

Tonal

TEST REPORT FOR

**Apollo Board, Model: 500-0806
Trainer, Model: T2**

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

**15.207 & 15.247
(DTS 2400-2483.5 MHz)**

Report No.: 110285-54

Date of issue: November 27, 2024



Test Certificate # 803.01

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.

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Administrative Information

Test Report Information

REPORT PREPARED FOR:

Tonal
69 Converse, Suite 200
San Francisco, CA 94103

Representative: Lars Gilstrom
Customer Reference Number: PO3196

DATE OF EQUIPMENT RECEIPT:

DATE(S) OF TESTING:

REPORT PREPARED BY:

Stacey Noriega
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 110285

October 2, 2024

October 10 & October 22, 2024 and November 4,
2024

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 2400-2483.5 MHz)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	PASS
15.247(b)(3)	Output Power	NA	PASS
15.247(e)	Power Spectral Density	NA	PASS
15.247(d)	RF Conducted Emissions & Band Edge	NA	PASS
15.247(d)	Radiated Emissions & Band Edge	Mod#1	PASS
15.207	AC Conducted Emissions	Mod#1	PASS

NA = Not Applicable

ISO/IEC 17025 Decision Rule

The equipment sample utilized for testing is selected by the manufacturer. The declaration of pass or fail herein is a binary statement for simple acceptance rule (ILAC G8) based upon assessment to the specification(s) listed above, without consideration 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

Modification #1 (Mod#1) = Added a ferrite (Würth: 742 712 21) on lower resistor wire
Green Resistor

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

None

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 A

Equipment Under Test (= EUT):*

Device Name	Manufacturer	Model #	S/N
Apollo Board	Tonal	500-0806	080600030001263

Support Devices:

Device Name	Manufacturer	Model #	S/N
MCB Board	Tonal	500-0131	500-0131_rev003_00001286_20240909_17
Laptop	Dell	XPS	22E00911
AC/DC Adapter for Laptop	Dell	DA130PM130	CN-06TTY6-48661-4CO-27M7-A00

Configuration 1

Equipment Under Test (= EUT):*

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal	T2	4000055

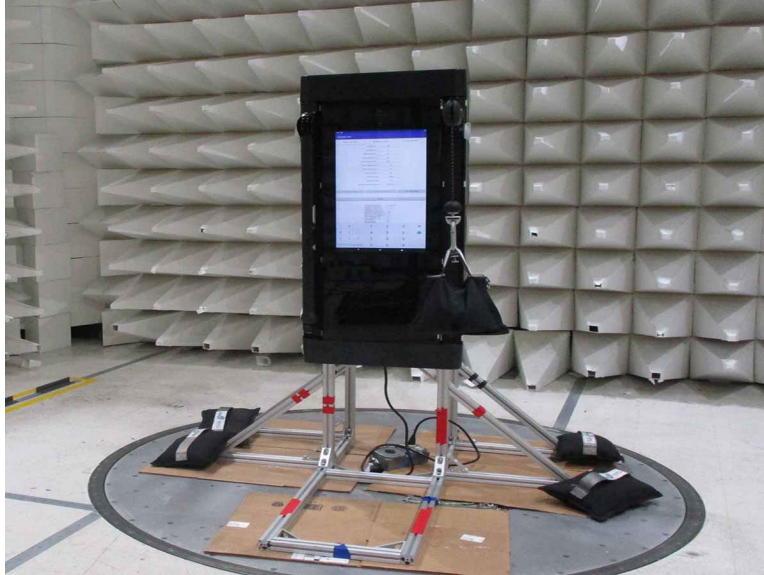
Support Devices:

Device Name	Manufacturer	Model #	S/N
Laptop	Dell	XPS	22E00911
AC/DC Adapter for Laptop	Dell	DA130PM130	CN-06TTY6-48661-4CO-27M7-A00

General Product Information:

Description of EUT	
Exercise Trainer	
Product Information	Manufacturer-Provided Details
Operating Frequencies Tested:	2402-2480MHz
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Bluetooth Low Energy
Maximum Duty Cycle:	100%
Modulation Type(s):	GFSK
Number of TX Chains:	1
Beamforming Type:	NA
Antenna Type(s) and Gain:	External/4.83dBi
Antenna Connection Type:	External Connector
Nominal Input Voltage:	12VDC
Firmware / Software Version(s):	Putty
Firmware / Software Description:	Using Putty through USB port to control all modulation types and frequencies to continuously transmit or receive as intended
Firmware / Software Setting(s):	NA
Tune-up or Adjustment(s):	NA
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

EUT and Accessory Photo(s)



EUT

Support Equipment Photo(s)

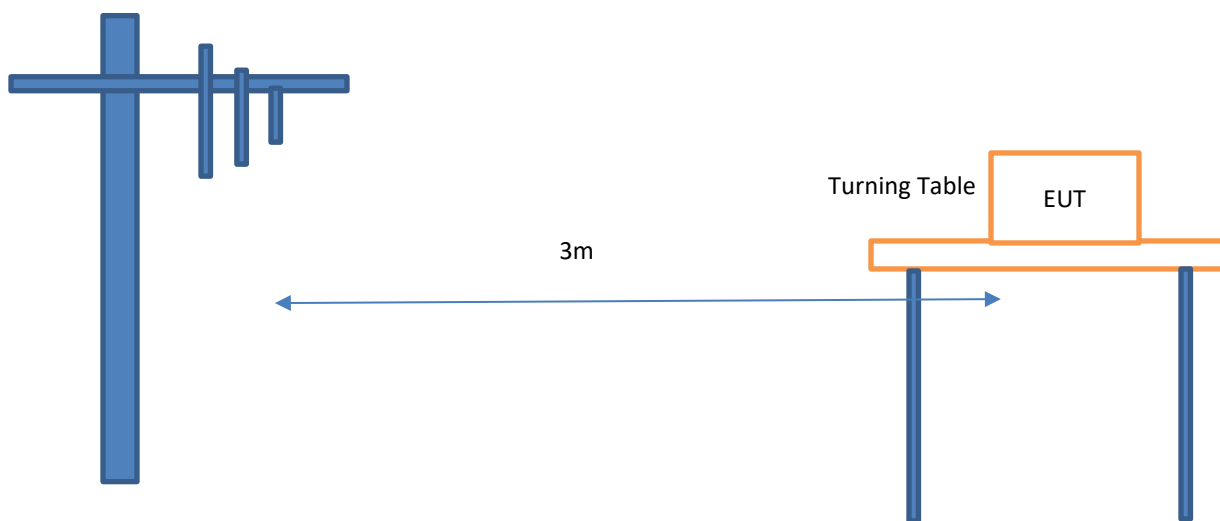


Support Equipment - Laptop

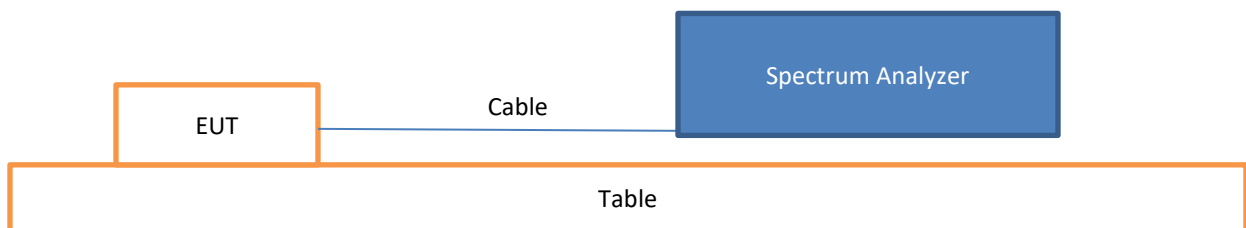
Block Diagram of Test Setup(s)

Configuration#	Setup Description of Block Diagram
1	Radiated Measurement: the Antenna is set up at 3meter distance from the EUT according to ANSI C63.10 2020. The EUT is set up and operated as intended. Conducted Measurement: The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.

Radiated Method Setup



Conducted Method Setup



FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

Test Setup/Conditions

Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 558074	Test Date(s):	10/10/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer		

Environmental Conditions

Temperature (°C)	21.8	Relative Humidity (%):	48
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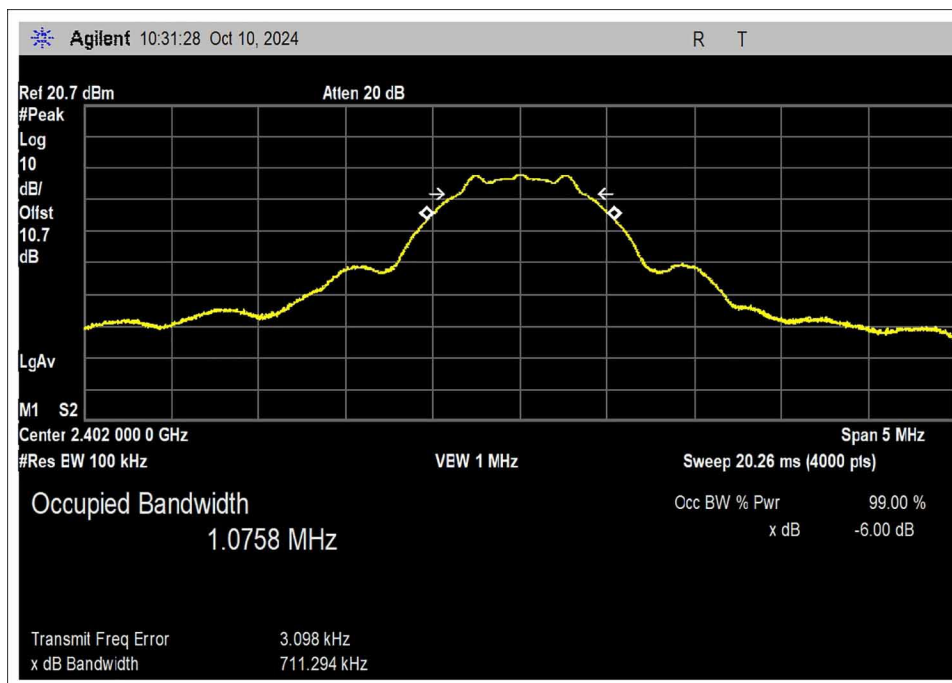
Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

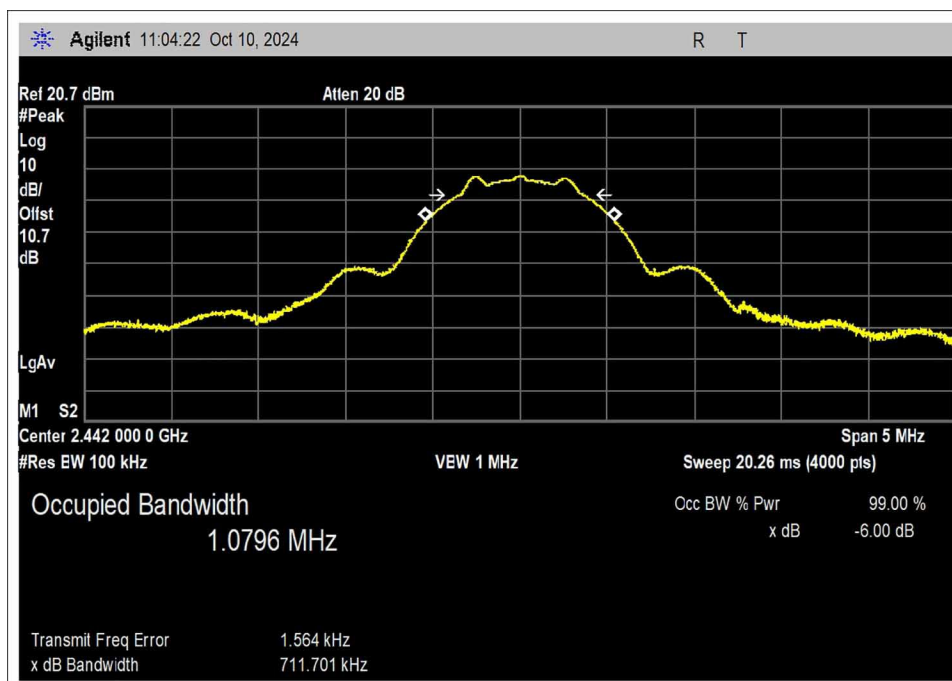
Test Data Summary

Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2402	1	GFSK	711.294	≥500	Pass
2442	1	GFSK	711.701	≥500	Pass
2480	1	GFSK	718.170	≥500	Pass

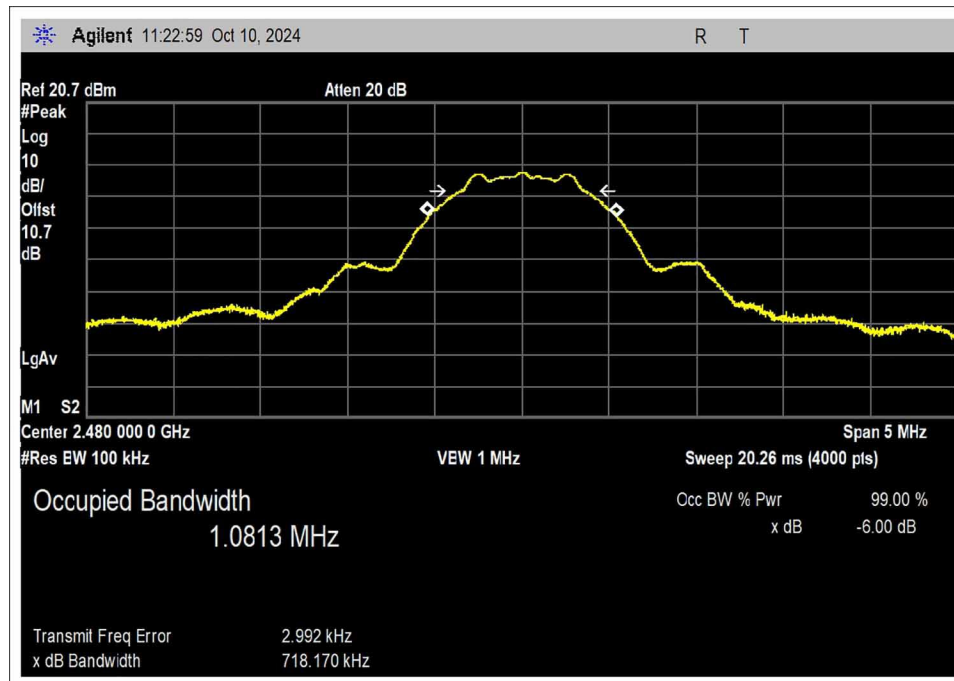
Plot(s)



Occupied Bandwidth, 6dB, Low Channel

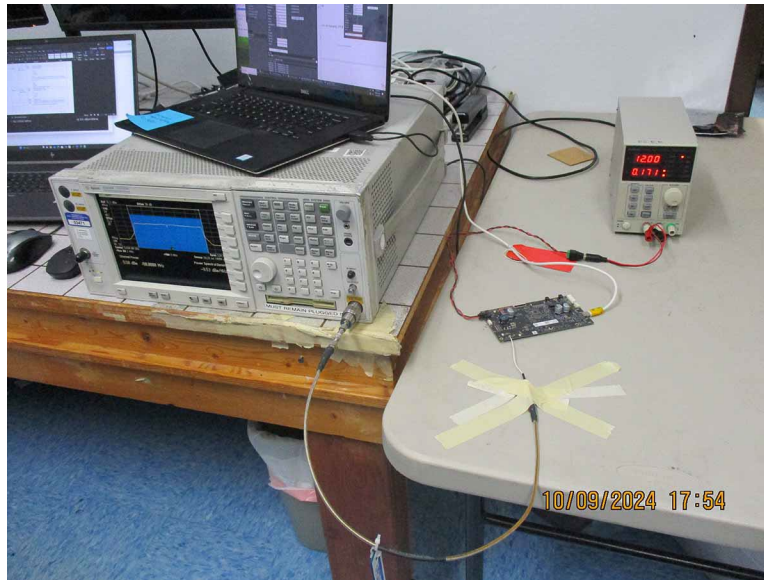


Occupied Bandwidth, 6dB, Middle Channel



Occupied Bandwidth, 6dB, High Channel

Test Setup Photo(s)



Test Setup



Test Setup, Close View

15.247(b)(3) Output Power

Test Setup/Conditions

Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 558074	Test Date(s):	10/10/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer		

Environmental Conditions

Temperature (°C)	21.8	Relative Humidity (%):	48
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Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

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	-1.18	-1.16	-1.19	0.03
2442	GFSK	-1.32	-1.32	-1.33	0.01
2480	GFSK	-1.45	-1.44	-1.44	0.01

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

Parameter Definitions:

Measurements performed at input voltage V_{nominal} ± 15%.

Parameter	Value
V _{Nominal} :	12VDC
V _{Minimum} :	10.2VDC
V _{Maximum} :	13.8VDC

Test Data Summary - RF Conducted Measurement							
Measurement Option: RBW > DTS Bandwidth							
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	RF Conducted (dBm)		EIRP (dBm)		Results
			Measured	Limit	Calculated	Limit	
2402	GFSK	External/4.83	-1.16	≤30	3.67	≤36	Pass
2442	GFSK	External/4.83	-1.32	≤30	3.51	≤36	Pass
2480	GFSK	External/4.83	-1.44	≤30	3.39	≤36	Pass

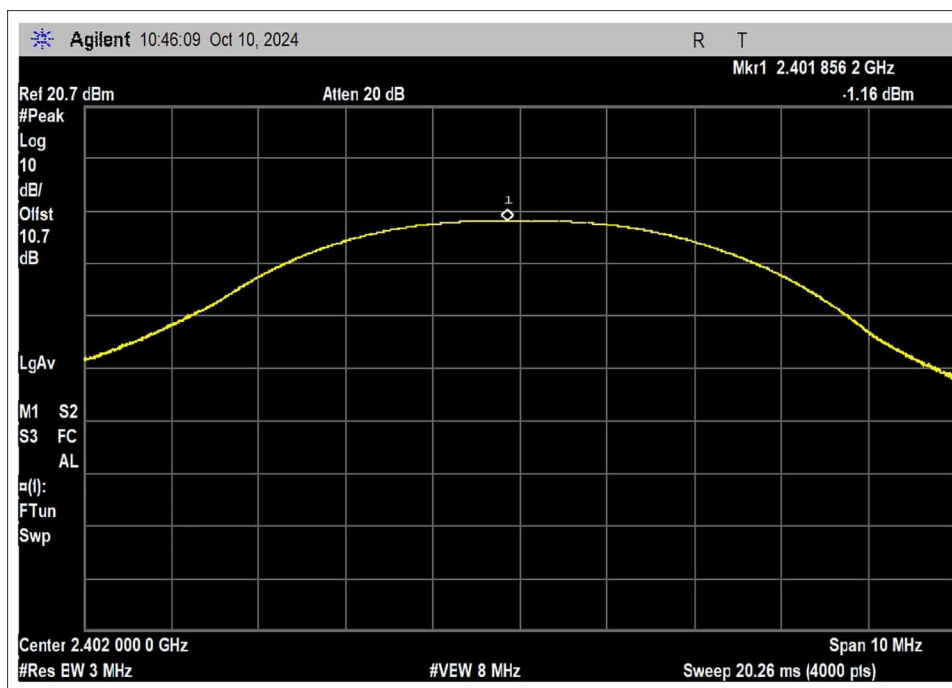
EIRP is calculated as RF conducted power (dBm) + antenna gain (dBi)

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

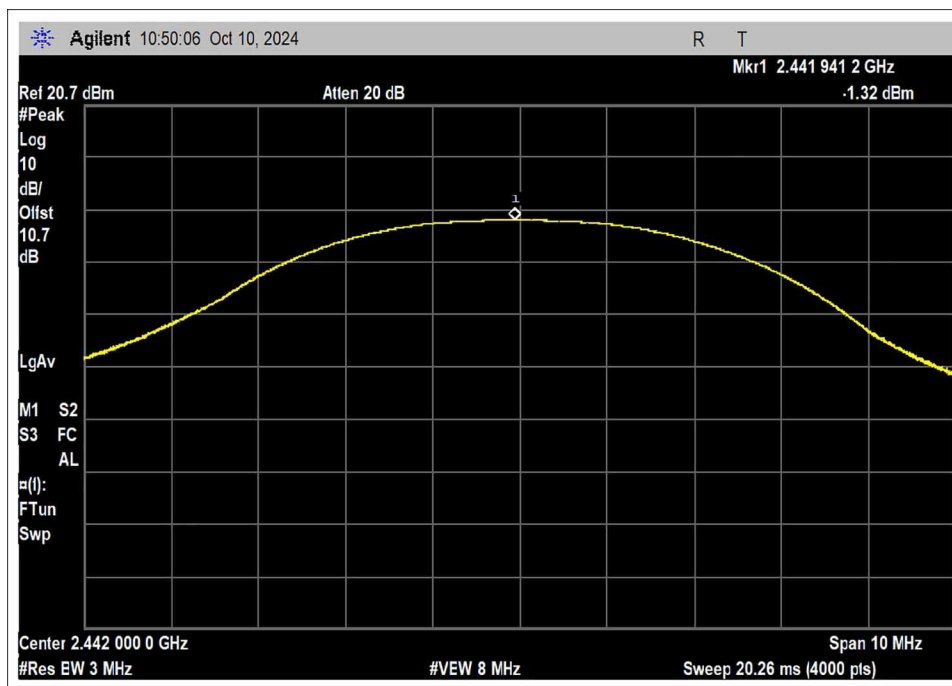
For all other antennas, the RF conducted power limit is calculated according to a maximum of 1W (30 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

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

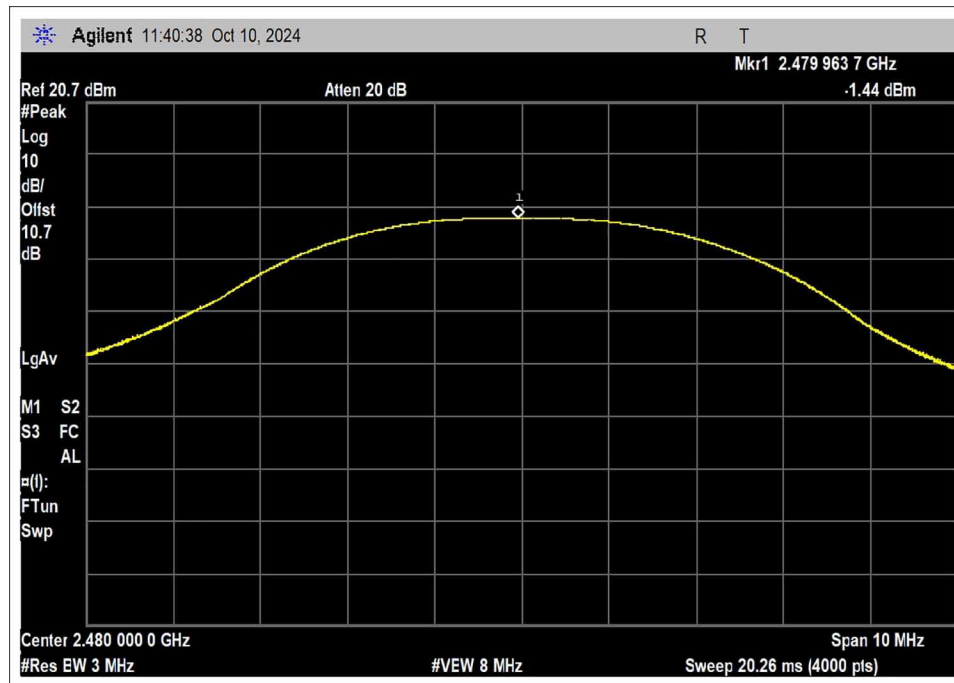
Plots



RF Output Power, Low Channel

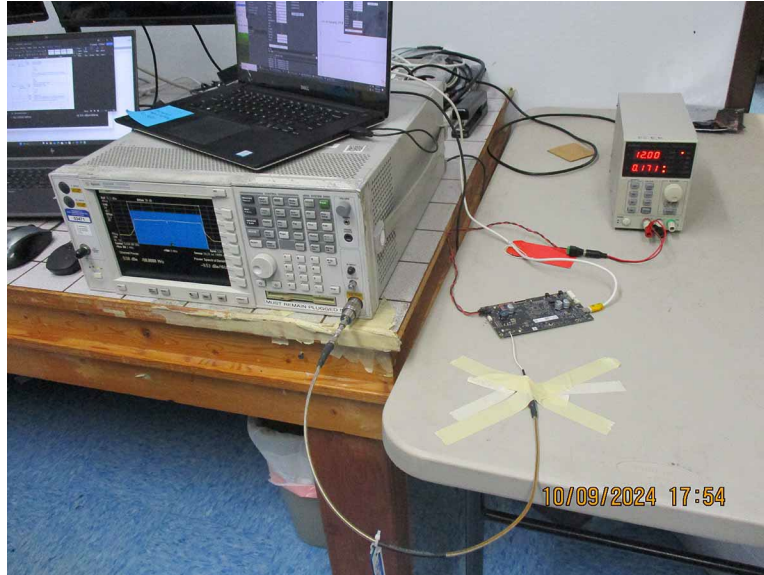


RF Output Power, Middle Channel



RF Output Power, High Channel

Test Setup Photo(s)



Test Setup



Test Setup, Close View

15.247(e) Power Spectral Density

Test Setup/Conditions

Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 558074	Test Date(s):	10/10/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer		

Environmental Conditions

Temperature (°C)	21.7	Relative Humidity (%):	48
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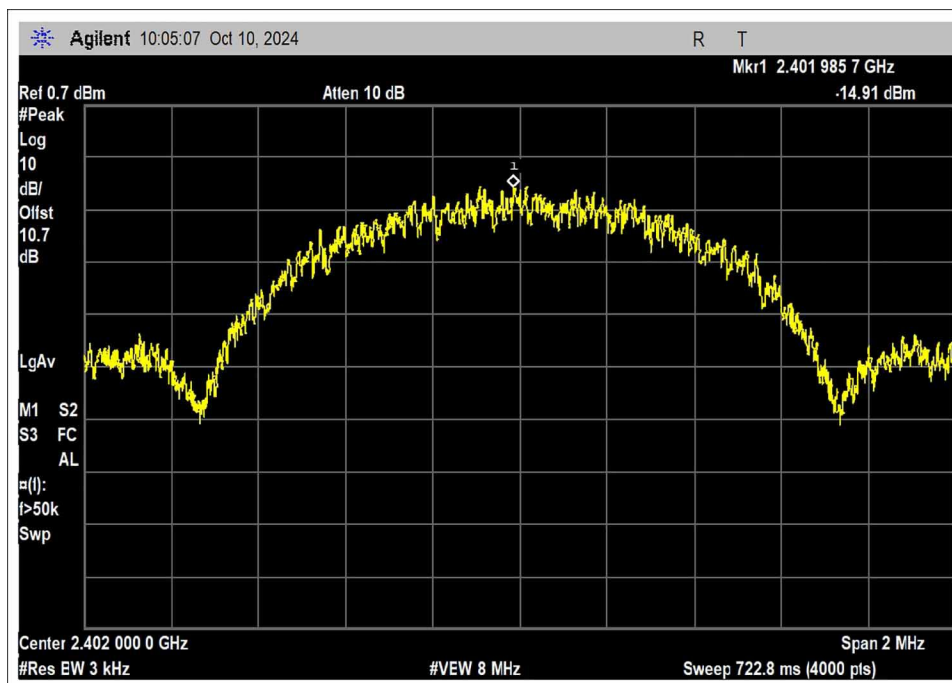
Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

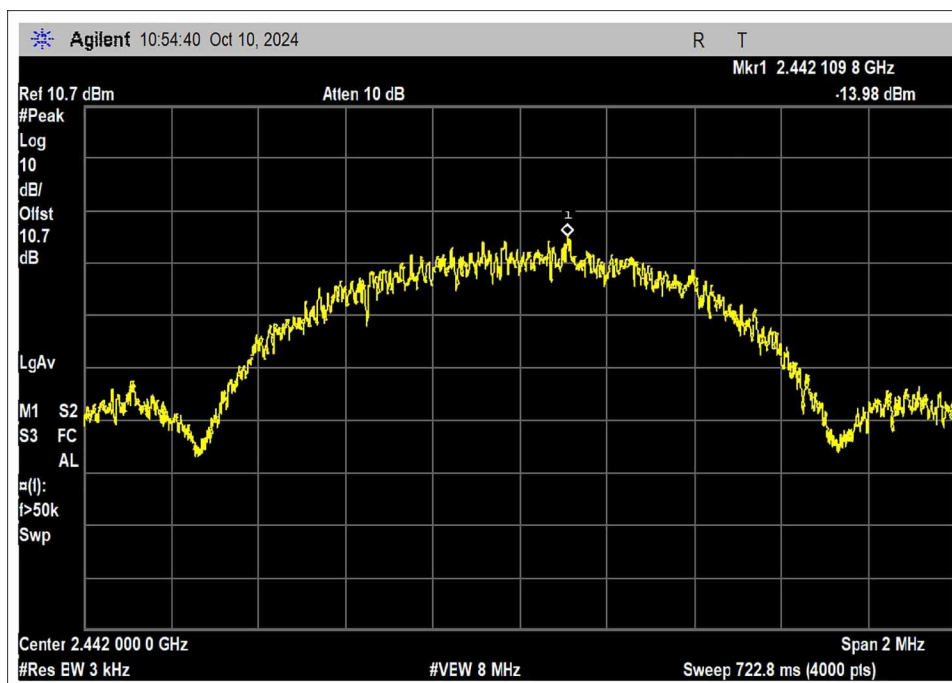
Test Data Summary - RF Conducted Measurement

Measurement Method: PKPSD				
Frequency (MHz)	Modulation	Measured (dBm/3kHz)	Limit (dBm/3kHz)	Results
2402	GFSK	-14.91	≤8	Pass
2442	GFSK	-13.98	≤8	Pass
2480	GFSK	-15.36	≤8	Pass

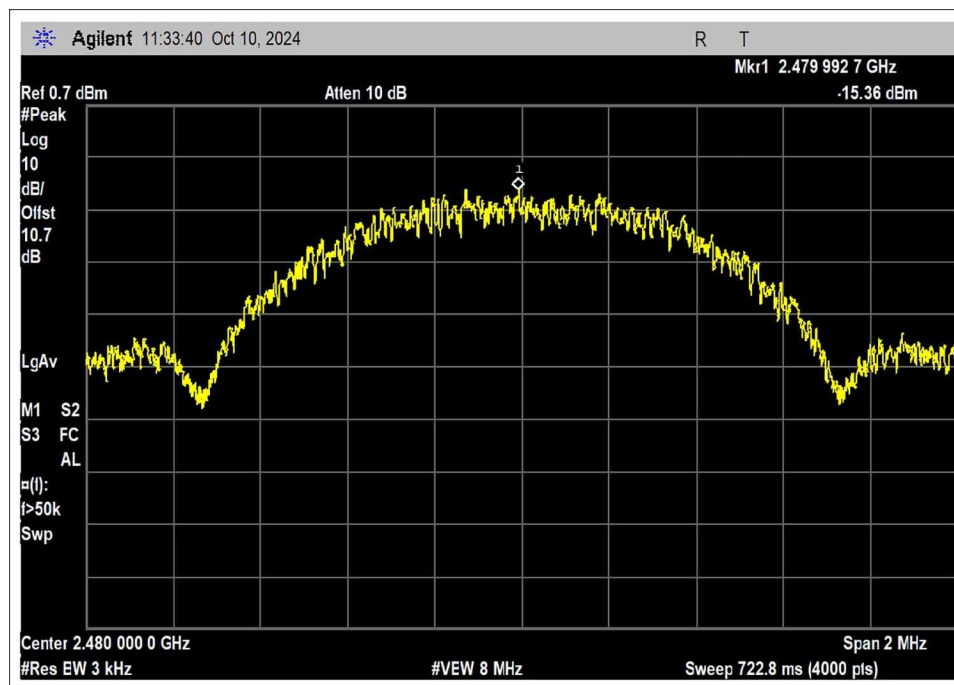
Plot(s)



Power Spectral Density, Low Channel

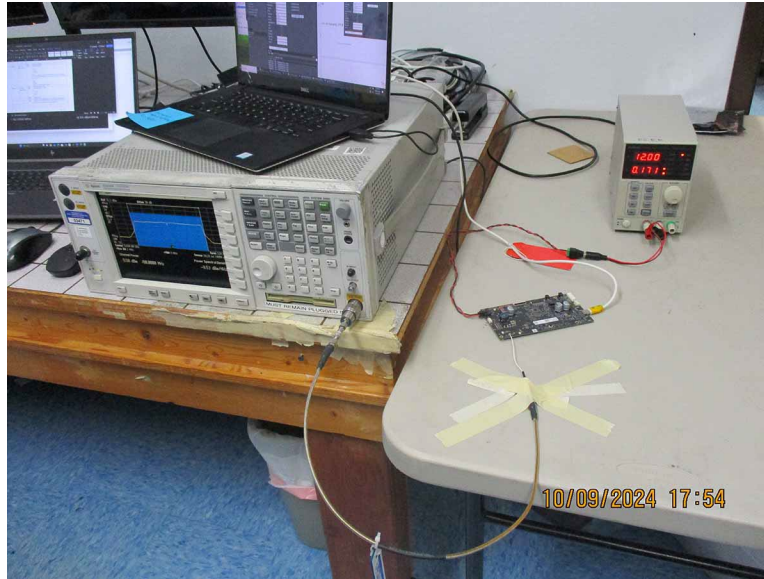


Power Spectral Density, Middle Channel



Power Spectral Density, High Channel

Test Setup Photo(s)



Test Setup



Test Setup, Close View

15.247(d) RF Conducted Emissions & Band Edge

Test Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **110285** Date: 10/10/2024
 Test Type: **Conducted Scan** Time: 1:50:57 PM
 Tested By: Hieu Song Nguyenpham Sequence#: 54
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration A			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration A			

Test Conditions / Notes:

Conducted Spurious Emission
 Frequency Range: 9kHz to 25GHz

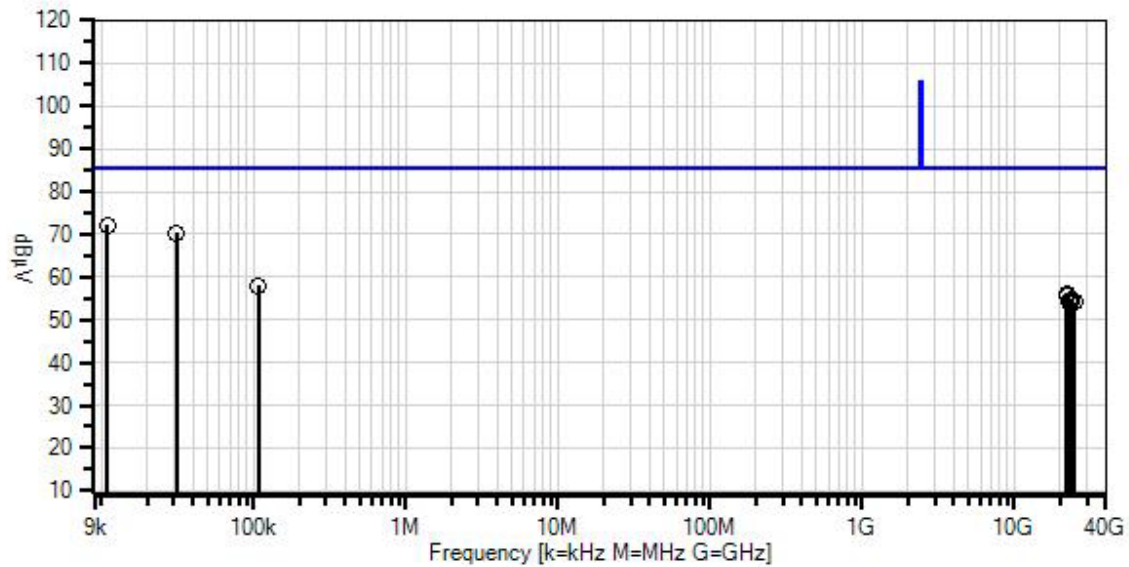
Test Environment Conditions:
 Temperature: 21.8°C
 Humidity: 47%
 Atmospheric Pressure: 101.5kPa

Highest Generated Frequency: 5.825GHz
 Test Method: ANSI C63.10 2020
 RF Output Set at 0dBm

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.

Note:
 Low Channel BLE (BOBBLE)

Total W/O#: 110285 Sequence#: 54 Date: 10/10/2024
15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
× QP Readings
▼ Ambient
— 1 - 15.247(d) Conducted Spurious Emissions
○ Peak Readings
* Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03471	Spectrum Analyzer	E4440A	2/23/2024	2/23/2026
T1	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025
T2	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB			Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	10.979k	62.2	+9.8	+0.1			+0.0	72.1	85.4	-13.3	None
2	31.065k	60.6	+9.8	+0.0			+0.0	70.4	85.4	-15.0	None
3	108.532k	48.2	+9.8	+0.0			+0.0	58.0	85.4	-27.4	None
4	22348.802 M	43.3	+10.1	+2.6			+0.0	56.0	85.4	-29.4	None
5	22139.221 M	42.9	+10.1	+2.6			+0.0	55.6	85.4	-29.8	None
6	23690.120 M	42.2	+10.0	+2.6			+0.0	54.8	85.4	-30.6	None
7	23103.293 M	41.5	+10.1	+2.6			+0.0	54.2	85.4	-31.2	None
8	23553.892 M	41.5	+10.0	+2.6			+0.0	54.1	85.4	-31.3	None
9	24696.108 M	41.2	+10.0	+2.8			+0.0	54.0	85.4	-31.4	None

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **110285** Date: 10/10/2024
 Test Type: **Conducted Scan** Time: 1:31:51 PM
 Tested By: Hieu Song Nguyenpham Sequence#: 53
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration A			

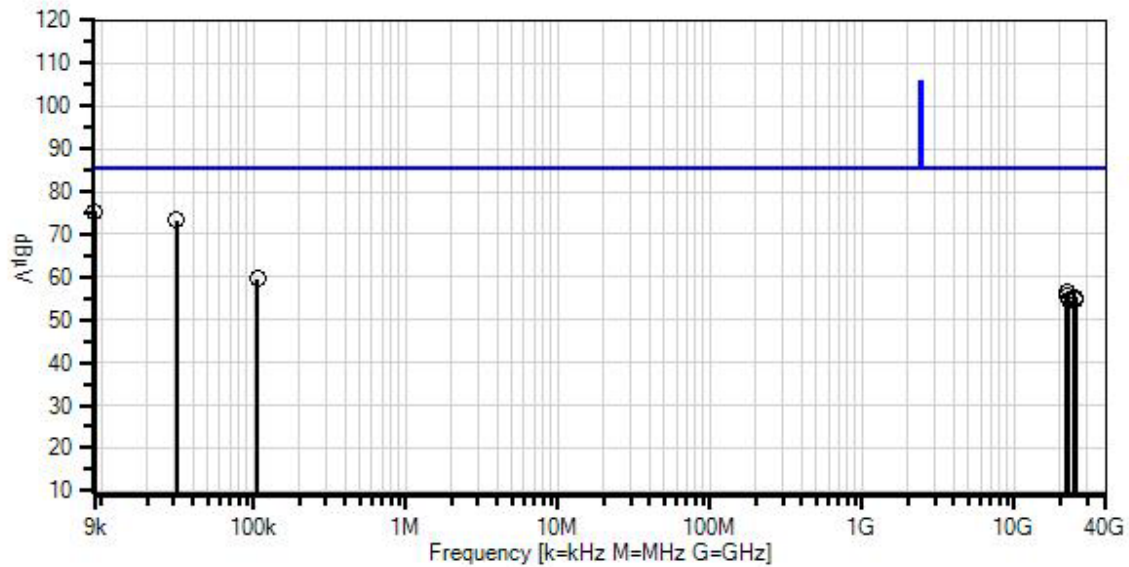
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration A			

Test Conditions / Notes:

Conducted Spurious Emission Frequency Range: 9kHz to 25GHz Test Environment Conditions: Temperature: 21.8°C Humidity: 47% Atmospheric Pressure: 101.5kPa Highest Generated Frequency: 5.825GHz Test Method: ANSI C63.10 2020 RF Output Set at 0dBm 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. Note: Middle Channel BLE (BOBBLE)
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Total W/O#: 110285 Sequence#: 53 Date: 10/10/2024
15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
× QP Readings
▼ Ambient
— 1 - 15.247(d) Conducted Spurious Emissions

○ Peak Readings
* Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03471	Spectrum Analyzer	E4440A	2/23/2024	2/23/2026
T1	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025
T2	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB			Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	9.000k	65.3	+9.9	+0.1			+0.0	75.3	85.4	-10.1	None
2	31.065k	63.5	+9.8	+0.0			+0.0	73.3	85.4	-12.1	None
3	106.707k	49.9	+9.8	+0.0			+0.0	59.7	85.4	-25.7	None
4	22327.844 M	43.9	+10.1	+2.6			+0.0	56.6	85.4	-28.8	None
5	22149.700 M	43.0	+10.1	+2.6			+0.0	55.7	85.4	-29.7	None
6	22254.491 M	42.9	+10.0	+2.6			+0.0	55.5	85.4	-29.9	None
7	24769.461 M	42.3	+10.0	+2.8			+0.0	55.1	85.4	-30.3	None
8	22705.089 M	42.0	+10.1	+2.6			+0.0	54.7	85.4	-30.7	None
9	24968.563 M	41.8	+10.1	+2.8			+0.0	54.7	85.4	-30.7	None

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **110285** Date: 10/10/2024
 Test Type: **Conducted Scan** Time: 1:24:21 PM
 Tested By: Hieu Song Nguyenpham Sequence#: 52
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration A			

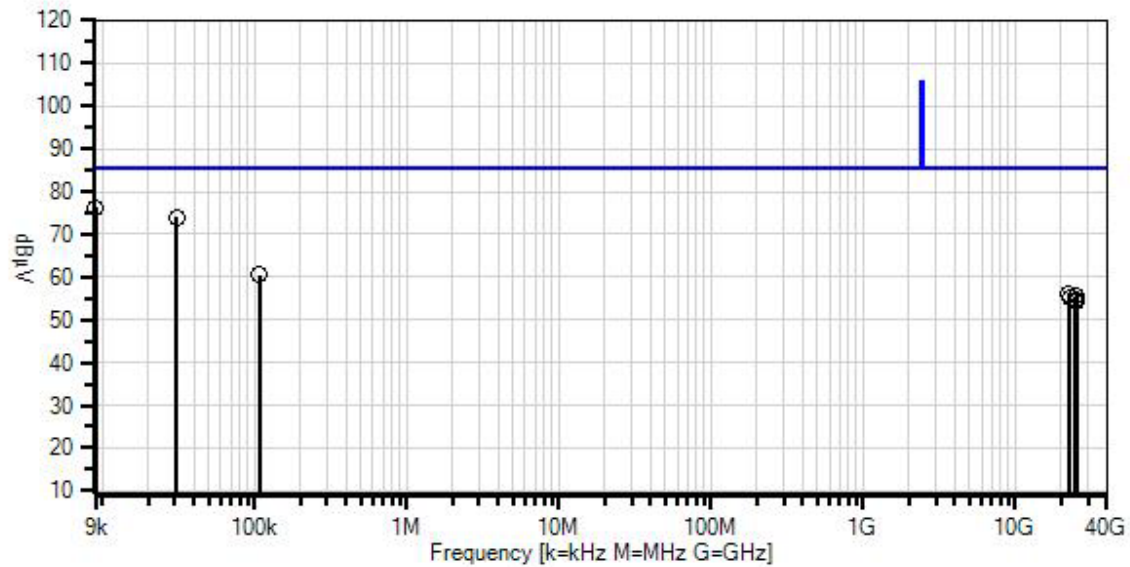
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration A			

Test Conditions / Notes:

Conducted Spurious Emission Frequency Range: 9kHz to 25GHz Test Environment Conditions: Temperature: 21.8°C Humidity: 47% Atmospheric Pressure: 101.5kPa Highest Generated Frequency: 5.825GHz Test Method: ANSI C63.10 2020 RF Output Set at 0dBm 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. Note: High Channel BLE (BOBBLE)
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Total W/O#: 110285 Sequence#: 52 Date: 10/10/2024
15.247(d) Conducted Spurious Emissions Test Distance: None None



— Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) Conducted Spurious Emissions
 ○ Peak Readings
 * Average Readings
 Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03471	Spectrum Analyzer	E4440A	2/23/2024	2/23/2026
T1	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025
T2	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026

Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB			Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	9.000k	66.2	+9.9	+0.1			+0.0	76.2	85.4	-9.2	None
2	30.990k	64.2	+9.8	+0.0			+0.0	74.0	85.4	-11.4	None
3	108.271k	50.6	+9.8	+0.0			+0.0	60.4	85.4	-25.0	None
4	22327.844 M	43.5	+10.1	+2.6			+0.0	56.2	85.4	-29.2	None
5	24884.731 M	42.6	+10.0	+2.8			+0.0	55.4	85.4	-30.0	None
6	22788.922 M	42.6	+10.1	+2.6			+0.0	55.3	85.4	-30.1	None
7	22747.006 M	42.3	+10.1	+2.6			+0.0	55.0	85.4	-30.4	None
8	24968.563 M	41.8	+10.1	+2.8			+0.0	54.7	85.4	-30.7	None
9	24800.898 M	41.6	+10.0	+2.8			+0.0	54.4	85.4	-31.0	None

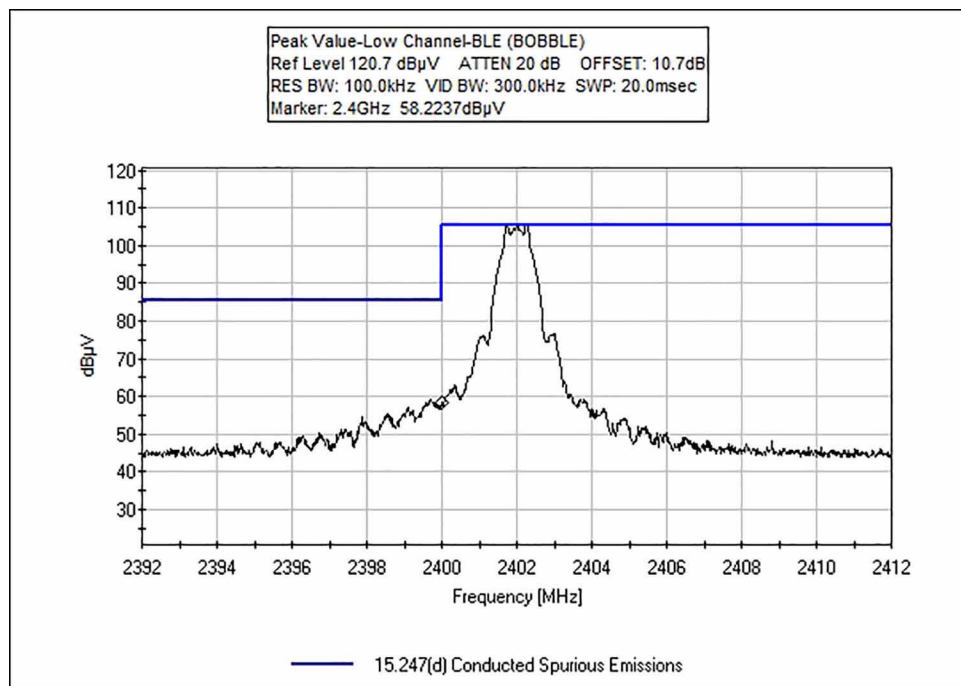
Band Edge

Band Edge Summary

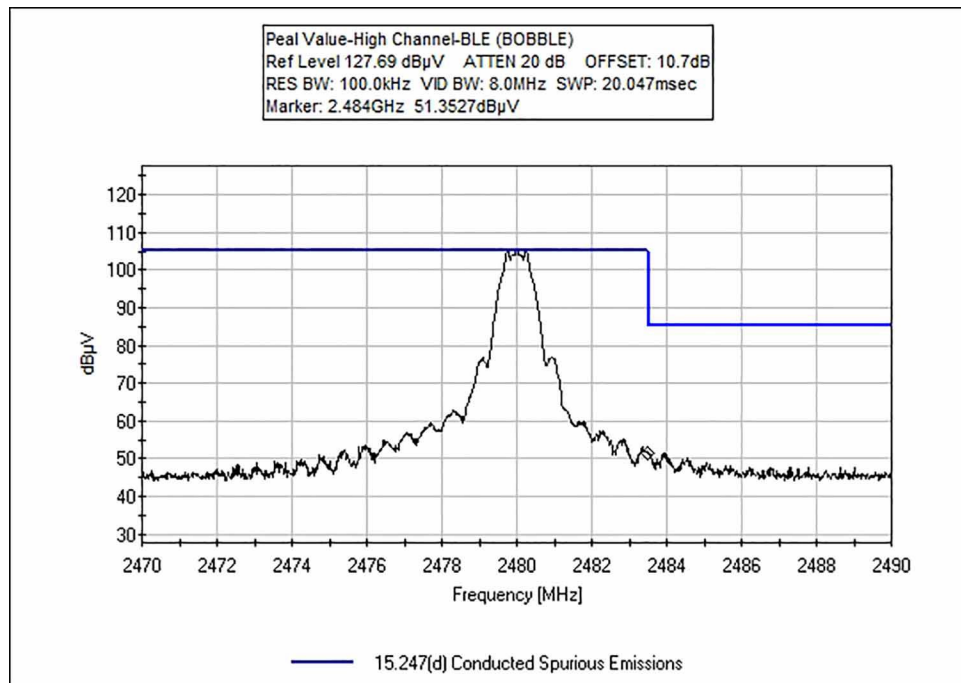
Limit applied: Max Power/100kHz - 20dB.

Frequency (MHz)	OBW (MHz)	Modulation	Measured (dBuV)	Limit (dBuV)	Results
2400	1	GFSK	49.7	<85.4	Pass
2483.5	1	GFSK	57.8	<85.4	Pass

Band Edge Plots



Low Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **Band Edge**
 Work Order #: **110285** Date: 10/10/2024
 Test Type: **Conducted Emission on Antenna Port** Time: 13:48:29
 Tested By: Hieu Song Nguyenpham Sequence#: 51
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration A			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration A			

Test Conditions / Notes:

Band Edge
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 2020
RF Output Set at 0dBm
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.

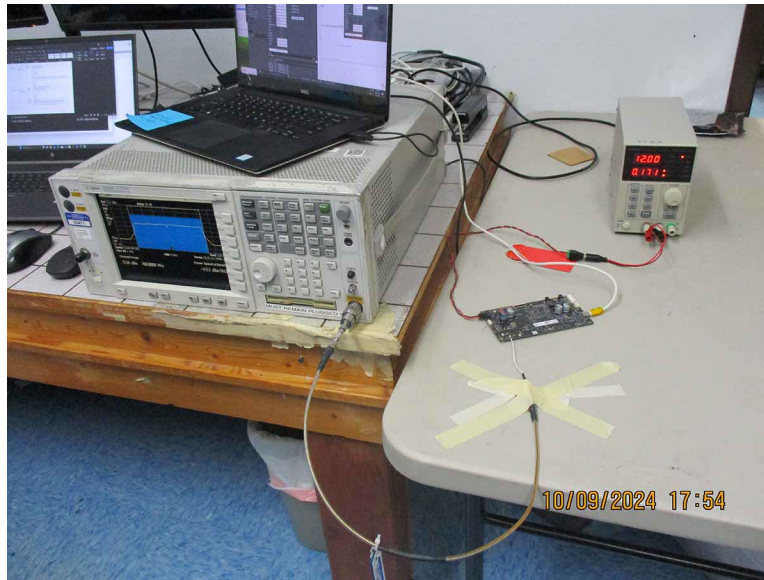
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03471	Spectrum Analyzer	E4440A	2/23/2024	2/23/2026
	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025
	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026

Measurement Data: Reading listed by order taken. Test Distance: None

#	Freq MHz	Rdng dBμV	dB	dB	dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2483.500M	49.7					+0.0	49.7	85.4	-35.7	None
2	2400.000M	57.8					+0.0	57.8	85.4	-27.6	None

Test Setup Photo(s)



Test Setup



Test Setup, Close View

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **110285** Date: 11/6/2024
 Test Type: **Radiated Scan** Time: 18:54:30
 Tested By: Hieu Song Nguyenpham Sequence#: 167
 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

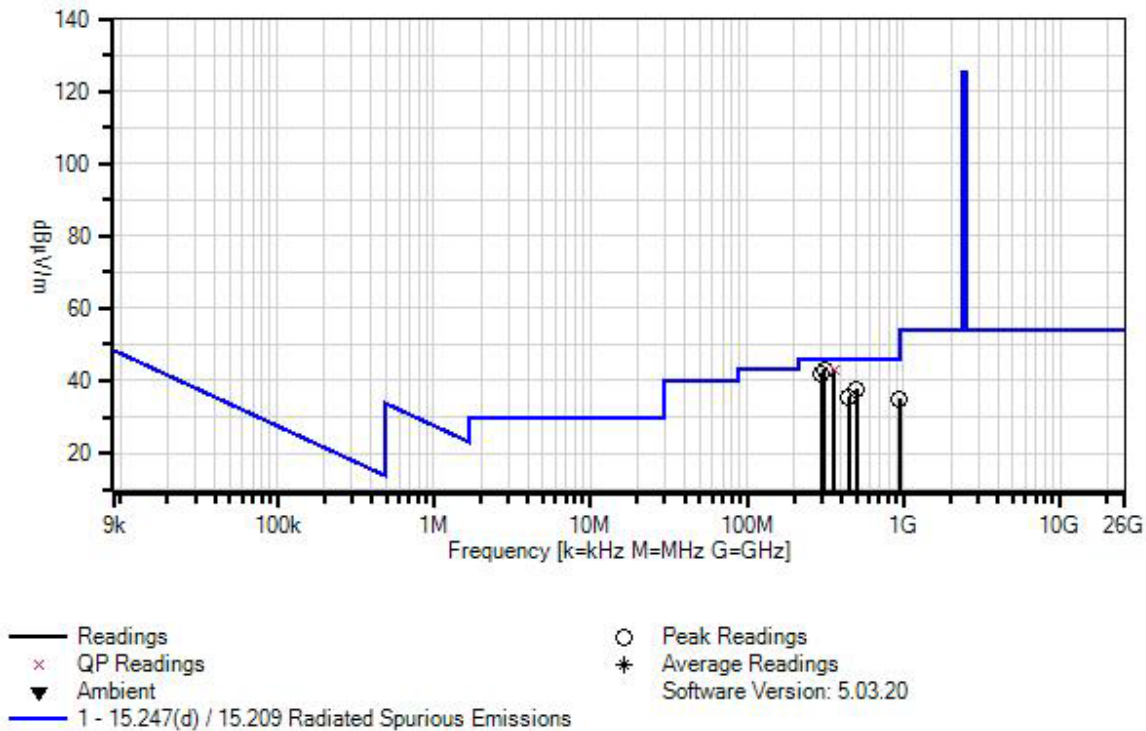
Test Environment Conditions:
 Temperature: 22.7°C
 Humidity: 36%
 Atmospheric Pressure: 101.8kPa
 Highest Generated Frequency: 5.825GHz
 Method: ANSI C63.10 2020

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
 BT transmitting continuously with GFSK modulation type, LE1Mbps with pattern of 0s and 1s at power level 0 dBm
 2442MHz-Middle Channel

Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire. Green Resistor

No emissions from EUT has been found in 20dB tolerance in the frequency range 9kHz to 30MHz.

Total WO#: 110285 Sequence#: 167 Date: 11/6/2024
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	4/5/2024	4/5/2026
	AN00432	Loop Antenna	6502	7/10/2023	7/10/2025
T2	AN01995	Biconilog Antenna	CBL6111C	5/16/2024	5/16/2026
T3	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T4	ANP01187	Cable	CNT-195	7/3/2024	7/3/2026
T5	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m	dB	Ant
1	311.943M	52.8	-31.9 +0.6	+19.4	+1.8	+0.5	+0.0	43.2	46.0	-2.8	Horiz
2	360.010M QP	51.3	-31.9 +0.7	+20.5	+1.9	+0.6	+0.0	43.1	46.0	-2.9	Horiz
^	360.010M	52.5	-31.9 +0.7	+20.5	+1.9	+0.6	+0.0	44.3	46.0	-1.7	Horiz
4	297.365M	51.6	-31.9 +0.6	+19.4	+1.8	+0.5	+0.0	42.0	46.0	-4.0	Horiz
5	503.752M	41.4	-32.0 +0.8	+24.5	+2.3	+0.7	+0.0	37.7	46.0	-8.3	Vert
6	448.289M	40.8	-32.0 +0.7	+23.2	+2.1	+0.7	+0.0	35.5	46.0	-10.5	Vert
7	945.121M	29.7	-31.0 +1.3	+30.6	+3.5	+1.0	+0.0	35.1	46.0	-10.9	Vert

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **110285** Date: 11/4/2024
 Test Type: **Radiated Scan** Time: 16:09:06
 Tested By: Hieu Song Nguyenpham Sequence#: 124
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

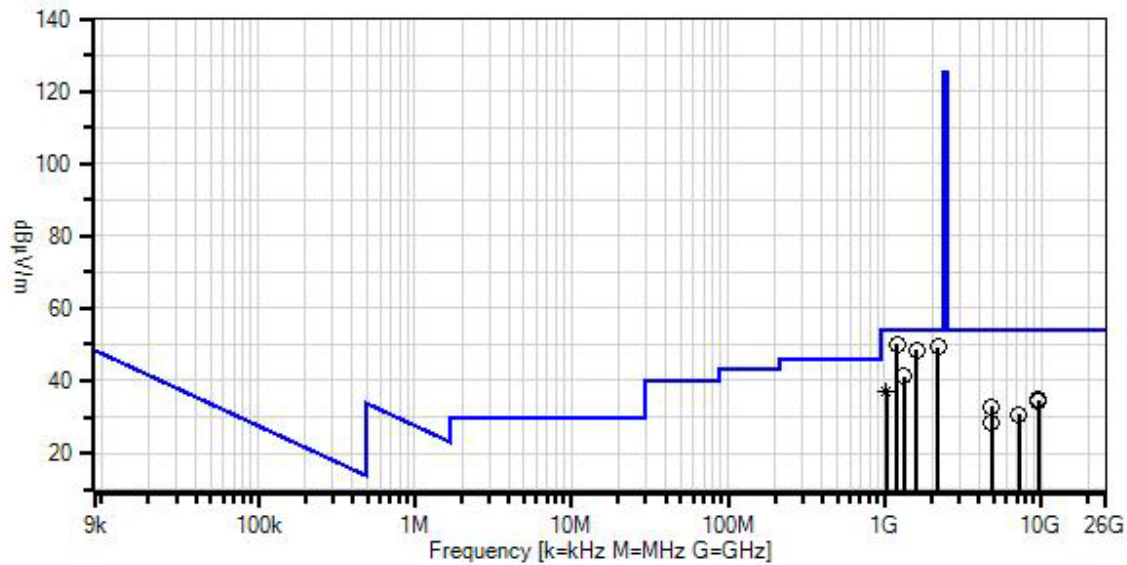
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission Frequency Range: 1GHz to 26GHz Test Environment Conditions: Temperature: 22.0°C Humidity: 37% Atmospheric Pressure: 101.5kPa Highest Generated Frequency: 5.825GHz Test Method: ANSI C63.10 2020 The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on. BT transmitting continuously with GFSK modulation type, LE1Mbps with pattern of 0s and 1s at power level 0 dBm Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire. Green Resistor Low Channel
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Total WO#: 110285 Sequence#: 124 Date: 11/4/2024
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
× QP Readings
▼ Ambient
○ Peak Readings
* Average Readings
Software Version: 5.03.20

1 - 15.247(d) / 15.209 Radiated Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026
	ANP00928	Cable	various	1/26/2024	1/26/2026

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	ANP00929	Cable	various	1/26/2024	1/26/2026
	ANP07698	Cable	32022-29094K- 29094K-72TC	8/16/2024	8/16/2026
T6	ANP07938	Preamp	83017A	6/14/2023	6/14/2025
T7	AN03386	High Pass Filter	11SH10- 3000/T10000- O/O	3/22/2024	3/22/2026
T8	AN03011	Cable	32022-2-2909K- 24TC	3/23/2023	3/23/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5 dB	T6 dB	T7 dB	T8 dB	Table	dBμV/m	dBμV/m	dB	Ant
1	1198.800M	50.7	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	50.2	54.0	-3.8	Vert
2	2198.400M	43.8	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	49.3	54.0	-4.7	Horiz
3	1596.400M	46.7	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	48.5	54.0	-5.5	Horiz
4	1336.000M	41.0	+25.1 +0.6	+1.0 +0.0	+1.9 +0.0	-28.3 +0.0	+0.0	41.3	54.0	-12.7	Horiz
5	1022.400M	38.3	+24.3 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	37.1	54.0	-16.9	Vert
^	1022.400M	58.1	+24.3 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	56.9	54.0	+2.9	Vert
7	9606.040M	45.3	+39.3 +1.6	+3.0 -33.6	+5.9 +0.2	-28.2 +1.3	+0.0	34.8	54.0	-19.2	Vert
8	9606.560M	44.6	+39.3 +1.6	+3.0 -33.6	+5.9 +0.2	-28.2 +1.3	+0.0	34.1	54.0	-19.9	Horiz
9	4797.560M	52.1	+33.4 +1.1	+2.0 -34.1	+3.6 +0.3	-26.4 +0.8	+0.0	32.8	54.0	-21.2	Vert
10	7206.000M	44.7	+36.0 +1.5	+2.5 -34.4	+4.5 +0.2	-25.6 +1.4	+0.0	30.8	54.0	-23.2	Vert
11	4805.680M	47.5	+33.4 +1.1	+2.0 -34.1	+3.6 +0.3	-26.4 +0.8	+0.0	28.2	54.0	-25.8	Horiz

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **110285** Date: 11/4/2024
 Test Type: **Radiated Scan** Time: 15:55:24
 Tested By: Hieu Song Nguyenpham Sequence#: 125
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

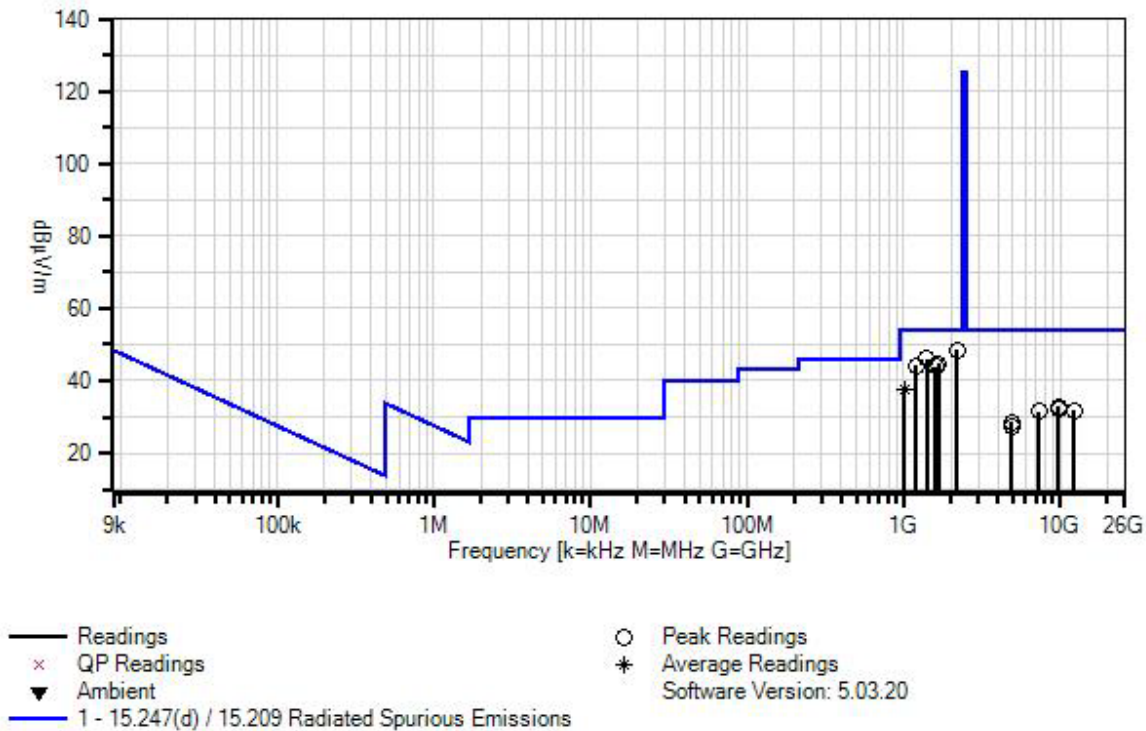
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission Frequency Range: 1GHz to 26GHz Test Environment Conditions: Temperature: 22.0°C Humidity: 37% Atmospheric Pressure: 101.5kPa Highest Generated Frequency: 5.825GHz Test Method: ANSI C63.10 2020 The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on. BT transmitting continuously with GFSK modulation type, LE1Mbps with pattern of 0s and 1s at power level 0 dBm Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire. Green Resistor Middle Channel
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Total WO#: 110285 Sequence#: 125 Date: 11/4/2024
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	ANP00928	Cable	various	1/26/2024	1/26/2026
	ANP00929	Cable	various	1/26/2024	1/26/2026
	ANP07698	Cable	32022-29094K-29094K-72TC	8/16/2024	8/16/2026
T6	ANP07938	Preamp	83017A	6/14/2023	6/14/2025
T7	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	3/22/2024	3/22/2026
T8	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5	T6	T7	T8	Table	dBμV/m	dBμV/m	dB	Ant
1	2192.200M	43.1	+28.2	+1.3	+2.4	-27.2	+0.0	48.6	54.0	-5.4	Vert
			+0.8	+0.0	+0.0	+0.0					
2	1397.900M	45.4	+25.3	+1.0	+1.9	-28.2	+0.0	46.0	54.0	-8.0	Horiz
			+0.6	+0.0	+0.0	+0.0					
3	1673.400M	42.3	+26.5	+1.1	+2.1	-27.9	+0.0	44.7	54.0	-9.3	Vert
			+0.6	+0.0	+0.0	+0.0					
4	1199.000M	44.6	+24.8	+0.9	+1.7	-28.5	+0.0	44.1	54.0	-9.9	Horiz
			+0.6	+0.0	+0.0	+0.0					
5	1595.700M	42.1	+26.1	+1.1	+2.0	-28.0	+0.0	43.9	54.0	-10.1	Horiz
			+0.6	+0.0	+0.0	+0.0					
6	1018.200M	38.9	+24.3	+1.0	+1.6	-28.7	+0.0	37.7	54.0	-16.3	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1018.200M	58.5	+24.3	+1.0	+1.6	-28.7	+0.0	57.3	54.0	+3.3	Vert
			+0.6	+0.0	+0.0	+0.0					
8	9768.680M	43.2	+39.5	+3.0	+5.9	-28.4	+0.0	32.8	54.0	-21.2	Horiz
			+1.6	-33.5	+0.2	+1.3					
9	9768.680M	42.4	+39.5	+3.0	+5.9	-28.4	+0.0	32.0	54.0	-22.0	Vert
			+1.6	-33.5	+0.2	+1.3					
10	12210.680 M	41.8	+40.0	+3.3	+6.5	-29.6	+0.0	31.7	54.0	-22.3	Vert
			+1.8	-34.1	+0.6	+1.4					
11	7326.680M	44.9	+36.3	+2.6	+4.6	-25.6	+0.0	31.5	54.0	-22.5	Vert
			+1.5	-34.5	+0.2	+1.5					
12	4884.480M	47.5	+33.6	+2.0	+3.6	-26.4	+0.0	28.5	54.0	-25.5	Horiz
			+1.1	-34.0	+0.2	+0.9					
13	4884.320M	46.4	+33.6	+2.0	+3.6	-26.4	+0.0	27.4	54.0	-26.6	Vert
			+1.1	-34.0	+0.2	+0.9					

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
 Work Order #: **110285** Date: 11/4/2024
 Test Type: **Radiated Scan** Time: 15:41:28
 Tested By: Hieu Song Nguyenpham Sequence#: 126
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

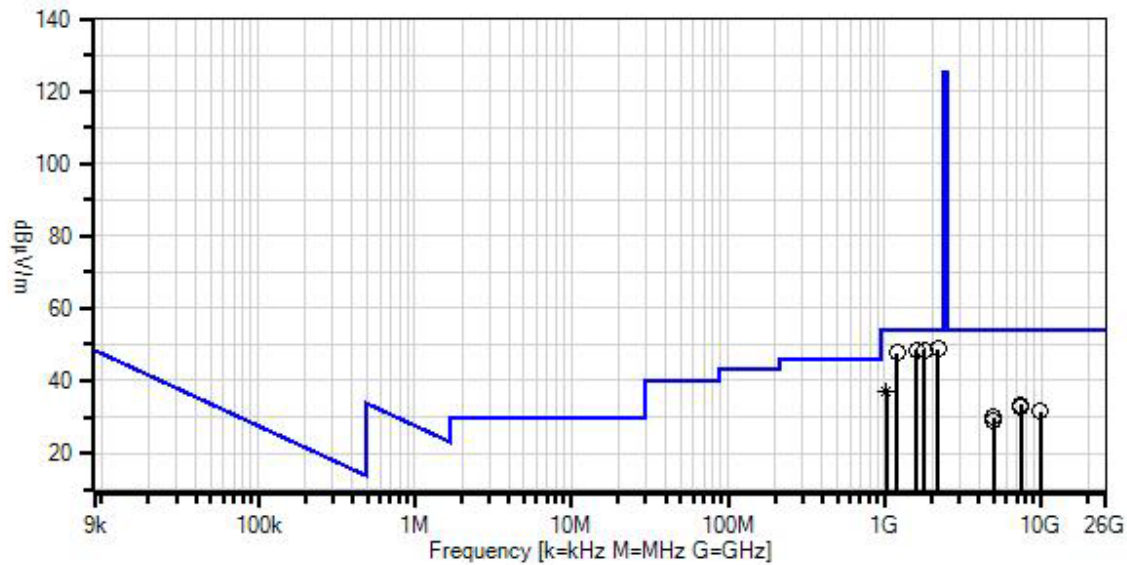
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission Frequency Range: 1GHz to 26GHz Test Environment Conditions: Temperature: 22.0°C Humidity: 37% Atmospheric Pressure: 101.5kPa Highest Generated Frequency: 5.825GHz Test Method: ANSI C63.10 2020 The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on. BT transmitting continuously with GFSK modulation type, LE1Mbps with pattern of 0s and 1s at power level 0 dBm Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire. Green Resistor High Channel

Total WO#: 110285 Sequence#: 126 Date: 11/4/2024
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters



— Readings
× QP Readings
▼ Ambient
○ Peak Readings
* Average Readings
Software Version: 5.03.20

1 - 15.247(d) / 15.209 Radiated Spurious Emissions

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026
	ANP00928	Cable	various	1/26/2024	1/26/2026

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	ANP00929	Cable	various	1/26/2024	1/26/2026
	ANP07698	Cable	32022-29094K- 29094K-72TC	8/16/2024	8/16/2026
T6	ANP07938	Preamp	83017A	6/14/2023	6/14/2025
T7	AN03386	High Pass Filter	11SH10- 3000/T10000- O/O	3/22/2024	3/22/2026
T8	AN03011	Cable	32022-2-2909K- 24TC	3/23/2023	3/23/2025

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5 dB	T6 dB	T7 dB	T8 dB	Table	dBμV/m	dBμV/m	dB	Ant
1	2194.200M	43.2	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	48.7	54.0	-5.3	Horiz
2	1796.600M	44.9	+27.2 +0.7	+1.2 +0.0	+2.2 +0.0	-27.7 +0.0	+0.0	48.5	54.0	-5.5	Vert
3	1599.200M	46.7	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	48.5	54.0	-5.5	Horiz
4	1198.800M	48.2	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	47.7	54.0	-6.3	Vert
5	1023.800M	38.1	+24.3 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	36.9	54.0	-17.1	Vert
^	1023.800M	58.1	+24.3 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	56.9	54.0	+2.9	Vert
7	7442.200M	46.7	+36.6 +1.5	+2.6 -34.6	+4.6 +0.2	-25.7 +1.5	+0.0	33.4	54.0	-20.6	Horiz
8	7440.860M	46.0	+36.6 +1.5	+2.6 -34.6	+4.6 +0.2	-25.7 +1.5	+0.0	32.7	54.0	-21.3	Vert
9	9920.860M	42.1	+39.6 +1.7	+3.0 -33.5	+5.8 +0.2	-28.6 +1.3	+0.0	31.6	54.0	-22.4	Vert
10	4960.140M	48.5	+33.8 +1.2	+2.0 -34.0	+3.6 +0.2	-26.4 +0.9	+0.0	29.8	54.0	-24.2	Horiz
11	4962.200M	47.6	+33.8 +1.2	+2.0 -34.0	+3.6 +0.2	-26.4 +0.9	+0.0	28.9	54.0	-25.1	Vert

Band Edge

Band Edge Summary

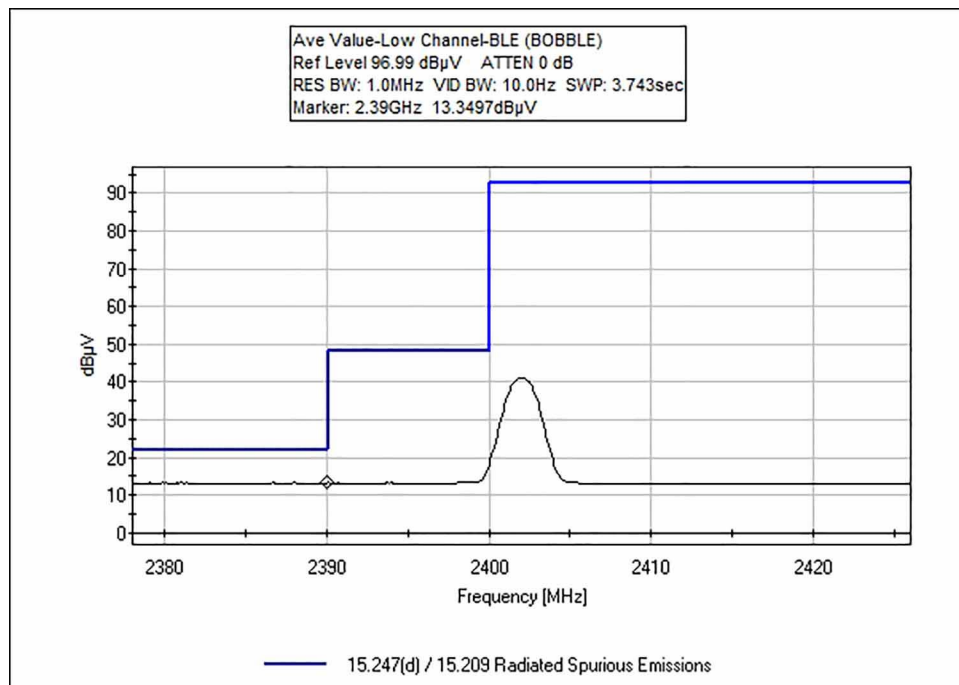
Limit applied at restricted bands: 15.209

Limit applied for other than restricted bands: Max Power/100kHz - 20dB.

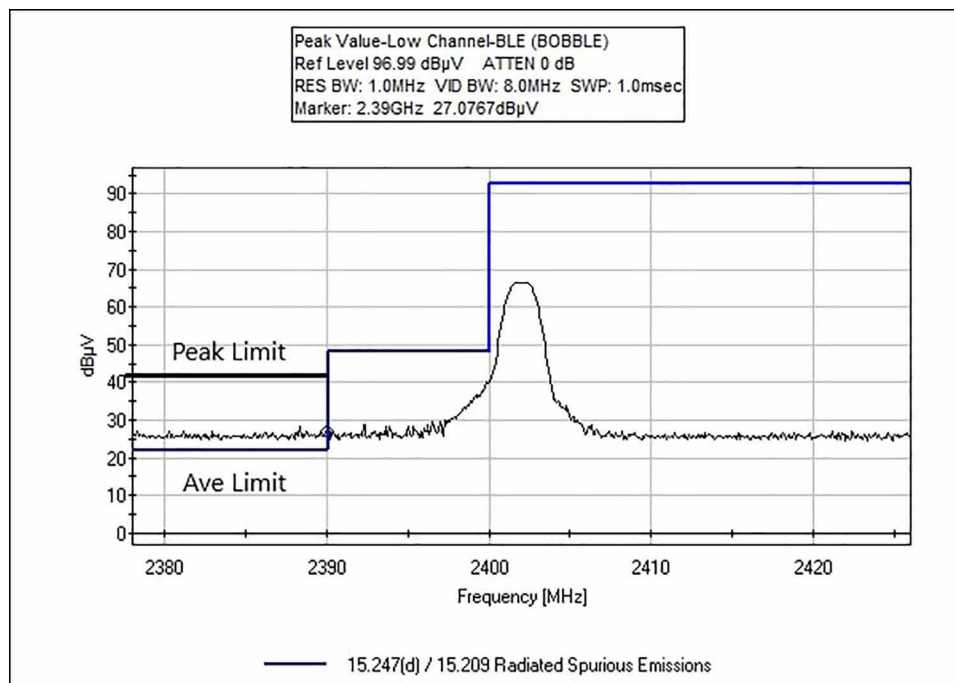
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Average (dBuV/m @3m)		Peak (dBuV/m @3m)		Results
			Measured	Limit	Measured	Limit	
2390.0	GFSK	External/4.83	45.4	≤54	59.2	≤74	Pass
2400.0	GFSK	External/4.83	NA2	NA2	53.3	≤78.2	Pass
2483.5	GFSK	External/4.83	45.2	≤54	62.8	≤74	Pass

NA2 = Average limit not applicable when applying 20dBc limit.

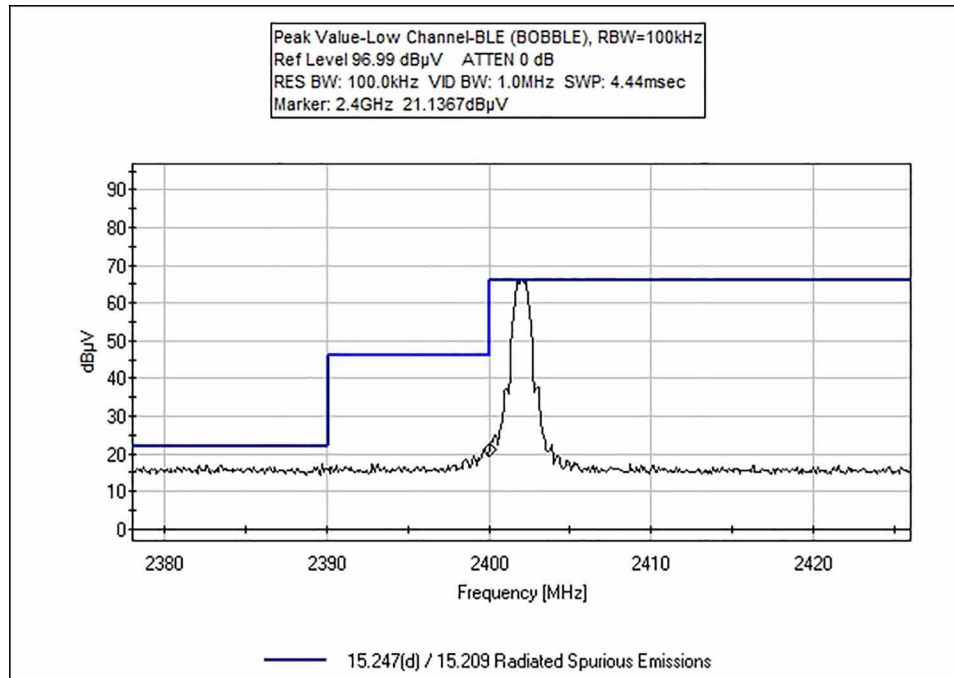
Band Edge Plots



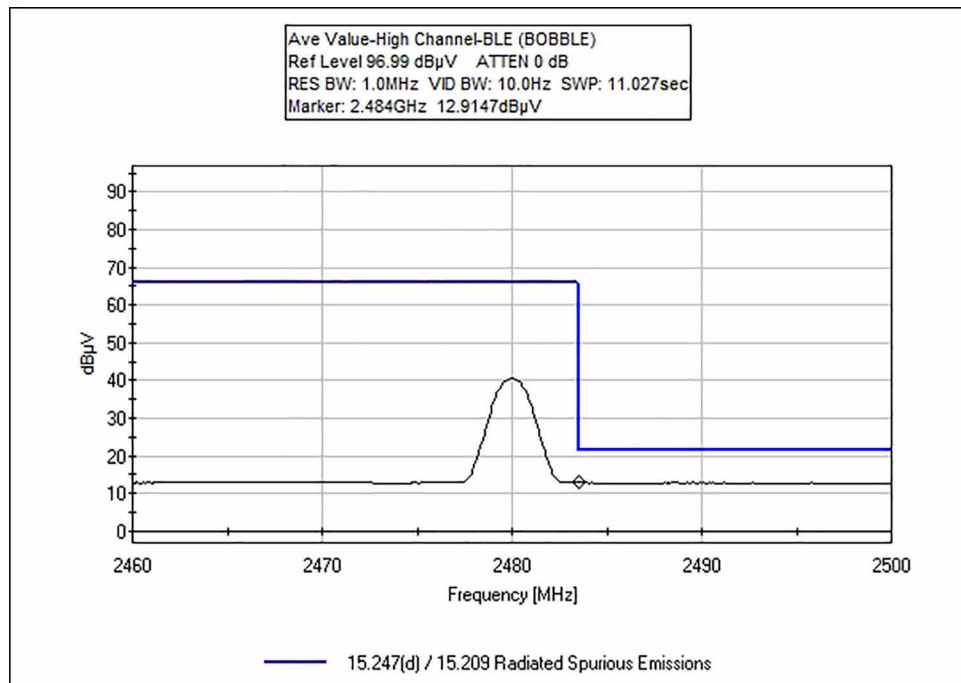
Average Value, Low Channel



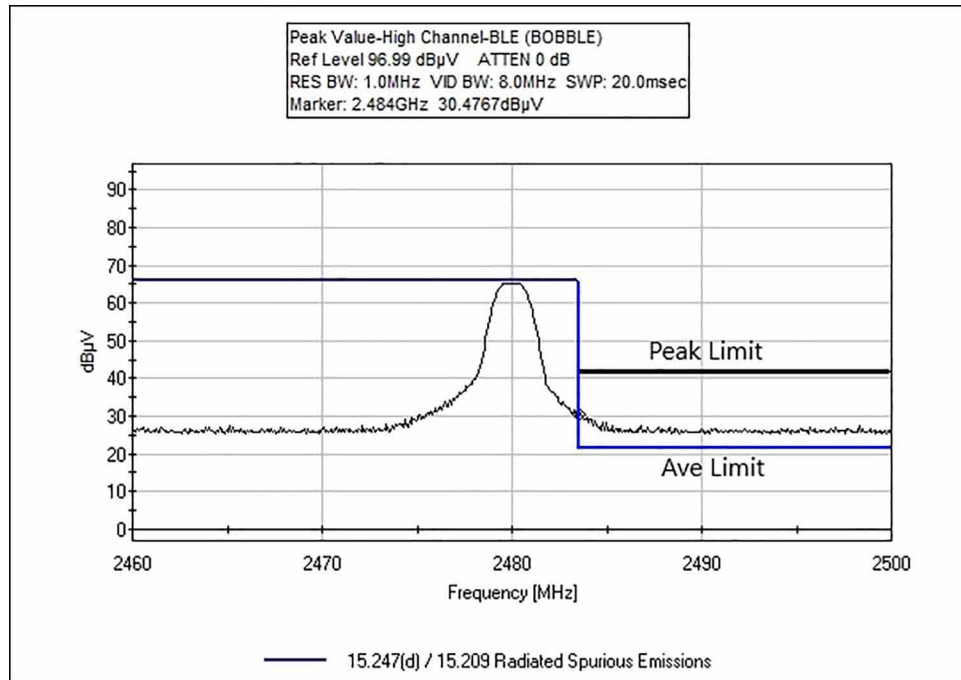
Peak Value, Low Channel



Peak Value, Low Channel, RBW=100kHz



Average Value, High Channel



Peak Value, High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **Band Edge**
 Work Order #: **110285** Date: 10/22/2024
 Test Type: **Radiated Scan** Time: 16:46:42
 Tested By: Hieu Song Nguyenpham Sequence#: 12
 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

Test Environment Conditions:
 Temperature: 21.8°C
 Humidity: 47%
 Atmospheric Pressure: 101.5kPa
 Highest Generated Frequency: 2.48GHz

Test Method: ANSI C63.10 2020
 RF output set at 0dBm

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.

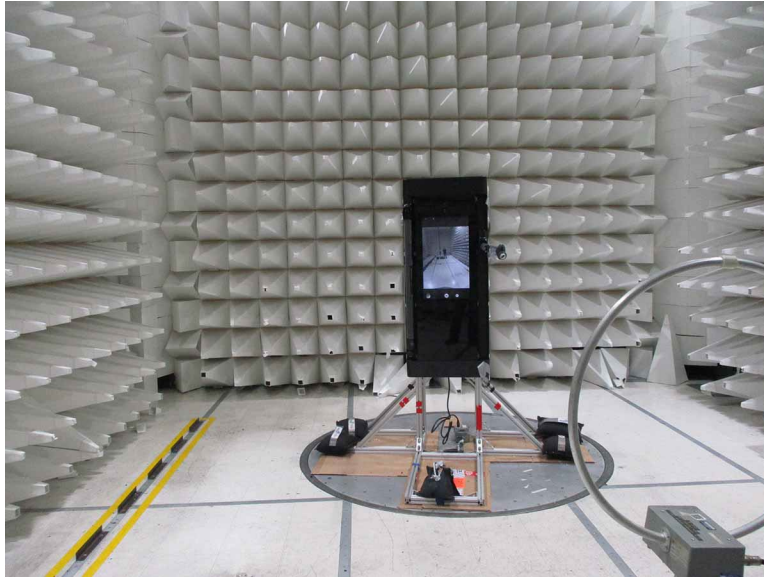
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	2390.000M	27.1	+28.3	+1.3	+2.5		+0.0	59.2	54.0	+5.2	Vert
2	2390.000M Ave	13.3	+28.3	+1.3	+2.5		+0.0	45.4	54.0	-8.6	Vert
3	2400.000M	21.1	+28.3	+1.4	+2.5		+0.0	53.3	78.2	-24.9	Vert
4	2483.500M	30.5	+28.3	+1.4	+2.6		+0.0	62.8	54.0	+8.8	Vert
5	2483.500M Ave	12.9	+28.3	+1.4	+2.6		+0.0	45.2	54.0	-8.8	Vert

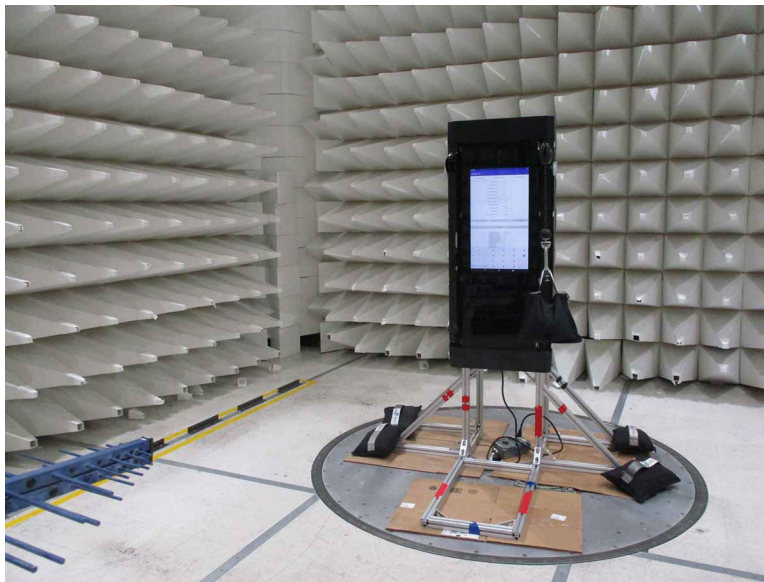
Test Setup Photo(s)



9kHz – 1GHz, Front View



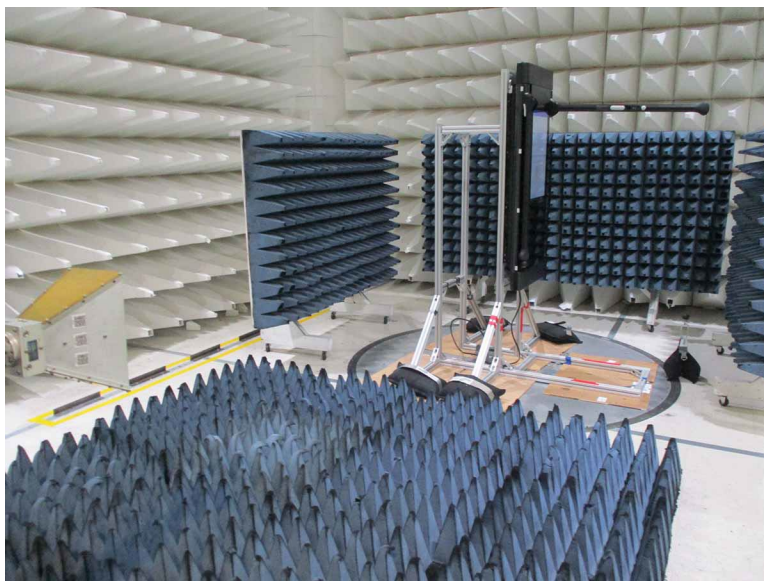
9kHz – 1GHz, Back View



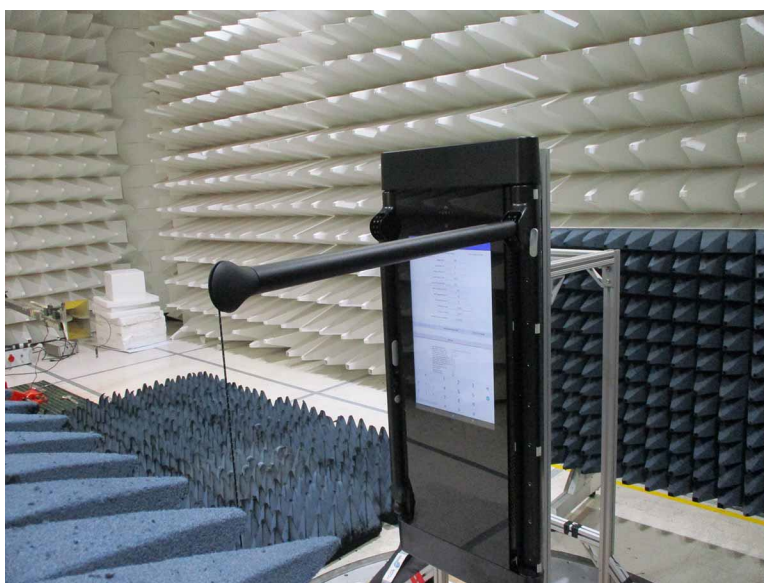
30MHz – 1GHz, Front View



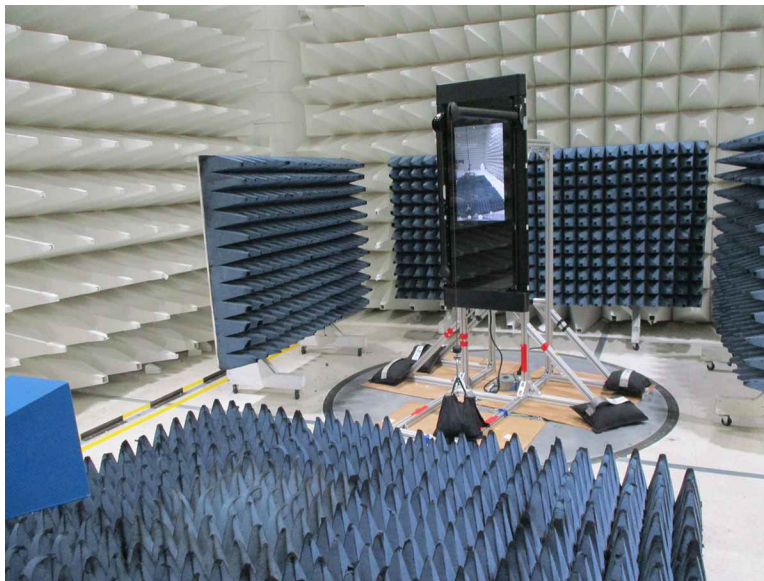
30MHz – 1GHz, Back View



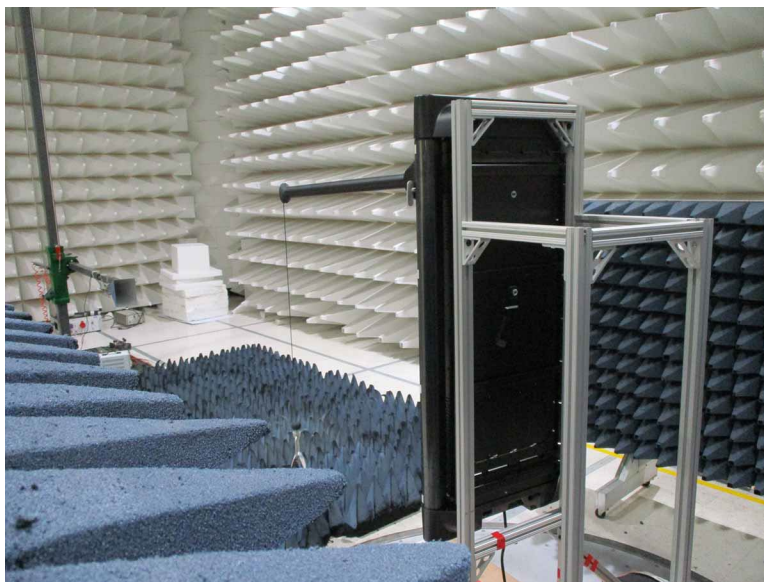
1GHz – 12GHz, Front View



1GHz – 12GHz, Back View



12GHz – 40GHz, Front View



12GHz – 40GHz, Back View

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **110285** Date: 10/17/2024
 Test Type: **Conducted Emissions** Time: 13:46:52
 Tested By: Hieu Song Nguyenpham Sequence#: 170
 Software: EMITest 5.03.20 120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

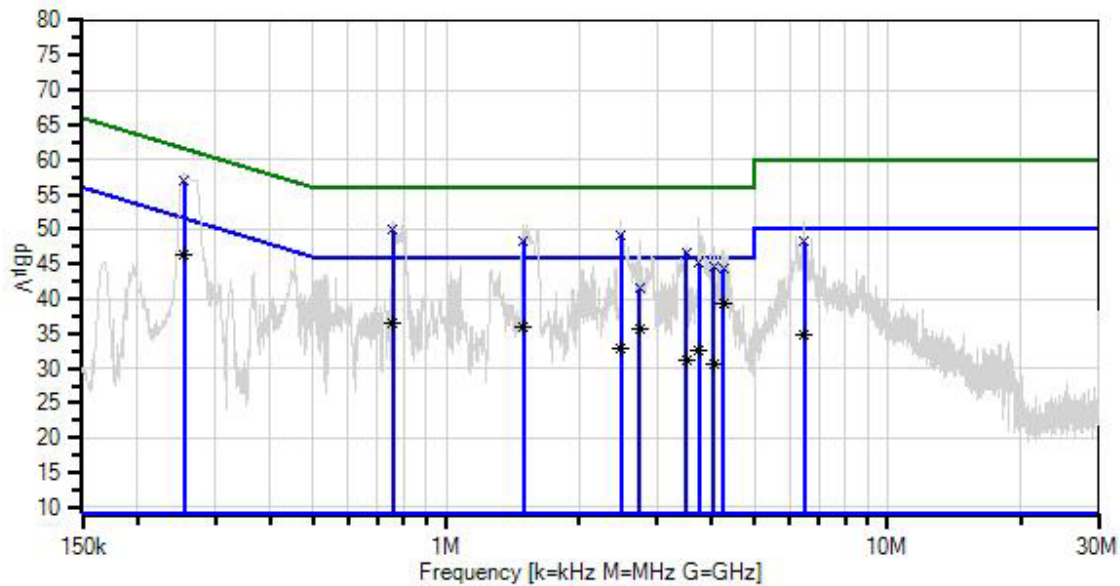
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Conducted Emission Frequency Range: 150kHz to 30MHz Test Environment Conditions: Temperature: 21.6°C Humidity: 49% Atmospheric Pressure: 101.4kPa Highest Generation Frequency: 5.825GHz Test Method: ANSI C63.4 2014 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. Video and Camera are On All WIFI and Bluetooth modules are on Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire. Green Resistor
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Tonal W/O#: 110285 Sequence#: 170 Date: 11/06/2024
15.207 AC Mains - Average Test Lead: 120V 60Hz Line



— Sweep Data
× QP Readings
Software Version: 5.03.20
— Readings
* Average Readings
— 1 - 15.207 AC Mains - Average
○ Peak Readings
▼ Ambient
— 2 - 15.207 AC Mains - Quasi-peak

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	12/2/2022	12/2/2024
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
T4	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN03814	50uH LISN-1PH-Neutral (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	5/6/2024	5/6/2026

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	254.718k	46.8	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	56.9	61.6	-4.7	Line
2	254.718k	36.2	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	46.3	51.6	-5.3	Line
^	254.718k	48.1	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	58.2	51.6	+6.6	Line
4	758.671k	39.7	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	50.0	56.0	-6.0	Line
5	4.237M	29.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	39.4	46.0	-6.6	Line
6	2.485M	39.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	49.2	56.0	-6.8	Line
7	1.494M	38.2	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	48.4	56.0	-7.6	Line
8	3.501M	36.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	46.6	56.0	-9.4	Line
9	758.671k	26.2	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	36.5	46.0	-9.5	Line
^	758.671k	41.9	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	52.2	46.0	+6.2	Line
11	1.494M	25.7	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	35.9	46.0	-10.1	Line
^	1.494M	41.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.2	46.0	+5.2	Line
13	2.744M	25.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	35.8	46.0	-10.2	Line
14	3.739M	34.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	45.1	56.0	-10.9	Line
15	4.041M	34.1	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	44.5	56.0	-11.5	Line
16	4.237M	33.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	44.3	56.0	-11.7	Line
^	4.237M	41.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	51.6	46.0	+5.6	Line
18	6.463M	37.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	48.2	60.0	-11.8	Line
19	2.485M	22.7	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	32.9	46.0	-13.1	Line
^	2.485M	41.1	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.3	46.0	+5.3	Line
21	3.739M	22.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	32.6	46.0	-13.4	Line
^	3.739M	42.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.4	46.0	+6.4	Line

23	2.744M	31.3	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	41.5	56.0	-14.5	Line
QP											
^	2.744M	36.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	46.8	46.0	+0.8	Line
25	3.501M	20.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	31.3	46.0	-14.7	Line
Ave											
^	3.501M	39.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	50.2	46.0	+4.2	Line
27	6.463M	24.3	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	34.7	50.0	-15.3	Line
Ave											
^	6.463M	41.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.1	50.0	+2.1	Line
29	4.041M	20.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	30.6	46.0	-15.4	Line
Ave											
^	4.041M	39.1	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	49.5	46.0	+3.5	Line

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • (510) 249-1170
 Customer: **Tonal**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **110285** Date: 10/17/2024
 Test Type: **Conducted Emissions** Time: 14:16:33
 Tested By: Hieu Song Nguyenpham Sequence#: 171
 Software: EMITest 5.03.20 120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

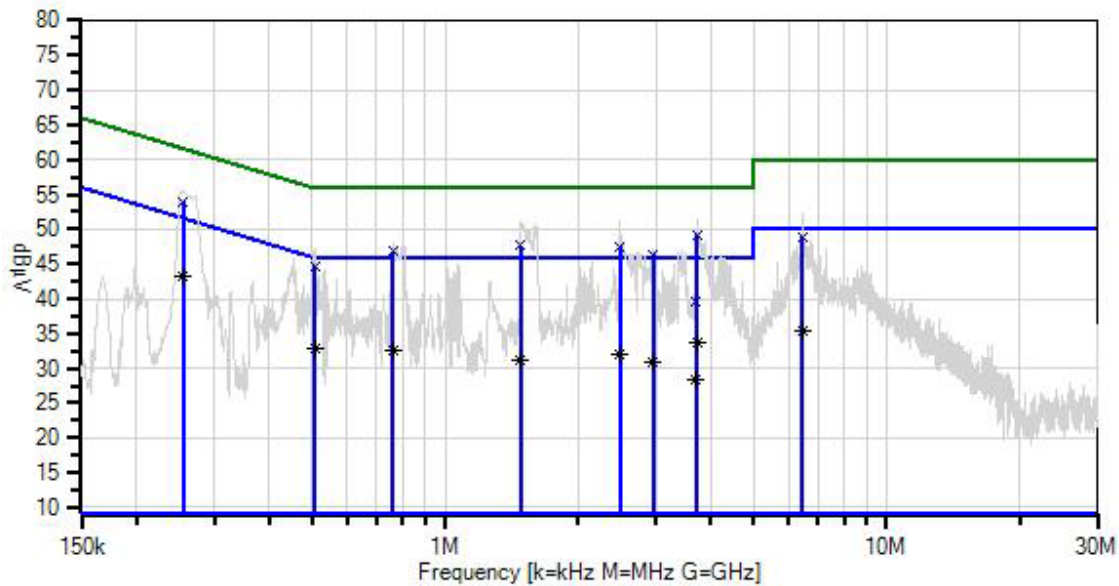
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Conducted Emission Frequency Range: 150kHz to 30MHz Test Environment Conditions: Temperature: 21.6°C Humidity: 49% Atmospheric Pressure: 101.4kPa Highest Generation Frequency: 5.825GHz Test Method: ANSI C63.4 2014 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. Video and Camera are On All WIFI and Bluetooth modules are on Modification #1 in use during testing: Added a ferrite (Würth: 742 712 21) on lower resistor wire Green Resistor
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Total WO#: 110285 Sequence#: 171 Date: 11/06/2024
15.207 AC Mains - Average Test Lead: 120V 60Hz Neutral



— Sweep Data
× QP Readings
Software Version: 5.03.20
— Readings
* Average Readings
— 1 - 15.207 AC Mains - Average
○ Peak Readings
▼ Ambient
— 2 - 15.207 AC Mains - Quasi-peak

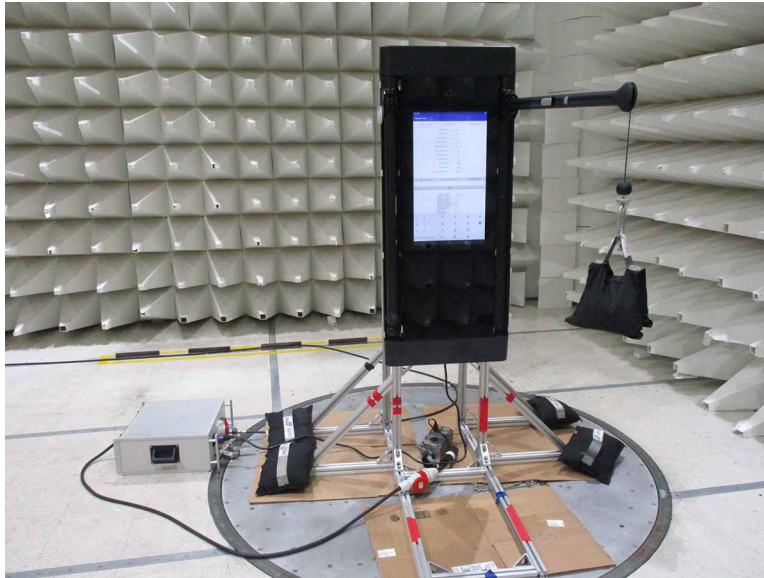
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	12/2/2022	12/2/2024
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
T4	AN03814	50uH LISN-1PH-Neutral (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	5/6/2024	5/6/2026

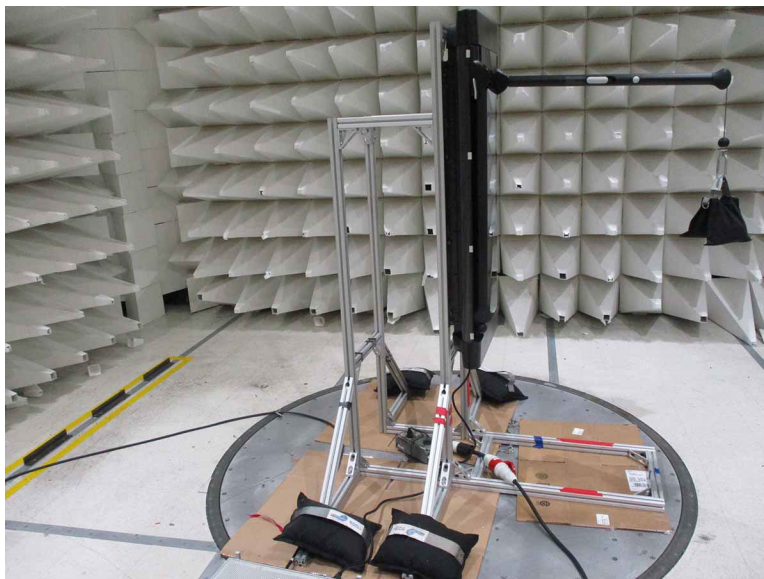
Measurement Data:			Reading listed by margin.					Test Lead: Neutral			
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV	dBμV	dB	Ant
1	3.722M	38.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	49.2	56.0	-6.8	Neutr
2	255.445k	44.0	+9.8 +0.1	+0.1	+0.0	+0.0	+0.0	54.0	61.6	-7.6	Neutr
3	255.445k	33.3	+9.8 +0.1	+0.1	+0.0	+0.0	+0.0	43.3	51.6	-8.3	Neutr
^	255.445k	44.9	+9.8 +0.1	+0.1	+0.0	+0.0	+0.0	54.9	51.6	+3.3	Neutr
5	1.485M	37.4	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	47.6	56.0	-8.4	Neutr
6	2.489M	37.3	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	47.5	56.0	-8.5	Neutr
7	761.580k	36.7	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	46.9	56.0	-9.1	Neutr
8	2.961M	36.2	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	46.4	56.0	-9.6	Neutr
9	6.449M	38.5	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	48.9	60.0	-11.1	Neutr
10	506.032k	34.5	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	44.7	56.0	-11.3	Neutr
11	3.722M	23.3	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	33.7	46.0	-12.3	Neutr
^	3.722M	42.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.6	46.0	+6.6	Neutr
13	506.032k	22.6	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	32.8	46.0	-13.2	Neutr
^	506.032k	38.9	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	49.1	46.0	+3.1	Neutr
15	761.580k	22.4	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	32.6	46.0	-13.4	Neutr
^	761.580k	39.4	+9.9 +0.2	+0.1	+0.0	+0.0	+0.0	49.6	46.0	+3.6	Neutr
17	2.489M	21.8	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	32.0	46.0	-14.0	Neutr
^	2.489M	41.5	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.7	46.0	+5.7	Neutr
19	6.449M	25.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	35.4	50.0	-14.6	Neutr
^	6.449M	42.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.6	50.0	+2.6	Neutr
21	1.485M	21.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	31.2	46.0	-14.8	Neutr
^	1.485M	41.5	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.7	46.0	+5.7	Neutr

23	2.961M	20.6	+9.9	+0.1	+0.0	+0.1	+0.0	30.8	46.0	-15.2	Neutr
	Ave		+0.1								
^	2.961M	38.9	+9.9	+0.1	+0.0	+0.1	+0.0	49.1	46.0	+3.1	Neutr
			+0.1								
25	3.705M	29.2	+9.9	+0.2	+0.1	+0.1	+0.0	39.6	56.0	-16.4	Neutr
	QP		+0.1								
26	3.705M	17.9	+9.9	+0.2	+0.1	+0.1	+0.0	28.3	46.0	-17.7	Neutr
	Ave		+0.1								
^	3.705M	39.7	+9.9	+0.2	+0.1	+0.1	+0.0	50.1	46.0	+4.1	Neutr
			+0.1								

Test Setup Photo(s)



Front View



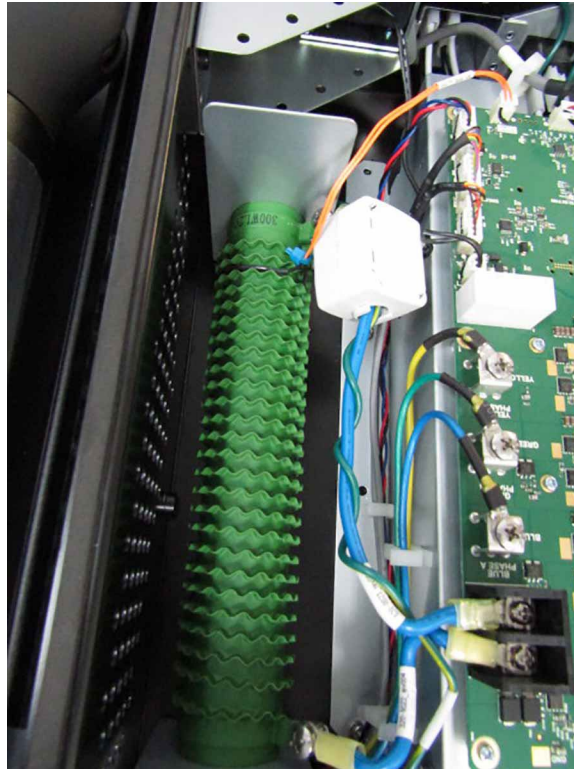
Side View

APPENDIX A: MODIFICATIONS MADE DURING TESTING

This list is a summary of the conditions noted for or modifications made to the equipment during testing.

Summary of Conditions
Modification #1 (Mod#1) = Added a ferrite (Würth: 742 712 21) on lower resistor wire Green Resistor

Modifications listed above must be incorporated into all production units.



Modification #1

Supplemental Information

Measurement Uncertainty

Uncertainty Value	Parameter
5.77 dB	Radiated Emissions
0.673 dB	RF Conducted Measurements
5.77×10^{-10}	Frequency Deviation
0.00005 s	Time Deviation
3.18 dB	Mains Conducted Emissions

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 $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ 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	($\text{dB}\mu\text{V}$)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

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.

End of Report