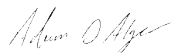


# Test Report TR3696A

|                        |                                                                                                       |                 |
|------------------------|-------------------------------------------------------------------------------------------------------|-----------------|
| Equipment Under Test:  | AEQ-001JKNF                                                                                           |                 |
| Requirement(s):        | FCC: 15.247<br>ISED: RSS-247                                                                          |                 |
| Test Date(s):          | 6/26/2023 – 6/28/2023, 7/11/2023, 12/27/2023 – 1/4/2024, 4/15/2024                                    |                 |
| Prepared for:          | Chicago Faucets, Inc<br>Attn: Larry Himelblau<br>2100 South Clearwater Drive<br>Des Plaines, IL 60018 |                 |
|                        |                                                                                                       |                 |
| Report Issued by:      | Dylan Rosenfeldt, EMC Engineer                                                                        |                 |
| Signature:             |                    | Date: 4/25/2024 |
| Report Reviewed by:    | Adam Alger, Laboratory Manager                                                                        |                 |
| Signature:             |                    | Date: 4/23/2024 |
| Report Constructed by: | Dylan Rosenfeldt, EMC Engineer                                                                        |                 |
| Signature:             |                    | Date: 1/8/2024  |

*This test report may not be reproduced, except in full, without approval of Ezurio*

|                                |              |                                   |
|--------------------------------|--------------|-----------------------------------|
| Company: Chicago Faucets, Inc. | Page 1 of 45 | Name: AEQ-001JKNF                 |
| Report: TR3696A                |              | Model: AEQ-001JKNF                |
| Quote: NBO-12-2021-004516-2    |              | Serial: Engineering Samples 1 & 2 |

## CONTENTS

|                                                                 |    |
|-----------------------------------------------------------------|----|
| Contents.....                                                   | 2  |
| Ezurio Test Services in Review .....                            | 3  |
| 1    Test Report Summary .....                                  | 4  |
| 2    Client Information.....                                    | 5  |
| 2.1    Equipment Under Test (EUT) Information .....             | 5  |
| 2.2    Product Description .....                                | 5  |
| 2.3    Modifications Incorporated for Compliance.....           | 5  |
| 2.4    Deviations and Exclusions from Test Specifications ..... | 5  |
| 2.5    Additional Information.....                              | 5  |
| 3    References .....                                           | 6  |
| 4    Uncertainty Summary .....                                  | 7  |
| 5    Test Data .....                                            | 8  |
| 5.1    Antenna Port Conducted Emissions.....                    | 8  |
| 5.2    Radiated Emissions .....                                 | 31 |
| 5.3    AC Mains Conducted Emissions .....                       | 42 |
| 6    Revision History .....                                     | 45 |

## Ezurio Test Services in Review

The Ezurio laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:



### **A2LA – American Association for Laboratory Accreditation**

*Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope*

*A2LA Certificate Number: 1255.01*

*Scope of accreditation includes all test methods listed herein unless otherwise noted*



### **Federal Communications Commission (FCC) – USA**

*Accredited Test Firm Registration Number: 953492*

*Recognition of two 3 meter Semi-Anechoic Chambers*



### **Innovation, Science and Economic Development Canada**

*Accredited U.S. Identification Number: US0218*

*Recognition of two 3 meter Semi-Anechoic Chambers*

|                                |              |                                   |
|--------------------------------|--------------|-----------------------------------|
| Company: Chicago Faucets, Inc. | Page 3 of 45 | Name: AEQ-001JKNF                 |
| Report: TR3696A                |              | Model: AEQ-001JKNF                |
| Quote: NBO-12-2021-004516-2    |              | Serial: Engineering Samples 1 & 2 |

## 1 TEST REPORT SUMMARY

During **6/26/2023 – 6/28/2023, 7/11/2023, 12/27/2023 – 1/4/2024, 4/15/2024**, the Equipment Under Test, **AEQ-001JKNF**, as provided by **Chicago Faucets, Inc.** was tested to the following requirements:

### FCC 15.247 / RSS-247, DTS

| Requirement                               | Description                                               | Specification             | Method      | Result |
|-------------------------------------------|-----------------------------------------------------------|---------------------------|-------------|--------|
| FCC: 15.247 (a)(2)<br>IC: RSS-247 5.2 (a) | Digital Modulation System 6 dB bandwidth                  | 500 kHz                   | ANSI C63.10 | Pass   |
| FCC: 2.1049<br>IC: RSS-GEN 6.7            | Occupied Bandwidth                                        | Reported                  | ANSI C63.10 | Pass   |
| FCC: 15.247 (b)(3)<br>IC: RSS-247 5.4 (d) | Maximum Conducted Output Power                            | 30 dBm                    | ANSI C63.10 | Pass   |
| FCC: 15.247 (e)<br>IC: RSS-247 5.2 (b)    | Digital Modulation System Power Spectral Density          | 8 dBm / 3 kHz             | ANSI C63.10 | Pass   |
| FCC: 15.247 (d)<br>IC: RSS-247 5.5        | RF Spurious Emissions at the Transmitter Antenna Terminal | 20 dBc                    | ANSI C63.10 | Pass   |
| FCC: 15.247 (d)<br>IC: RSS-GEN 8.10       | Spurious Radiated Emissions in Restricted Bands           | FCC 15.209<br>RSS-GEN 8.9 | ANSI C63.10 | Pass   |
| FCC: 2.1055 (d)<br>IC: RSS-GEN 6.11       | Frequency Stability                                       | Reported                  | ANSI C63.10 | Pass   |
| FCC: 15.207<br>IC: RSS-GEN 8.8            | AC Power Line Conducted Emissions                         | 0.150-30 MHz              | ANSI C63.10 | Pass   |

### Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

| Measurement Type      | Rule                           |
|-----------------------|--------------------------------|
| Emissions – Amplitude | 1 dB below specified limit     |
| Emissions – Frequency | 1% less than the specification |
| Immunity              | Tested at specified level      |

## 2 CLIENT INFORMATION

|                       |                                                      |
|-----------------------|------------------------------------------------------|
| <b>Company Name</b>   | Chicago Faucets, Inc                                 |
| <b>Contact Person</b> | Larry Himelblau                                      |
| <b>Address</b>        | 2100 South Clearwater Drive<br>Des Plaines, IL 60018 |

### 2.1 Equipment Under Test (EUT) Information

*The following information has been supplied by the client*

|                      |                           |
|----------------------|---------------------------|
| <b>Product Name</b>  | AEQ-001JKNF               |
| <b>Model Number</b>  | AEQ-001JKNF               |
| <b>Serial Number</b> | Engineering Samples 1 & 2 |
| <b>FCC ID</b>        | 2APTX-CFC05               |
| <b>IC ID</b>         | 31327-CFC05               |

### 2.2 Product Description

BLE module

### 2.3 Modifications Incorporated for Compliance

None noted at time of test

### 2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

### 2.5 Additional Information

Powered by 6VDC from 120VAC adapter. Device is programmed via FTDI-USB cable. Programmed using STM32CubeMonitor-RF version 2.11.0. Channels used low, mid, high (2402 MHz, 2440 MHz, 2480 MHz) with a data rate of 1Mbps and 2Mbps using a pseudo-random bit sequence 9 modulation. The transmit power setting used was 'PA level 31 (+6dBm)'. FTDI leads and header added to program module for both units. Unit 2 – Resistor removed in line to chip antenna and u.fl connector added for conducted RF testing.

### 3 REFERENCES

| Publication | Edition | Date | AMD 1 | AMD 2 |
|-------------|---------|------|-------|-------|
| FCC eCFR    | -       | 2023 | -     | -     |
| RSS-247     | 3       | 2023 | -     | -     |
| RSS-GEN     | 5       | 2018 | 2019  | 2021  |
| ANSI C63.10 | -       | 2020 | -     | -     |

## 4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of  $k = 2$ .

| References      |
|-----------------|
| CISPR 16-4-1    |
| CISPR 16-4-2    |
| CISPR 32        |
| ANSI C63.23     |
| A2LA P103       |
| A2LA P103c      |
| ETSI TR 100-028 |

| Measurement Type            | Configuration                 | Uncertainty $\pm$ |
|-----------------------------|-------------------------------|-------------------|
| Radiated Emissions          | Biconical Antenna             | 5.0 dB            |
| Radiated Emissions          | Log Periodic Antenna          | 5.3 dB            |
| Radiated Emissions          | Horn Antenna                  | 4.7 dB            |
| AC Line Conducted Emissions | Artificial Mains Network      | 3.4 dB            |
| Telecom Conducted Emissions | Asymmetric Artificial Network | 4.9 dB            |
| Disturbance Power Emissions | Absorbing Clamp               | 4.1 dB            |
| Radiated Immunity           | 3 Volts/meter                 | 2.2 dB            |
| Conducted Immunity          | CDN/EM/BCI                    | 2.4/3.5/3.4 dB    |
| EFT Burst/Surge             | Peak pulse voltage            | 164 volts         |
| ESD Immunity                | 15 kV level                   | 1377 Volts        |

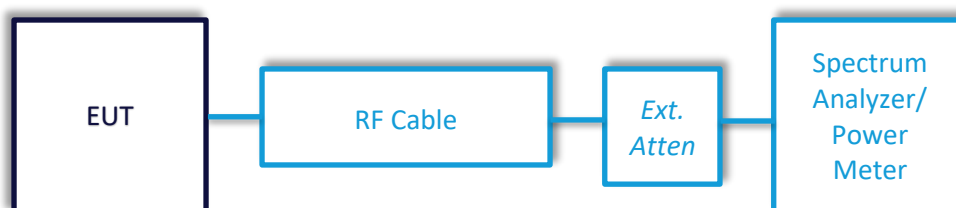
| Parameter                                  | ETSI U.C. $\pm$    | U.C. $\pm$            |
|--------------------------------------------|--------------------|-----------------------|
| Radio Frequency, from F0                   | $1 \times 10^{-7}$ | $0.55 \times 10^{-7}$ |
| Occupied Channel Bandwidth                 | 5 %                | 2 %                   |
| RF conducted Power (Power Meter)           | 1.5 dB             | 1.2 dB                |
| RF conducted emissions (Spectrum Analyzer) | 3.0 dB             | 1.7 dB                |
| All emissions, radiated                    | 6.0 dB             | 5.3 dB                |
| Temperature                                | 1° C               | 0.65° C               |
| Humidity                                   | 5 %                | 2.9 %                 |
| Supply voltages                            | 3 %                | 1 %                   |

## 5 TEST DATA

### 5.1 Antenna Port Conducted Emissions

|                                   |                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description of Measurement</b> | <p>The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter.</p> <p>The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.</p> |
| <b>Example Calculations</b>       | <p>Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm)</p> <p>Margin (dB) = Limit (dBm) – Corrected Reading (dBm)</p>                                                                                                                                                                  |

#### Block Diagram



### 5.1.1 DTS Bandwidth

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

**Limits: Greater than 500kHz**

### Test Parameters

|                    |                      |              |           |
|--------------------|----------------------|--------------|-----------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b> | Conducted |
| <b>RBW</b>         | 100 kHz              | <b>VBW</b>   | 300 kHz   |
| <b>Detector(s)</b> | Max Peak Hold        |              |           |

### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

#### EUT Parameters

|                    |                      |                               |                   |
|--------------------|----------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC via AC adapter  | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2               | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

#### Data Table

| Channel | Data Rate | DTS BW (kHz) | Limit (kHz) | Margin (kHz) |
|---------|-----------|--------------|-------------|--------------|
| 37      | BLE 1Mbps | 664.0        | 500         | 164.0        |
| 37      | BLE 2Mbps | 1136.0       | 500         | 636.0        |
| 17      | BLE 1Mbps | 661.6        | 500         | 161.6        |
| 17      | BLE 2Mbps | 1135.0       | 500         | 635.0        |
| 39      | BLE 1Mbps | 662.0        | 500         | 162.0        |
| 39      | BLE 2Mbps | 1134.0       | 500         | 134.0        |

## Plots



### 5.1.2 99% Occupied Bandwidth

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

### Limits: Reported

### Test Parameters

|                    |                      |              |              |
|--------------------|----------------------|--------------|--------------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b> | Conducted    |
| <b>RBW</b>         | 30, 62 kHz           | <b>VBW</b>   | 100, 300 kHz |
| <b>Detector(s)</b> | Max Peak Hold        |              |              |

### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

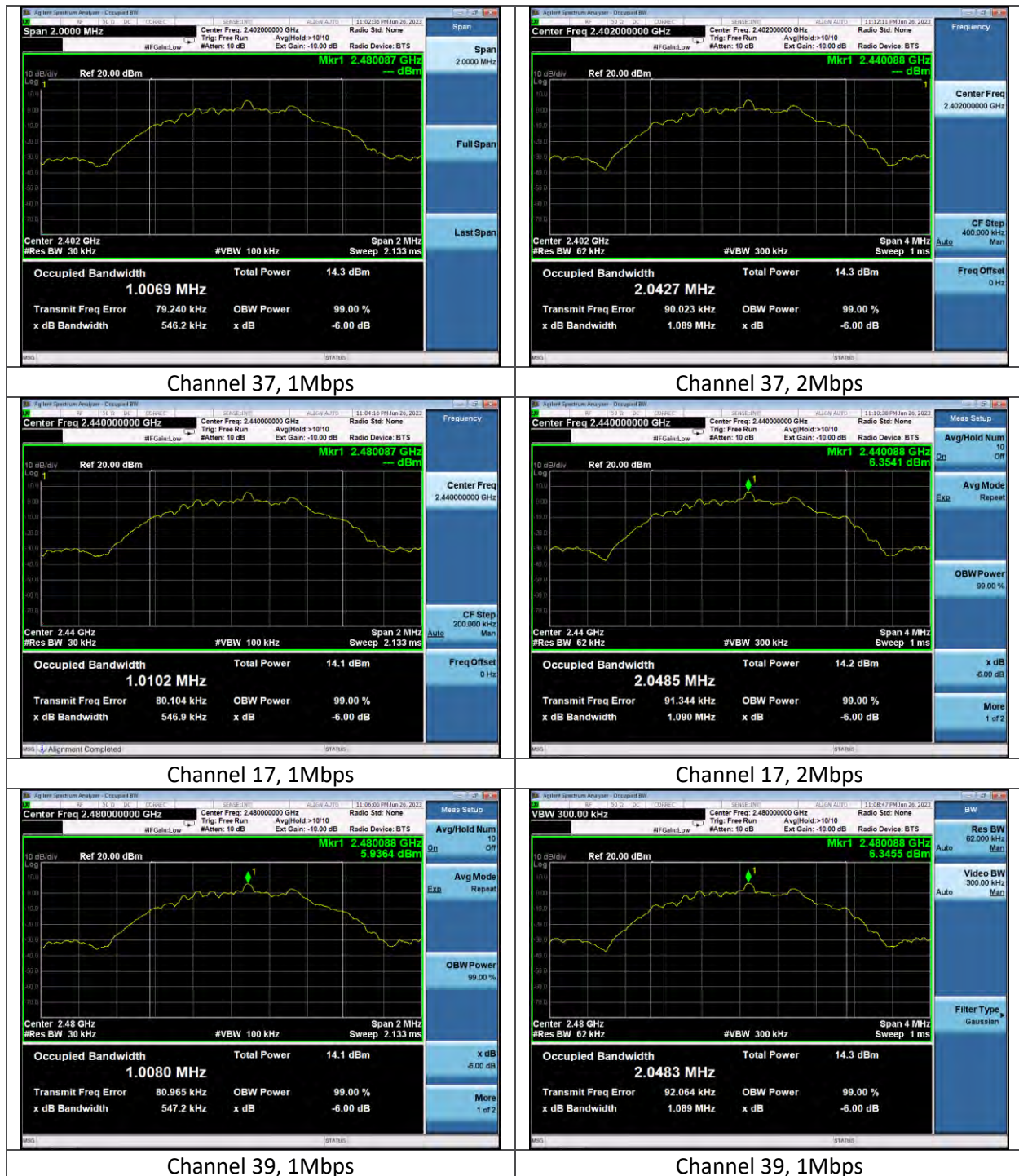
#### EUT Parameters

|                    |                      |                               |                   |
|--------------------|----------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC via AC adapter  | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2               | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

#### Data Table

| Channel | Data Rate | 99% OBW (MHz) |
|---------|-----------|---------------|
| 37      | BLE 1Mbps | 1.01          |
| 37      | BLE 2Mbps | 2.04          |
| 17      | BLE 1Mbps | 1.01          |
| 17      | BLE 2Mbps | 2.05          |
| 39      | BLE 1Mbps | 1.01          |
| 39      | BLE 2Mbps | 2.05          |

## Plots



### 5.1.3 Peak Output Power

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

**Limits: 30dBm**

#### Test Parameters

|                    |                      |              |           |
|--------------------|----------------------|--------------|-----------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b> | Conducted |
| <b>RBW</b>         | 1, 2 MHz             | <b>VBW</b>   | 3, 6 MHz  |
| <b>Detector(s)</b> | Max Peak Hold        |              |           |

#### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

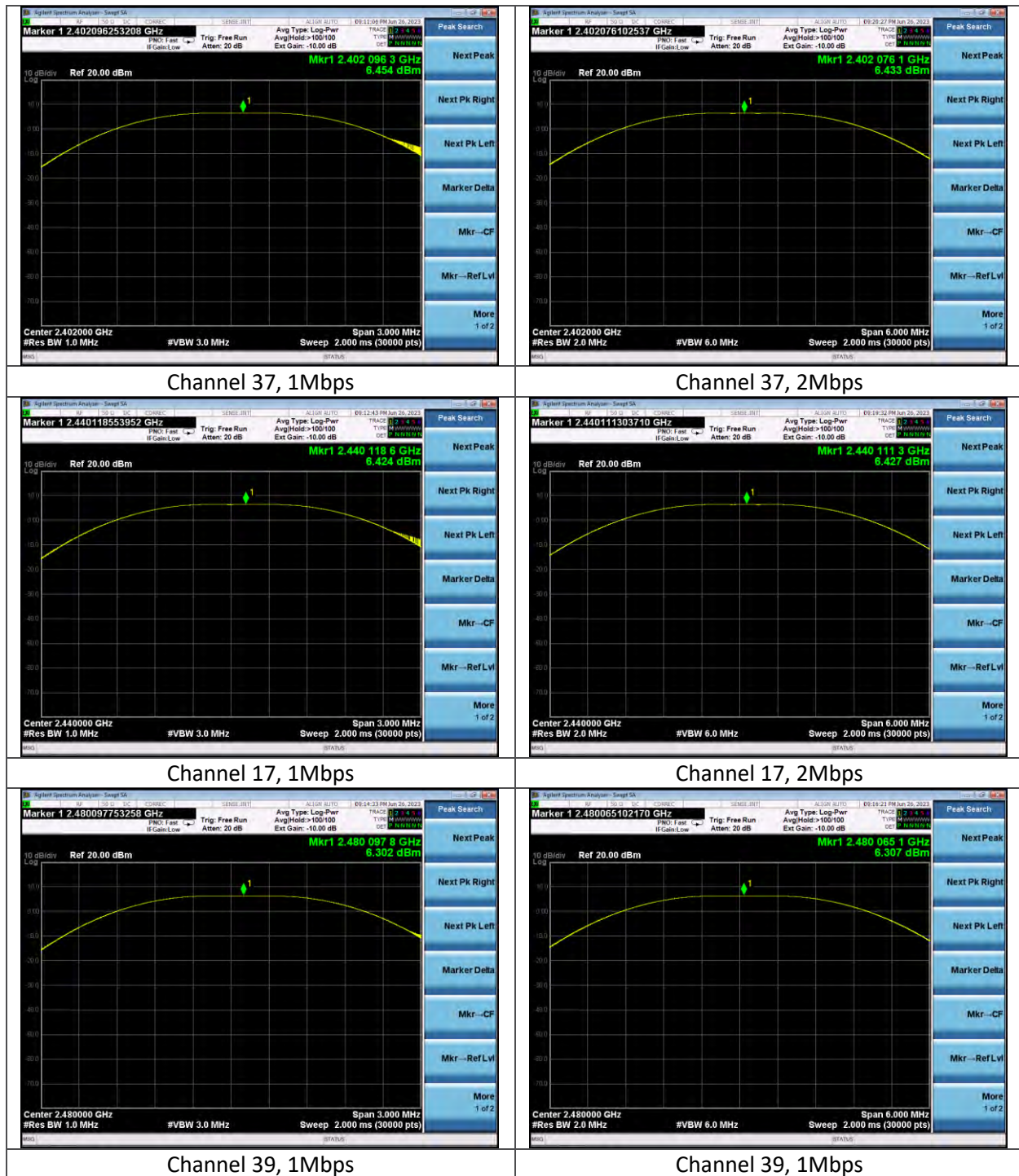
#### EUT Parameters

|                    |                      |                               |                   |
|--------------------|----------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC via AC adapter  | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2               | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

#### Data Table

| Channel | Data Rate | Transmit Power Setting | Peak Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------|------------------------|-------------------------|-------------|-------------|
| 37      | BLE 1Mbps | 31                     | 6.5                     | 30          | 23.5        |
| 37      | BLE 2Mbps | 31                     | 6.4                     | 30          | 23.6        |
| 17      | BLE 1Mbps | 31                     | 6.4                     | 30          | 23.6        |
| 17      | BLE 2Mbps | 31                     | 6.4                     | 30          | 23.6        |
| 39      | BLE 1Mbps | 31                     | 6.3                     | 30          | 23.7        |
| 39      | BLE 2Mbps | 31                     | 6.3                     | 30          | 23.7        |

## Plots



#### 5.1.4 Peak Power Spectral Density

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

Limits: 8dBm / 3kHz

#### Test Parameters

|                    |                      |              |           |
|--------------------|----------------------|--------------|-----------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b> | Conducted |
| <b>RBW</b>         | 100 kHz              | <b>VBW</b>   | 300 kHz   |
| <b>Detector(s)</b> | Max Peak Hold        |              |           |

#### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

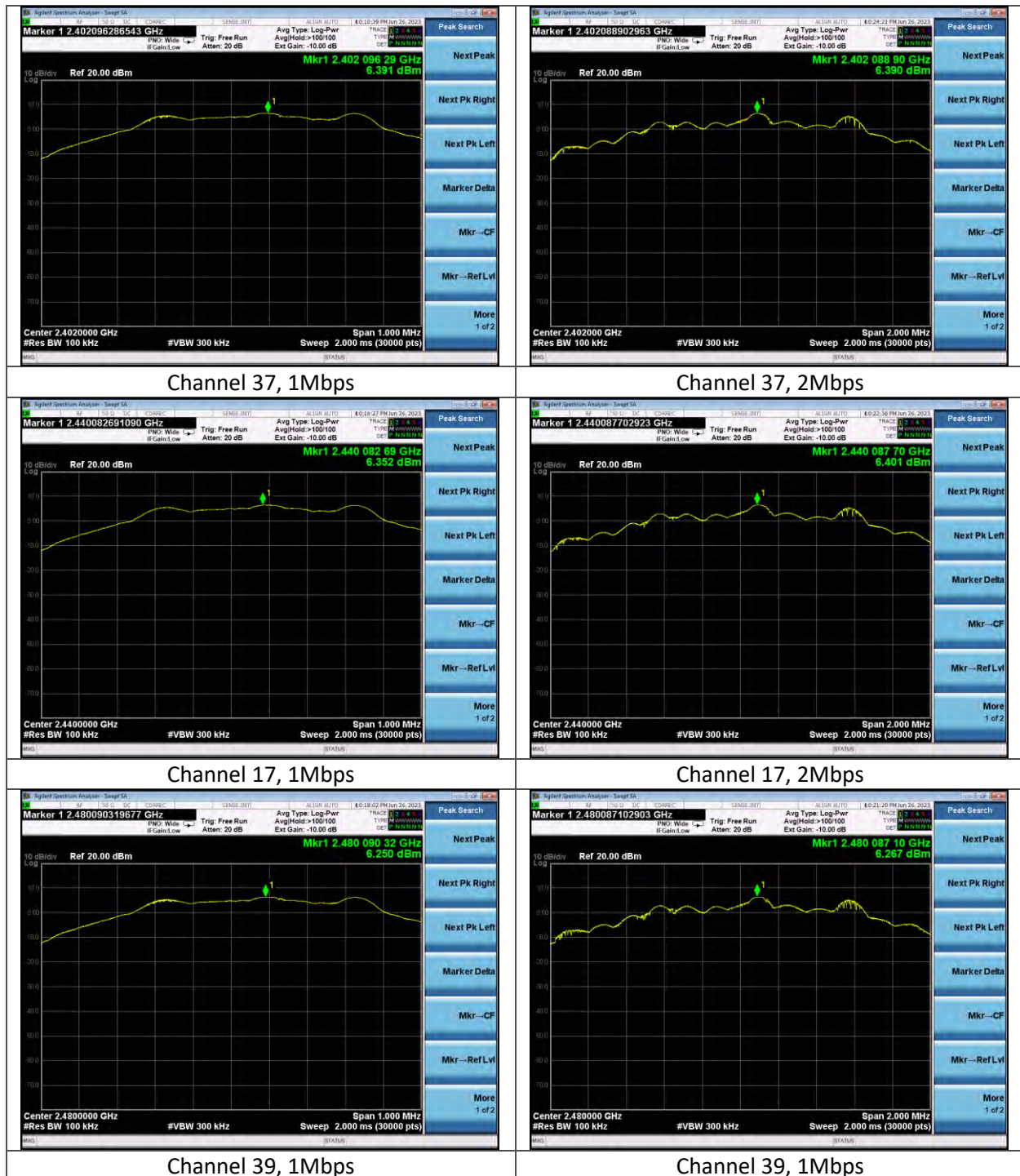
#### EUT Parameters

|                    |                      |                               |                   |
|--------------------|----------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC via AC adapter  | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2               | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

#### Data Table

| Channel | Data Rate | Transmit Power Setting | PSD Reading (dBm/100kHz) | Limit (dBm/3 kHz) | Margin (dB) |
|---------|-----------|------------------------|--------------------------|-------------------|-------------|
| 37      | BLE 1Mbps | 31                     | 6.4                      | 8.0               | 1.6         |
| 37      | BLE 2Mbps | 31                     | 6.4                      | 8.0               | 1.6         |
| 17      | BLE 1Mbps | 31                     | 6.4                      | 8.0               | 1.6         |
| 17      | BLE 2Mbps | 31                     | 6.4                      | 8.0               | 1.6         |
| 39      | BLE 1Mbps | 31                     | 6.3                      | 8.0               | 1.7         |
| 39      | BLE 2Mbps | 31                     | 6.3                      | 8.0               | 1.7         |

## Plots



### 5.1.5 Conducted Spurious Emissions

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

**Limits: 20 dBc**

**Reference level = 6.4 dBm**

**Limit = -13.6 dBm**

#### Test Parameters

|                    |                      |                          |                                             |
|--------------------|----------------------|--------------------------|---------------------------------------------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b>             | Conducted                                   |
| <b>RBW</b>         | 100 kHz              | <b>VBW</b>               | 300 kHz                                     |
| <b>Detector(s)</b> | Max Peak Hold        | <b>Limit Calculation</b> | Reference Level (dBm) – 20 dB = Limit (dBm) |

#### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

## Reference Level Plot



## EUT Parameters

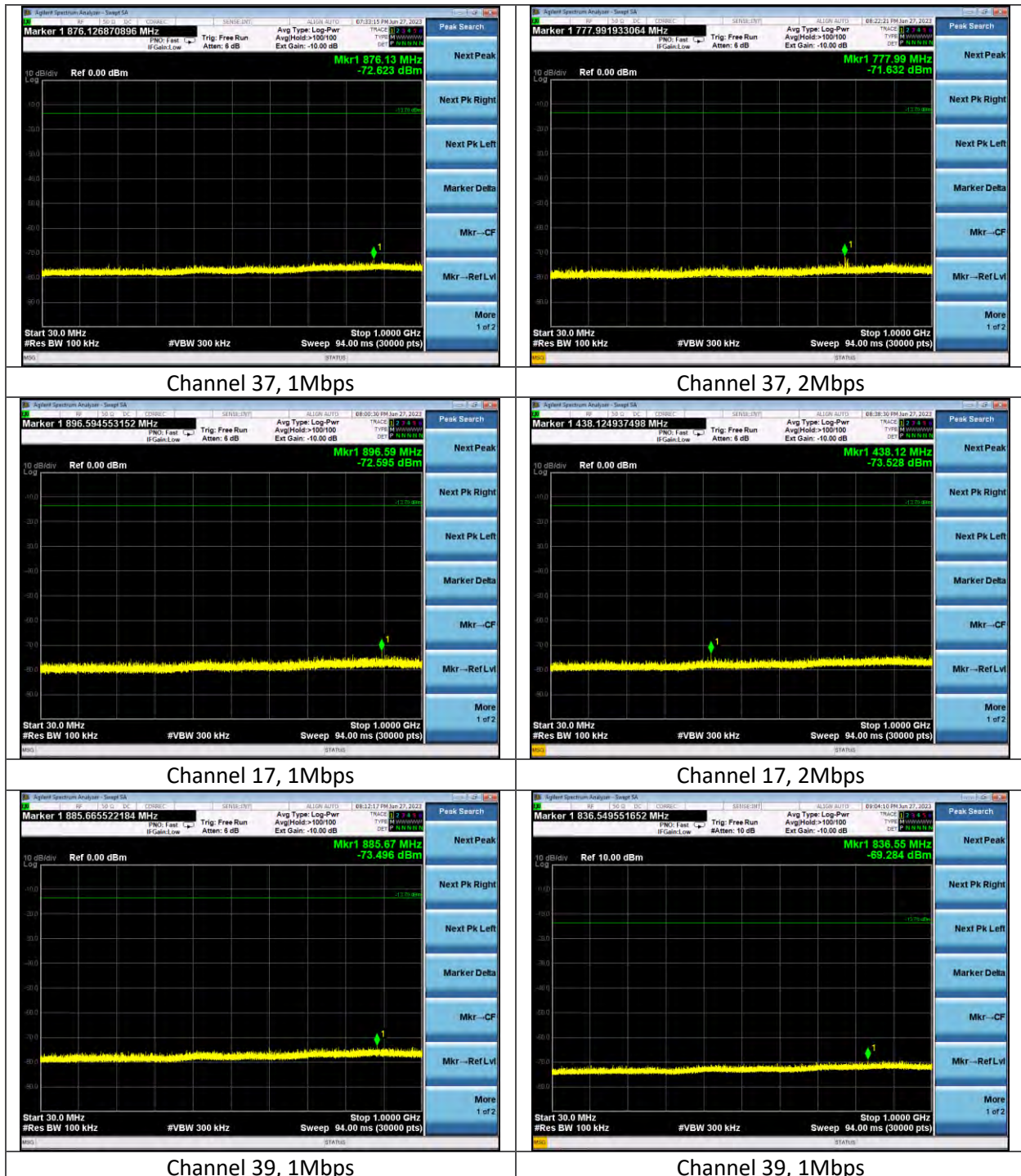
|                    |                      |                               |                   |
|--------------------|----------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC via AC adapter  | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2               | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

## Data Table

| Frequency (MHz) | Emission Measurement (dBm) | Limit (dBm) | Margin (dB) | Channel | Data Rate |
|-----------------|----------------------------|-------------|-------------|---------|-----------|
| 876.1           | -72.6                      | -13.6       | 59.0        | 37      | 1 Mbps    |
| 2400.0          | -34.9                      | -13.6       | 21.3        | 37      | 1 Mbps    |
| 12011.3         | -54.7                      | -13.6       | 41.1        | 37      | 1 Mbps    |
| 9609.5          | -57.0                      | -13.6       | 43.4        | 37      | 1 Mbps    |
| 869.6           | -72.6                      | -13.6       | 59.0        | 17      | 1 Mbps    |
| 2328.0          | -61.0                      | -13.6       | 47.4        | 17      | 1 Mbps    |
| 23570.2         | -53.5                      | -13.6       | 39.9        | 17      | 1 Mbps    |
| 885.7           | -73.5                      | -13.6       | 59.9        | 39      | 1 Mbps    |
| 2372.4          | -61.2                      | -13.6       | 47.6        | 39      | 1 Mbps    |
| 2483.5          | -43.7                      | -13.6       | 30.1        | 39      | 1 Mbps    |
| 778.0           | -71.6                      | -13.6       | 58.0        | 37      | 2 Mbps    |
| 2400.0          | -16.7                      | -13.6       | 3.1         | 37      | 2 Mbps    |
| 12012.8         | -53.9                      | -13.6       | 40.3        | 37      | 2 Mbps    |
| 438.1           | -73.5                      | -13.6       | 59.9        | 17      | 2 Mbps    |
| 2290.0          | -61.7                      | -13.6       | 48.1        | 17      | 2 Mbps    |
| 23980.7         | -55.2                      | -13.6       | 41.6        | 17      | 2 Mbps    |
| 836.6           | -69.3                      | -13.6       | 55.7        | 39      | 2 Mbps    |
| 2360.5          | -57.9                      | -13.6       | 44.3        | 39      | 2 Mbps    |
| 2483.6          | -41.8                      | -13.6       | 28.2        | 39      | 2 Mbps    |

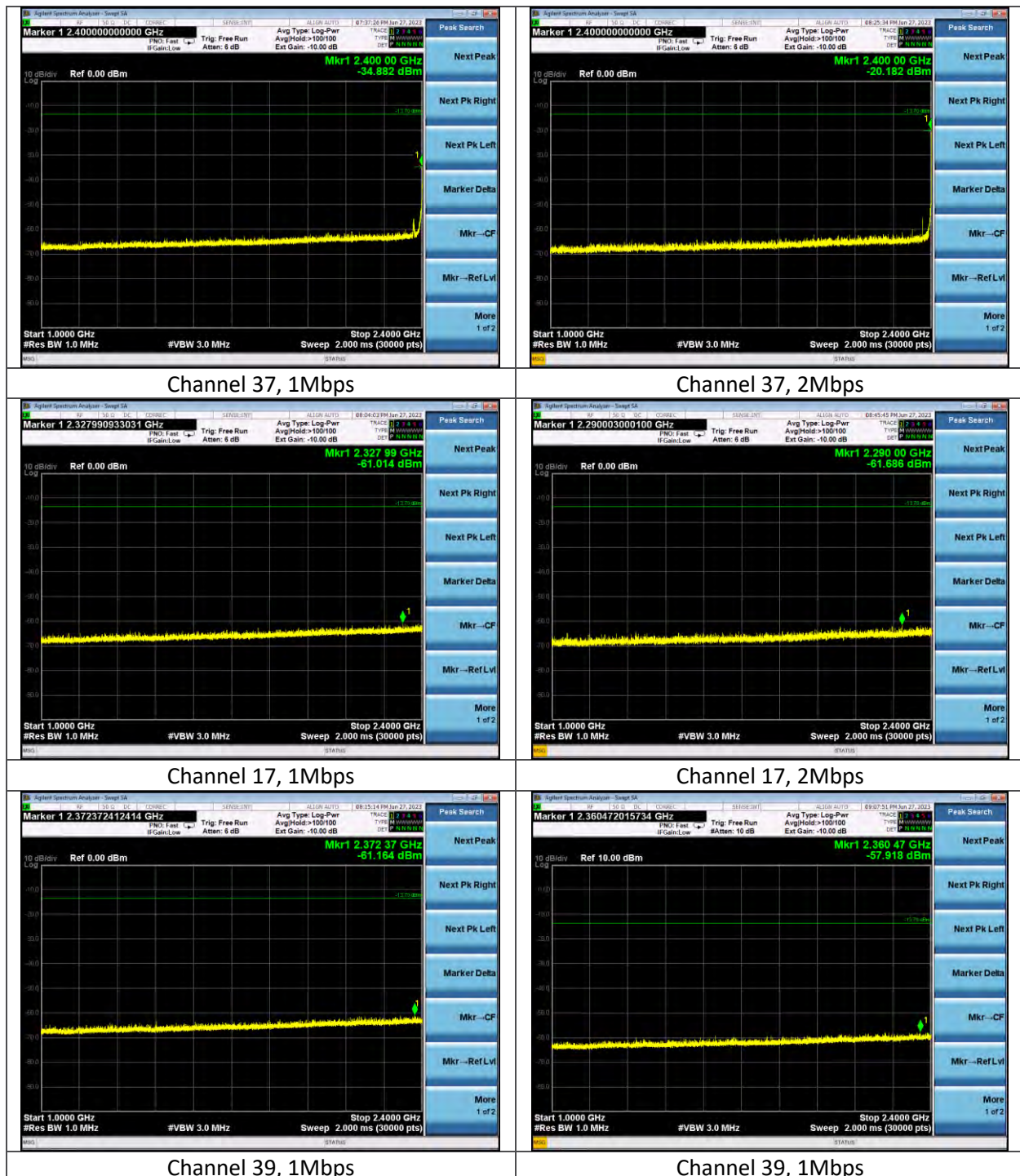
## Plots

### 30 – 1000 MHz



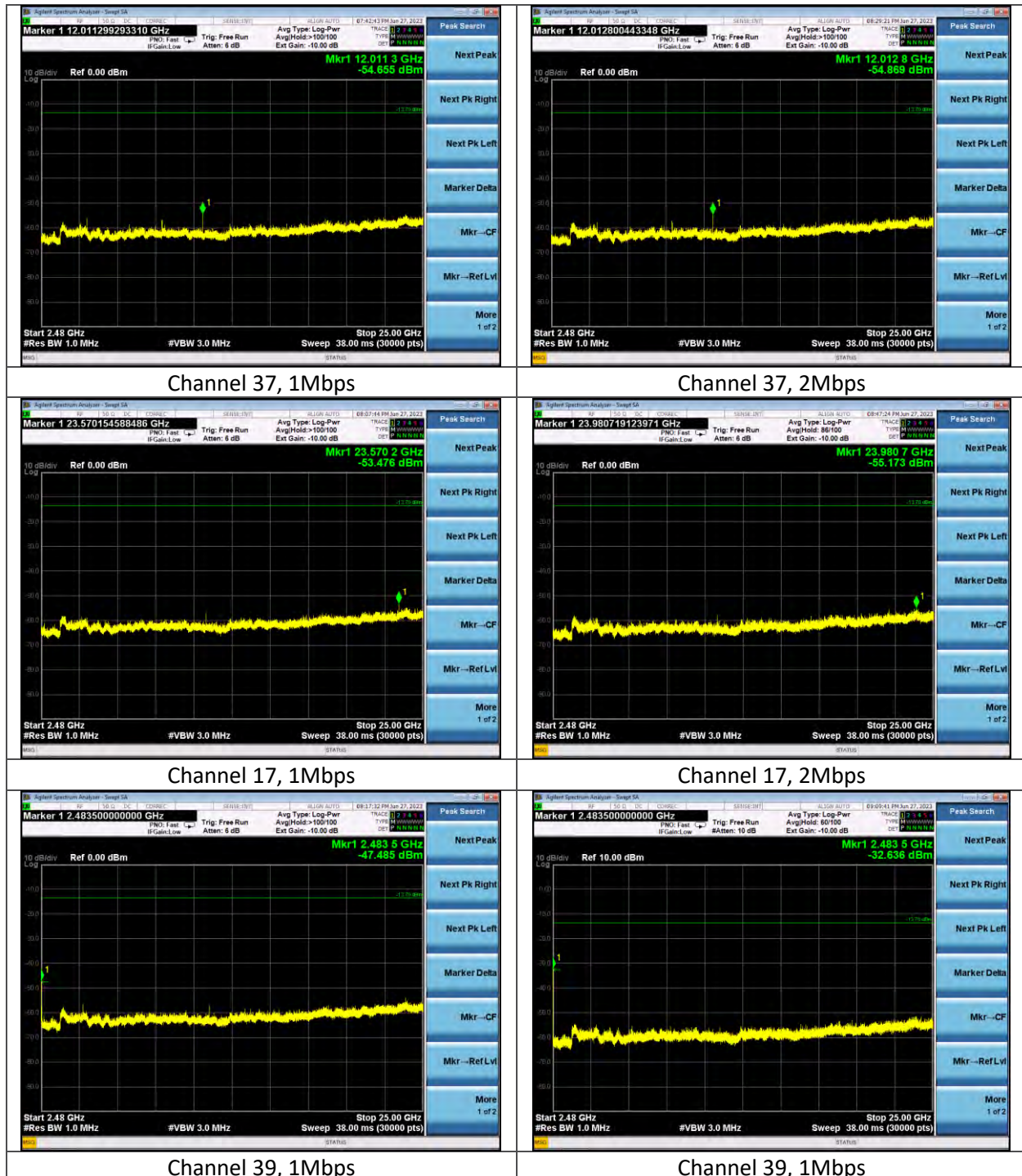
# Plots

## 1000 – 2400 MHz



# Plots

2483.5 – 25000 MHz



Company: Chicago Faucets, Inc.

Report: TR3696A

Quote: NBO-12-2021-004516-2

Name: AEQ-001JKNF

Model: AEQ-001JKNF

Serial: Engineering Samples 1 & 2

### 5.1.6 Frequency Stability

|                    |                              |                 |                    |
|--------------------|------------------------------|-----------------|--------------------|
| <b>Operator</b>    | Dylan Rosenfeldt             | <b>QA</b>       | Anthony Smith      |
| <b>Temperature</b> | 21.3°C                       | <b>R.H. %</b>   | 46.9%              |
| <b>Test Date</b>   | 6/6/2023                     | <b>Location</b> | Conducted RF Bench |
| <b>Requirement</b> | FCC: 15.247<br>ISED: RSS-247 | <b>Method</b>   | ANSI C63.10        |

### Limits: Reported

### Test Parameters

|                    |                      |              |           |
|--------------------|----------------------|--------------|-----------|
| <b>Frequency</b>   | 2402, 2440, 2480 MHz | <b>Setup</b> | Conducted |
| <b>RBW</b>         | 1 kHz                | <b>VBW</b>   | 3 kHz     |
| <b>Detector(s)</b> | Max Peak Hold        |              |           |

### Instrumentation

| Asset #   | Description         | Manufacturer       | Model #   | Serial #   | Date      | Due Date  | Status              |
|-----------|---------------------|--------------------|-----------|------------|-----------|-----------|---------------------|
| EE 960087 | Analyzer - Spectrum | Agilent            | N9010A    | MY53400296 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960173 | Cable               | A.H. Systems, Inc. | SAC-26G-1 | 388        | 6/13/2023 | 6/12/2024 | Active Verification |

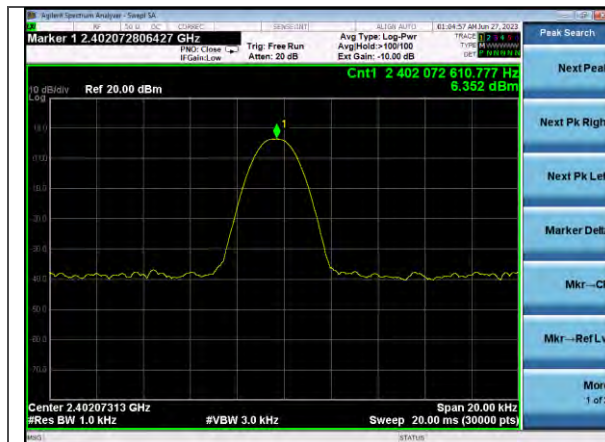
#### EUT Parameters

|                    |                                             |                               |                   |
|--------------------|---------------------------------------------|-------------------------------|-------------------|
| <b>Input Power</b> | 6VDC, 5.1VDC, 6.9VDC via Bench Power supply | <b>Mode</b>                   | BLE TX            |
| <b>Frequency</b>   | 2402, 2440, 2480 MHz                        | <b>Channel</b>                | 37, 17, 39        |
| <b>Serial</b>      | Unit 2                                      | <b>Data Rate / Modulation</b> | 1 & 2 Mbps, PRBS9 |

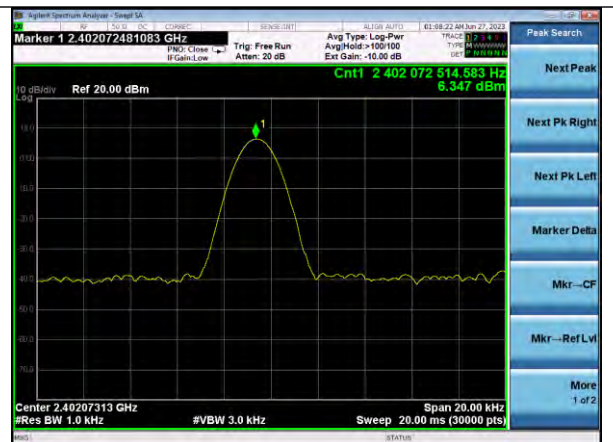
#### Data Table

| Channel | Voltage | Frequency (Hz) | Frequency Deviation (Hz) |
|---------|---------|----------------|--------------------------|
| 37      | 6.0     | 2402072611     | 0                        |
| 37      | 5.1     | 2402072515     | 96                       |
| 37      | 6.9     | 2402072340     | 271                      |
| 17      | 6.0     | 2440073132     | 0                        |
| 17      | 5.1     | 2440073235     | 103                      |
| 17      | 6.9     | 2440073195     | 63                       |
| 39      | 6.0     | 2480074699     | 0                        |
| 39      | 5.1     | 2480074639     | 60                       |
| 39      | 6.9     | 2480074503     | 196                      |

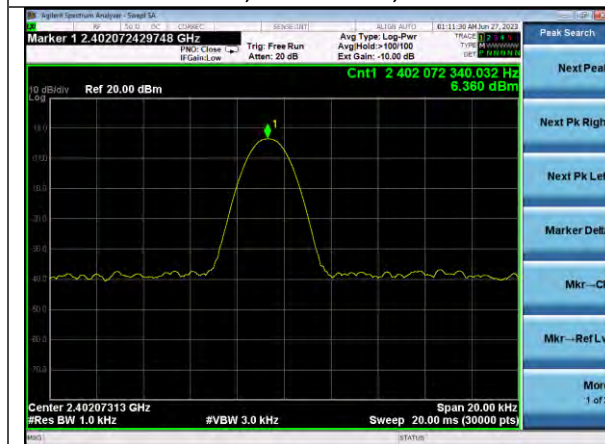
## Plots



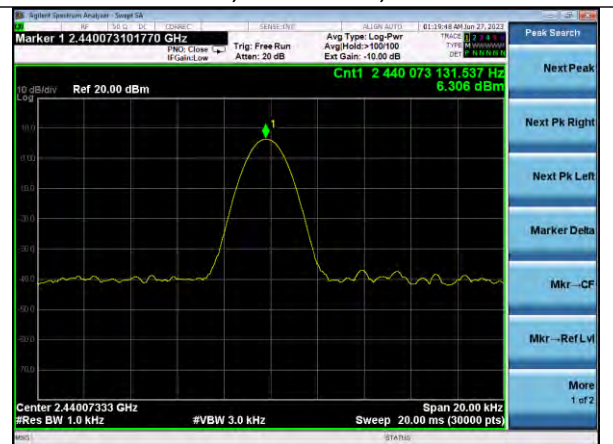
6.0V, Channel 37, CW



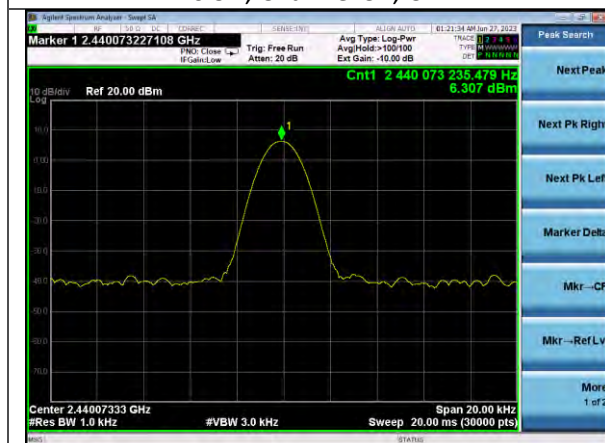
5.1V, Channel 37, CW



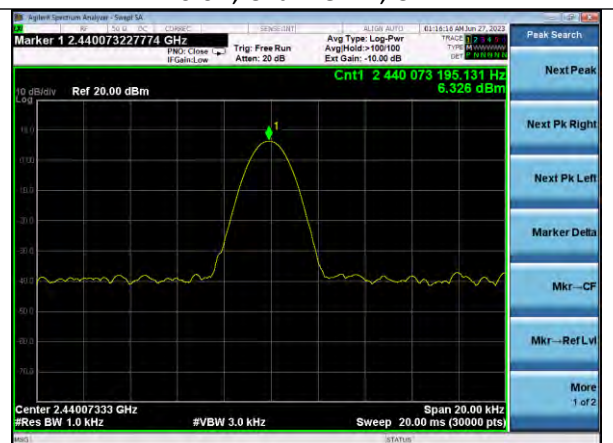
6.9V, Channel 37, CW



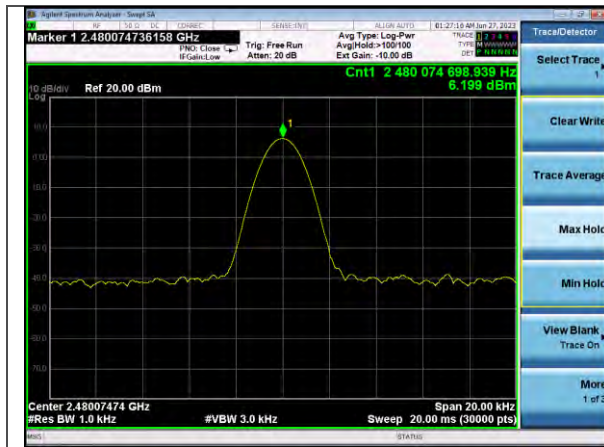
6.0V, Channel 17, CW



5.1V, Channel 17, CW



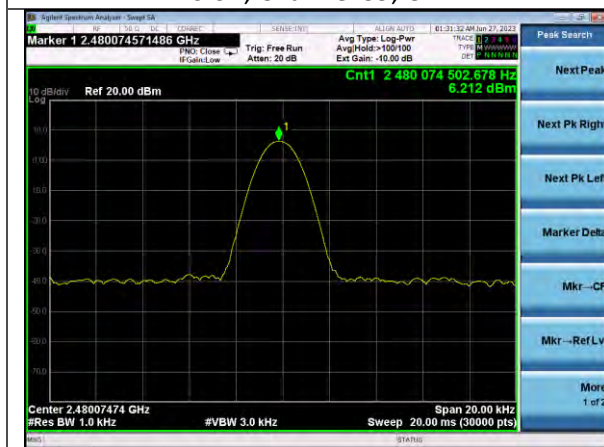
6.9V, Channel 17, CW



6.0V, Channel 39, CW



5.1V, Channel 39, CW



6.9V, Channel 39, CW

## 5.2 Radiated Emissions

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description of Measurement</b> | <p>The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna.</p> <p>The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values.</p> <p>The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.</p> |
| <b>Example Calculations</b>       | <p>Measurement (dBμV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBμV/m)</p> <p>Margin (dB) = Limit (dBμV/m) - Corrected Reading (dBμV/m)</p> <p>Example at 4000 MHz:<br/> Reading = 40 dBμV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBμV/m<br/> Average Limit = 20 log (500) = 54 dBμV/m<br/> Margin = 54 dBμV/m - 50.8 dBμV/m = 3.2 dB</p>                                                                                                                                                                                                                                                                                                                             |

### Block Diagram



### 5.2.1 Radiated Emissions

|                    |                                                 |                 |               |
|--------------------|-------------------------------------------------|-----------------|---------------|
| <b>Operator</b>    | Dylan Rosenfeldt                                | <b>QA</b>       | Jon Dilley    |
| <b>Temperature</b> | 21.8°C – 23.9°C                                 | <b>R.H. %</b>   | 24.8% – 32.3% |
| <b>Test Date</b>   | 12/27/2023 – 12/29/2023,<br>1/2/2024, 4/15/2024 | <b>Location</b> | Chamber 3     |
| <b>Requirement</b> | FCC: 15.247/15.209<br>ISED: RSS-247             | <b>Method</b>   | ANSI C63.10   |

#### FCC 15.209 Limits:

| Frequency (MHz) | Quasi Peak Limit (dBuV/m)     | Average Limit (dBuV/m)       | Peak Limit (dBuV/m) |
|-----------------|-------------------------------|------------------------------|---------------------|
| 0.009 – 0.490   | $20\log(2400/F(\text{kHz}))$  | $20\log(2400/F(\text{kHz}))$ | -                   |
| 0.490 – 1.705   | $20\log(24000/F(\text{kHz}))$ | -                            | -                   |
| 1.705 - 30      | 49.5                          | -                            | -                   |
| 30 – 88         | 40.0                          | -                            | -                   |
| 88 – 216        | 43.5                          | -                            | -                   |
| 216 – 960       | 46.0                          | -                            | -                   |
| 960 – 1000      | 54.0                          | -                            | -                   |
| 1000 – 25000    | -                             | 54.0                         | 74.0                |

#### Test Parameters

|                             |                                                                                                                                              |                     |                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------|
| <b>Frequency</b>            | 0.009 – 25000 MHz                                                                                                                            | <b>Distance</b>     | 3m                             |
| <b>Detector(s)</b>          | Peak – Trace/Final<br>Quasi-Peak – Final                                                                                                     | <b>Table height</b> | 80cm (<1GHz), 150cm (>1GHz)    |
| <b>RBW</b>                  | 120 kHz (<1GHz), 1 MHz (>1GHz)                                                                                                               | <b>VBW</b>          | 1.2 MHz (<1GHz), 3 MHz (>1GHz) |
| <b>Notes</b>                | A Reduced VBW of 470 Hz was used for average measurements of the 1Mbps data rate, and 910Hz for average measurements of the 2Mbps data rate. |                     |                                |
| <b>Example Calculations</b> | $\text{VBW} = 1 / \text{on-time} = 1 / 2.160\text{ms} = 463 \text{ Hz}$                                                                      |                     |                                |

## Instrumentation

| Asset #   | Description                   | Manufacturer       | Model #     | Serial #   | Date      | Due Date  | Status              |
|-----------|-------------------------------|--------------------|-------------|------------|-----------|-----------|---------------------|
| EE 960203 | Analyzer - EMI Receiver       | Keysight           | N9038A      | MY56400072 | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960158 | Antenna - Double Ridge Horn   | ETS Lindgren       | 3117        | 109300     | 1/30/2023 | 1/30/2024 | Active Calibration  |
| AA 960220 | Cable                         | A.H. Systems, Inc. | SAC-26G-6   | 552        | 2/16/2023 | 2/16/2024 | Active Verification |
| AA 960211 | Antenna - Low Noise Amplifier | Mini-Circuits      | ZVA-213X-S+ | 977711030  | 1/30/2023 | 1/30/2024 | Active Calibration  |
| LSC-216   | Cable                         | A.H. Systems, Inc. | 2533-8.5    | 1534       | 4/25/2023 | 4/25/2024 | Active Verification |
| AA 960163 | Antenna - Log Periodic        | A.H. Systems, Inc. | SAS-512-2   | 500        | 8/10/2023 | 8/10/2024 | Active Calibration  |
| AA 960218 | Antenna - Biconical           | A.H. Systems, Inc. | SAS-540     | 853        | 7/17/2023 | 7/17/2024 | Active Calibration  |
| AA 960174 | Antenna - Small Horn          | ETS Lindgren       | 3116C-PA    | 00206880   | 8/30/2023 | 8/30/2024 | Active Calibration  |
| AA 960154 | Filter - High Pass 2.4 GHz    | KWM                | HPF-L-14186 | 7272-02    | 4/11/2023 | 4/11/2024 | Active Calibration  |
| AA 960206 | Antenna - Loop                | A.H. Systems, Inc. | SAS-565-H   | 2758       | 8/31/2023 | 8/31/2025 | Active Calibration  |

## EUT Parameters

|                    |                                                 |                     |                |
|--------------------|-------------------------------------------------|---------------------|----------------|
| <b>Input Power</b> | 6VDC from 120VAC adapter                        | <b>Mode</b>         | BLE TX         |
| <b>Channels</b>    | 37 (2402 MHz)<br>17 (2440 MHz)<br>39 (2480 MHz) | <b>Data Rate(s)</b> | 1 Mbps, 2 Mbps |

|                                |               |                                   |
|--------------------------------|---------------|-----------------------------------|
| Company: Chicago Faucets, Inc. | Page 33 of 45 | Name: AEQ-001JKNF                 |
| Report: TR3696A                |               | Model: AEQ-001JKNF                |
| Quote: NBO-12-2021-004516-2    |               | Serial: Engineering Samples 1 & 2 |

**Band Edge Data Table (Average)**

| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Average Reading (dBμV/m) | Average Limit (dBμV/m) | Average Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|--------------------------|------------------------|---------------------|-----------|---------|
| 2386.0          | Horizontal       | Flat            | 150         | 210              | 42.7                     | 54.0                   | 11.3                | 1Mbps     | 37      |
| 2387.2          | Vertical         | Vertical        | 141         | 312              | 42.6                     | 54.0                   | 11.4                | 1Mbps     | 37      |
| 2367.9          | Vertical         | Horizontal      | 160         | 69               | 42.7                     | 54.0                   | 11.3                | 1Mbps     | 37      |
| 2386.4          | Vertical         | Horizontal      | 160         | 70               | 43.1                     | 54.0                   | 10.9                | 2Mbps     | 37      |
| 2335.7          | Vertical         | Vertical        | 141         | 308              | 43.0                     | 54.0                   | 11.0                | 2Mbps     | 37      |
| 2389.5          | Horizontal       | Flat            | 150         | 223              | 43.0                     | 54.0                   | 11.0                | 2Mbps     | 37      |
| 2494.7          | Vertical         | Vertical        | 150         | 292              | 43.1                     | 54.0                   | 10.9                | 1Mbps     | 39      |
| 2489.6          | Vertical         | Vertical        | 150         | 292              | 43.6                     | 54.0                   | 10.4                | 2Mbps     | 39      |
| 2494.5          | Horizontal       | Horizontal      | 120         | 189              | 43.0                     | 54.0                   | 11.0                | 1Mbps     | 39      |
| 2486.6          | Horizontal       | Horizontal      | 120         | 189              | 43.5                     | 54.0                   | 10.5                | 2Mbps     | 39      |
| 2494.3          | Horizontal       | Flat            | 150         | 198              | 43.1                     | 54.0                   | 10.9                | 1Mbps     | 39      |
| 2483.9          | Horizontal       | Flat            | 150         | 198              | 43.4                     | 54.0                   | 10.6                | 2Mbps     | 39      |

**Band Edge Data Table (Peak)**

| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Peak Reading (dBμV/m) | Peak Limit (dBμV/m) | Peak Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|-----------------------|---------------------|------------------|-----------|---------|
| 2386.0          | Horizontal       | Flat            | 150         | 210              | 54.4                  | 74.0                | 19.6             | 1Mbps     | 37      |
| 2387.2          | Vertical         | Vertical        | 141         | 312              | 54.2                  | 74.0                | 19.8             | 1Mbps     | 37      |
| 2367.9          | Vertical         | Horizontal      | 160         | 69               | 54.0                  | 74.0                | 20.0             | 1Mbps     | 37      |
| 2386.4          | Vertical         | Horizontal      | 160         | 70               | 54.1                  | 74.0                | 19.9             | 2Mbps     | 37      |
| 2335.7          | Vertical         | Vertical        | 141         | 308              | 53.9                  | 74.0                | 20.1             | 2Mbps     | 37      |
| 2389.5          | Horizontal       | Flat            | 150         | 223              | 54.3                  | 74.0                | 19.7             | 2Mbps     | 37      |
| 2494.7          | Vertical         | Vertical        | 150         | 292              | 54.4                  | 74.0                | 19.6             | 1Mbps     | 39      |
| 2489.6          | Vertical         | Vertical        | 150         | 292              | 54.4                  | 74.0                | 19.6             | 2Mbps     | 39      |
| 2494.5          | Horizontal       | Horizontal      | 120         | 189              | 54.4                  | 74.0                | 19.6             | 1Mbps     | 39      |
| 2486.6          | Horizontal       | Horizontal      | 120         | 189              | 54.5                  | 74.0                | 19.5             | 2Mbps     | 39      |
| 2494.3          | Horizontal       | Flat            | 150         | 198              | 54.5                  | 74.0                | 19.5             | 1Mbps     | 39      |
| 2483.9          | Horizontal       | Flat            | 150         | 198              | 54.5                  | 74.0                | 19.5             | 2Mbps     | 39      |

### Spurious Emissions Data Table (Average)

| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Average Reading (dBμV/m) | Average Limit (dBμV/m) | Average Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|--------------------------|------------------------|---------------------|-----------|---------|
| 12202.6         | Horizontal       | Vertical        | 150         | 53               | 49.0                     | 54.0                   | 5.0                 | 2 Mbps    | 17      |
| 12202.6         | Vertical         | Vertical        | 183         | 331              | 44.5                     | 54.0                   | 9.5                 | 2 Mbps    | 17      |
| 12202.6         | Vertical         | Horizontal      | 149         | 328              | 47.4                     | 54.0                   | 6.6                 | 2 Mbps    | 17      |
| 12008.2         | Horizontal       | Horizontal      | 221         | 325              | 52.5                     | 54.0                   | 1.5                 | 2 Mbps    | 17      |
| 12202.6         | Horizontal       | Horizontal      | 142         | 40               | 44.2                     | 54.0                   | 9.8                 | 2 Mbps    | 17      |
| 12008.2         | Vertical         | Flat            | 255         | 146              | 51.9                     | 54.0                   | 2.1                 | 2 Mbps    | 37      |
| 12402.6         | Vertical         | Flat            | 293         | 172              | 42.9                     | 54.0                   | 11.1                | 2 Mbps    | 39      |
| 7320.8          | Vertical         | Flat            | 270         | 300              | 48.0                     | 54.0                   | 6.0                 | 2 Mbps    | 17      |
| 7320.8          | Horizontal       | Flat            | 100         | 208              | 46.8                     | 54.0                   | 7.2                 | 2 Mbps    | 17      |
| 7321.4          | Horizontal       | Vertical        | 202         | 344              | 44.5                     | 54.0                   | 9.5                 | 2 Mbps    | 17      |
| 7321.5          | Vertical         | Vertical        | 100         | 0                | 48.0                     | 54.0                   | 6.0                 | 2 Mbps    | 17      |
| 7321.5          | Vertical         | Horizontal      | 220         | 356              | 45.0                     | 54.0                   | 9.0                 | 2 Mbps    | 17      |
| 7321.5          | Horizontal       | Horizontal      | 186         | 321              | 49.8                     | 54.0                   | 4.2                 | 2 Mbps    | 17      |
| 7439.0          | Horizontal       | Horizontal      | 182         | 329              | 47.1                     | 54.0                   | 6.9                 | 2 Mbps    | 39      |
| 7320.8          | Horizontal       | Flat            | 400         | 227              | 46.2                     | 54.0                   | 7.8                 | 1 Mbps    | 17      |
| 7440.7          | Horizontal       | Flat            | 400         | 227              | 43.4                     | 54.0                   | 10.6                | 1 Mbps    | 39      |
| 12201.4         | Horizontal       | Flat            | 291         | 303              | 43.9                     | 54.0                   | 10.1                | 1 Mbps    | 37      |
| 12201.5         | Vertical         | Flat            | 259         | 260              | 47.4                     | 54.0                   | 6.6                 | 1 Mbps    | 17      |
| 7320.8          | Vertical         | Flat            | 100         | 307              | 47.2                     | 54.0                   | 6.8                 | 1 Mbps    | 17      |
| 7440.8          | Vertical         | Flat            | 100         | 302              | 45.1                     | 54.0                   | 8.9                 | 1 Mbps    | 39      |
| 12401.5         | Vertical         | Flat            | 260         | 259              | 45.9                     | 54.0                   | 8.1                 | 1 Mbps    | 39      |
| 12011.4         | Vertical         | Flat            | 160         | 156              | 52.6                     | 54.0                   | 1.4                 | 1 Mbps    | 37      |
| 12011.4         | Horizontal       | Flat            | 291         | 295              | 46.8                     | 54.0                   | 7.2                 | 1 Mbps    | 37      |
| 12401.4         | Horizontal       | Flat            | 288         | 305              | 41.1                     | 54.0                   | 12.9                | 1 Mbps    | 39      |
| 7320.8          | Vertical         | Vertical        | 180         | 0                | 48.1                     | 54.0                   | 5.9                 | 1 Mbps    | 17      |
| 7440.7          | Vertical         | Vertical        | 186         | 0                | 45.0                     | 54.0                   | 9.0                 | 1 Mbps    | 39      |
| 4960.2          | Vertical         | Vertical        | 205         | 0                | 41.3                     | 54.0                   | 12.7                | 1 Mbps    | 39      |
| 4880.2          | Vertical         | Vertical        | 191         | 12               | 37.6                     | 54.0                   | 16.4                | 1 Mbps    | 17      |
| 4804.2          | Vertical         | Vertical        | 193         | 8                | 37.9                     | 54.0                   | 16.1                | 1 Mbps    | 37      |
| 14413.8         | Vertical         | Vertical        | 155         | 8                | 43.2                     | 54.0                   | 10.8                | 1 Mbps    | 37      |
| 12011.4         | Horizontal       | Vertical        | 291         | 300              | 47.5                     | 54.0                   | 6.5                 | 1 Mbps    | 37      |
| 12201.5         | Horizontal       | Vertical        | 160         | 5                | 47.7                     | 54.0                   | 6.3                 | 1 Mbps    | 17      |
| 12401.4         | Horizontal       | Vertical        | 166         | 53               | 47.9                     | 54.0                   | 6.1                 | 1 Mbps    | 39      |
| 12401.4         | Vertical         | Horizontal      | 150         | 330              | 46.3                     | 54.0                   | 7.7                 | 1 Mbps    | 39      |
| 12201.4         | Vertical         | Horizontal      | 154         | 336              | 48.4                     | 54.0                   | 5.6                 | 1 Mbps    | 17      |
| 12011.5         | Vertical         | Horizontal      | 152         | 339              | 49.3                     | 54.0                   | 4.7                 | 1 Mbps    | 37      |
| 4804.1          | Horizontal       | Horizontal      | 210         | 325              | 40.6                     | 54.0                   | 13.4                | 1 Mbps    | 37      |
| 12009.3         | Horizontal       | Horizontal      | 253         | 209              | 51.2                     | 54.0                   | 2.8                 | 1 Mbps    | 37      |
| 4880.1          | Horizontal       | Horizontal      | 218         | 316              | 39.9                     | 54.0                   | 14.1                | 1 Mbps    | 17      |
| 12201.4         | Horizontal       | Horizontal      | 246         | 221              | 50.8                     | 54.0                   | 3.2                 | 1 Mbps    | 17      |
| 4960.1          | Horizontal       | Horizontal      | 237         | 317              | 43.3                     | 54.0                   | 10.7                | 1 Mbps    | 39      |
| 14413.8         | Horizontal       | Horizontal      | 150         | 353              | 43.6                     | 54.0                   | 10.4                | 1 Mbps    | 37      |
| 7440.7          | Horizontal       | Horizontal      | 175         | 330              | 48.3                     | 54.0                   | 5.7                 | 1 Mbps    | 39      |
| 7320.8          | Horizontal       | Horizontal      | 187         | 321              | 50.3                     | 54.0                   | 3.7                 | 1 Mbps    | 17      |
| 19522.3         | Horizontal       | Horizontal      | 174         | 65               | 47.5                     | 54.0                   | 6.5                 | 1 Mbps    | 17      |

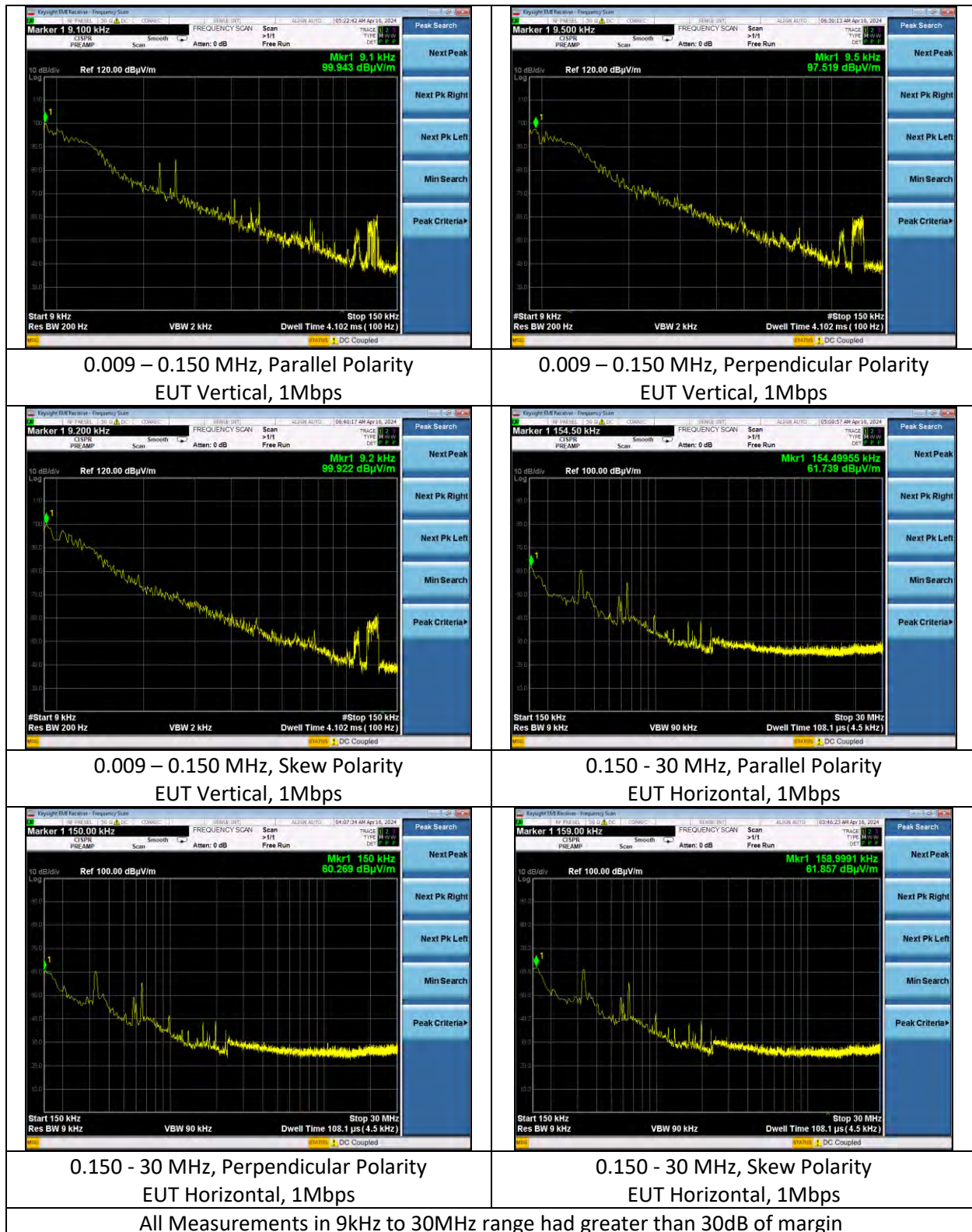
| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Average Reading (dBμV/m) | Average Limit (dBμV/m) | Average Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|--------------------------|------------------------|---------------------|-----------|---------|
| 19218.4         | Horizontal       | Horizontal      | 171         | 61               | 47.9                     | 54.0                   | 6.1                 | 1 Mbps    | 37      |
| 19842.4         | Horizontal       | Horizontal      | 174         | 63               | 46.3                     | 54.0                   | 7.7                 | 1 Mbps    | 39      |
| 22322.8         | Horizontal       | Horizontal      | 125         | 19               | 45.8                     | 54.0                   | 8.2                 | 1 Mbps    | 39      |
| 19524.4         | Horizontal       | Horizontal      | 150         | 44               | 46.4                     | 54.0                   | 7.6                 | 2 Mbps    | 17      |
| 19220.4         | Horizontal       | Horizontal      | 150         | 58               | 46.5                     | 54.0                   | 7.5                 | 2 Mbps    | 37      |
| 19836.9         | Horizontal       | Horizontal      | 150         | 34               | 44.8                     | 54.0                   | 9.2                 | 2 Mbps    | 39      |
| 22324.9         | Horizontal       | Horizontal      | 136         | 18               | 45.7                     | 54.0                   | 8.3                 | 2 Mbps    | 39      |
| 19844.3         | Vertical         | Vertical        | 150         | 9                | 44.8                     | 54.0                   | 9.2                 | 2 Mbps    | 39      |
| 22324.9         | Vertical         | Vertical        | 154         | 20               | 44.3                     | 54.0                   | 9.7                 | 2 Mbps    | 39      |
| 19516.7         | Vertical         | Vertical        | 135         | 0                | 45.6                     | 54.0                   | 8.4                 | 2 Mbps    | 17      |
| 19220.5         | Vertical         | Vertical        | 132         | 0                | 45.1                     | 54.0                   | 8.9                 | 2 Mbps    | 37      |
| 19842.3         | Vertical         | Vertical        | 140         | 0                | 45.4                     | 54.0                   | 8.6                 | 1 Mbps    | 39      |
| 22322.8         | Vertical         | Vertical        | 140         | 7                | 44.5                     | 54.0                   | 9.5                 | 1 Mbps    | 39      |
| 19522.3         | Vertical         | Vertical        | 143         | 6                | 46.4                     | 54.0                   | 7.6                 | 1 Mbps    | 17      |
| 19218.4         | Vertical         | Vertical        | 141         | 0                | 46.8                     | 54.0                   | 7.2                 | 1 Mbps    | 37      |
| 22322.7         | Vertical         | Flat            | 282         | 348              | 42.8                     | 54.0                   | 11.2                | 1 Mbps    | 39      |
| 19838.9         | Vertical         | Flat            | 286         | 353              | 43.6                     | 54.0                   | 10.4                | 1 Mbps    | 39      |
| 19522.4         | Vertical         | Flat            | 280         | 0                | 45.2                     | 54.0                   | 8.8                 | 1 Mbps    | 17      |
| 19218.4         | Vertical         | Flat            | 285         | 0                | 45.3                     | 54.0                   | 8.7                 | 1 Mbps    | 37      |
| 22316.6         | Vertical         | Flat            | 280         | 341              | 43.3                     | 54.0                   | 10.7                | 2 Mbps    | 39      |
| 19836.8         | Vertical         | Flat            | 285         | 341              | 43.5                     | 54.0                   | 10.5                | 2 Mbps    | 39      |
| 19516.7         | Vertical         | Flat            | 307         | 0                | 44.9                     | 54.0                   | 9.1                 | 2 Mbps    | 17      |
| 19220.4         | Vertical         | Flat            | 302         | 0                | 44.4                     | 54.0                   | 9.6                 | 2 Mbps    | 37      |

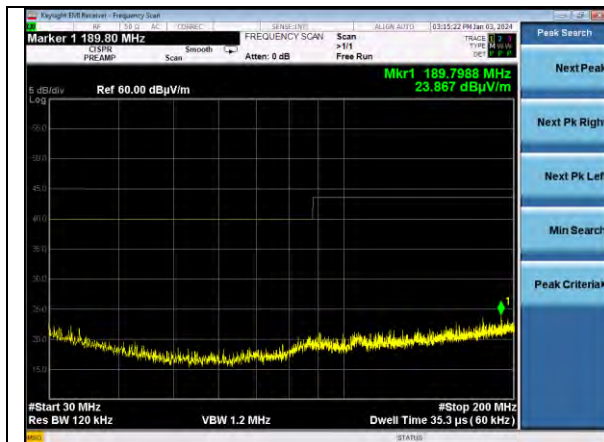
### Spurious Emissions Data Table (Peak)

| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Peak Reading (dBμV/m) | Peak Limit (dBμV/m) | Peak Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|-----------------------|---------------------|------------------|-----------|---------|
| 12202.6         | Horizontal       | Vertical        | 150         | 53               | 57.0                  | 74.0                | 17.0             | 2 Mbps    | 17      |
| 12202.6         | Vertical         | Vertical        | 183         | 331              | 53.2                  | 74.0                | 20.8             | 2 Mbps    | 17      |
| 12202.6         | Vertical         | Horizontal      | 149         | 328              | 55.8                  | 74.0                | 18.2             | 2 Mbps    | 17      |
| 12008.2         | Horizontal       | Horizontal      | 221         | 325              | 59.7                  | 74.0                | 14.3             | 2 Mbps    | 37      |
| 12202.6         | Horizontal       | Horizontal      | 142         | 40               | 52.3                  | 74.0                | 21.7             | 2 Mbps    | 17      |
| 12008.2         | Vertical         | Flat            | 255         | 146              | 59.4                  | 74.0                | 14.6             | 2 Mbps    | 37      |
| 12402.6         | Vertical         | Flat            | 293         | 172              | 51.5                  | 74.0                | 22.5             | 2 Mbps    | 39      |
| 7320.8          | Vertical         | Flat            | 270         | 300              | 54.5                  | 74.0                | 19.5             | 2 Mbps    | 17      |
| 7320.8          | Horizontal       | Flat            | 100         | 208              | 53.5                  | 74.0                | 20.5             | 2 Mbps    | 17      |
| 7321.4          | Horizontal       | Vertical        | 202         | 344              | 52.3                  | 74.0                | 21.7             | 2 Mbps    | 17      |
| 7321.5          | Vertical         | Vertical        | 100         | 0                | 55.1                  | 74.0                | 18.9             | 2 Mbps    | 17      |
| 7321.5          | Vertical         | Horizontal      | 220         | 356              | 52.4                  | 74.0                | 21.6             | 2 Mbps    | 17      |
| 7321.5          | Horizontal       | Horizontal      | 186         | 321              | 56.8                  | 74.0                | 17.2             | 2 Mbps    | 17      |
| 7439.0          | Horizontal       | Horizontal      | 182         | 329              | 54.5                  | 74.0                | 19.5             | 2 Mbps    | 39      |
| 7320.8          | Horizontal       | Flat            | 400         | 227              | 52.7                  | 74.0                | 21.3             | 1 Mbps    | 17      |
| 7440.7          | Horizontal       | Flat            | 400         | 227              | 50.6                  | 74.0                | 23.4             | 1 Mbps    | 39      |
| 12201.4         | Horizontal       | Flat            | 291         | 303              | 52.8                  | 74.0                | 21.2             | 1 Mbps    | 37      |
| 12201.5         | Vertical         | Flat            | 259         | 260              | 55.3                  | 74.0                | 18.7             | 1 Mbps    | 17      |
| 7320.8          | Vertical         | Flat            | 100         | 307              | 53.8                  | 74.0                | 20.2             | 1 Mbps    | 17      |
| 7440.8          | Vertical         | Flat            | 100         | 302              | 52.1                  | 74.0                | 21.9             | 1 Mbps    | 39      |
| 12401.5         | Vertical         | Flat            | 260         | 259              | 54.3                  | 74.0                | 19.7             | 1 Mbps    | 39      |
| 12011.4         | Vertical         | Flat            | 160         | 156              | 59.6                  | 74.0                | 14.4             | 1 Mbps    | 37      |
| 12011.4         | Horizontal       | Flat            | 291         | 295              | 54.5                  | 74.0                | 19.5             | 1 Mbps    | 37      |
| 12401.4         | Horizontal       | Flat            | 288         | 305              | 50.2                  | 74.0                | 23.8             | 1 Mbps    | 39      |
| 7320.8          | Vertical         | Vertical        | 180         | 0                | 54.6                  | 74.0                | 19.4             | 1 Mbps    | 17      |
| 7440.7          | Vertical         | Vertical        | 186         | 0                | 51.9                  | 74.0                | 22.1             | 1 Mbps    | 39      |
| 4960.2          | Vertical         | Vertical        | 205         | 0                | 47.3                  | 74.0                | 26.7             | 1 Mbps    | 39      |
| 4880.2          | Vertical         | Vertical        | 191         | 12               | 45.3                  | 74.0                | 28.7             | 1 Mbps    | 17      |
| 4804.2          | Vertical         | Vertical        | 193         | 8                | 46.0                  | 74.0                | 28.0             | 1 Mbps    | 37      |
| 14413.8         | Vertical         | Vertical        | 155         | 8                | 51.7                  | 74.0                | 22.3             | 1 Mbps    | 37      |
| 12011.4         | Horizontal       | Vertical        | 291         | 300              | 54.5                  | 74.0                | 19.5             | 1 Mbps    | 37      |
| 12201.5         | Horizontal       | Vertical        | 160         | 5                | 55.3                  | 74.0                | 18.7             | 1 Mbps    | 17      |
| 12401.4         | Horizontal       | Vertical        | 166         | 53               | 55.6                  | 74.0                | 18.4             | 1 Mbps    | 39      |
| 12401.4         | Vertical         | Horizontal      | 150         | 330              | 54.0                  | 74.0                | 20.0             | 1 Mbps    | 39      |
| 12201.4         | Vertical         | Horizontal      | 154         | 336              | 56.4                  | 74.0                | 17.6             | 1 Mbps    | 17      |
| 12011.5         | Vertical         | Horizontal      | 152         | 339              | 56.5                  | 74.0                | 17.5             | 1 Mbps    | 37      |
| 4804.1          | Horizontal       | Horizontal      | 210         | 325              | 46.8                  | 74.0                | 27.2             | 1 Mbps    | 37      |
| 12009.3         | Horizontal       | Horizontal      | 253         | 209              | 58.4                  | 74.0                | 15.6             | 1 Mbps    | 37      |
| 4880.1          | Horizontal       | Horizontal      | 218         | 316              | 46.6                  | 74.0                | 27.4             | 1 Mbps    | 17      |
| 4960.1          | Horizontal       | Horizontal      | 237         | 317              | 47.9                  | 74.0                | 26.1             | 1 Mbps    | 39      |
| 12201.4         | Horizontal       | Horizontal      | 246         | 221              | 58.0                  | 74.0                | 16.0             | 1 Mbps    | 17      |
| 14413.8         | Horizontal       | Horizontal      | 150         | 353              | 52.4                  | 74.0                | 21.6             | 1 Mbps    | 37      |
| 7440.7          | Horizontal       | Horizontal      | 175         | 330              | 54.7                  | 74.0                | 19.3             | 1 Mbps    | 39      |
| 7320.8          | Horizontal       | Horizontal      | 187         | 321              | 56.5                  | 74.0                | 17.5             | 1 Mbps    | 17      |
| 19522.3         | Horizontal       | Horizontal      | 174         | 65               | 56.9                  | 74.0                | 17.1             | 1 Mbps    | 17      |

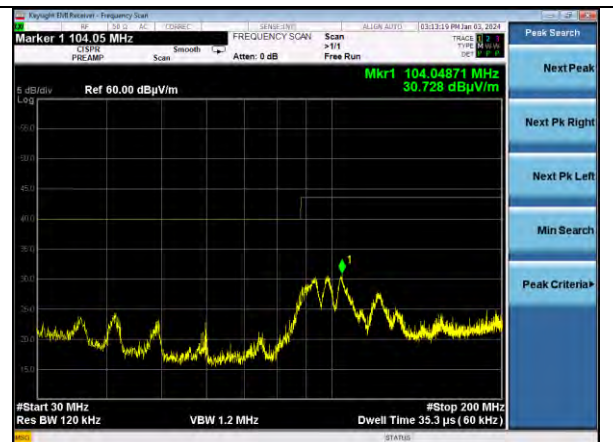
| Frequency (MHz) | Antenna Polarity | EUT Orientation | Height (cm) | Azimuth (degree) | Peak Reading (dBμV/m) | Peak Limit (dBμV/m) | Peak Margin (dB) | Data Rate | Channel |
|-----------------|------------------|-----------------|-------------|------------------|-----------------------|---------------------|------------------|-----------|---------|
| 19218.4         | Horizontal       | Horizontal      | 171         | 61               | 56.7                  | 74.0                | 17.3             | 1 Mbps    | 37      |
| 19842.4         | Horizontal       | Horizontal      | 174         | 63               | 56.1                  | 74.0                | 17.9             | 1 Mbps    | 39      |
| 22322.8         | Horizontal       | Horizontal      | 125         | 19               | 55.5                  | 74.0                | 18.5             | 1 Mbps    | 39      |
| 19524.4         | Horizontal       | Horizontal      | 150         | 44               | 56.0                  | 74.0                | 18.0             | 2 Mbps    | 17      |
| 19220.4         | Horizontal       | Horizontal      | 150         | 58               | 55.2                  | 74.0                | 18.8             | 2 Mbps    | 37      |
| 19836.9         | Horizontal       | Horizontal      | 150         | 34               | 53.8                  | 74.0                | 20.2             | 2 Mbps    | 39      |
| 22324.9         | Horizontal       | Horizontal      | 136         | 18               | 54.9                  | 74.0                | 19.1             | 2 Mbps    | 39      |
| 19844.3         | Vertical         | Vertical        | 150         | 9                | 54.4                  | 74.0                | 19.6             | 2 Mbps    | 39      |
| 22324.9         | Vertical         | Vertical        | 154         | 20               | 54.0                  | 74.0                | 20.0             | 2 Mbps    | 39      |
| 19516.7         | Vertical         | Vertical        | 135         | 0                | 54.4                  | 74.0                | 19.6             | 2 Mbps    | 17      |
| 19220.5         | Vertical         | Vertical        | 132         | 0                | 54.3                  | 74.0                | 19.7             | 2 Mbps    | 37      |
| 19842.3         | Vertical         | Vertical        | 140         | 0                | 54.8                  | 74.0                | 19.2             | 1 Mbps    | 39      |
| 22322.8         | Vertical         | Vertical        | 140         | 7                | 54.6                  | 74.0                | 19.4             | 1 Mbps    | 39      |
| 19522.3         | Vertical         | Vertical        | 143         | 6                | 56.0                  | 74.0                | 18.0             | 1 Mbps    | 17      |
| 19218.4         | Vertical         | Vertical        | 141         | 0                | 55.2                  | 74.0                | 18.8             | 1 Mbps    | 37      |
| 22322.7         | Vertical         | Flat            | 282         | 348              | 53.0                  | 74.0                | 21.0             | 1 Mbps    | 39      |
| 19838.9         | Vertical         | Flat            | 286         | 353              | 53.5                  | 74.0                | 20.5             | 1 Mbps    | 39      |
| 19522.4         | Vertical         | Flat            | 280         | 0                | 54.3                  | 74.0                | 19.7             | 1 Mbps    | 17      |
| 19218.4         | Vertical         | Flat            | 285         | 0                | 54.1                  | 74.0                | 19.9             | 1 Mbps    | 37      |
| 22316.6         | Vertical         | Flat            | 280         | 341              | 52.2                  | 74.0                | 21.8             | 2 Mbps    | 39      |
| 19836.8         | Vertical         | Flat            | 285         | 341              | 53.1                  | 74.0                | 20.9             | 2 Mbps    | 39      |
| 19516.7         | Vertical         | Flat            | 307         | 0                | 54.6                  | 74.0                | 19.4             | 2 Mbps    | 17      |
| 19220.4         | Vertical         | Flat            | 302         | 0                | 54.1                  | 74.0                | 19.9             | 2 Mbps    | 37      |

## Plots

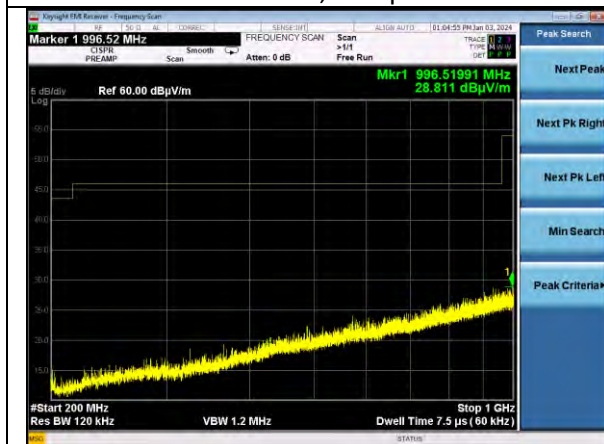




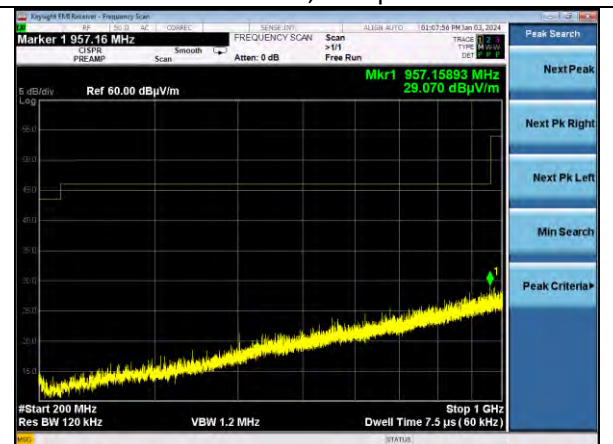
30 – 200 MHz, Horizontal Polarity  
EUT Flat, 1Mbps



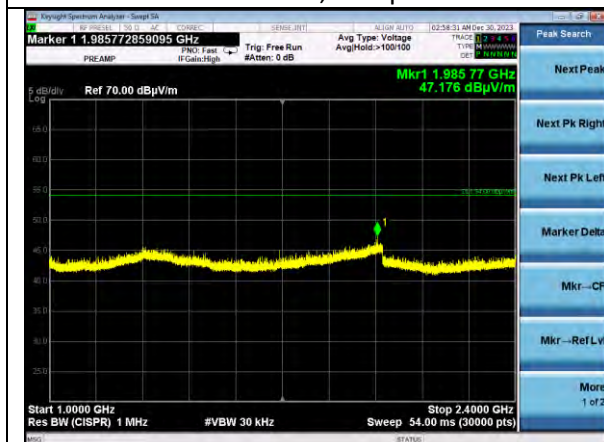
30 – 200 MHz, Vertical Polarity  
EUT Flat, 1Mbps



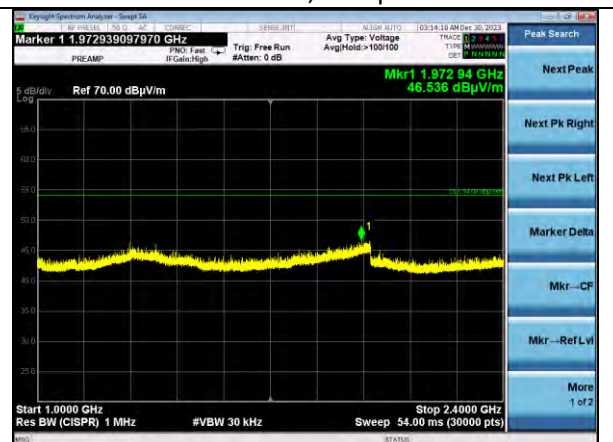
200 – 1000 MHz, Horizontal Polarity  
EUT Flat, 1Mbps



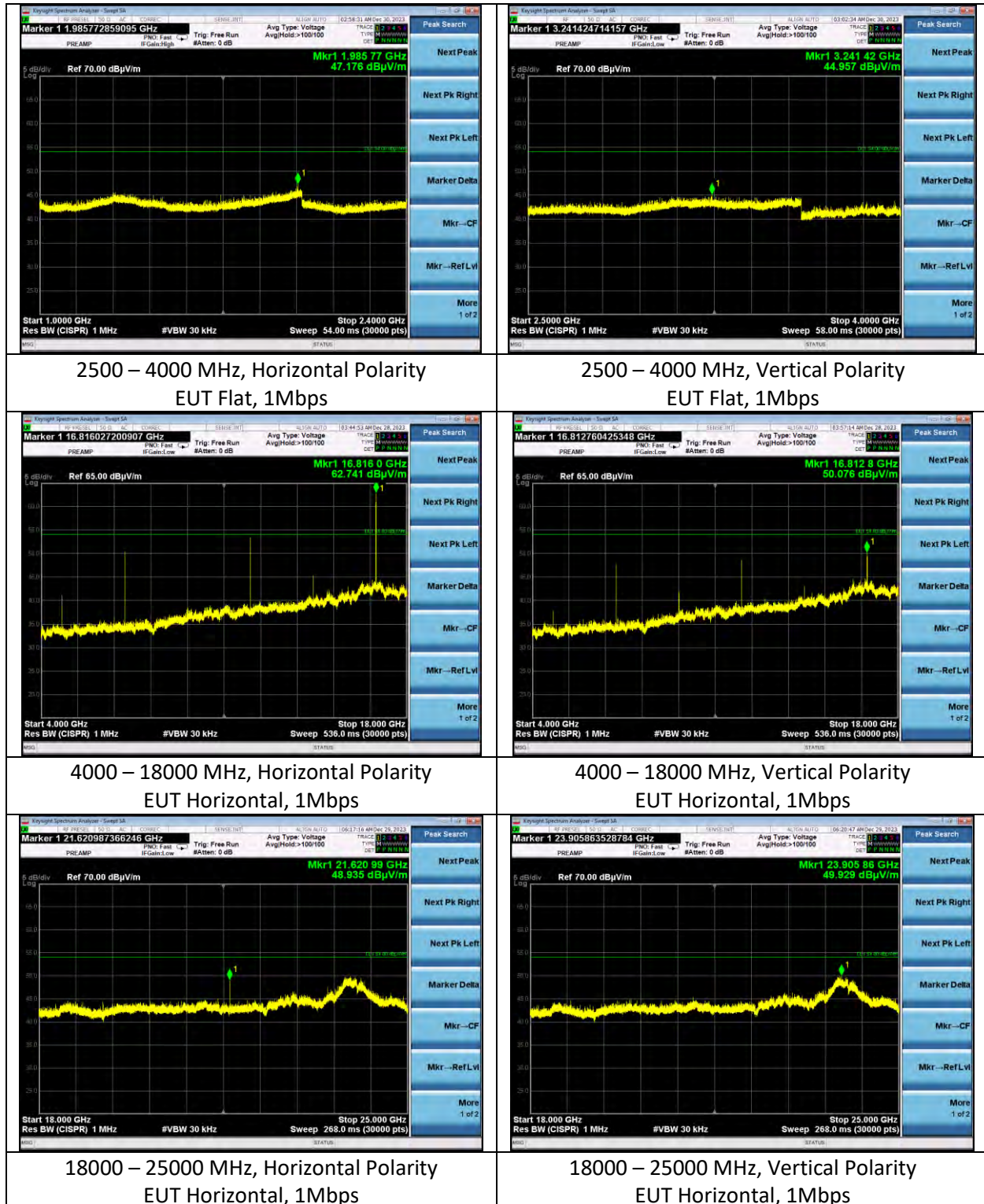
200 – 1000 MHz, Vertical Polarity  
EUT Flat, 1Mbps



1000 – 2400 MHz, Horizontal Polarity  
EUT Flat, 1Mbps



1000 – 2400 MHz, Vertical Polarity  
EUT Flat, 1Mbps



### 5.3 AC Mains Conducted Emissions

A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains.

#### Description of Measurement

The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values.

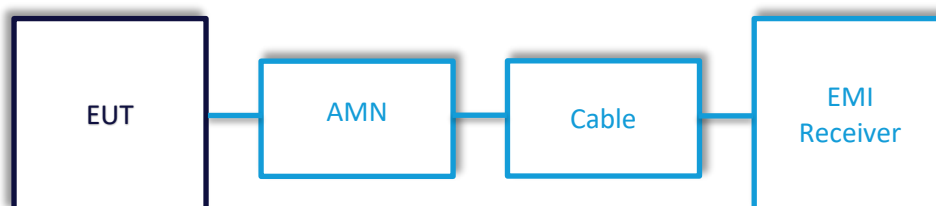
Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)

#### Example Calculations

Measurement (dBμV) + Cable factor (dB) + Other (dB) = Corrected Reading (dBμV)

Margin (dB) = Limit (dBμV) - Corrected Reading (dBμV)

#### Block Diagram



### 5.3.1 AC Mains Conducted Emissions

|                    |                  |                 |                 |
|--------------------|------------------|-----------------|-----------------|
| <b>Operator</b>    | Dylan Rosenfeldt | <b>QA</b>       | Adam Hauke      |
| <b>Temperature</b> | 21.3C            | <b>R.H. %</b>   | 36.1%           |
| <b>Test Date</b>   | 1/4/2024         | <b>Location</b> | Conducted Bench |
| <b>Requirement</b> | FCC 15.207       | <b>Method</b>   | ANSI C63.10     |

#### FCC 15.207 Limits:

| Frequency (MHz) | Quasi-Peak (dBμV) | Average (dBμV) |
|-----------------|-------------------|----------------|
| 0.15 – 0.5      | 66 to 56          | 56 to 46       |
| 0.5 – 5         | 56                | 46             |
| 5 – 30          | 60                | 50             |

#### Test Parameters

|                    |                                                       |                     |                                              |
|--------------------|-------------------------------------------------------|---------------------|----------------------------------------------|
| <b>Frequency</b>   | 0.150 – 30 MHz                                        | <b>Distance</b>     | 40cm from VCP, 80cm from LISN, 80cm from RGP |
| <b>Detector(s)</b> | Peak – Trace<br>Quasi-Peak – Final<br>Average – Final | <b>Table height</b> | 80cm                                         |
| <b>RBW</b>         | 9kHz                                                  | <b>VBW</b>          | 62kHz                                        |

#### Instrumentation

| Asset #   | Description             | Manufacturer       | Model #               | Serial #         | Date      | Due Date  | Status              |
|-----------|-------------------------|--------------------|-----------------------|------------------|-----------|-----------|---------------------|
| EE 960088 | Analyzer - EMI Receiver | Agilent            | N9038A                | MY51210138       | 4/10/2023 | 4/10/2024 | Active Calibration  |
| LSC-214   | Cable                   | Micro-Coax         | UFB311A-0-1440-70U70U | 64639 224071-006 | 4/25/2023 | 4/25/2024 | Active Verification |
| EE 960162 | LISN                    | COM-POWER          | LI-215A               | 191969           | 4/10/2023 | 4/10/2024 | Active Calibration  |
| EE 960110 | Meter - Milliohm        | Extech Instruments | 380560                | H.292953         | 4/13/2023 | 4/13/2024 | Active Calibration  |

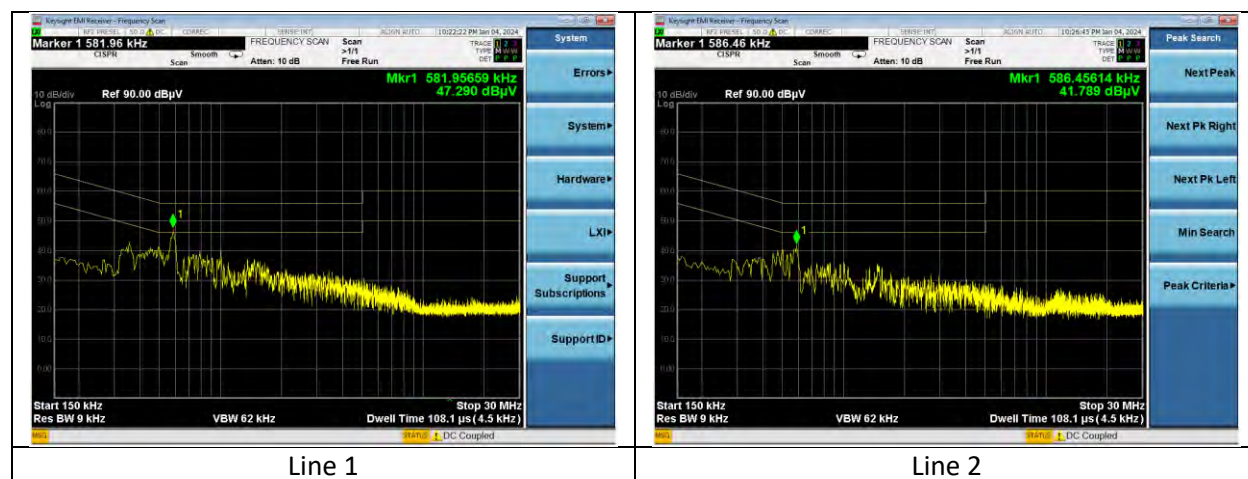
## EUT Parameters

|                    |                                                                                                                                             |             |        |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------|
| <b>Input Power</b> | 6VDC via 120VAC adapter                                                                                                                     | <b>Mode</b> | BLE TX |
| <b>Notes</b>       | Plots shown are with device transmitting on channel 17 at 1Mbps, there is no significant difference between different channels or datarates |             |        |

## Conducted Emissions Data Table

| Line | Frequency (MHz) | Peak Reading (dBμV) | Quasi-Peak Reading (dBμV) | Average Reading (dBμV) | Quasi-Peak Limit (dBμV) | Average Limit (dBμV) | Quasi-Peak Margin (dB) | Average Margin (dB) |
|------|-----------------|---------------------|---------------------------|------------------------|-------------------------|----------------------|------------------------|---------------------|
| 1    | 0.16            | 40.2                | 35.4                      | 28.3                   | 65.7                    | 55.7                 | 30.3                   | 27.4                |
| 1    | 0.58            | 45.4                | 40.8                      | 27.0                   | 56.0                    | 46.0                 | 15.2                   | 19.0                |
| 1    | 1.5             | 34.5                | 28.7                      | 16.7                   | 56.0                    | 46.0                 | 27.3                   | 29.3                |
| 2    | 0.19            | 40.0                | 34.4                      | 26.7                   | 64.2                    | 54.2                 | 29.8                   | 27.5                |
| 2    | 0.6             | 47.2                | 42.8                      | 27.8                   | 56.0                    | 46.0                 | 13.2                   | 18.2                |
| 2    | 1.4             | 36.9                | 31.3                      | 18.0                   | 56.0                    | 46.0                 | 24.7                   | 28.0                |

## Plots



## 6 REVISION HISTORY

| Version | Date      | Notes                                      | Person           |
|---------|-----------|--------------------------------------------|------------------|
| 0       | 8/21/2023 | Initial Draft                              | Dylan Rosenfeldt |
| 1       | 1/4/2024  | Revised Radiated and AC Mains Emissions    | Dylan Rosenfeldt |
| 2       | 1/8/2024  | Final Draft                                | Dylan Rosenfeldt |
| 3       | 2/27/2024 | Updated References                         | Dylan Rosenfeldt |
| 4       | 3/22/2024 | Updated to Ezurio                          | Adam Alger       |
| 5       | 4/22/2024 | Added Radiated Emissions plots below 30MHz | Dylan Rosenfeldt |
| 6       | 4/25/2024 | Statement added to 9kHz to 30MHz plots     | Dylan Rosenfeldt |

**END OF REPORT**