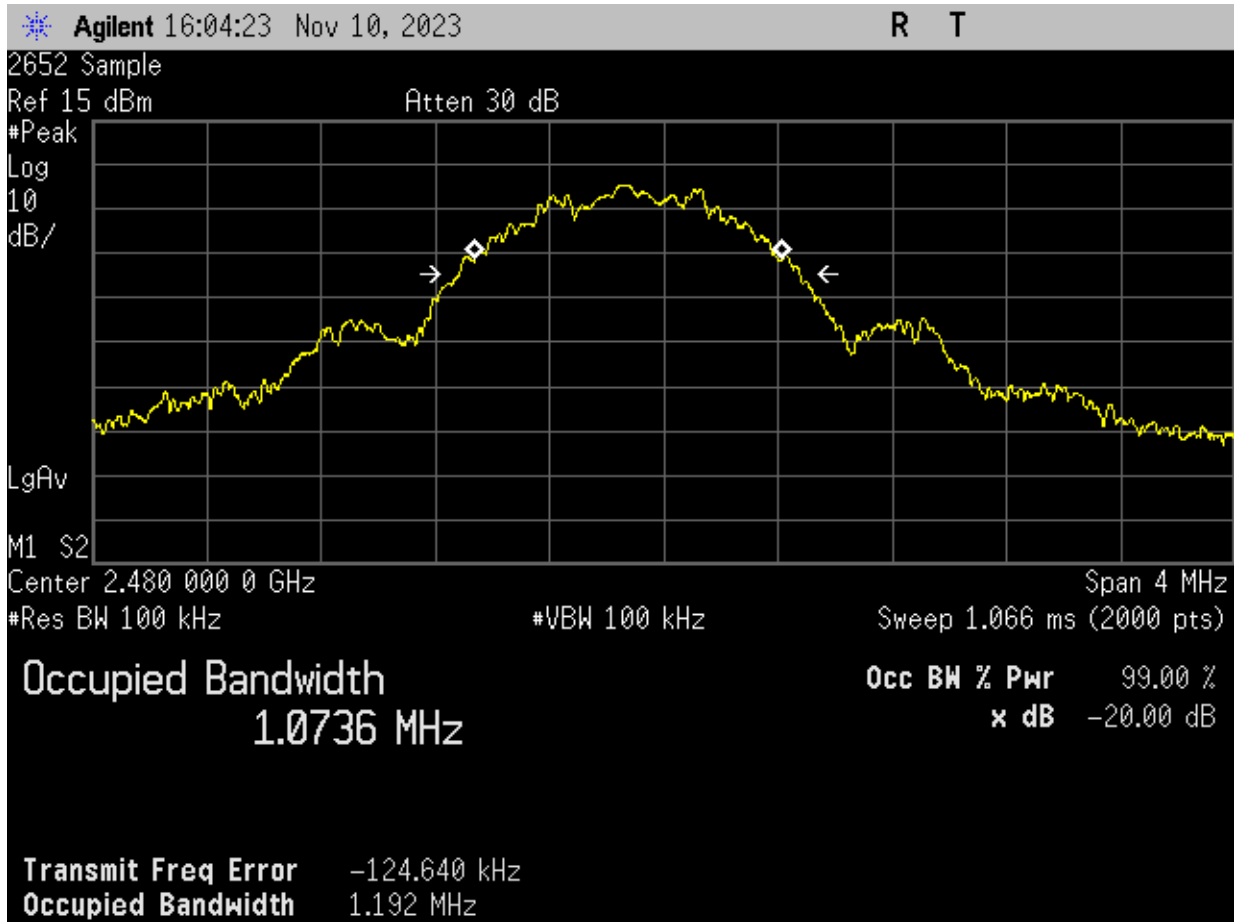
The 20 dB OBW is within the allowed 2400 to 2483.5 MHz authorized band.

| Channel | 99% EBW<br>MHz | 20 dB OBW<br>MHz |
|---------|----------------|------------------|
| 2402    | 1.0474         | 1.140            |
| 2440    | 1.0623         | 1.198            |
| 2480    | 1.0736         | 1.192            |

**Figure 2. Occupied Bandwidth Plot**







### 11.2.1 Measurement Instrumentation Uncertainty

| Measurement                                             | Uncertainty          |
|---------------------------------------------------------|----------------------|
| Radiated Emissions, E-field, 3 meters, 30 to 200 MHz    | 4.8 dB               |
| Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz  | 4.6 dB               |
| Radiated Emissions, E-field, 3 meters, 1 to 6 GHz       | 5.0 dB               |
| Radiated Emissions, E-field, 3 meters, 6 to 18 GHz      | 5.5 dB               |
| Radiated Emissions, E-field, 3 meters, 18 to 26 GHz     | 5.9 dB               |
| Bandwidth using marker delta method at a span of 10 MHz | 4 kHz                |
| 99% Occupied Bandwidth using REC-44                     | 1% of frequency span |
| Temperature THM-02                                      | 0.6 Deg C            |

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.

**12.0 REVISION HISTORY**

| Document RP-9829 Revisions: |                   |             |           |
|-----------------------------|-------------------|-------------|-----------|
| Rev.                        | Affected Sections | Description | Rationale |
|                             |                   |             |           |
|                             |                   |             |           |
|                             |                   |             |           |