# Tonal

**TEST REPORT FOR**

**Trainer**
**Model: T1522**

**Tested to The Following Standards:**

**FCC Part 15 Subpart C Section(s)**

**15.207 & 15.247**
**(DTS 2400-2483.5MHz)**
**Bluetooth DTS for MCB Board for Arm lock/unlock**

**Report No.: 105488-38**

**Date of issue: February 15, 2022**

**This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.**

**We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.**

**Test Certificate # 803.01**

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# ADMINISTRATIVE INFORMATION

## Test Report Information

**REPORT PREPARED FOR:**

Tonal
617 Bryant Street
San Francisco, CA 94107

Representative: Lars Gilstrom
Customer Reference Number: PO1203

**REPORT PREPARED BY:**

Darcy Thompson
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 105488

**DATE OF EQUIPMENT RECEIPT:** December 7, 2021
**DATE(S) OF TESTING:** December 7, 2021 – January 25, 2022

## Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

***Steve Behm***
***Director of Quality Assurance & Engineering Services***
***CKC Laboratories, Inc.***

# Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

# Software Versions

| CKC Laboratories Proprietary Software | Version |
|---|---|
| EMITest Emissions | 5.03.20 |

# Site Registration & Accreditation Information

| Location | *NIST CB # | FCC | Canada | Japan |
|---|---|---|---|---|
| Canyon Park, Bothell, WA | US0103 | US1024 | 3082C | A-0136 |
| Brea, CA | US0103 | US1024 | 3082D | A-0136 |
| Fremont, CA | US0103 | US1024 | 3082B | A-0136 |
| Mariposa, CA | US0103 | US1024 | 3082A | A-0136 |

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

# SUMMARY OF RESULTS

## Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS)

| Test Procedure | Description | Modifications | Results |
|---|---|---|---|
| 15.247(a)(2) | 6dB Bandwidth | NA | Pass |
| 15.247(b)(3) | Output Power | NA | Pass |
| 15.247(d) | RF Conducted Emissions & Band Edge | NA | Pass |
| 15.247(d) | Radiated Emissions & Band Edge | Mods. #1, #2, #3 #4, #5, #6 | Pass |
| 15.247(e) | Power Spectral Density | NA | Pass |
| 15.207 | AC Conducted Emissions | NA | Pass |

NA = Not Applicable

| ISO/IEC 17025 Decision Rule |
|---|
| The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing. |

# Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

| Summary of Conditions |
|---|
| **Radiated Emissions only; Configuration: 1**<br>Mod. #1 = Copper tape between microphone PCBA gold-plated pads and chassis.<br>Mod. #2 = Screws on hydra backplane mounting bracket.<br>Mod. #3 = Copper tape on hydra backplane to display backplane.<br>Mod. #4 = Ferrite (1 each) 742-712-21 on upper lead to shunt.<br>Mod. #5 = Door bonding replaced with three (3) lug-to-lug wire strap.<br>Mod. #6 = Set display mode into spread spectrum. |

**Modifications listed above must be incorporated into all production units.**

# Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

| Summary of Conditions |
|---|
| The Test Setup Photos are incorporated by reference 105488-38_Test Setup_Photos |

# EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

## Configuration 1

***Equipment Under Test* (* = EUT):**

| Device Name | Manufacturer | Model # | S/N |
|---|---|---|---|
| Trainer | Tonal System | T1522 | 02016558 |
| MCB Board | Tonal System | 500-0105 Rev 003 | 02000169 |
| Internal Power Supply | Artesyn Embedded Tech. | LCM1500W-T | K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021 |
| Direct Bond 2312 Touch screen display | BOE | 380-0015 Rev. 1-1 CJ238FSB-TG21 | 00000015 |

***Support Equipment:***

| Device Name | Manufacturer | Model # | S/N |
|---|---|---|---|
| None | | | |

## Configuration 10

***Equipment Under Test* (* = EUT):**

| Device Name | Manufacturer | Model # | S/N |
|---|---|---|---|
| MCB Board | Tonal System | 500-0105 Rev 003 | 02000170 |

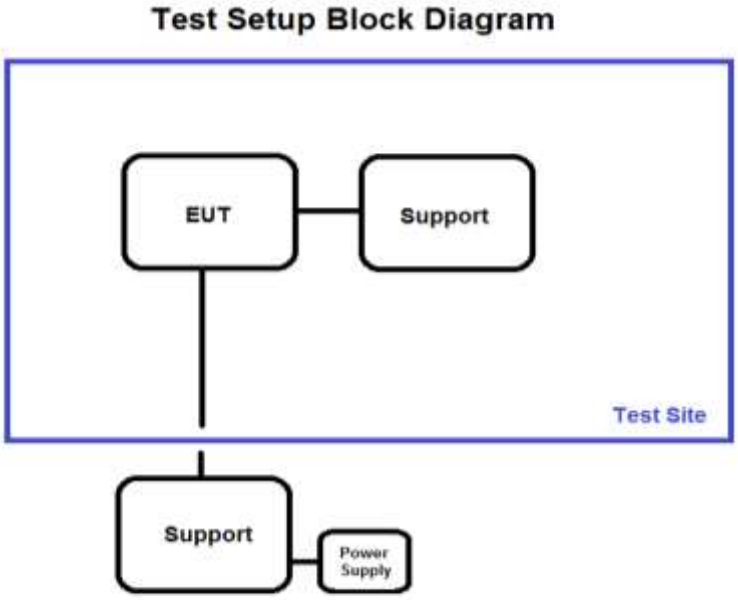
***Support Equipment:***

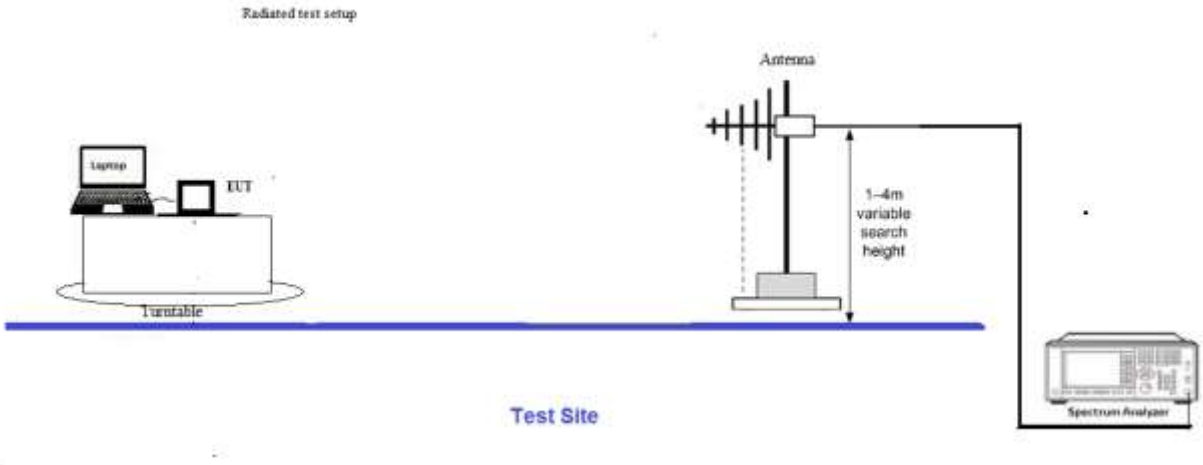
| Device Name | Manufacturer | Model # | S/N |
|---|---|---|---|
| Laptop | Apple | MacBook Pro A1278 | C1MMF2KDDV30 |
| Laptop Power Supply | Apple | ADP-60AD T | E131881 |

## General Product Information:

| Product Information | Manufacturer-Provided Details |
|---|---|
| Equipment Type: | Stand-Alone Equipment |
| Type of Wideband System: | Bluetooth DTS for MCB Board for Arm lock/unlock |
| Operating Frequency Range: | 2402-2480MHz |
| Modulation Type(s): | GFSK |
| Maximum Duty Cycle: | 100% |
| Number of TX Chains: | 1 |
| Antenna Type(s) and Gain: | Integral 5.00dBi |
| Beamforming Type: | NA |
| Antenna Connection Type: | Integral |
| Nominal Input Voltage: | 15VDC |
| Firmware / Software used for Test: | Putty version 0.74 |
| The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility. | |

## Block Diagram of Test Setup(s)




Rev. C

# FCC Part 15 Subpart C

## 15.247(a)(2) 6dB Bandwidth

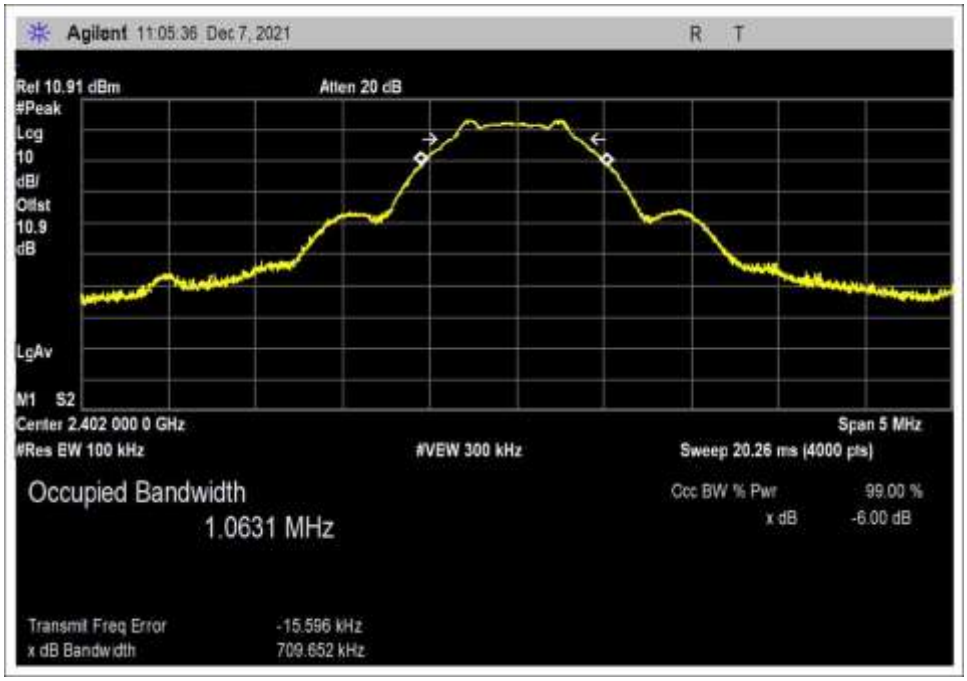
| Test Setup/Conditions | | | |
|---|---|---|---|
| Test Location: | Fremont Lab C3 | Test Engineer: | Hoang Cao |
| Test Method: | ANSI C63.10 (2013),<br>KDB 558074 D01 15.247<br>Meas Guidance v05r02 | Test Date(s): | 12/7/2021 |
| Configuration: | 10 | | |
| Test Setup: | The EUT is placed non-conducted table.<br>It is operated as intended. It is connected straight to a Spectrum Analyzer. | | |

| Environmental Conditions | | | |
|---|---|---|---|
| Temperature (ºC) | 22.5 | Relative Humidity (%): | 45 |

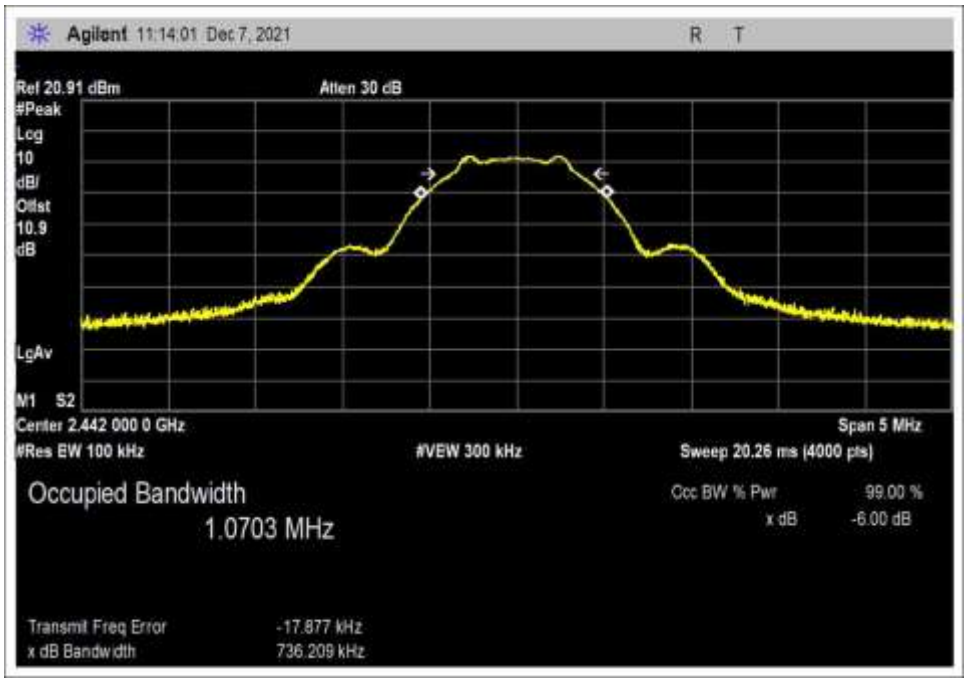
| Test Equipment | | | | | |
|---|---|---|---|---|---|
| **Asset#** | **Description** | **Manufacturer** | **Model** | **Cal Date** | **Cal Due** |
| 03360 | Cable | Astrolab | 32022-2-29094-36TC | 4/9/2020 | 4/9/2022 |
| P06239 | Attenuator | Weinschel | 54A-10 | 6/17/2020 | 6/17/2022 |
| 03471 | Spectrum Analyzer | Agilent | E4440A | 2/11/2020 | 2/11/2022 |

| Test Data Summary | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Antenna Port** | **Modulation** | **Measured (kHz)** | **Limit (kHz)** | **Results** |
| 2402 | 1 | GFSK | 709.652 | ≥500 | Pass |
| 2442 | 1 | GFSK | 736.209 | ≥500 | Pass |
| 2480 | 1 | GFSK | 728.354 | ≥500 | Pass |

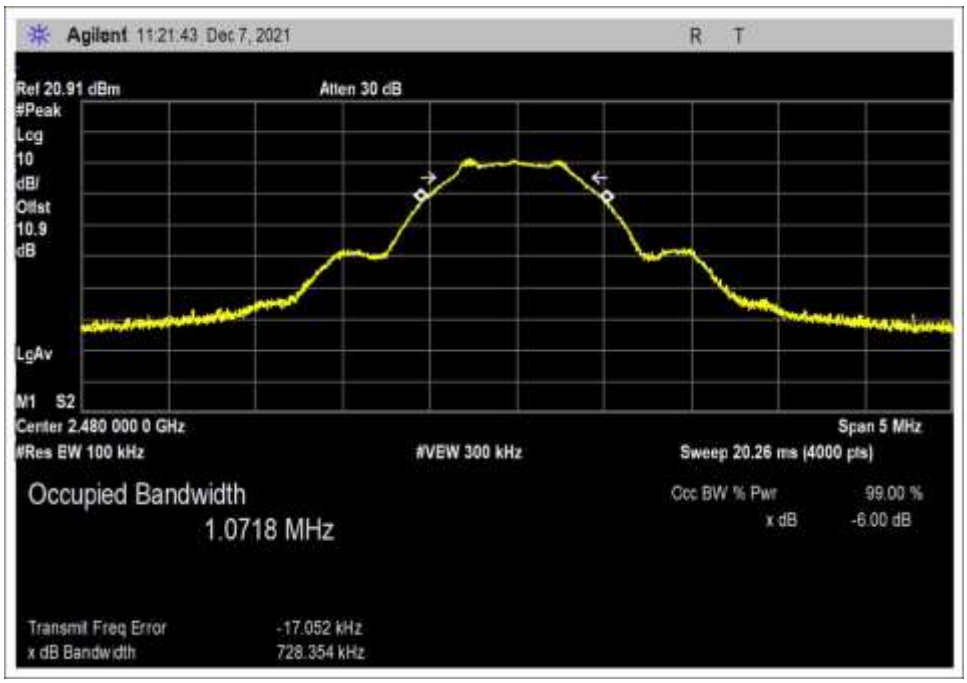
## Plot(s)




Low Channel




Middle Channel




High Channel

# 15.247(b)(3) Output Power

| Test Setup / Conditions | | | |
|---|---|---|---|
| Test Location: | Fremont Lab C3 | Test Engineer: | Hoang Cao |
| Test Method: | ANSI C63.10 (2013),<br>KDB 558074 D01 15.247<br>Meas Guidance v05r02 | Test Date(s): | 1/25/2022 |
| Configuration: | 10 | | |
| Test Setup: | The EUT is placed non-conducted table. It is operated as intended.<br>It is connected straight to a Spectrum Analyzer. | | |

| Environmental Conditions | | | |
|---|---|---|---|
| Temperature (ºC) | 22.5 | Relative Humidity (%): | 45 |

| Test Equipment | | | | | |
|---|---|---|---|---|---|
| **Asset#** | **Description** | **Manufacturer** | **Model** | **Cal Date** | **Cal Due** |
| 03360 | Cable | Astrolab | 32022-2-29094-36TC | 4/9/2020 | 4/9/2022 |
| P06239 | Attenuator | Weinschel | 54A-10 | 6/17/2020 | 6/17/2022 |
| 03471 | Spectrum Analyzer | Agilent | E4440A | 2/11/2020 | 2/11/2022 |

| Test Data Summary - Voltage Variations | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Modulation / Ant Port** | **$V_{Minimum}$ (dBm)** | **$V_{Nominal}$ (dBm)** | **$V_{Maximum}$ (dBm)** | **Max Deviation from $V_{Nominal}$ (dB)** |
| 2402 | GFSK | -1.40 | -1.42 | -1.47 | 0.07 |
| 2442 | GFSK | -2.42 | -2.43 | -2.40 | 0.03 |
| 2480 | GFSK | -3.69 | -3.73 | -3.74 | 0.05 |

Test performed using operational mode with the highest output power, representing worst case.

***Parameter Definitions:***

Measurements performed at input voltage Vnominal ± 15%.

| Parameter | Value |
|---|---|
| $V_{Nominal}$: | 15 VDC |
| $V_{Minimum}$: | 12.75 VDC |
| $V_{Maximum}$: | 17.25 VDC |

| Power Output Test Data Summary - RF Conducted Measurement | | | | | |
|---|---|---|---|---|---|
| Measurement Option: RBW > DTS Bandwidth | | | | | |
| **Frequency (MHz)** | **Modulation** | **Ant. Type / Gain (dBi)** | **Measured (dBm)** | **Limit (dBm)** | **Results** |
| 2402 | GFSK | Integral /5.00 | -1.40 | ≤30 | Pass |
| 2442 | GFSK | Integral /5.00 | -2.43 | ≤30 | Pass |
| 2480 | GFSK | Integral /5.00 | -3.73 | ≤30 | Pass |

For fixed point-to-point antennas, the limit is calculated in accordance with 15.247(c)(1):

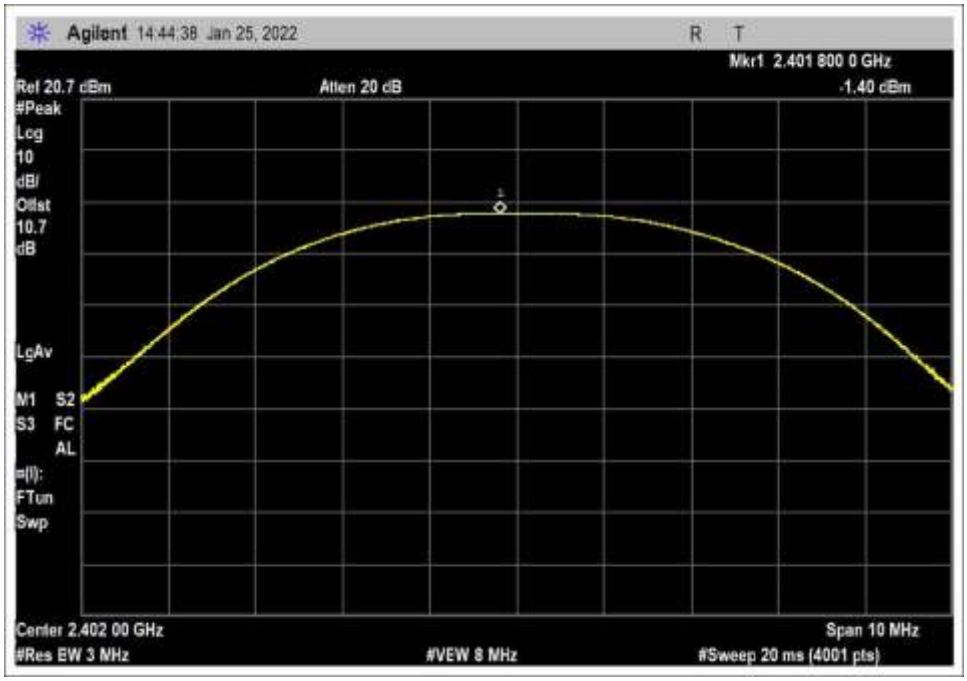
$$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$$

For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

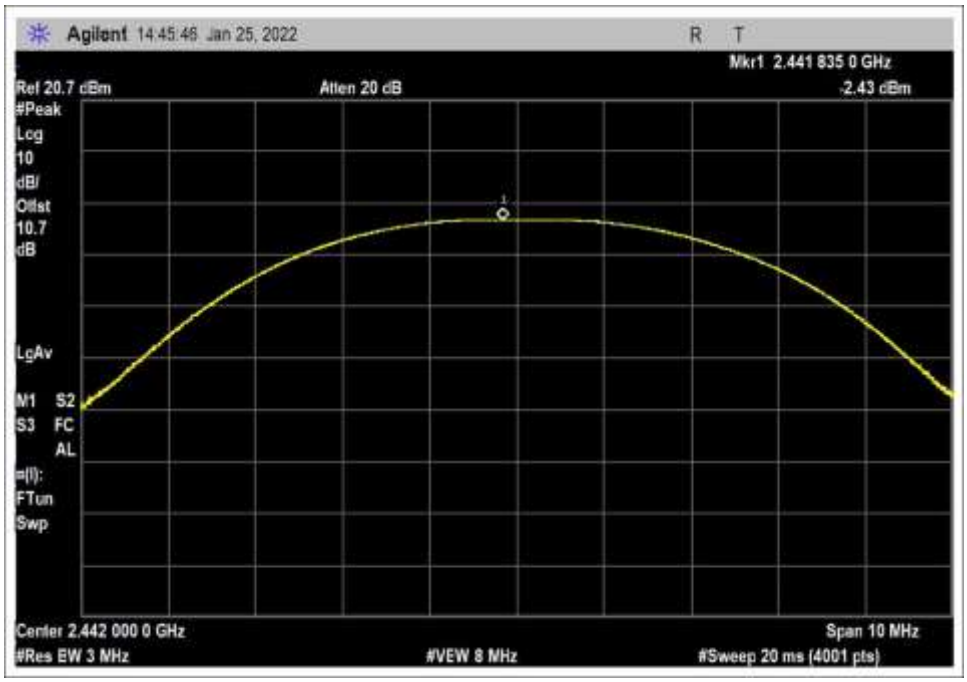
For all other antennas, the limit is calculated according to a maximum of 1W (30 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

$$Limit = 30 - Roundup(G - 6)$$

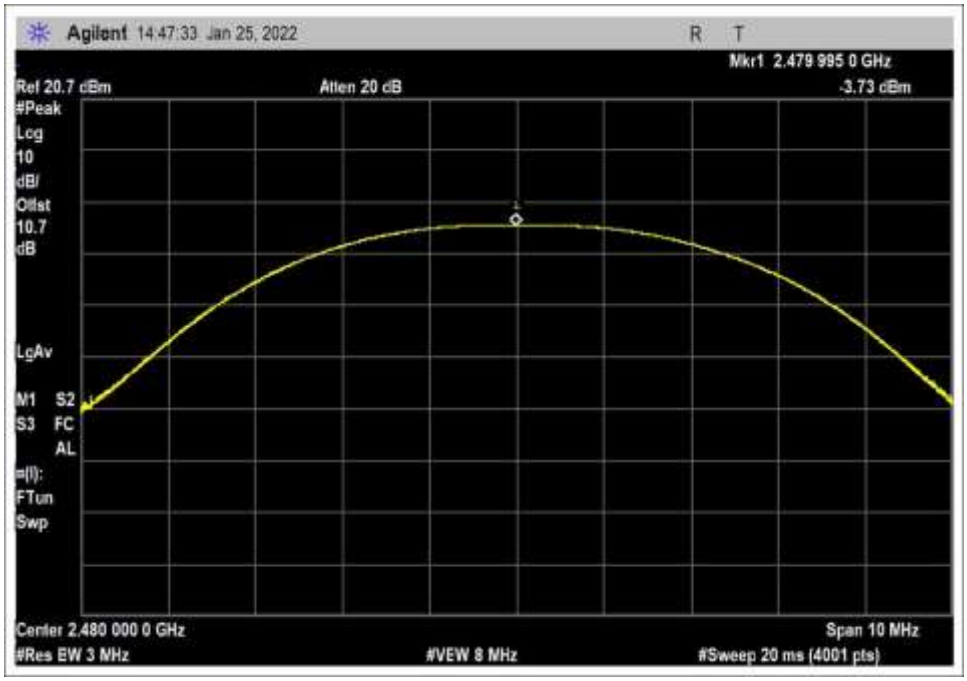
## Plots




Low Channel




Middle Channel




High Channel

# 15.247(d) RF Conducted Emissions & Band Edge

## Test Setup / Conditions / Data

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) Conducted Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 12/7/2021 |
| Test Type: | **Conducted Scan** | Time: | 11:34:55 AM |
| Tested By: | Hoang Cao | Sequence#: | 4 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Test Conditions / Notes:***

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

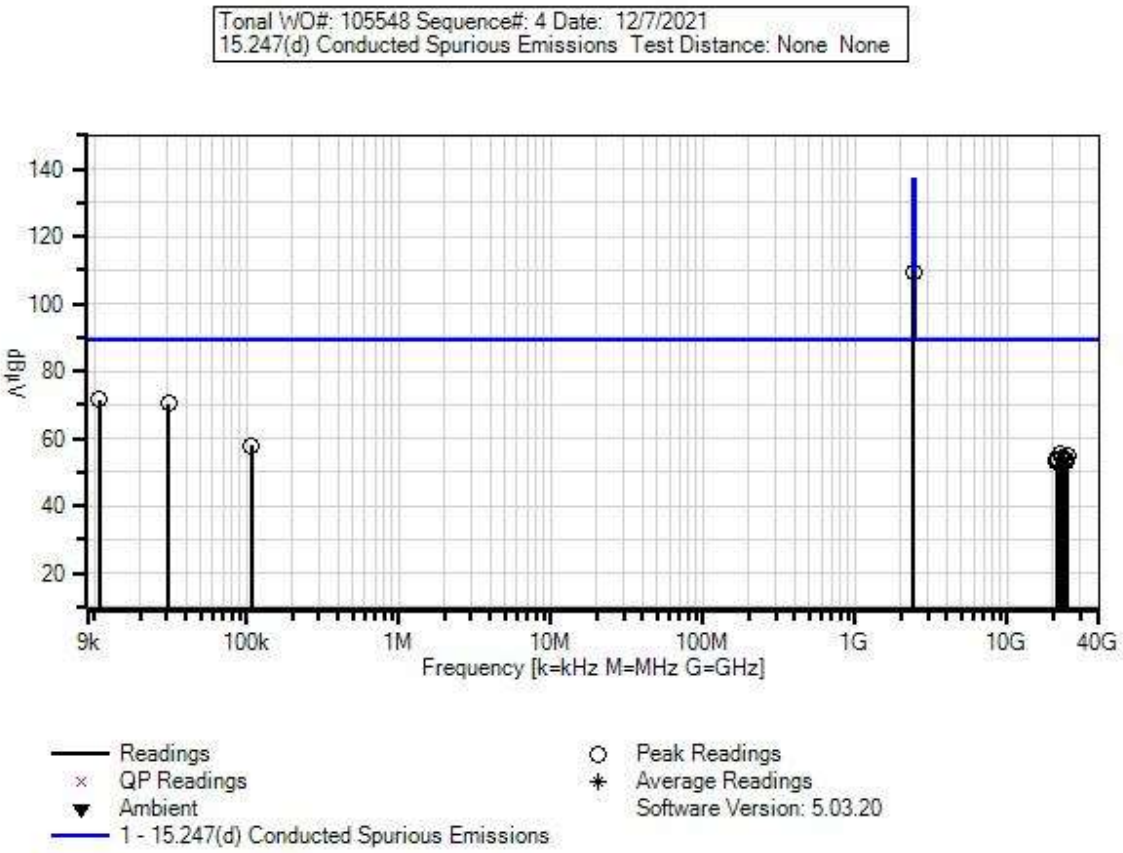
Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is placed non-conducted table.
It is operated as intended. It is connected straight to a Spectrum Analyzer.
A laptop is used to send the command to the EUT.

RF output power: 4dBm

Note:
**Low Channel**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07365 | Attenuator | 54A-10 | 5/26/2021 | 5/26/2023 |
| T2 | ANP06904 | Cable | 32022-29094K-29094K-36TC | 1/7/2020 | 1/7/2022 |
| | AN03471 | Spectrum Analyzer | E4440A | 2/11/2020 | 2/11/2022 |

***Measurement Data:*** Reading listed by margin. Test Distance: None

| # | Freq MHz | Rdng dBµV | T1 dB | T2 dB | dB | dB | Dist Table | Corr dBµV | Spec dBµV | Margin dB | Polar Ant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10.847k | 61.9 | +9.7 | +0.0 | | | +0.0 | 71.6 | 89.2 | -17.6 | None |
| 2 | 30.990k | 60.8 | +9.7 | +0.0 | | | +0.0 | 70.5 | 89.2 | -18.7 | None |
| 3 | 2400.765M | 98.8 | +9.9 | +0.8 | | | +0.0 | 109.5 | 137.0 | -27.5 | None |
| 4 | 107.749k | 48.3 | +9.7 | +0.0 | | | +0.0 | 58.0 | 89.2 | -31.2 | None |
| 5 | 22023.952 M | 43.2 | +10.1 | +2.4 | | | +0.0 | 55.7 | 89.2 | -33.5 | None |
| 6 | 24926.647 M | 42.0 | +10.1 | +2.6 | | | +0.0 | 54.7 | 89.2 | -34.5 | None |
| 7 | 22526.946 M | 42.0 | +10.0 | +2.4 | | | +0.0 | 54.4 | 89.2 | -34.8 | None |
| 8 | 23124.251 M | 41.5 | +10.0 | +2.5 | | | +0.0 | 54.0 | 89.2 | -35.2 | None |
| 9 | 21185.628 M | 41.5 | +10.0 | +2.4 | | | +0.0 | 53.9 | 89.2 | -35.3 | None |
| 10 | 21646.706 M | 41.3 | +10.0 | +2.4 | | | +0.0 | 53.7 | 89.2 | -35.5 | None |
| 11 | 21510.478 M | 41.2 | +10.0 | +2.4 | | | +0.0 | 53.6 | 89.2 | -35.6 | None |
| 12 | 24193.114 M | 40.9 | +10.1 | +2.5 | | | +0.0 | 53.5 | 89.2 | -35.7 | None |
| 13 | 21573.353 M | 41.0 | +10.0 | +2.4 | | | +0.0 | 53.4 | 89.2 | -35.8 | None |
| 14 | 23501.497 M | 40.8 | +10.1 | +2.5 | | | +0.0 | 53.4 | 89.2 | -35.8 | None |
| 15 | 23805.389 M | 40.8 | +10.1 | +2.5 | | | +0.0 | 53.4 | 89.2 | -35.8 | None |
| 16 | 20976.047 M | 40.9 | +10.0 | +2.4 | | | +0.0 | 53.3 | 89.2 | -35.9 | None |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 24517.964 M | 40.7 | +10.1 | +2.5 | | +0.0 | 53.3 | 89.2 | -35.9 | None |
| 18 | 24077.844 M | 40.6 | +10.1 | +2.5 | | +0.0 | 53.2 | 89.2 | -36.0 | None |
| 19 | 24140.718 M | 40.6 | +10.1 | +2.5 | | +0.0 | 53.2 | 89.2 | -36.0 | None |
| 20 | 24538.922 M | 40.6 | +10.1 | +2.5 | | +0.0 | 53.2 | 89.2 | -36.0 | None |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) Conducted Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 12/7/2021 |
| Test Type: | **Conducted Scan** | Time: | 11:42:28 AM |
| Tested By: | Hoang Cao | Sequence#: | 5 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Test Conditions / Notes:***

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

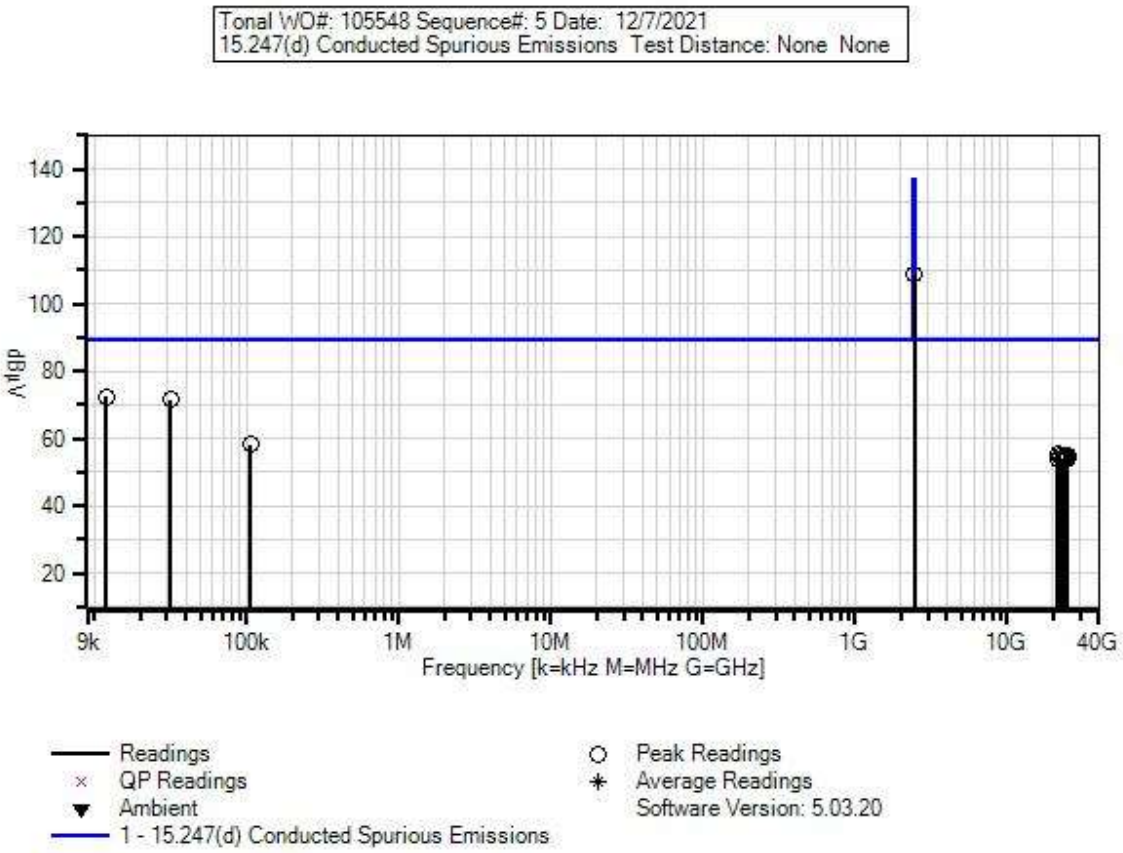
Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is placed non-conducted table.
It is operated as intended.
It is connected straight to a Spectrum Analyzer.
A laptop is used to send the command to the EUT.

RF output power: 4dBm

Note:
**Middle Channel**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07365 | Attenuator | 54A-10 | 5/26/2021 | 5/26/2023 |
| T2 | ANP06904 | Cable | 32022-29094K-29094K-36TC | 1/7/2020 | 1/7/2022 |
| | AN03471 | Spectrum Analyzer | E4440A | 2/11/2020 | 2/11/2022 |

***Measurement Data:*** Reading listed by margin. Test Distance: None

| # | Freq MHz | Rdng dBµV | T1 dB | T2 dB | dB | dB | Dist Table | Corr dBµV | Spec dBµV | Margin dB | Polar Ant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11.923k | 62.7 | +9.7 | +0.0 | | | +0.0 | 72.4 | 89.2 | -16.8 | None |
| 2 | 31.595k | 61.8 | +9.7 | +0.0 | | | +0.0 | 71.5 | 89.2 | -17.7 | None |
| 3 | 2442.659M | 98.0 | +9.9 | +0.8 | | | +0.0 | 108.7 | 137.0 | -28.3 | None |
| 4 | 106.707k | 48.6 | +9.7 | +0.0 | | | +0.0 | 58.3 | 89.2 | -30.9 | None |
| 5 | 21782.934 M | 43.2 | +10.0 | +2.4 | | | +0.0 | 55.6 | 89.2 | -33.6 | None |
| 6 | 21971.556 M | 42.5 | +10.1 | +2.4 | | | +0.0 | 55.0 | 89.2 | -34.2 | None |
| 7 | 24832.335 M | 42.3 | +10.1 | +2.6 | | | +0.0 | 55.0 | 89.2 | -34.2 | None |
| 8 | 22128.742 M | 42.4 | +10.1 | +2.4 | | | +0.0 | 54.9 | 89.2 | -34.3 | None |
| 9 | 24455.090 M | 42.3 | +10.1 | +2.5 | | | +0.0 | 54.9 | 89.2 | -34.3 | None |
| 10 | 21866.766 M | 42.2 | +10.1 | +2.4 | | | +0.0 | 54.7 | 89.2 | -34.5 | None |
| 11 | 24193.114 M | 41.7 | +10.1 | +2.5 | | | +0.0 | 54.3 | 89.2 | -34.9 | None |
| 12 | 24727.545 M | 41.4 | +10.1 | +2.6 | | | +0.0 | 54.1 | 89.2 | -35.1 | None |
| 13 | 24360.778 M | 41.3 | +10.1 | +2.5 | | | +0.0 | 53.9 | 89.2 | -35.3 | None |
| 14 | 22799.401 M | 41.4 | +10.0 | +2.4 | | | +0.0 | 53.8 | 89.2 | -35.4 | None |
| 15 | 21342.814 M | 41.3 | +10.0 | +2.4 | | | +0.0 | 53.7 | 89.2 | -35.5 | None |
| 16 | 22642.215 M | 41.2 | +10.0 | +2.4 | | | +0.0 | 53.6 | 89.2 | -35.6 | None |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 23344.311 M | 40.9 | +10.1 | +2.5 | | +0.0 | 53.5 | 89.2 | -35.7 | None |
| 18 | 23260.479 M | 40.9 | +10.1 | +2.5 | | +0.0 | 53.5 | 89.2 | -35.7 | None |
| 19 | 23752.994 M | 40.9 | +10.1 | +2.5 | | +0.0 | 53.5 | 89.2 | -35.7 | None |
| 20 | 23459.581 M | 40.9 | +10.1 | +2.5 | | +0.0 | 53.5 | 89.2 | -35.7 | None |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) Conducted Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 12/7/2021 |
| Test Type: | **Conducted Scan** | Time: | 11:49:36 AM |
| Tested By: | Hoang Cao | Sequence#: | 6 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 10 | | | |

***Test Conditions / Notes:***

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

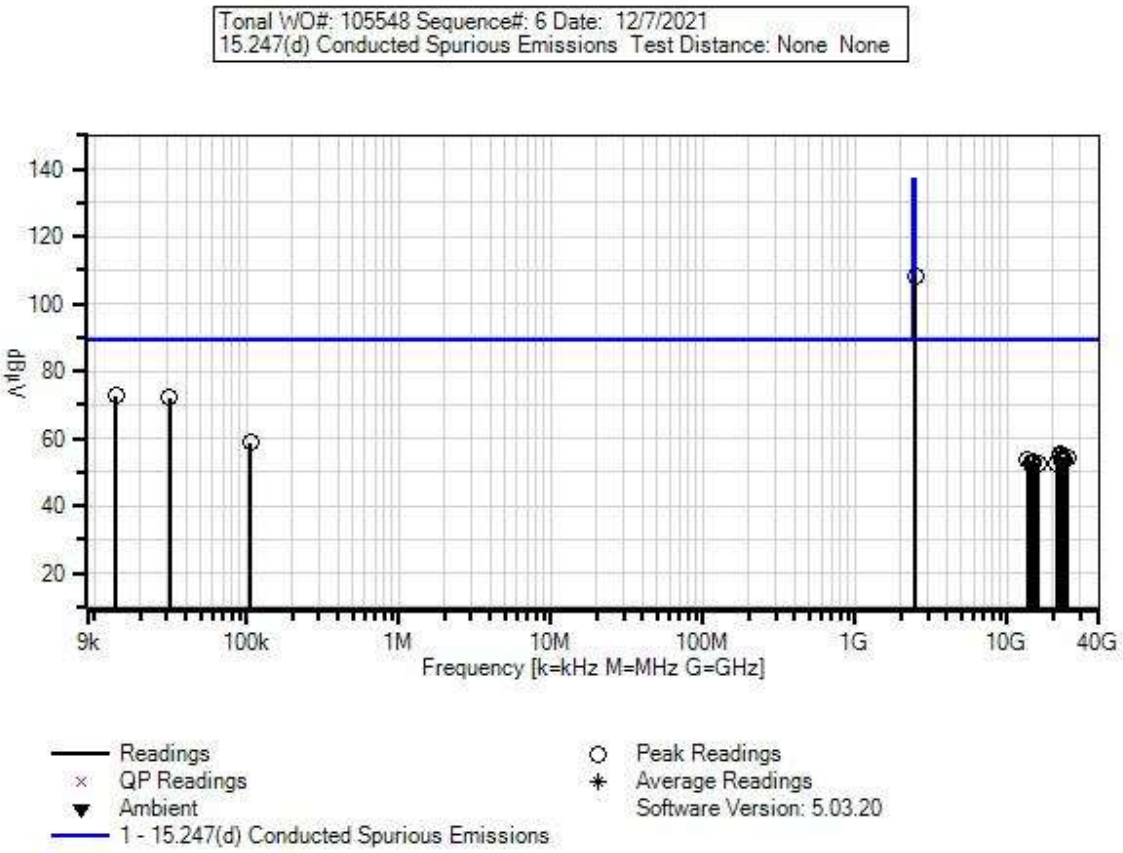
Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is placed non-conducted table.
It is operated as intended.
It is connected straight to a Spectrum Analyzer.
A laptop is used to send the command to the EUT.

RF output power: 4dBm

Note:
**High Channel**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07365 | Attenuator | 54A-10 | 5/26/2021 | 5/26/2023 |
| T2 | ANP06904 | Cable | 32022-29094K-29094K-36TC | 1/7/2020 | 1/7/2022 |
| | AN03471 | Spectrum Analyzer | E4440A | 2/11/2020 | 2/11/2022 |

***Measurement Data:*** Reading listed by margin. Test Distance: None

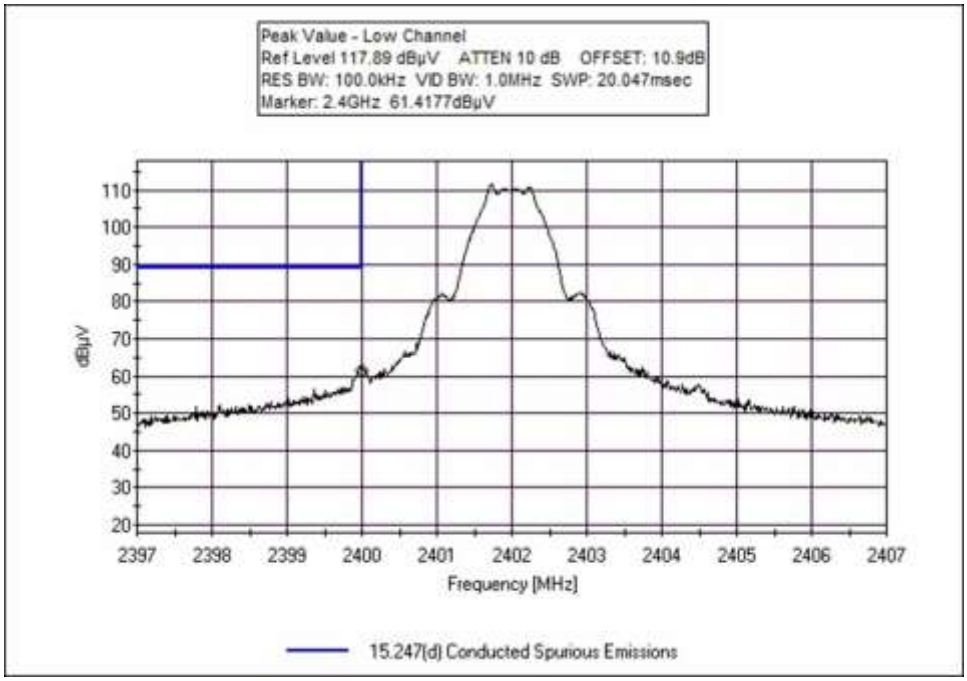
| # | Freq MHz | Rdng dBµV | T1 dB | T2 dB | dB | dB | Dist Table | Corr dBµV | Spec dBµV | Margin dB | Polar Ant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13.837k | 63.0 | +9.7 | +0.0 | | | +0.0 | 72.7 | 89.2 | -16.5 | None |
| 2 | 31.292k | 62.4 | +9.7 | +0.0 | | | +0.0 | 72.1 | 89.2 | -17.1 | None |
| 3 | 2478.568M | 97.5 | +9.9 | +0.8 | | | +0.0 | 108.2 | 137.0 | -28.8 | None |
| 4 | 106.707k | 49.0 | +9.7 | +0.0 | | | +0.0 | 58.7 | 89.2 | -30.5 | None |
| 5 | 22002.993 M | 42.7 | +10.1 | +2.4 | | | +0.0 | 55.2 | 89.2 | -34.0 | None |
| 6 | 21856.287 M | 42.7 | +10.0 | +2.4 | | | +0.0 | 55.1 | 89.2 | -34.1 | None |
| 7 | 22076.347 M | 42.5 | +10.1 | +2.4 | | | +0.0 | 55.0 | 89.2 | -34.2 | None |
| 8 | 22883.233 M | 41.8 | +10.0 | +2.5 | | | +0.0 | 54.3 | 89.2 | -34.9 | None |
| 9 | 24790.419 M | 41.5 | +10.1 | +2.6 | | | +0.0 | 54.2 | 89.2 | -35.0 | None |
| 10 | 24717.066 M | 41.4 | +10.1 | +2.6 | | | +0.0 | 54.1 | 89.2 | -35.1 | None |
| 11 | 13603.919 M | 42.0 | +10.0 | +1.9 | | | +0.0 | 53.9 | 89.2 | -35.3 | None |
| 12 | 23187.125 M | 41.3 | +10.1 | +2.5 | | | +0.0 | 53.9 | 89.2 | -35.3 | None |
| 13 | 23553.892 M | 41.2 | +10.1 | +2.5 | | | +0.0 | 53.8 | 89.2 | -35.4 | None |
| 14 | 23008.982 M | 41.0 | +10.0 | +2.5 | | | +0.0 | 53.5 | 89.2 | -35.7 | None |
| 15 | 14500.349 M | 41.4 | +10.0 | +1.9 | | | +0.0 | 53.3 | 89.2 | -35.9 | None |
| 16 | 23061.377 M | 40.6 | +10.0 | +2.5 | | | +0.0 | 53.1 | 89.2 | -36.1 | None |

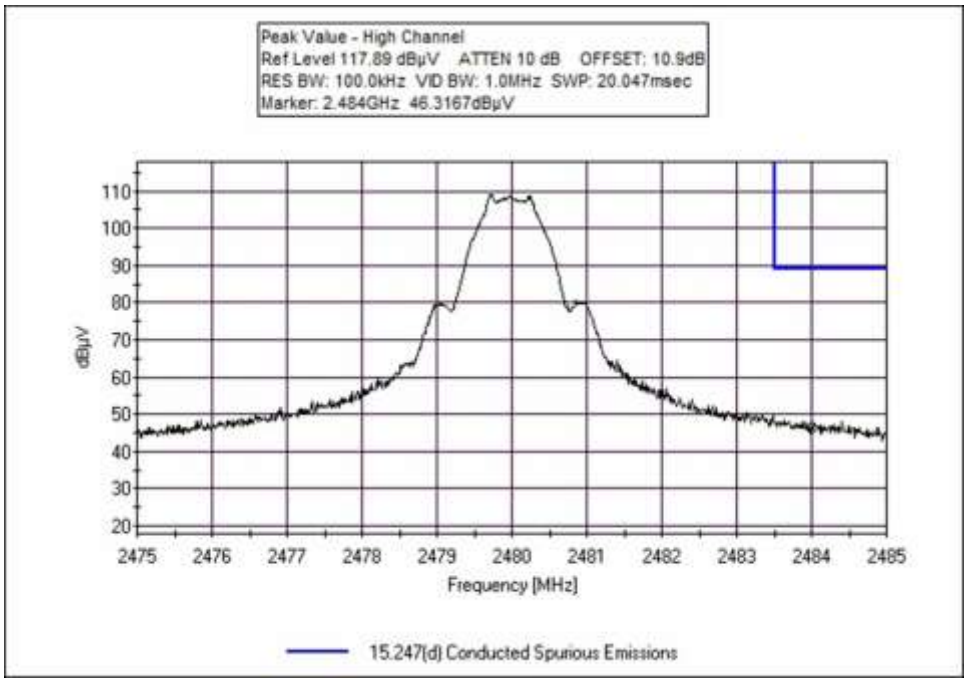
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 14211.842 M | 40.9 | +10.0 | +1.9 | | +0.0 | 52.8 | 89.2 | -36.4 | None |
| 18 | 14866.765 M | 40.8 | +10.0 | +1.9 | | +0.0 | 52.7 | 89.2 | -36.5 | None |
| 19 | 15820.358 M | 40.7 | +10.0 | +2.0 | | +0.0 | 52.7 | 89.2 | -36.5 | None |
| 20 | 20913.173 M | 40.2 | +10.0 | +2.4 | | +0.0 | 52.6 | 89.2 | -36.6 | None |

## Band Edge

| Band Edge Summary | | | | |
|---|---|---|---|---|
| Limit applied: Max Power/100kHz - 20dB. | | | | |
| **Frequency (MHz)** | **Modulation** | **Measured (dBm)** | **Limit (dBm)** | **Results** |
| 2400.0 | GFSK | 61.4177 | <89.16 | Pass |
| 2483.5 | GFSK | 46.3167 | <89.16 | Pass |

## Band Edge Plots



# 15.247(d) Radiated Emissions & Band Edge

## Test Setup / Conditions / Data

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 16:32:25 |
| Tested By: | Hoang Cao | Sequence#: | 296 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**Low Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**


***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07508 | Preamp | 310N | 7/9/2020 | 7/9/2022 |
| T2 | AN00852 | Biconilog Antenna | CBL 6111C | 4/14/2020 | 4/14/2022 |
| T3 | ANP06049 | Attenuator | PE7002-6 | 5/11/2020 | 5/11/2022 |
| T4 | ANP01187 | Cable | CNT-195 | 7/6/2020 | 7/6/2022 |
| T5 | ANP06691 | Cable | PE3062-180 | 3/25/2020 | 3/25/2022 |
| T6 | ANP06694 | Cable | PE3062-480 | 3/25/2020 | 3/25/2022 |
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| | AN00432 | Loop Antenna | 6502 | 7/19/2021 | 7/19/2023 |

***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

| # | Freq | Rdng | T1<br>T5 | T2<br>T6 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 149.432M | 50.5 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 37.6 | 43.5 | -5.9 | Horiz |
| | QP | | +0.4 | +1.1 | | | | | | | |
| ^ | 149.432M | 53.4 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 40.5 | 43.5 | -3.0 | Horiz |
| | | | +0.4 | +1.1 | | | | | | | |
| 3 | 296.282M | 49.8 | -31.9 | +13.2 | +6.0 | +0.4 | +0.0 | 39.7 | 46.0 | -6.3 | Horiz |
| | QP | | +0.6 | +1.6 | | | | | | | |
| ^ | 296.282M | 57.3 | -31.9 | +13.2 | +6.0 | +0.4 | +0.0 | 47.2 | 46.0 | +1.2 | Horiz |
| | | | +0.6 | +1.6 | | | | | | | |
| 5 | 147.567M | 50.0 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 37.1 | 43.5 | -6.4 | Horiz |
| | QP | | +0.4 | +1.1 | | | | | | | |
| ^ | 147.567M | 52.7 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 39.8 | 43.5 | -3.7 | Horiz |
| | | | +0.4 | +1.1 | | | | | | | |
| 7 | 444.404M | 44.6 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 38.9 | 46.0 | -7.1 | Horiz |
| | QP | | +0.8 | +2.1 | | | | | | | |
| ^ | 444.404M | 47.8 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 42.1 | 46.0 | -3.9 | Horiz |
| | | | +0.8 | +2.1 | | | | | | | |
| 9 | 446.615M | 44.0 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 38.3 | 46.0 | -7.7 | Horiz |
| | QP | | +0.8 | +2.1 | | | | | | | |
| ^ | 446.615M | 47.1 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 41.4 | 46.0 | -4.6 | Horiz |
| | | | +0.8 | +2.1 | | | | | | | |
| 11 | 383.035M | 45.7 | -31.9 | +15.3 | +6.0 | +0.4 | +0.0 | 38.1 | 46.0 | -7.9 | Vert |
| | | | +0.7 | +1.9 | | | | | | | |
| 12 | 884.626M | 34.5 | -31.4 | +23.1 | +5.9 | +0.7 | +0.0 | 37.2 | 46.0 | -8.8 | Horiz |
| | QP | | +1.2 | +3.2 | | | | | | | |
| ^ | 884.626M | 38.5 | -31.4 | +23.1 | +5.9 | +0.7 | +0.0 | 41.2 | 46.0 | -4.8 | Horiz |
| | | | +1.2 | +3.2 | | | | | | | |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 17:06:18 |
| Tested By: | Hoang Cao | Sequence#: | 299 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

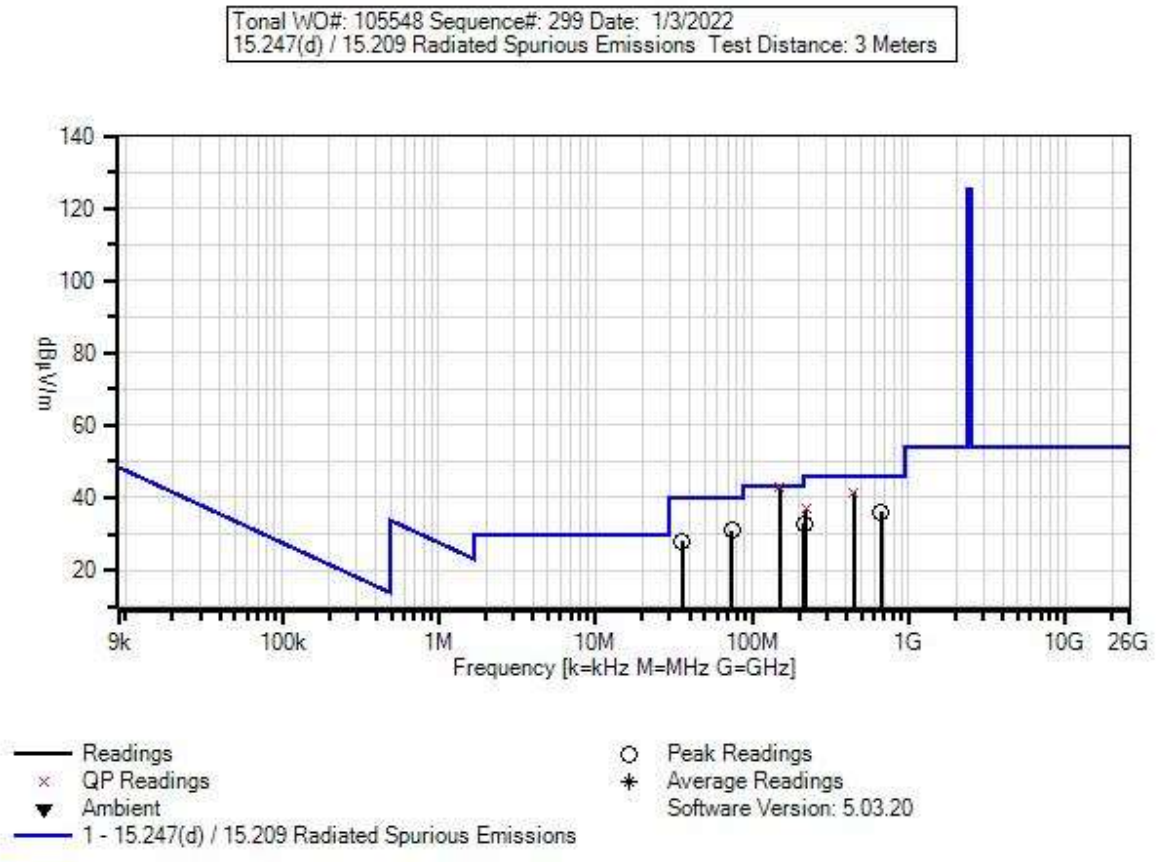
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**Middle Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07508 | Preamp | 310N | 7/9/2020 | 7/9/2022 |
| T2 | AN00852 | Biconilog Antenna | CBL 6111C | 4/14/2020 | 4/14/2022 |
| T3 | ANP06049 | Attenuator | PE7002-6 | 5/11/2020 | 5/11/2022 |
| T4 | ANP01187 | Cable | CNT-195 | 7/6/2020 | 7/6/2022 |
| T5 | ANP06691 | Cable | PE3062-180 | 3/25/2020 | 3/25/2022 |
| T6 | ANP06694 | Cable | PE3062-480 | 3/25/2020 | 3/25/2022 |
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| | AN00432 | Loop Antenna | 6502 | 7/19/2021 | 7/19/2023 |

***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

| # | Freq | Rdng | T1<br>T5 | T2<br>T6 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 149.385M | 55.9 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 43.0 | 43.5 | -0.5 | Horiz |
| | QP | | +0.4 | +1.1 | | | | | | | |
| ^ | 149.385M | 63.6 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 50.7 | 43.5 | +7.2 | Horiz |
| | | | +0.4 | +1.1 | | | | | | | |
| 3 | 446.603M | 47.3 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 41.6 | 46.0 | -4.4 | Horiz |
| | QP | | +0.8 | +2.1 | | | | | | | |
| ^ | 446.603M | 50.5 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 44.8 | 46.0 | -1.2 | Horiz |
| | | | +0.8 | +2.1 | | | | | | | |
| 5 | 74.473M | 49.2 | -32.0 | +6.8 | +5.9 | +0.1 | +0.0 | 31.0 | 40.0 | -9.0 | Horiz |
| | | | +0.3 | +0.7 | | | | | | | |
| 6 | 221.314M | 50.0 | -31.9 | +10.7 | +5.9 | +0.3 | +0.0 | 36.9 | 46.0 | -9.1 | Horiz |
| | QP | | +0.5 | +1.4 | | | | | | | |
| ^ | 221.314M | 53.6 | -31.9 | +10.7 | +5.9 | +0.3 | +0.0 | 40.5 | 46.0 | -5.5 | Horiz |
| | | | +0.5 | +1.4 | | | | | | | |
| 8 | 672.407M | 37.4 | -32.0 | +20.6 | +5.9 | +0.6 | +0.0 | 36.2 | 46.0 | -9.8 | Horiz |
| | | | +1.0 | +2.7 | | | | | | | |
| 9 | 215.969M | 46.4 | -31.9 | +10.4 | +5.9 | +0.3 | +0.0 | 32.9 | 43.5 | -10.6 | Vert |
| | | | +0.5 | +1.3 | | | | | | | |
| 10 | 35.976M | 37.5 | -32.0 | +16.0 | +5.9 | +0.0 | +0.0 | 28.0 | 40.0 | -12.0 | Vert |
| | | | +0.2 | +0.4 | | | | | | | |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 17:25:06 |
| Tested By: | Hoang Cao | Sequence#: | 302 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

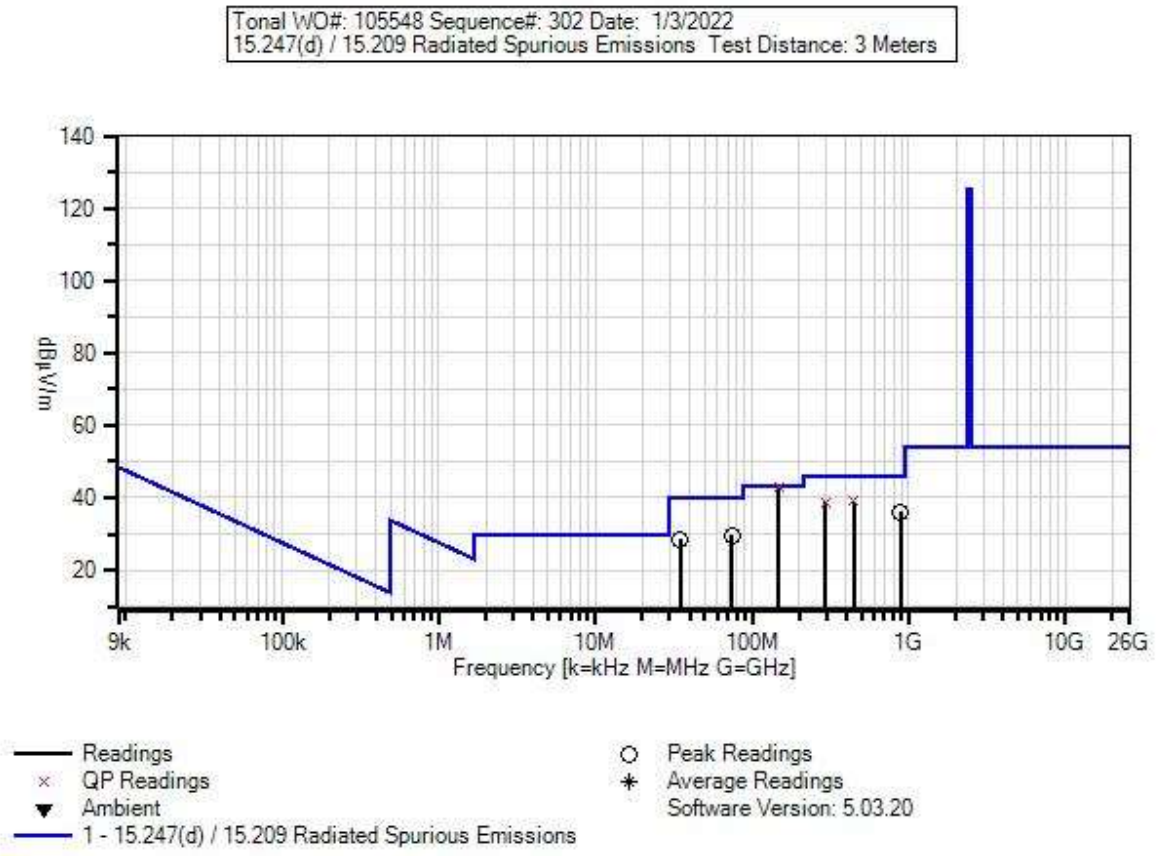
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**High Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP07508 | Preamp | 310N | 7/9/2020 | 7/9/2022 |
| T2 | AN00852 | Biconilog Antenna | CBL 6111C | 4/14/2020 | 4/14/2022 |
| T3 | ANP06049 | Attenuator | PE7002-6 | 5/11/2020 | 5/11/2022 |
| T4 | ANP01187 | Cable | CNT-195 | 7/6/2020 | 7/6/2022 |
| T5 | ANP06691 | Cable | PE3062-180 | 3/25/2020 | 3/25/2022 |
| T6 | ANP06694 | Cable | PE3062-480 | 3/25/2020 | 3/25/2022 |
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| | AN00432 | Loop Antenna | 6502 | 7/19/2021 | 7/19/2023 |

***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

| # | Freq | Rdng | T1<br>T5 | T2<br>T6 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 148.127M | 55.8 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 42.9 | 43.5 | -0.6 | Horiz |
| | QP | | +0.4 | +1.1 | | | | | | | |
| ^ | 148.127M | 62.5 | -32.0 | +11.5 | +5.9 | +0.2 | +0.0 | 49.6 | 43.5 | +6.1 | Horiz |
| | | | +0.4 | +1.1 | | | | | | | |
| 3 | 444.373M | 44.8 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 39.1 | 46.0 | -6.9 | Horiz |
| | QP | | +0.8 | +2.1 | | | | | | | |
| ^ | 444.373M | 48.7 | -31.9 | +16.9 | +5.9 | +0.5 | +0.0 | 43.0 | 46.0 | -3.0 | Horiz |
| | | | +0.8 | +2.1 | | | | | | | |
| 5 | 295.700M | 48.8 | -31.9 | +13.2 | +6.0 | +0.4 | +0.0 | 38.7 | 46.0 | -7.3 | Horiz |
| | QP | | +0.6 | +1.6 | | | | | | | |
| ^ | 295.700M | 54.9 | -31.9 | +13.2 | +6.0 | +0.4 | +0.0 | 44.8 | 46.0 | -1.2 | Horiz |
| | | | +0.6 | +1.6 | | | | | | | |
| 7 | 885.571M | 33.4 | -31.4 | +23.1 | +5.9 | +0.7 | +0.0 | 36.1 | 46.0 | -9.9 | Vert |
| | | | +1.2 | +3.2 | | | | | | | |
| 8 | 74.511M | 47.7 | -32.0 | +6.8 | +5.9 | +0.1 | +0.0 | 29.5 | 40.0 | -10.5 | Horiz |
| | | | +0.3 | +0.7 | | | | | | | |
| 9 | 35.050M | 37.4 | -32.0 | +16.6 | +5.9 | +0.0 | +0.0 | 28.5 | 40.0 | -11.5 | Vert |
| | | | +0.2 | +0.4 | | | | | | | |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 13:47:45 |
| Tested By: | Hoang Cao | Sequence#: | 287 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

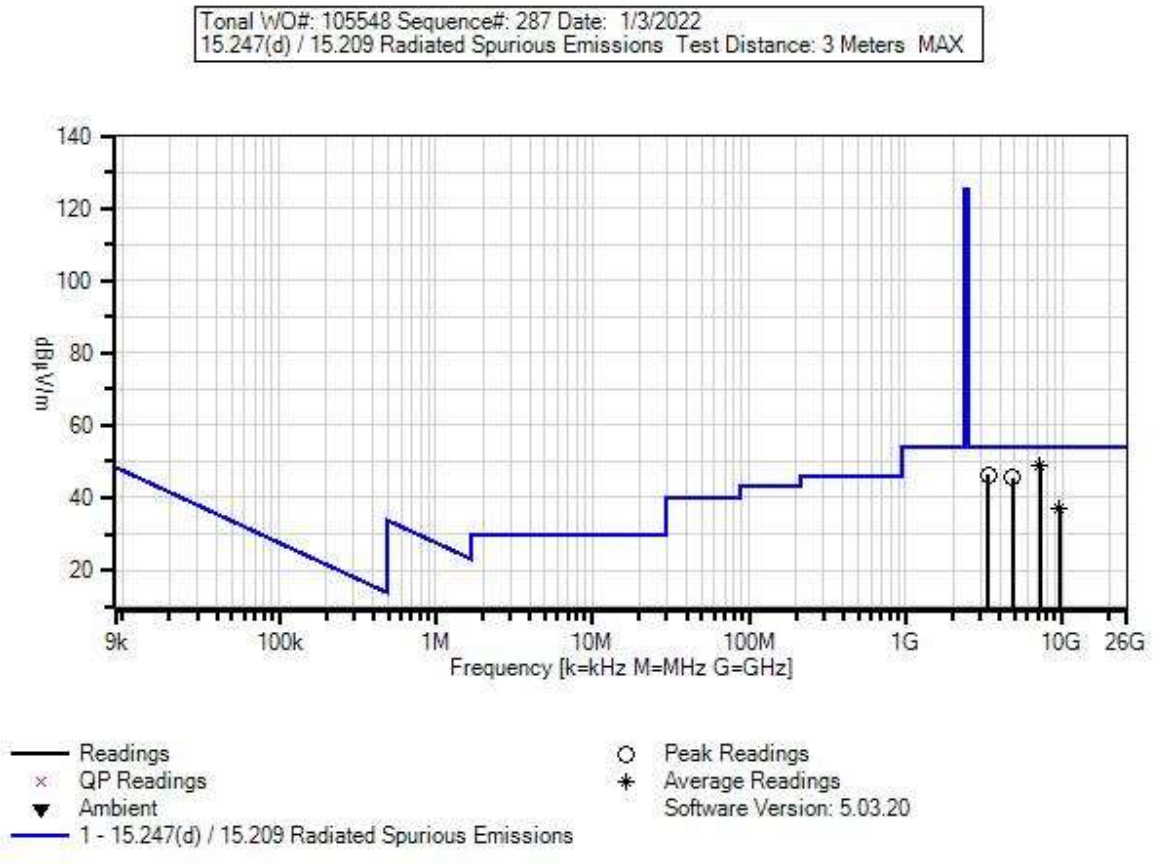
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**Low Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T1 | AN02113 | Horn Antenna-ANSI C63.5 | 3115 | 3/11/2021 | 3/11/2023 |
| T2 | AN02812 | Preamp | 83017-69004 | 9/22/2020 | 9/22/2022 |
| T3 | AN03302 | Cable | 32026-29094K-29094K-72TC | 1/9/2020 | 1/9/2022 |
| T4 | ANP01210 | Cable | FSJ1P-50A-4A | 11/2/2020 | 11/2/2022 |
| T5 | ANP06902 | Cable | 32022-29094K-29094K-36TC | 8/13/2020 | 8/13/2022 |
| | AN02693 | Active Horn Antenna | AMFW-5F-12001800-20-10P | 10/26/2021 | 10/26/2023 |
| | AN02694 | Horn Antenna | AMFW-5F-18002650-20-10P | 10/26/2021 | 10/26/2023 |
| | AN03619 | Cable | OKOCQoCQ177.2 | 9/17/2021 | 9/17/2023 |
| | ANP00928 | Cable | various | 1/9/2020 | 1/9/2022 |
| | ANP00929 | Cable | various | 1/9/2020 | 1/9/2022 |

***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

| # | Freq | Rdng | T1<br>T5 | T2 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 7206.689M<br>Ave | 37.6 | +34.6<br>+1.5 | -31.4 | +2.3 | +4.5 | +0.0 | 49.1 | 54.0 | -4.9 | Vert |
| ^ | 7206.689M | 46.4 | +34.6<br>+1.5 | -31.4 | +2.3 | +4.5 | +0.0 | 57.9 | 54.0 | +3.9 | Vert |
| 3 | 3387.385M | 39.5 | +30.9<br>+1.0 | -29.6 | +1.5 | +3.1 | +0.0 | 46.4 | 54.0 | -7.6 | Horiz |
| 4 | 4804.496M | 36.5 | +32.2<br>+1.2 | -30.0 | +1.8 | +3.7 | +0.0 | 45.4 | 54.0 | -8.6 | Vert |
| 5 | 9607.782M<br>Ave | 23.6 | +36.5<br>+1.7 | -32.4 | +2.6 | +5.3 | +0.0 | 37.3 | 54.0 | -16.7 | Vert |
| ^ | 9607.782M | 36.7 | +36.5<br>+1.7 | -32.4 | +2.6 | +5.3 | +0.0 | 50.4 | 54.0 | -3.6 | Vert |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 14:15:38 |
| Tested By: | Hoang Cao | Sequence#: | 290 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**Middle Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**


***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T1 | AN02113 | Horn Antenna-ANSI C63.5 | 3115 | 3/11/2021 | 3/11/2023 |
| T2 | AN02812 | Preamp | 83017-69004 | 9/22/2020 | 9/22/2022 |
| T3 | AN03302 | Cable | 32026-29094K-29094K-72TC | 1/9/2020 | 1/9/2022 |
| T4 | ANP01210 | Cable | FSJ1P-50A-4A | 11/2/2020 | 11/2/2022 |
| T5 | ANP06902 | Cable | 32022-29094K-29094K-36TC | 8/13/2020 | 8/13/2022 |
| | AN02693 | Active Horn Antenna | AMFW-5F-12001800-20-10P | 10/26/2021 | 10/26/2023 |
| | AN02694 | Horn Antenna | AMFW-5F-18002650-20-10P | 10/26/2021 | 10/26/2023 |
| | AN03619 | Cable | OKOCQoCQ177.2 | 9/17/2021 | 9/17/2023 |
| | ANP00928 | Cable | various | 1/9/2020 | 1/9/2022 |
| | ANP00929 | Cable | various | 1/9/2020 | 1/9/2022 |

***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

| # | Freq | Rdng | T1<br>T5 | T2 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 1637.295M | 47.6 | +26.1<br>+0.7 | -31.6 | +1.0 | +2.1 | +0.0 | 45.9 | 54.0 | -8.1 | Vert |
| 2 | 4884.000M | 36.3 | +32.4<br>+1.2 | -29.9 | +1.8 | +3.7 | +0.0 | 45.5 | 54.0 | -8.5 | Vert |
| 3 | 7325.247M<br>Ave | 33.1 | +35.0<br>+1.5 | -31.5 | +2.3 | +4.6 | +0.0 | 45.0 | 54.0 | -9.0 | Vert |
| ^ | 7325.247M | 42.3 | +35.0<br>+1.5 | -31.5 | +2.3 | +4.6 | +0.0 | 54.2 | 54.0 | +0.2 | Vert |
| 5 | 9767.761M<br>Ave | 23.1 | +36.6<br>+1.7 | -32.2 | +2.6 | +5.3 | +0.0 | 37.1 | 54.0 | -16.9 | Vert |
| ^ | 9767.761M | 35.4 | +36.6<br>+1.7 | -32.2 | +2.6 | +5.3 | +0.0 | 49.4 | 54.0 | -4.6 | Vert |
| 7 | 2093.039M<br>Ave | 30.2 | +27.6<br>+0.8 | -30.9 | +1.2 | +2.4 | +0.0 | 31.3 | 54.0 | -22.7 | Horiz |
| ^ | 2093.039M | 52.7 | +27.6<br>+0.8 | -30.9 | +1.2 | +2.4 | +0.0 | 53.8 | 54.0 | -0.2 | Horiz |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.247(d) / 15.209 Radiated Spurious Emissions** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | 14:39:20 |
| Tested By: | Hoang Cao | Sequence#: | 293 |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

**High Channel**

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn
Display is showing home screen

**Modifications #1, #2, #3 #4, #5 and #6 were in place during testing.**


***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T1 | AN02113 | Horn Antenna-ANSI C63.5 | 3115 | 3/11/2021 | 3/11/2023 |
| T2 | AN02812 | Preamp | 83017-69004 | 9/22/2020 | 9/22/2022 |
| T3 | AN03302 | Cable | 32026-29094K-29094K-72TC | 1/9/2020 | 1/9/2022 |
| T4 | ANP01210 | Cable | FSJ1P-50A-4A | 11/2/2020 | 11/2/2022 |
| T5 | ANP06902 | Cable | 32022-29094K-29094K-36TC | 8/13/2020 | 8/13/2022 |
| | AN02693 | Active Horn Antenna | AMFW-5F-12001800-20-10P | 10/26/2021 | 10/26/2023 |
| | AN02694 | Horn Antenna | AMFW-5F-18002650-20-10P | 10/26/2021 | 10/26/2023 |
| | AN03619 | Cable | OKOCQoCQ177.2 | 9/17/2021 | 9/17/2023 |
| | ANP00928 | Cable | various | 1/9/2020 | 1/9/2022 |
| | ANP00929 | Cable | various | 1/9/2020 | 1/9/2022 |

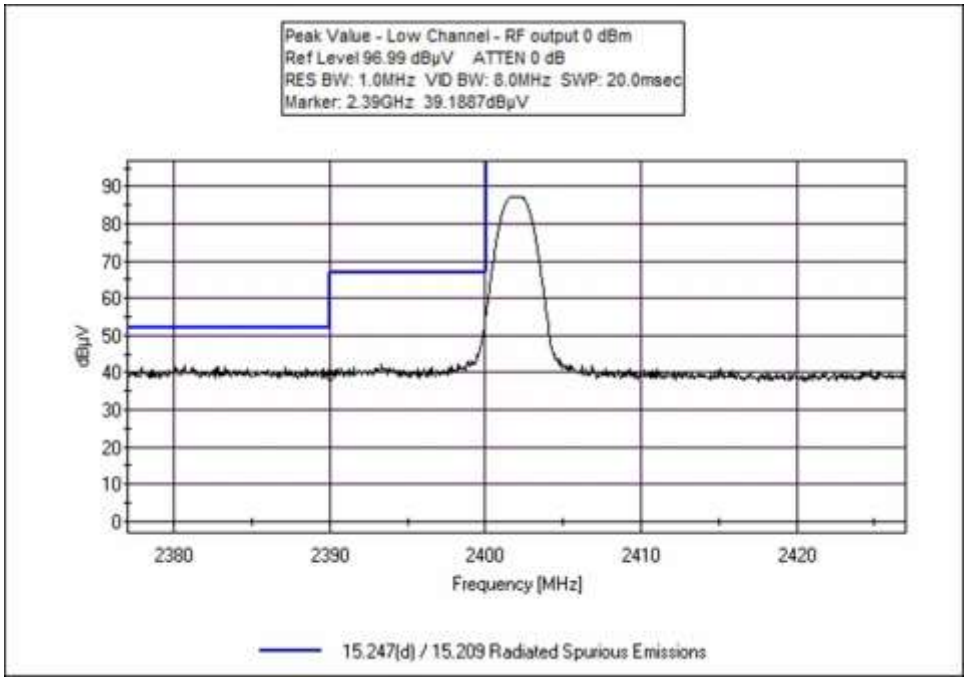
***Measurement Data:*** Reading listed by margin. Test Distance: 3 Meters

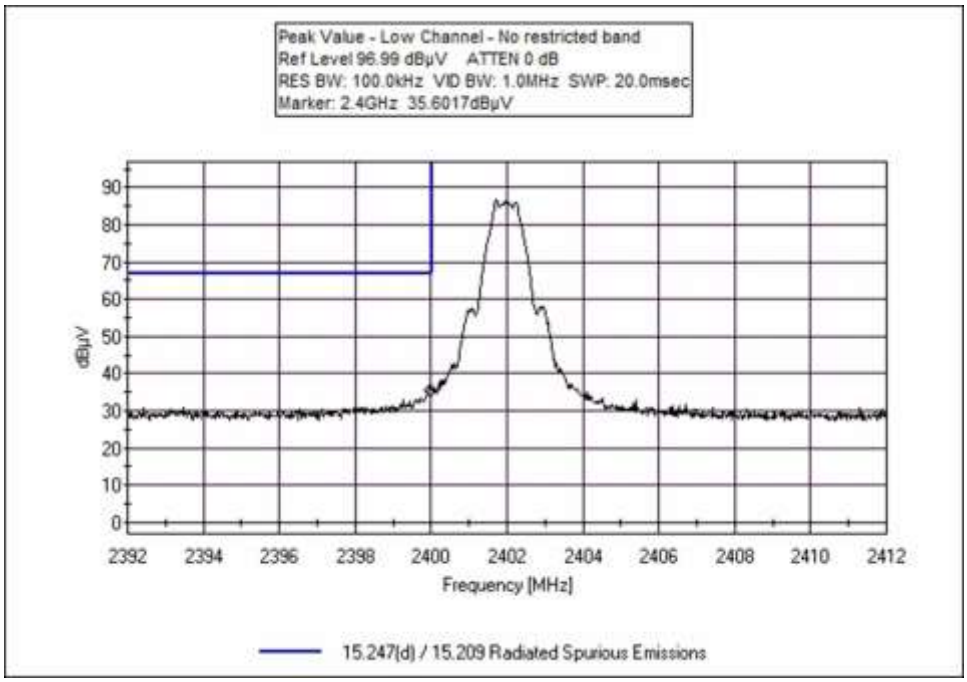
| # | Freq | Rdng | T1<br>T5 | T2 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV/m | dBµV/m | dB | Ant |
| 1 | 7439.131M<br>Ave | 36.0 | +35.2<br>+1.5 | -31.7 | +2.3 | +4.6 | +0.0 | 47.9 | 54.0 | -6.1 | Vert |
| ^ | 7439.131M | 44.9 | +35.2<br>+1.5 | -31.7 | +2.3 | +4.6 | +0.0 | 56.8 | 54.0 | +2.8 | Vert |
| 3 | 1631.267M | 48.0 | +26.1<br>+0.7 | -31.6 | +1.0 | +2.1 | +0.0 | 46.3 | 54.0 | -7.7 | Vert |
| 4 | 4960.292M | 36.8 | +32.6<br>+1.2 | -29.9 | +1.8 | +3.8 | +0.0 | 46.3 | 54.0 | -7.7 | Vert |
| 5 | 9919.654M<br>Ave | 23.3 | +36.7<br>+1.7 | -32.1 | +2.7 | +5.4 | +0.0 | 37.7 | 54.0 | -16.3 | Vert |
| ^ | 9919.654M | 36.0 | +36.7<br>+1.7 | -32.1 | +2.7 | +5.4 | +0.0 | 50.4 | 54.0 | -3.6 | Vert |
| 7 | 2074.316M<br>Ave | 30.6 | +27.5<br>+0.8 | -30.9 | +1.2 | +2.3 | +0.0 | 31.5 | 54.0 | -22.5 | Horiz |
| ^ | 2074.316M | 51.0 | +27.5<br>+0.8 | -30.9 | +1.2 | +2.3 | +0.0 | 51.9 | 54.0 | -2.1 | Horiz |

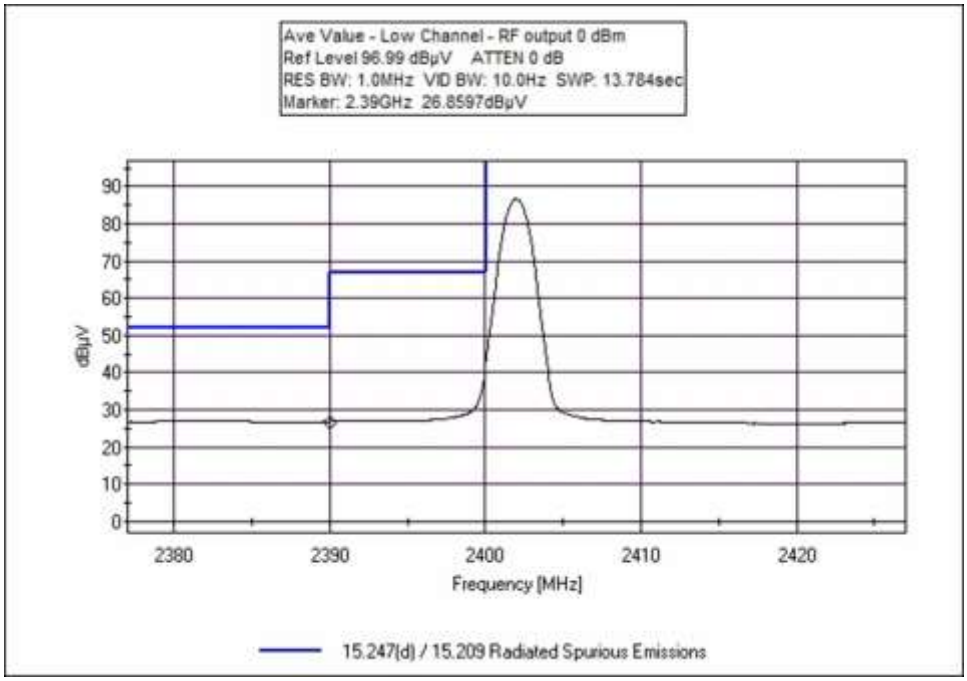
## Band Edge

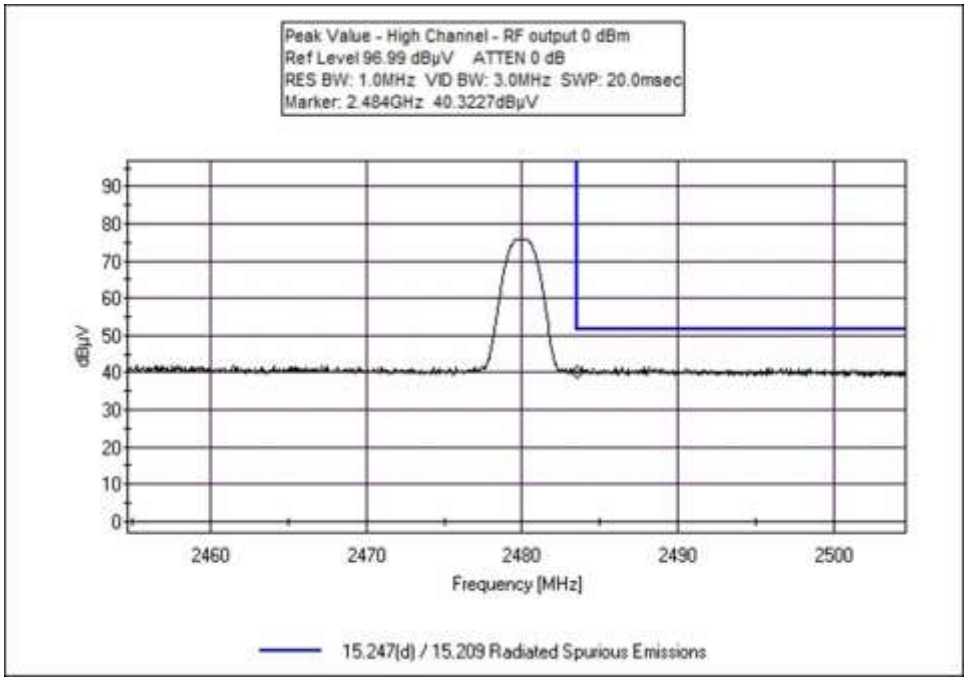
| Band Edge Summary | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Modulation** | **Ant. Type** | **Field Strength (dBuV/m @3m)** | **Limit (dBuV/m @3m)** | **Results** |
| 2390.0 | GFSK | Integral | 29.2597 | <54 | Pass |
| 2400.0 | GFSK | Integral | 38.0017 | <79 | Pass |
| 2483.5 | GFSK | Integral | 29.4517 | <54 | Pass |

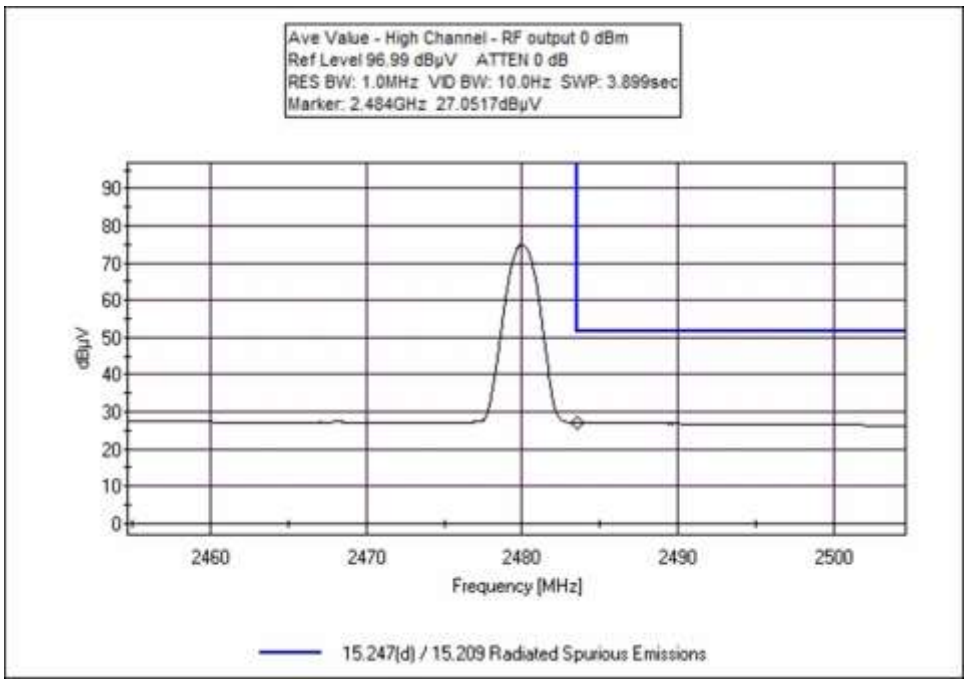
## Band Edge Plots




Ave Value - Low Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 26.8597dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2380
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value - High Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.484GHz 40.3227dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value - High Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.899sec
Marker: 2.484GHz 27.0517dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

## Test Setup / Conditions / Data

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **Band Edge** | | |
| Work Order #: | **105488** | Date: | 1/3/2022 |
| Test Type: | **Radiated Scan** | Time: | |
| Tested By: | Hoang Cao | Sequence#: | |
| Software: | EMITest 5.03.20 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Band edge

Environmental Conditions:
Temperature: 20.4°C
Humidity: 42%
Atmospheric Pressure: 101.5kPa

Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T1 | AN03302 | Cable | 32026-29094K-29094K-72TC | 1/9/2020 | 1/9/2022 |
| T2 | ANP01210 | Cable | FSJ1P-50A-4A | 11/2/2020 | 11/2/2022 |
| T3 | AN02113 | Horn Antenna-ANSI C63.5 | 3115 | 3/11/2021 | 3/11/2023 |
| T4 | AN02812 | Preamp | 83017-69004 | 9/22/2020 | 9/22/2022 |
| T5 | ANP06902 | Cable | 32022-29094K-29094K-36TC | 8/13/2020 | 8/13/2022 |

# 15.247(e) Power Spectral Density

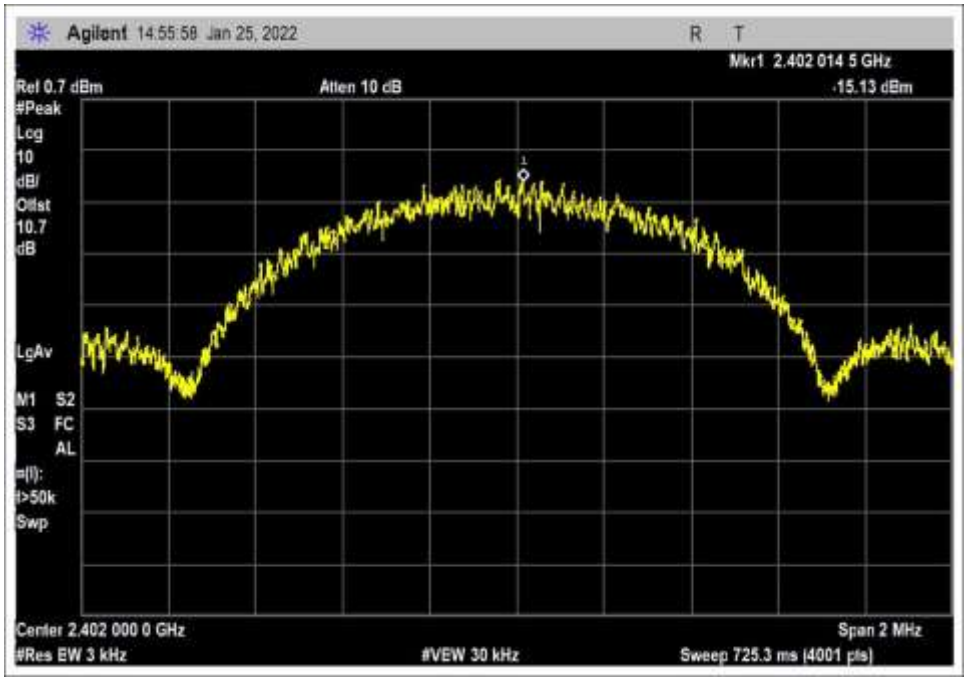
| Test Setup / Conditions / Data | | | |
|---|---|---|---|
| Test Location: | Fremont Lab C3 | Test Engineer: | Hoang Cao |
| Test Method: | ANSI C63.10 (2013),<br>KDB 558074 D01 15.247<br>Meas Guidance v05r02 | Test Date(s): | 1/25/2022 |
| Configuration: | 10 | | |
| Test Setup: | The EUT is placed non-conducted table. It is operated as intended.<br>It is connected straight to a Spectrum Analyzer. | | |

| Environmental Conditions | | | |
|---|---|---|---|
| Temperature (ºC) | 22.5 | Relative Humidity (%): | 45 |

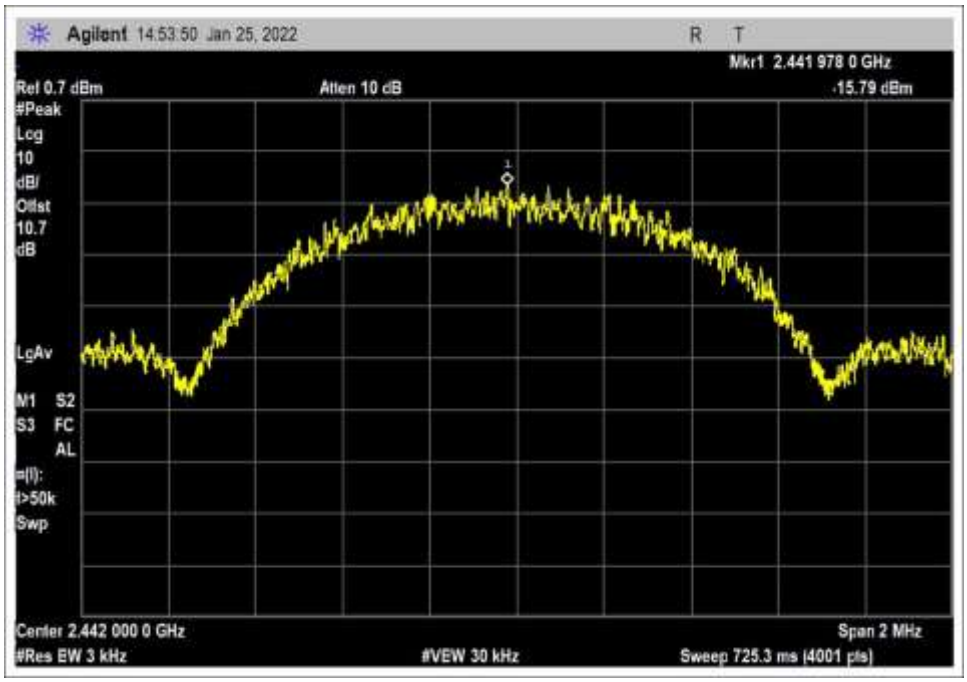
| Test Equipment | | | | | |
|---|---|---|---|---|---|
| **Asset#** | **Description** | **Manufacturer** | **Model** | **Cal Date** | **Cal Due** |
| 03360 | Cable | Astrolab | 32022-2-29094-36TC | 4/9/2020 | 4/9/2022 |
| P06239 | Attenuator | Weinschel | 54A-10 | 6/17/2020 | 6/17/2022 |
| 03471 | Spectrum Analyzer | Agilent | E4440A | 2/11/2020 | 2/11/2022 |

| PSD Test Data Summary - RF Conducted Measurement | | | | |
|---|---|---|---|---|
| Measurement Method: PKPSD | | | | |
| **Frequency (MHz)** | **Modulation** | **Measured (dBm/3kHz)** | **Limit (dBm/3kHz)** | **Results** |
| 2402 | GFSK | -15.13 | ≤8 | Pass |
| 2442 | GFSK | -15.79 | ≤8 | Pass |
| 2480 | GFSK | -17.88 | ≤8 | Pass |

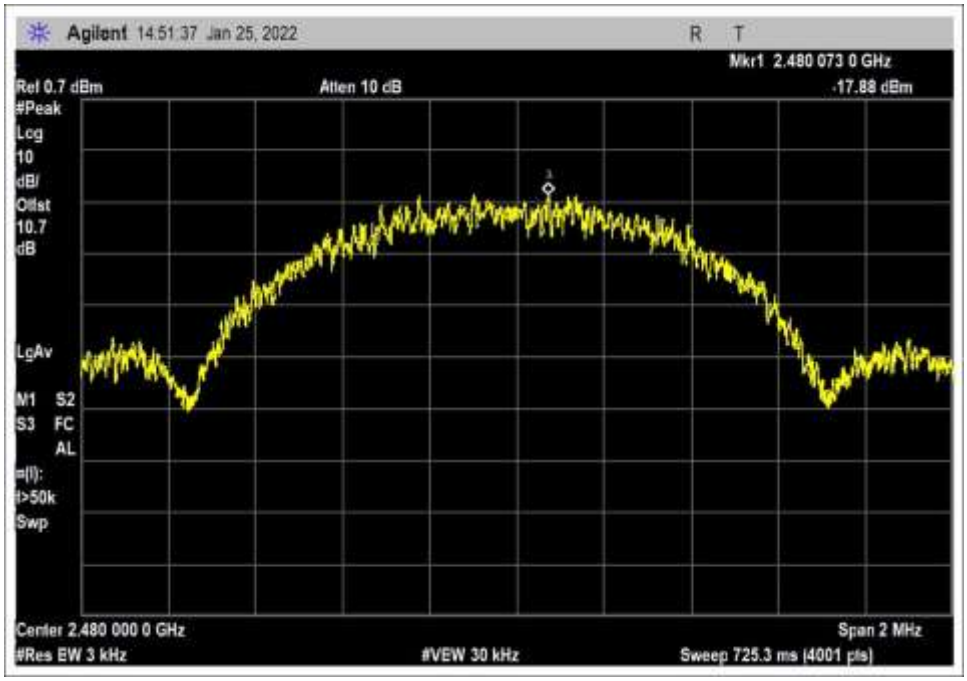
## Plots




Low Channel




Middle Channel




High Channel

# 15.207 AC Conducted Emissions

## Test Setup / Conditions / Data

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.207 AC Mains - Average** | | |
| Work Order #: | **105488** | Date: | 12/17/2021 |
| Test Type: | **Conducted Emissions** | Time: | 10:10:04 |
| Tested By: | Hoang Cao | Sequence#: | 46 |
| Software: | EMITest 5.03.20 | | 120V 60Hz |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

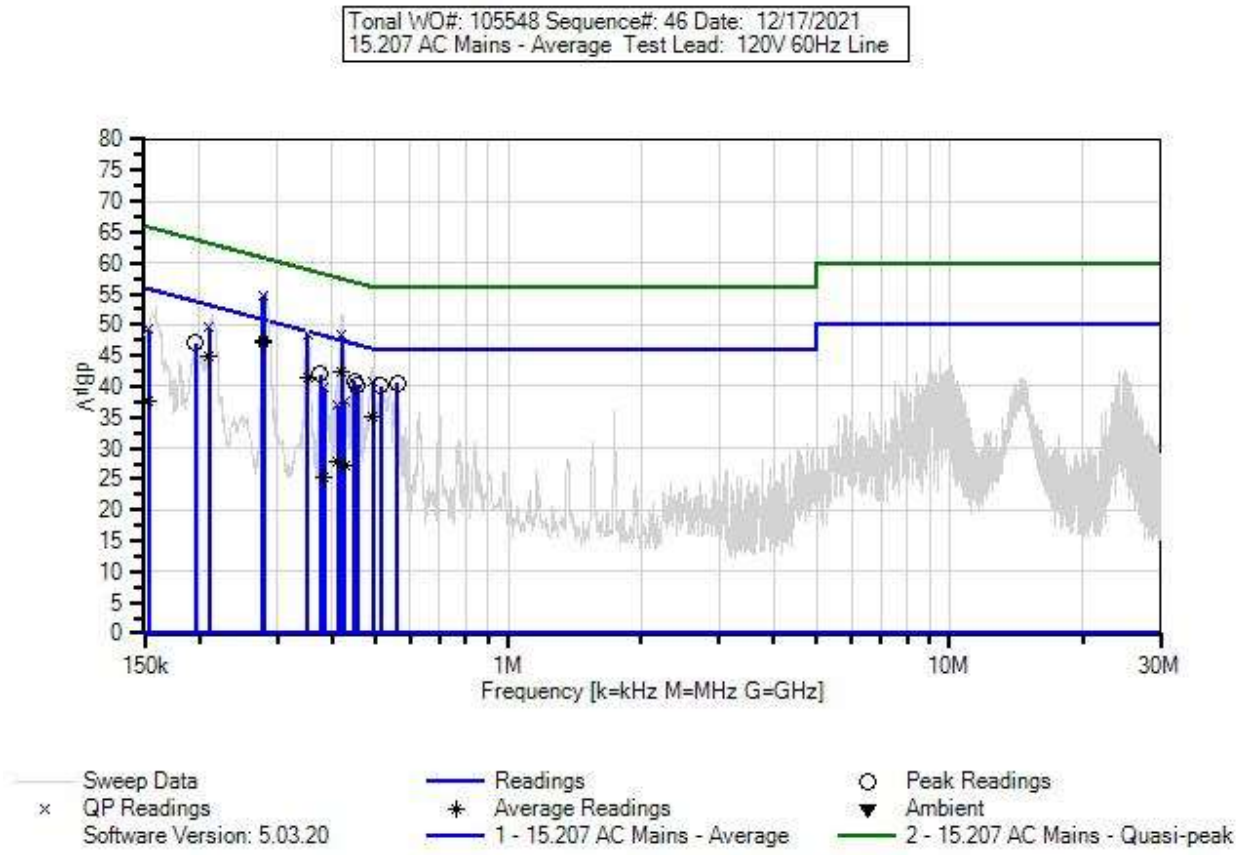
Conducted Emission
Frequency Range: 150kHz to 30MHz

Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generation Frequency: 5.8GHz
Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
It is set in a testing mode, lifting a weight on a loop.
All WIFI and Bluetooth modules are on.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP01211 | Attenuator | 23-10-34 | 2/25/2021 | 2/25/2023 |
| T2 | ANP06691 | Cable | PE3062-180 | 3/25/2020 | 3/25/2022 |
| T3 | ANP06694 | Cable | PE3062-480 | 3/25/2020 | 3/25/2022 |
| T4 | AN00494 | 50uH LISN-Line Loss (dB) | 3816/NM | 3/11/2021 | 3/11/2023 |
| | AN00494 | 50uH LISN-Return Loss (dB) | 3816/NM | 3/11/2021 | 3/11/2023 |
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T5 | ANP05258 | High Pass Filter | HE9615-150K-50-720B | 7/6/2020 | 7/6/2022 |

***Measurement Data:*** Reading listed by margin. Test Lead: Line

| # | Freq | Rdng | T1 T5 | T2 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV | dBµV | dB | Ant |
| 1 | 280.316k Ave | 37.3 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 47.4 | 50.8 | -3.4 | Line |
| 2 | 278.856k Ave | 37.1 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 47.2 | 50.8 | -3.6 | Line |
| 3 | 420.747k Ave | 32.4 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 42.4 | 47.4 | -5.0 | Line |
| 4 | 562.324k | 30.3 | +9.9 +0.2 | +0.0 | +0.1 | +0.1 | +0.0 | 40.6 | 46.0 | -5.4 | Line |
| 5 | 515.783k | 29.7 | +9.9 +0.2 | +0.0 | +0.1 | +0.1 | +0.0 | 40.0 | 46.0 | -6.0 | Line |
| 6 | 280.316k QP | 44.6 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 54.7 | 60.8 | -6.1 | Line |
| 7 | 448.880k | 30.7 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 40.8 | 46.9 | -6.1 | Line |
| 8 | 278.856k QP | 44.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 54.6 | 60.8 | -6.2 | Line |
| ^ | 280.316k | 46.6 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 56.7 | 50.8 | +5.9 | Line |
| ^ | 278.856k | 46.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 56.6 | 50.8 | +5.8 | Line |
| 11 | 375.432k | 31.8 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 41.9 | 48.4 | -6.5 | Line |
| 12 | 454.698k | 30.1 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 40.2 | 46.8 | -6.6 | Line |
| 13 | 195.812k | 36.8 | +9.9 +0.2 | +0.0 | +0.0 | +0.1 | +0.0 | 47.0 | 53.8 | -6.8 | Line |
| 14 | 351.428k Ave | 31.4 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 41.4 | 48.9 | -7.5 | Line |
| 15 | 209.905k Ave | 34.9 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 45.0 | 53.2 | -8.2 | Line |
| 16 | 420.747k QP | 38.3 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 48.3 | 57.4 | -9.1 | Line |
| ^ | 420.747k | 43.2 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 53.2 | 47.4 | +5.8 | Line |
| 18 | 351.428k QP | 38.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 48.5 | 58.9 | -10.4 | Line |
| ^ | 351.428k | 42.2 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 52.2 | 48.9 | +3.3 | Line |
| 20 | 493.040k Ave | 24.9 | +9.9 +0.1 | +0.0 | +0.1 | +0.1 | +0.0 | 35.1 | 46.1 | -11.0 | Line |
| 21 | 209.905k QP | 39.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 49.6 | 63.2 | -13.6 | Line |
| ^ | 209.905k | 43.1 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 53.2 | 53.2 | +0.0 | Line |
| 23 | 493.040k QP | 30.7 | +9.9 +0.1 | +0.0 | +0.1 | +0.1 | +0.0 | 40.9 | 56.1 | -15.2 | Line |
| ^ | 493.040k | 35.1 | +9.9 +0.1 | +0.0 | +0.1 | +0.1 | +0.0 | 45.3 | 46.1 | -0.8 | Line |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 153.270k QP | 37.7 | +9.9 +1.6 | +0.0 | +0.0 | +0.1 | +0.0 | 49.3 | 65.8 | -16.5 | Line |
| 26 | 153.270k Ave | 25.9 | +9.9 +1.6 | +0.0 | +0.0 | +0.1 | +0.0 | 37.5 | 55.8 | -18.3 | Line |
| ^ | 153.270k | 44.2 | +9.9 +1.6 | +0.0 | +0.0 | +0.1 | +0.0 | 55.8 | 55.8 | +0.0 | Line |
| 28 | 383.373k QP | 29.6 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 39.7 | 58.2 | -18.5 | Line |
| 29 | 427.092k QP | 27.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 37.5 | 57.3 | -19.8 | Line |
| 30 | 411.207k Ave | 17.7 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 27.7 | 47.6 | -19.9 | Line |
| 31 | 427.092k Ave | 17.3 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 27.3 | 47.3 | -20.0 | Line |
| ^ | 427.092k | 37.0 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 47.0 | 47.3 | -0.3 | Line |
| 33 | 411.207k QP | 26.9 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 36.9 | 57.6 | -20.7 | Line |
| ^ | 411.207k | 35.2 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 45.2 | 47.6 | -2.4 | Line |
| ^ | 409.611k | 32.4 | +9.9 +0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 42.4 | 47.7 | -5.3 | Line |
| 36 | 383.373k Ave | 15.2 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 25.3 | 48.2 | -22.9 | Line |
| ^ | 383.373k | 35.4 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 45.5 | 48.2 | -2.7 | Line |
| ^ | 385.613k | 32.5 | +9.9 +0.1 | +0.0 | +0.0 | +0.1 | +0.0 | 42.6 | 48.2 | -5.6 | Line |

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170 | | |
| Customer: | **Tonal** | | |
| Specification: | **15.207 AC Mains - Average** | | |
| Work Order #: | **105488** | Date: | 12/17/2021 |
| Test Type: | **Conducted Emissions** | Time: | 10:28:13 |
| Tested By: | Hoang Cao | Sequence#: | 47 |
| Software: | EMITest 5.03.20 | | 120V 60Hz |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

Conducted Emission
Frequency Range: 150kHz to 30MHz

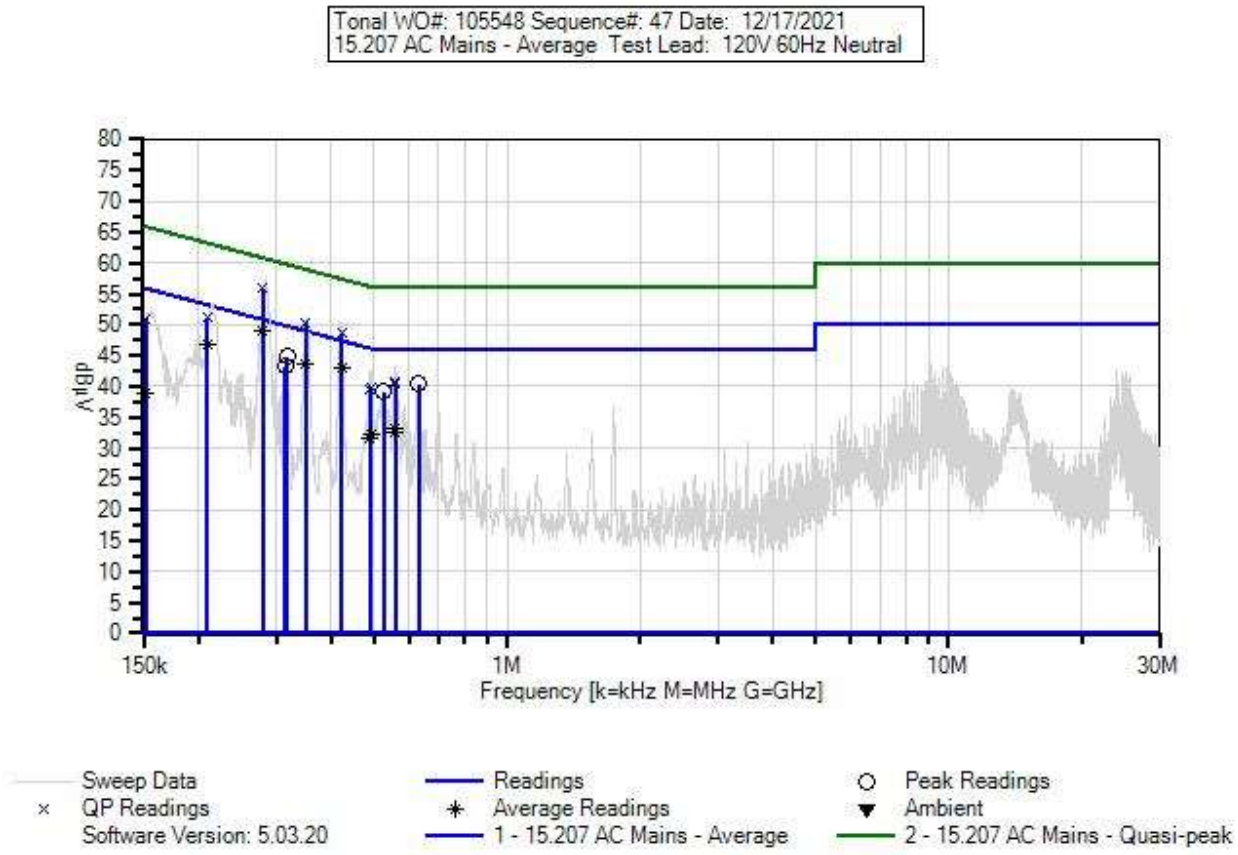
Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generation Frequency: 5.8GHz

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
It is set in a testing mode, lifting a weight on a loop.
All WIFI and Bluetooth modules are on.

Notes:
Touch screen display: Direct bond 2312
Power Supply: Artesyn




***Test Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| T1 | ANP01211 | Attenuator | 23-10-34 | 2/25/2021 | 2/25/2023 |
| T2 | ANP06691 | Cable | PE3062-180 | 3/25/2020 | 3/25/2022 |
| T3 | ANP06694 | Cable | PE3062-480 | 3/25/2020 | 3/25/2022 |
| | AN00494 | 50uH LISN-Line Loss (dB) | 3816/NM | 3/11/2021 | 3/11/2023 |
| T4 | AN00494 | 50uH LISN-Return Loss (dB) | 3816/NM | 3/11/2021 | 3/11/2023 |
| | AN02660 | Spectrum Analyzer | E4446A | 12/4/2020 | 12/4/2022 |
| T5 | ANP05258 | High Pass Filter | HE9615-150K-50-720B | 7/6/2020 | 7/6/2022 |

***Measurement Data:*** Reading listed by margin. Test Lead: Neutral

| # | Freq | Rdng | T1<br>T5 | T2 | T3 | T4 | Dist | Corr | Spec | Margin | Polar |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBµV | dB | dB | dB | dB | Table | dBµV | dBµV | dB | Ant |
| 1 | 280.264k<br>Ave | 38.9 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 48.9 | 50.8 | -1.9 | Neutr |
| 2 | 421.660k<br>Ave | 33.0 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 43.0 | 47.4 | -4.4 | Neutr |
| 3 | 280.264k<br>QP | 45.9 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 55.9 | 60.8 | -4.9 | Neutr |
| ^ | 280.264k | 47.7 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 57.7 | 50.8 | +6.9 | Neutr |
| 5 | 317.256k | 34.8 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 44.8 | 49.8 | -5.0 | Neutr |
| 6 | 350.035k<br>Ave | 33.5 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 43.5 | 49.0 | -5.5 | Neutr |
| 7 | 630.682k | 30.2 | +9.9<br>+0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 40.4 | 46.0 | -5.6 | Neutr |
| 8 | 209.412k<br>Ave | 36.7 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 46.7 | 53.2 | -6.5 | Neutr |
| 9 | 315.074k | 33.3 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 43.3 | 49.8 | -6.5 | Neutr |
| 10 | 525.237k | 29.0 | +9.9<br>+0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 39.2 | 46.0 | -6.8 | Neutr |
| 11 | 350.035k<br>QP | 40.4 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 50.4 | 59.0 | -8.6 | Neutr |
| ^ | 350.035k | 43.5 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 53.5 | 49.0 | +4.5 | Neutr |
| 13 | 421.660k<br>QP | 38.6 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 48.6 | 57.4 | -8.8 | Neutr |
| ^ | 421.660k | 43.9 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 53.9 | 47.4 | +6.5 | Neutr |
| 15 | 209.412k<br>QP | 41.1 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 51.1 | 63.2 | -12.1 | Neutr |
| ^ | 209.412k | 44.4 | +9.9<br>+0.1 | +0.0 | +0.0 | +0.0 | +0.0 | 54.4 | 53.2 | +1.2 | Neutr |
| 17 | 558.862k<br>Ave | 23.0 | +9.9<br>+0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 33.2 | 46.0 | -12.8 | Neutr |
| 18 | 558.003k<br>Ave | 22.4 | +9.9<br>+0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 32.6 | 46.0 | -13.4 | Neutr |
| 19 | 492.486k<br>Ave | 22.0 | +9.9<br>+0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 32.1 | 46.1 | -14.0 | Neutr |
| 20 | 488.923k<br>Ave | 21.6 | +9.9<br>+0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 31.7 | 46.2 | -14.5 | Neutr |
| 21 | 152.236k<br>QP | 38.8 | +9.9<br>+2.1 | +0.0 | +0.0 | +0.1 | +0.0 | 50.9 | 65.9 | -15.0 | Neutr |
| 22 | 558.862k<br>QP | 30.4 | +9.9<br>+0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 40.6 | 56.0 | -15.4 | Neutr |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 558.003k QP | 30.3 | +9.9 +0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 40.5 | 56.0 | -15.5 | Neutr |
| ^ | 558.003k | 33.6 | +9.9 +0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 43.8 | 46.0 | -2.2 | Neutr |
| ^ | 558.862k | 33.4 | +9.9 +0.2 | +0.0 | +0.1 | +0.0 | +0.0 | 43.6 | 46.0 | -2.4 | Neutr |
| 26 | 492.486k QP | 29.9 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 40.0 | 56.1 | -16.1 | Neutr |
| 27 | 488.923k QP | 29.5 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 39.6 | 56.2 | -16.6 | Neutr |
| ^ | 488.923k | 33.9 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 44.0 | 46.2 | -2.2 | Neutr |
| ^ | 492.486k | 33.6 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 43.7 | 46.1 | -2.4 | Neutr |
| ^ | 485.968k | 30.0 | +9.9 +0.1 | +0.0 | +0.1 | +0.0 | +0.0 | 40.1 | 46.2 | -6.1 | Neutr |
| 31 | 152.236k Ave | 26.9 | +9.9 +2.1 | +0.0 | +0.0 | +0.1 | +0.0 | 39.0 | 55.9 | -16.9 | Neutr |
| ^ | 152.236k | 44.8 | +9.9 +2.1 | +0.0 | +0.0 | +0.1 | +0.0 | 56.9 | 55.9 | +1.0 | Neutr |

# SUPPLEMENTAL INFORMATION

## Measurement Uncertainty

| Uncertainty Value | Parameter |
|---|---|
| 4.73 dB | Radiated Emissions |
| 3.34 dB | Mains Conducted Emissions |
| 3.30 dB | Disturbance Power |

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

## Emissions Test Details

**TESTING PARAMETERS**

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

**CORRECTION FACTORS**

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

| SAMPLE CALCULATIONS | | |
|---|---|---|
| | Meter reading | (dBµV) |
| + | Antenna Factor | (dB/m) |
| + | Cable Loss | (dB) |
| - | Distance Correction | (dB) |
| - | Preamplifier Gain | (dB) |
| = | Corrected Reading | (dBµV/m) |

**TEST INSTRUMENTATION AND ANALYZER SETTINGS**

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

| MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE | | | |
|---|---|---|---|
| TEST | BEGINNING FREQUENCY | ENDING FREQUENCY | BANDWIDTH SETTING |
| CONDUCTED EMISSIONS | 150 kHz | 30 MHz | 9 kHz |
| RADIATED EMISSIONS | 9 kHz | 150 kHz | 200 Hz |
| RADIATED EMISSIONS | 150 kHz | 30 MHz | 9 kHz |
| RADIATED EMISSIONS | 30 MHz | 1000 MHz | 120 kHz |
| RADIATED EMISSIONS | 1000 MHz | >1 GHz | 1 MHz |

**SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS**

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

**Peak**

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

**Quasi-Peak**

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

**Average**

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.