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.: 110285-34

Date of issue: November 27, 2024

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

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

Administrative Information

Test Report Information

REPORT PREPARED FOR:

Tonal
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San Francisco, CA 94103

Representative: Lars Gilstrom
Customer Reference Number: PO3196

REPORT PREPARED BY:

Viviana Prado
CKC Laboratories, Inc.
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Mariposa, CA 95338

Project Number: 110285

DATE OF EQUIPMENT RECEIPT: October 2, 2024
DATE(S) OF TESTING: October 7, 8, 9, 17, 24, and 25, 2024
And November 1 and 6, 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(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	Mod. #1	Pass
15.247(e)	Power Spectral Density	NA	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: Added a ferrite (Wurth: 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 Systems	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

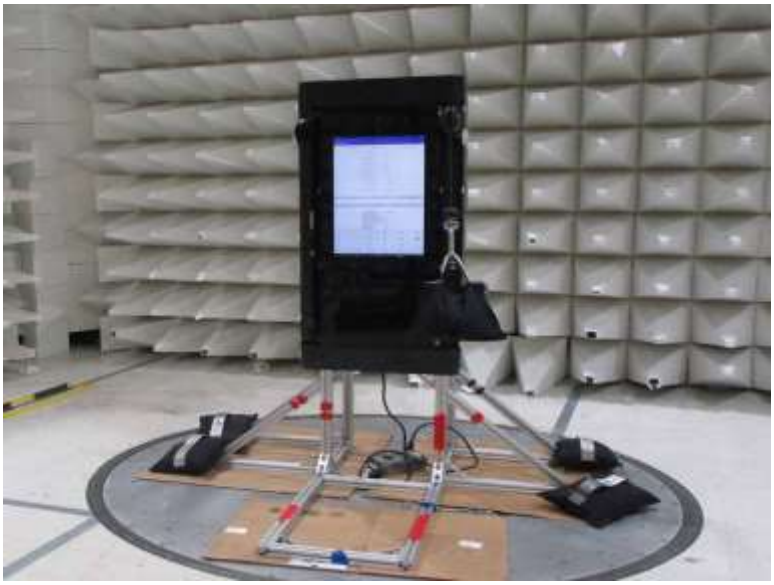
General Product Information:

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 (1MHz and 2MHz CBW)
Maximum Duty Cycle:	100%
Modulation Type(s):	GFSK
Number of TX Chains:	1
Beamforming Type:	NA
Antenna Type(s) and Gain:	External/3.67dBi
Antenna Connection Type:	External Connector
Nominal Input Voltage:	12VDC
Firmware / Software Version(s):	QRCT (Qualcomm Radio Control Toolkit) Version 4.1
Firmware / Software Description:	Using C-Prompt and QRCT application 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)

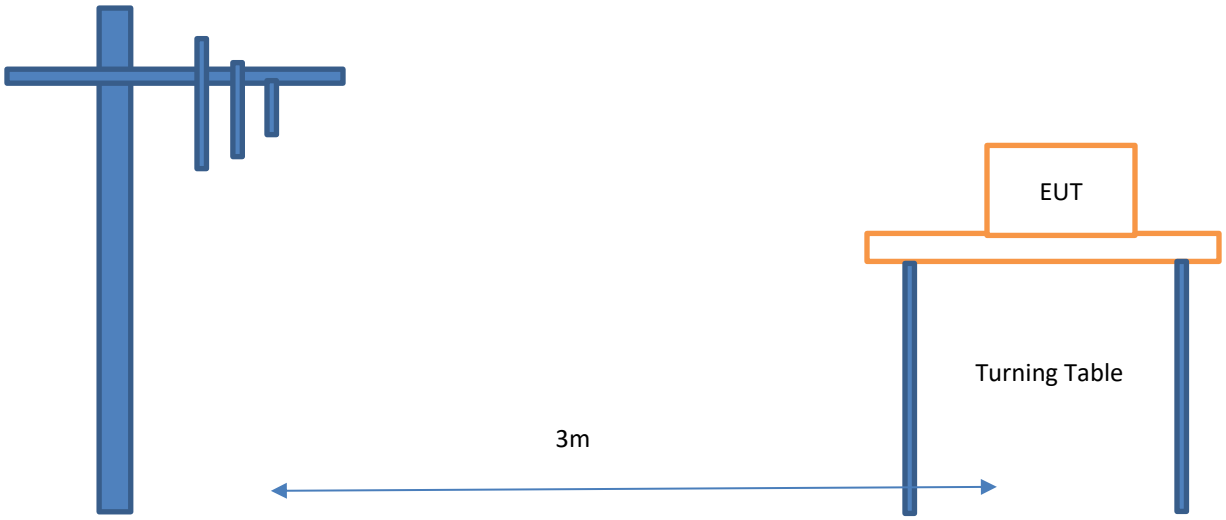


Support Equipment Photo(s)

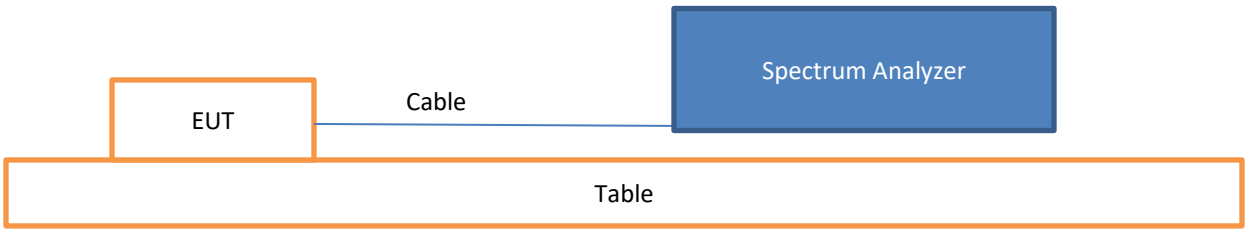
Block Diagram of Test Setup(s)

Config#	Setup Description of Block Diagram
1 & A	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):	10/3/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer		

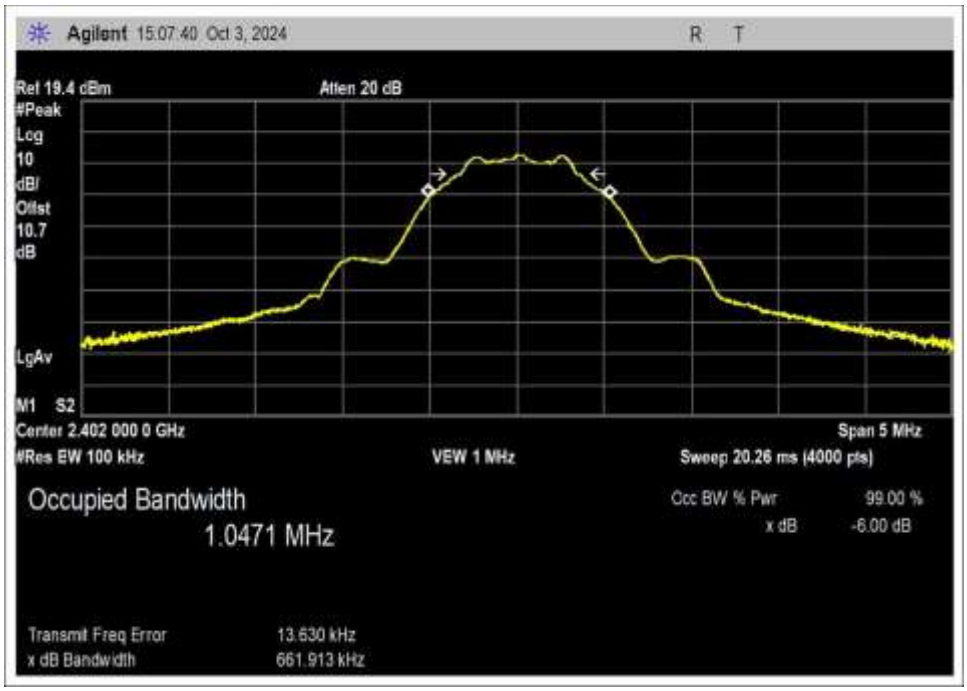
Environmental Conditions			
Temperature (ºC)	22.3	Relative Humidity (%):	42

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

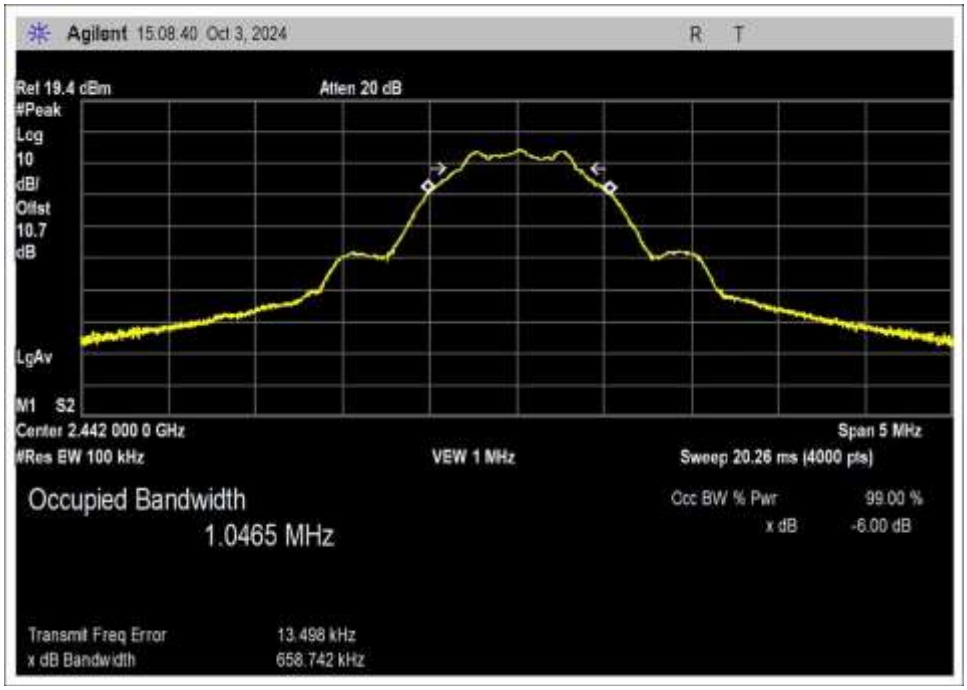
Test Data Summary						
Frequency (MHz)	**Antenna Port**	**OBW (MHz)**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	1	GFSK	661.913	≥500	Pass
2442	1	1	GFSK	658.742	≥500	Pass
2480	1	1	GFSK	699.526	≥500	Pass
2402	1	2	GFSK	1132	≥500	Pass
2442	1	2	GFSK	1134	≥500	Pass
2480	1	2	GFSK	1138	≥500	Pass

Plot(s)

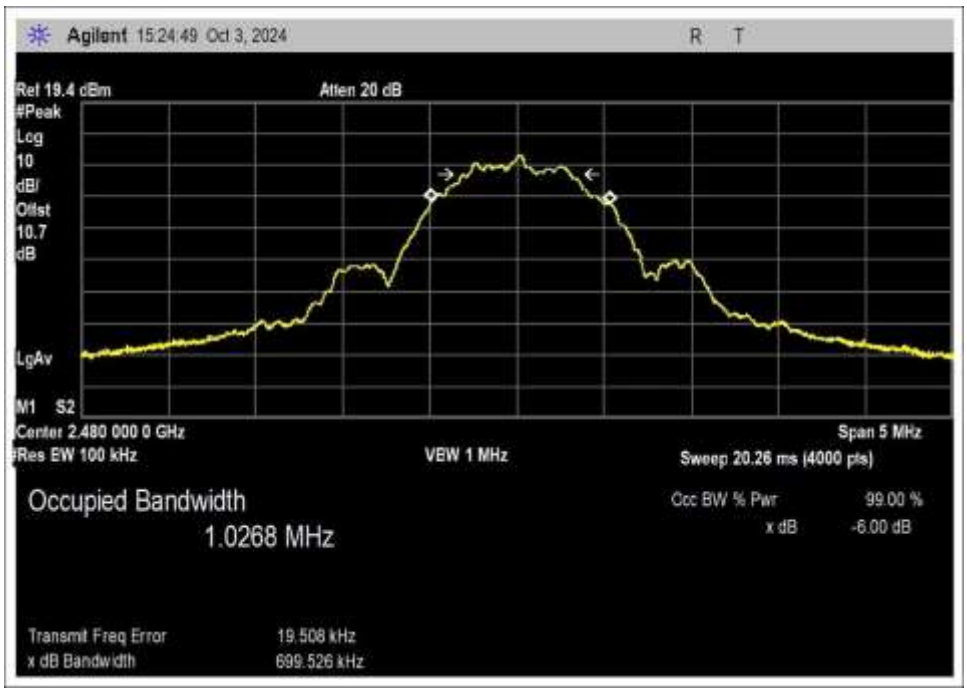
1MHz 6dB



Low Channel

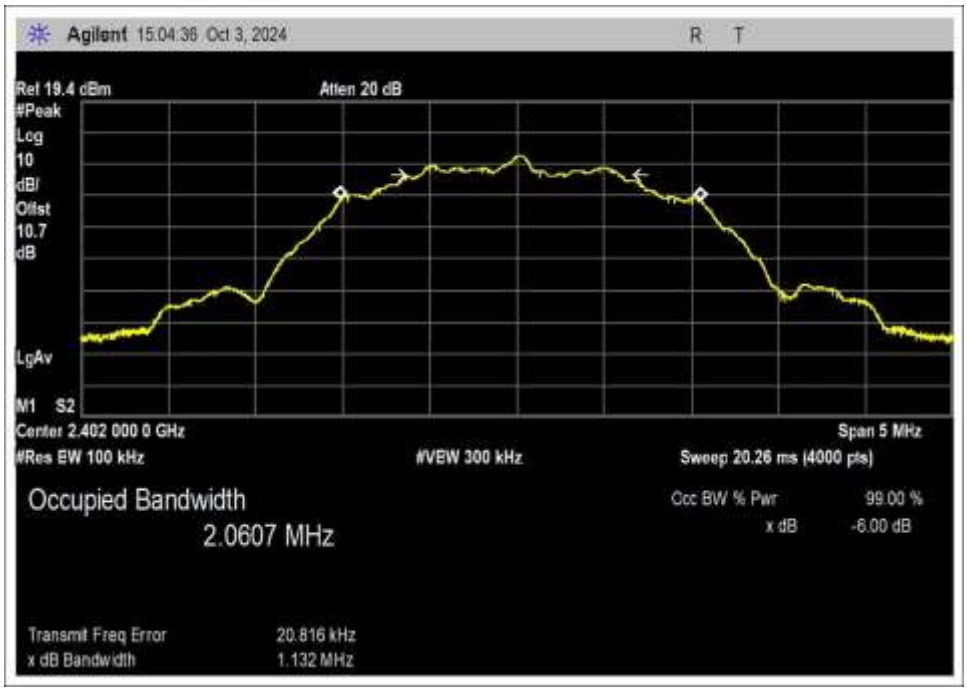


Middle Channel

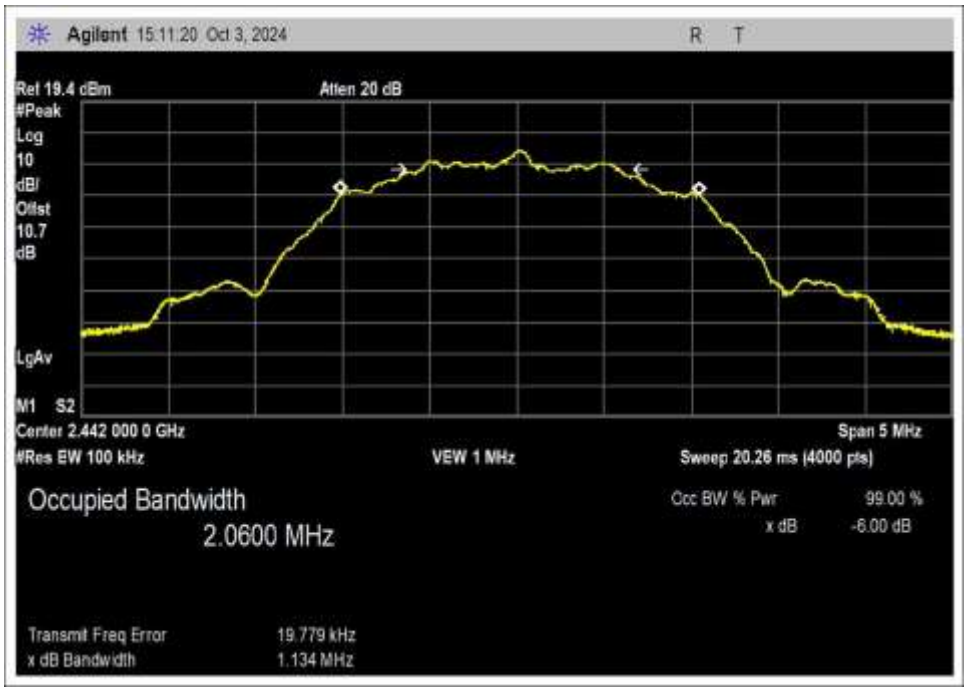


High Channel

2MHz 6dB



Low Channel



Middle Channel

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):	10/3/2024
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 (ºC)	23.2	Relative Humidity (%):	43

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)	**OBW (MHz)**	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
2402	2	GFSK	2.63	2.65	2.63	0.02
2442	2	GFSK	4.16	4.16	4.15	0.01
2480	2	GFSK	3.82	3.84	3.85	0.02

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	12VDC
$V_{Minimum}$:	10.2VDC
$V_{Maximum}$:	13.8VDC

Test Data Summary - RF Conducted Measurement								
Measurement Option: RBW > DTS Bandwidth								
Frequency (MHz)	**OBW (MHz)**	**Modulation**	**Ant. Type / Gain (dBi)**	**RF Conducted (dBm)**		**EIRP (dBm)**		**Results**
				Measured	**Limit**	**Calculated**	**Limit**	
2402	1	GFSK	External/3.67	2.54	≤30	6.21	≤36	Pass
2442	1	GFSK	External/3.67	4.01	≤30	7.68	≤36	Pass
2480	1	GFSK	External/3.67	3.67	≤30	7.34	≤36	Pass
2402	2	GFSK	External/3.67	2.65	≤30	6.32	≤36	Pass
2442	2	GFSK	External/3.67	4.16	≤30	7.83	≤36	Pass
2480	2	GFSK	External/3.67	3.84	≤30	7.51	≤36	Pass

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

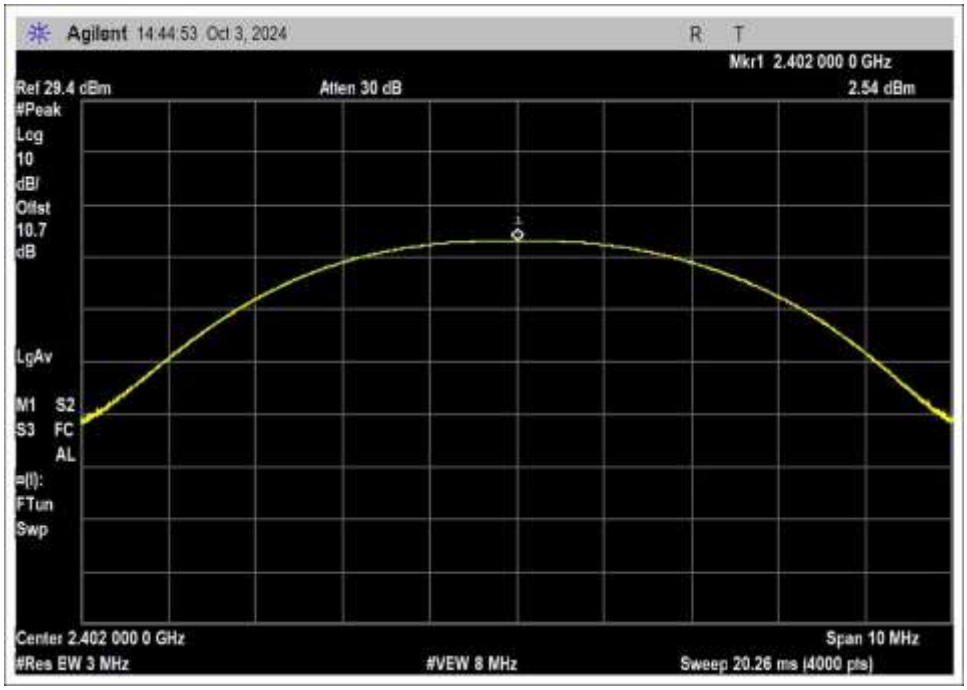
For fixed point-to-point antennas, the limit is calculated in accordance with 15.247(c)(1):

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).

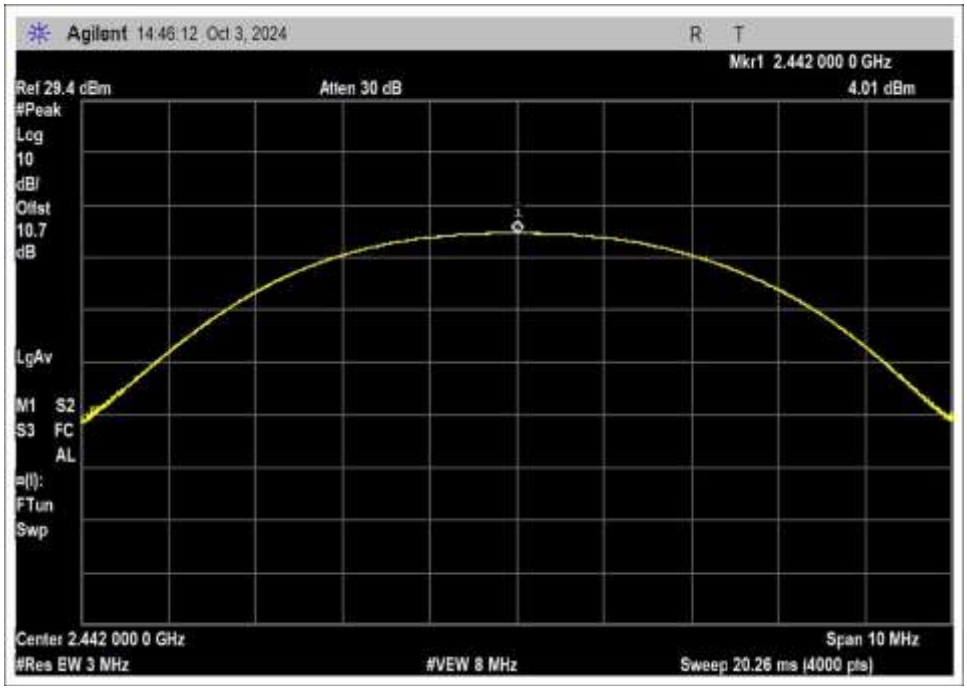
For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

Plots

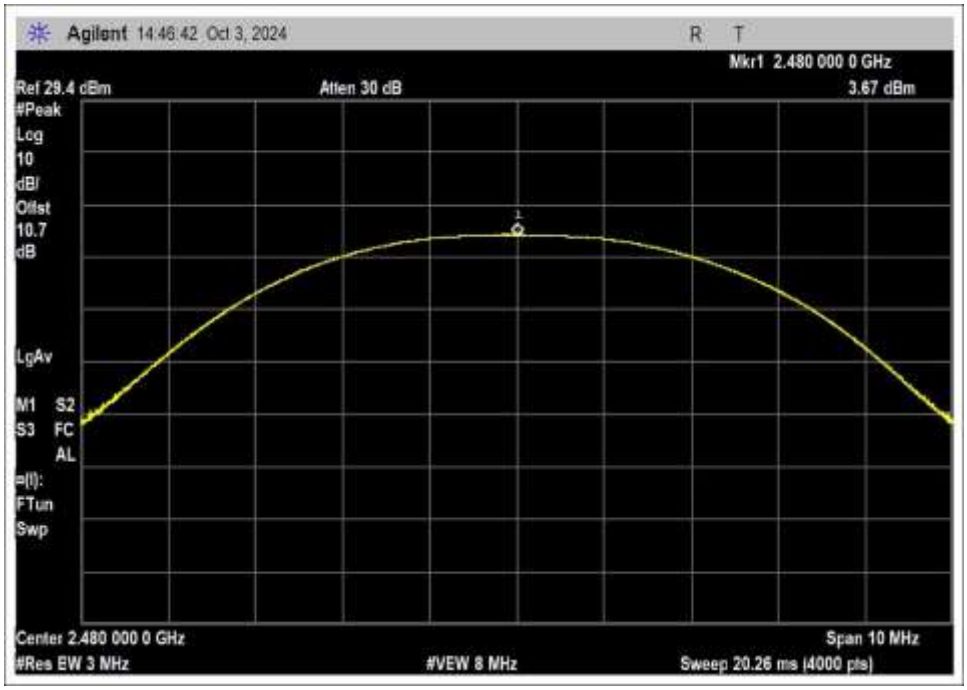
1MHz



Low Channel

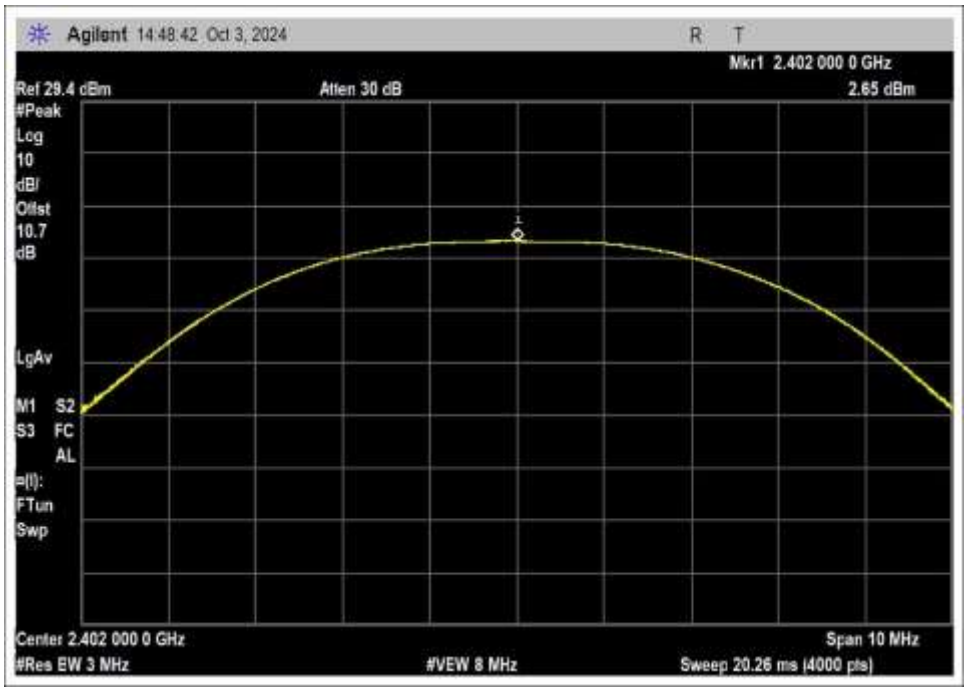


Middle Channel

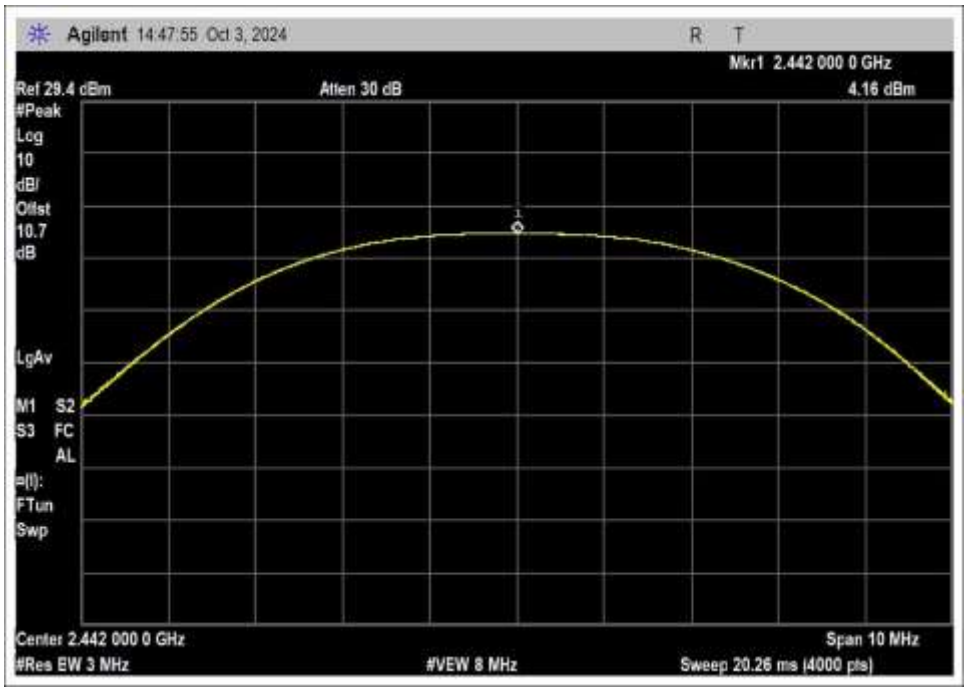


High Channel

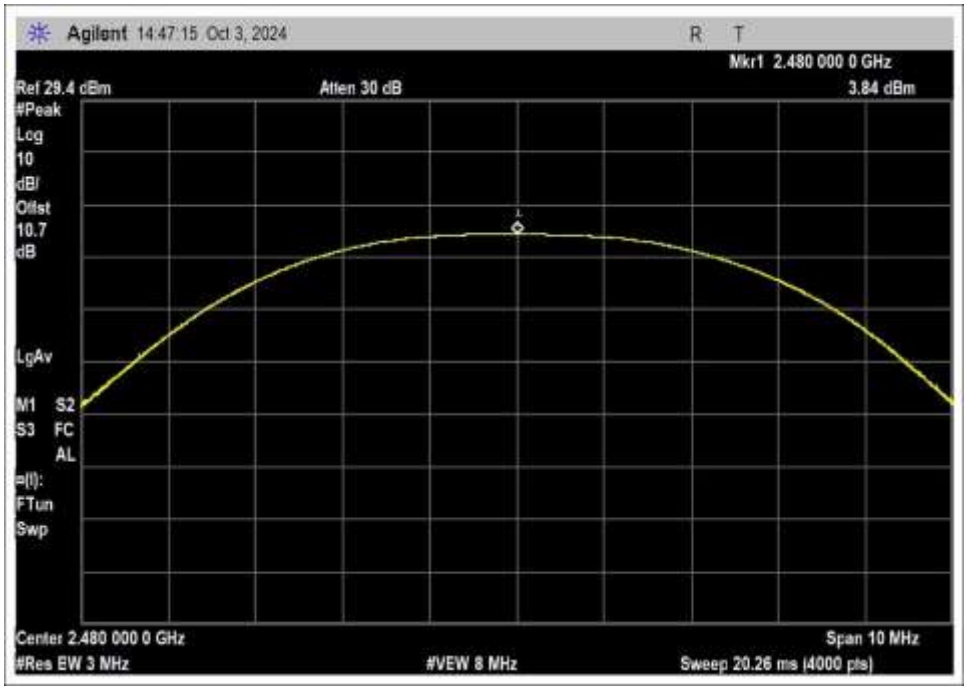
2MHz



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.247(d) RF Conducted 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) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/3/2024
Test Type:	**Conducted Scan**	Time:	4:42:04 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	6
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:

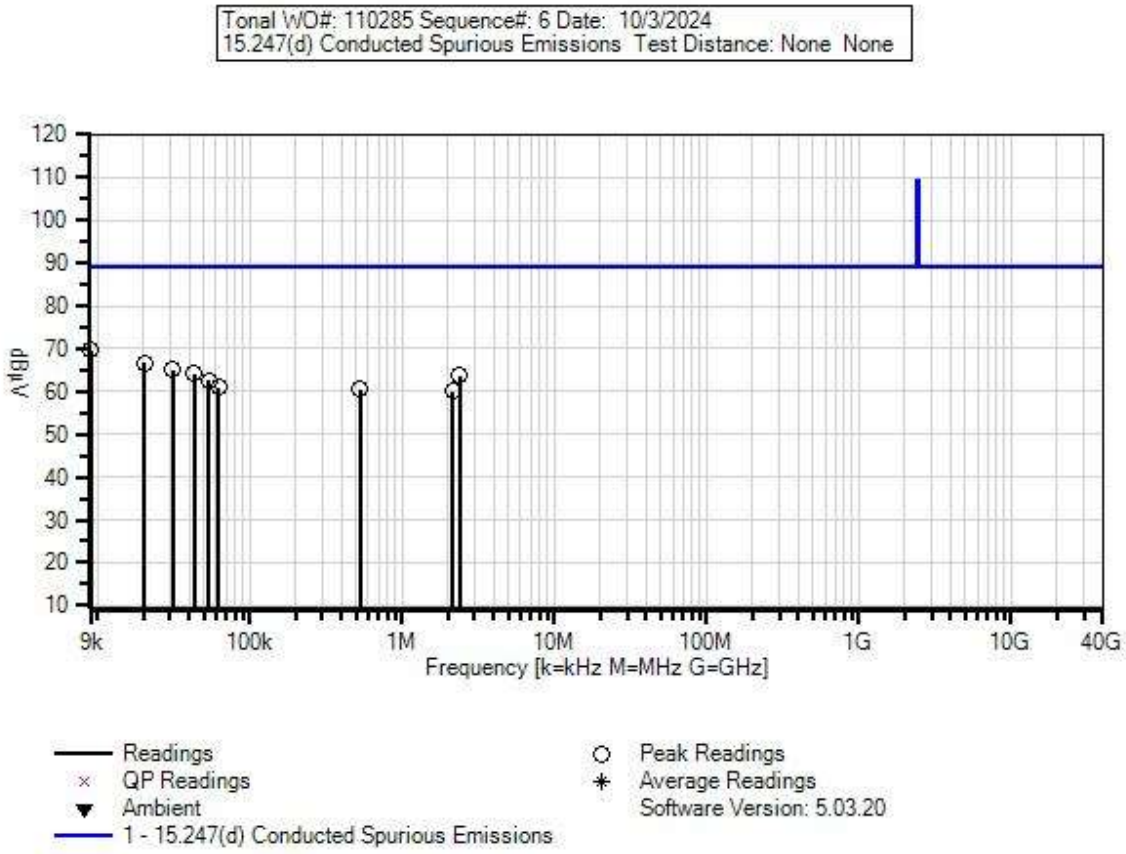
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
1MHz OBW



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	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.020k	59.7	+9.8	+0.1			+0.0	69.6	89.1	-19.5	None
2	20.324k	56.9	+9.8	+0.0			+0.0	66.7	89.1	-22.4	None
3	31.444k	55.2	+9.8	+0.0			+0.0	65.0	89.1	-24.1	None
4	43.483k	54.2	+9.9	+0.0			+0.0	64.1	89.1	-25.0	None
5	2.397M	53.9	+9.9	+0.0			+0.0	63.8	89.1	-25.3	None
6	54.083k	52.6	+9.9	+0.0			+0.0	62.5	89.1	-26.6	None
7	62.488k	51.1	+9.8	+0.0			+0.0	60.9	89.1	-28.2	None
8	529.013k	50.6	+9.9	+0.0			+0.0	60.5	89.1	-28.6	None
9	2.171M	50.2	+9.9	+0.0			+0.0	60.1	89.1	-29.0	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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	4:23:26 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	5
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:

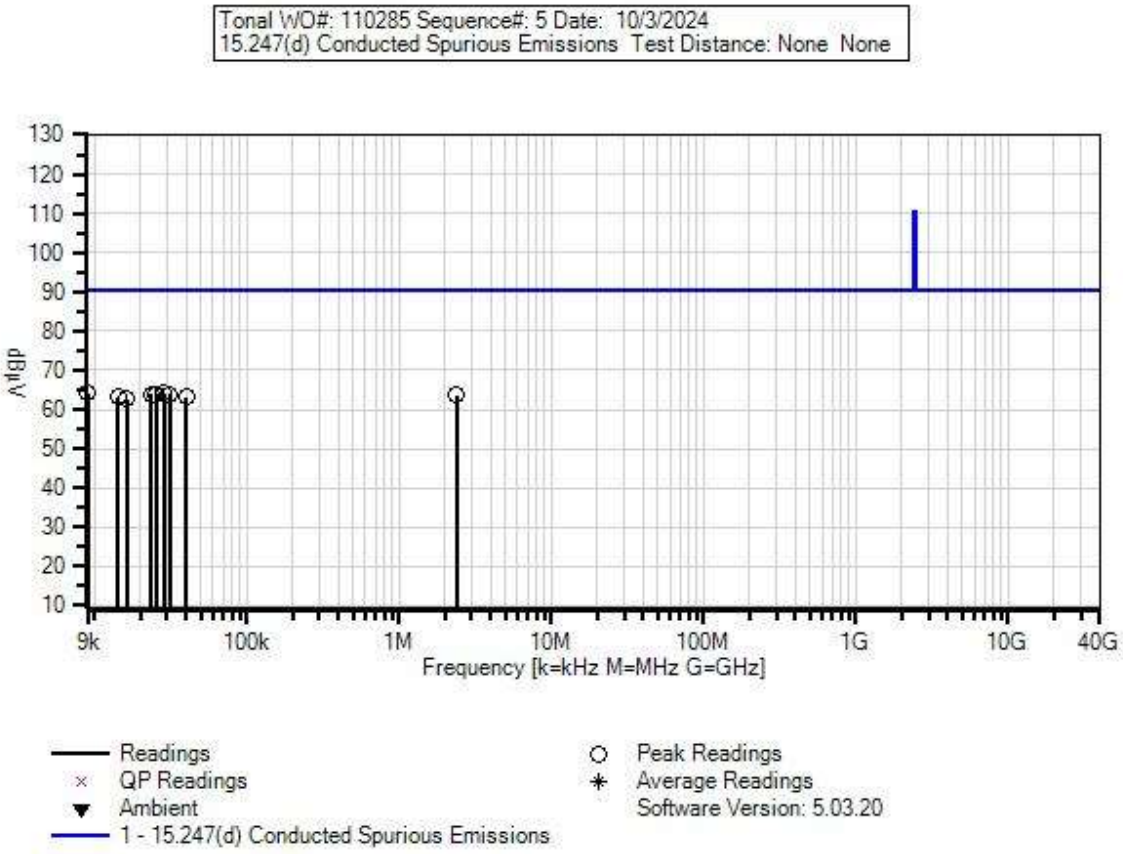
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
1MHz OBW



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	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.086k	54.3	+9.8	+0.1			+0.0	64.2	90.5	-26.3	None
2	28.681k	54.4	+9.8	+0.0			+0.0	64.2	90.5	-26.3	None
3	25.361k	54.2	+9.8	+0.0			+0.0	64.0	90.5	-26.5	None
4	31.217k	54.0	+9.8	+0.0			+0.0	63.8	90.5	-26.7	None
5	23.535k	54.0	+9.8	+0.0			+0.0	63.8	90.5	-26.7	None
6	2.403M	53.8	+9.9	+0.0			+0.0	63.7	90.5	-26.8	None
7	14.233k	53.1	+9.9	+0.1			+0.0	63.1	90.5	-27.4	None
8	40.227k	53.2	+9.9	+0.0			+0.0	63.1	90.5	-27.4	None
9	16.322k	52.7	+9.9	+0.1			+0.0	62.7	90.5	-27.8	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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	4:01:06 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	3
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:

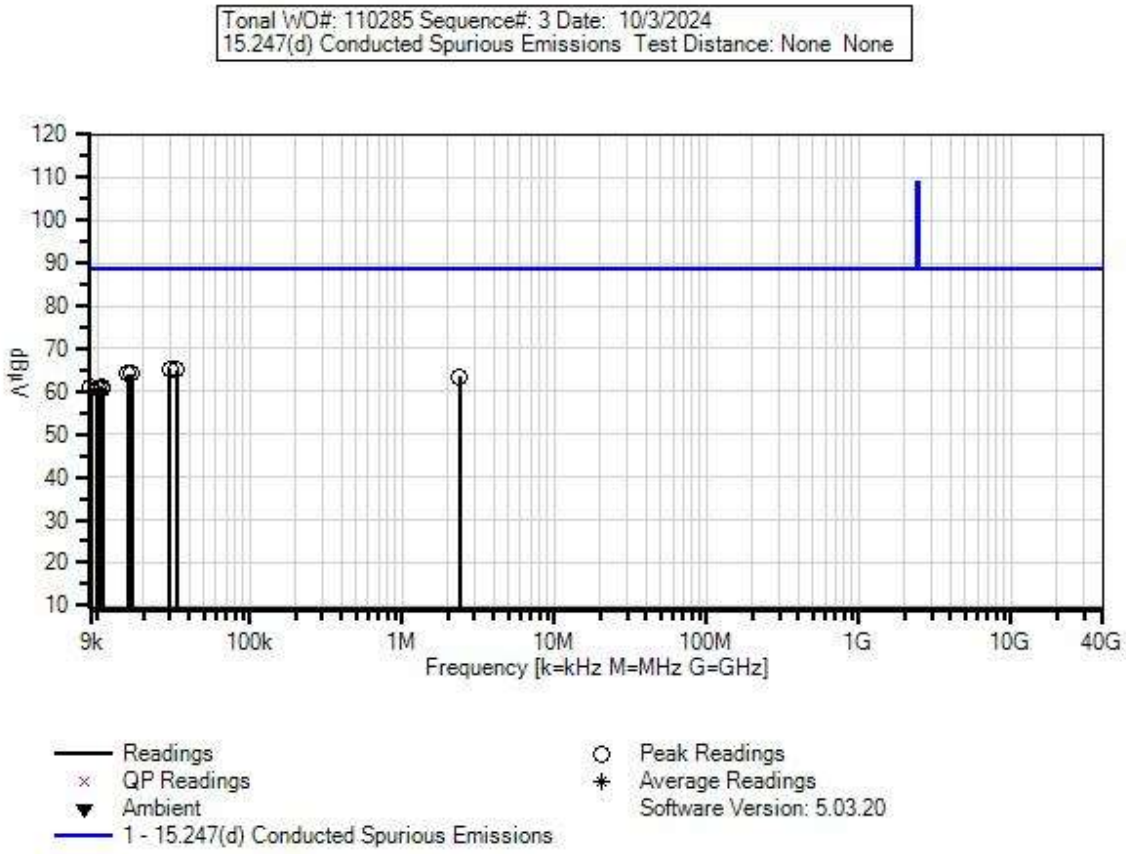
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
1MHz OBW



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	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	30.089k	55.5	+9.8	+0.0			+0.0	65.3	88.9	-23.6	None
2	33.412k	55.3	+9.8	+0.0			+0.0	65.1	88.9	-23.8	None
3	16.916k	54.2	+9.9	+0.1			+0.0	64.2	88.9	-24.7	None
4	15.860k	54.1	+9.9	+0.1			+0.0	64.1	88.9	-24.8	None
5	2.390M	53.5	+9.9	+0.0			+0.0	63.4	88.9	-25.5	None
6	10.670k	51.4	+9.8	+0.1			+0.0	61.3	88.9	-27.6	None
7	9.020k	51.0	+9.8	+0.1			+0.0	60.9	88.9	-28.0	None
8	10.010k	50.9	+9.8	+0.1			+0.0	60.8	88.9	-28.1	None
9	10.824k	50.9	+9.8	+0.1			+0.0	60.8	88.9	-28.1	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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	4:49:07 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	7
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:

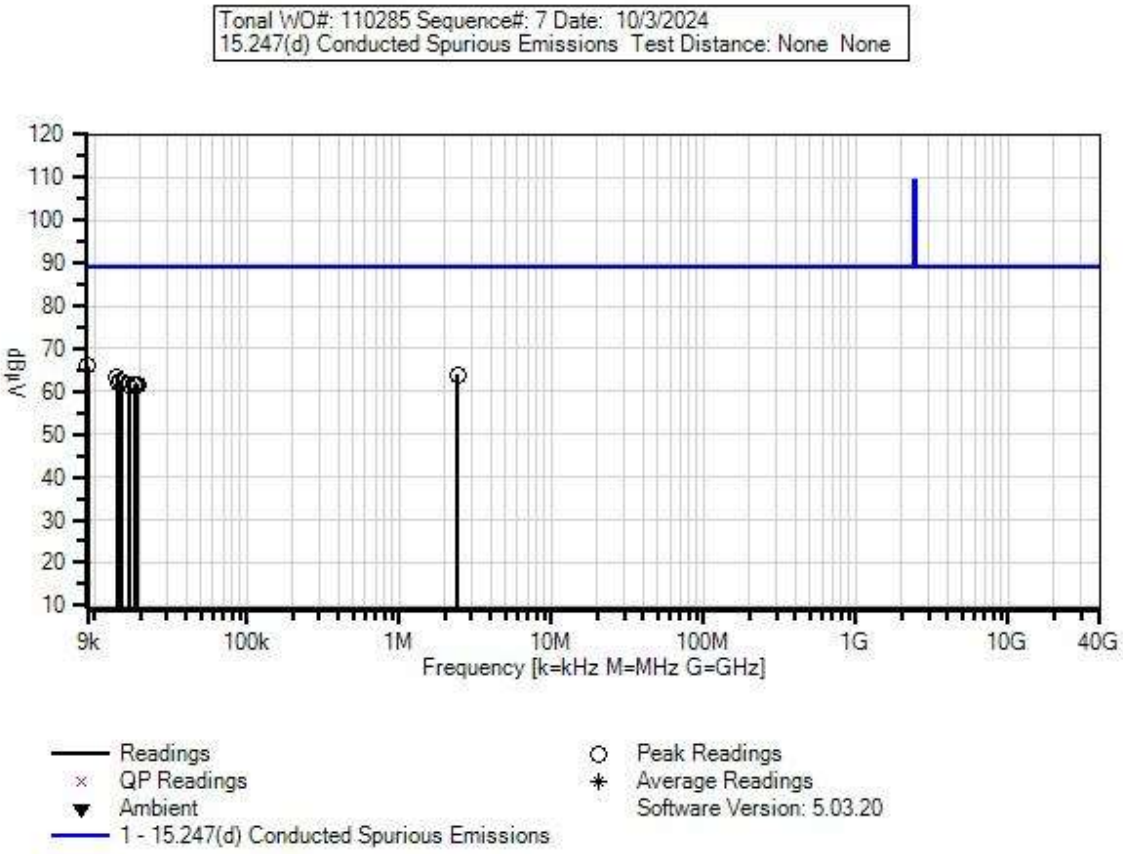
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
2MHz OBW



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	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.086k	56.1	+9.8	+0.1			+0.0	66.0	89.1	-23.1	None
2	2.424M	54.0	+9.9	+0.0			+0.0	63.9	89.1	-25.2	None
3	14.057k	53.4	+9.9	+0.1			+0.0	63.4	89.1	-25.7	None
4	14.892k	52.5	+9.9	+0.1			+0.0	62.5	89.1	-26.6	None
5	14.431k	51.9	+9.9	+0.1			+0.0	61.9	89.1	-27.2	None
6	16.740k	51.7	+9.9	+0.1			+0.0	61.7	89.1	-27.4	None
7	19.137k	51.7	+9.9	+0.1			+0.0	61.7	89.1	-27.4	None
8	18.477k	51.6	+9.9	+0.1			+0.0	61.6	89.1	-27.5	None
9	18.653k	51.6	+9.9	+0.1			+0.0	61.6	89.1	-27.5	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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	4:15:58 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	4
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:

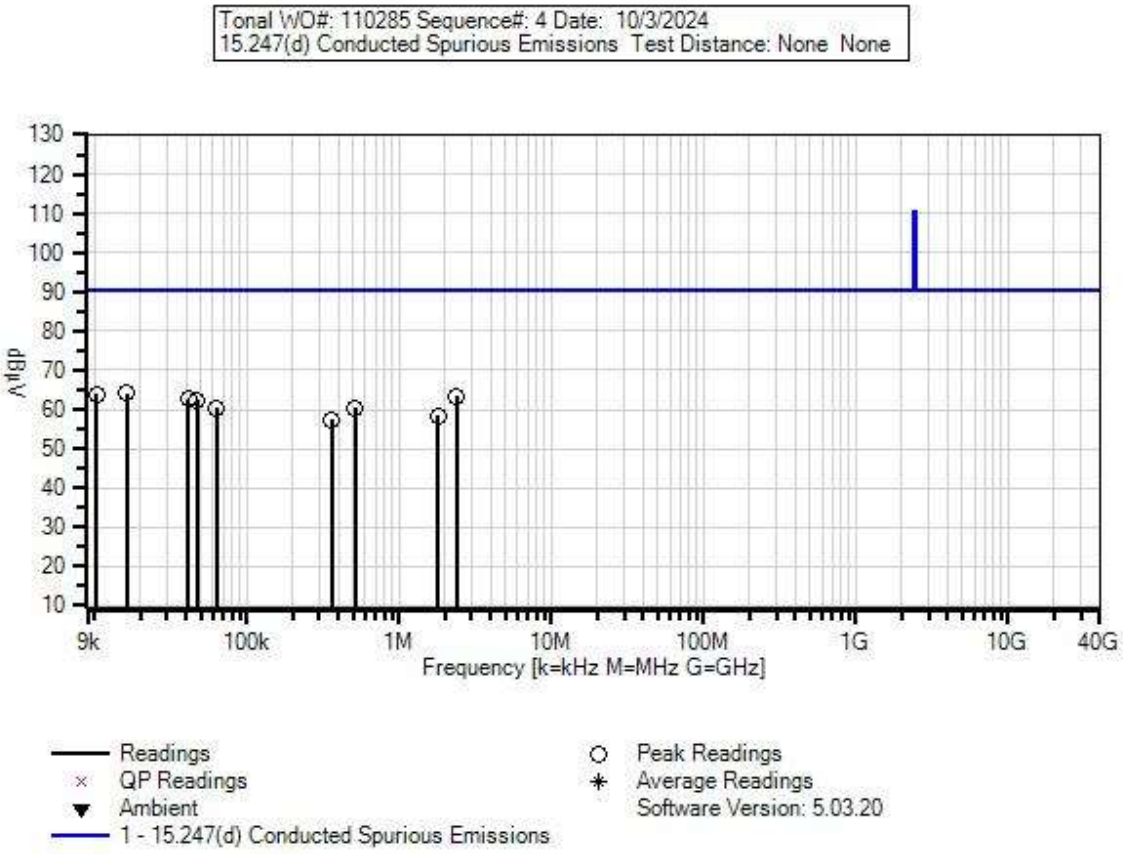
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
2MHz OBW



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	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	16.234k	54.1	+9.9	+0.1			+0.0	64.1	90.5	-26.4	None
2	10.297k	53.9	+9.8	+0.1			+0.0	63.8	90.5	-26.7	None
3	2.384M	53.4	+9.9	+0.0			+0.0	63.3	90.5	-27.2	None
4	41.666k	52.7	+9.9	+0.0			+0.0	62.6	90.5	-27.9	None
5	47.193k	52.4	+9.9	+0.0			+0.0	62.3	90.5	-28.2	None
6	63.700k	50.6	+9.8	+0.0			+0.0	60.4	90.5	-30.1	None
7	518.240k	50.4	+9.9	+0.0			+0.0	60.3	90.5	-30.2	None
8	1.815M	48.4	+9.9	+0.0			+0.0	58.3	90.5	-32.2	None
9	362.990k	47.6	+9.8	+0.0			+0.0	57.4	90.5	-33.1	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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	3:46:35 PM
Tested By:	Hieu Song Nguyenpham	Sequence#:	2
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:

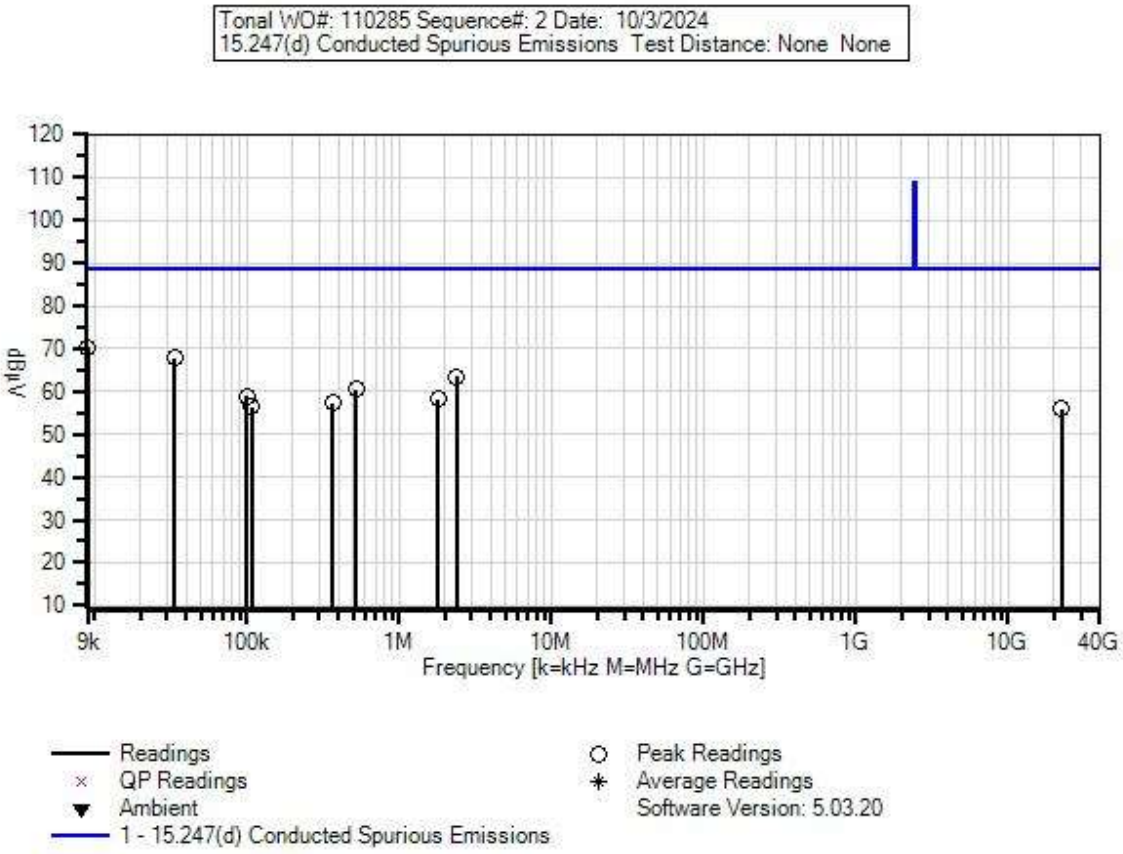
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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
2MHz OBW



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

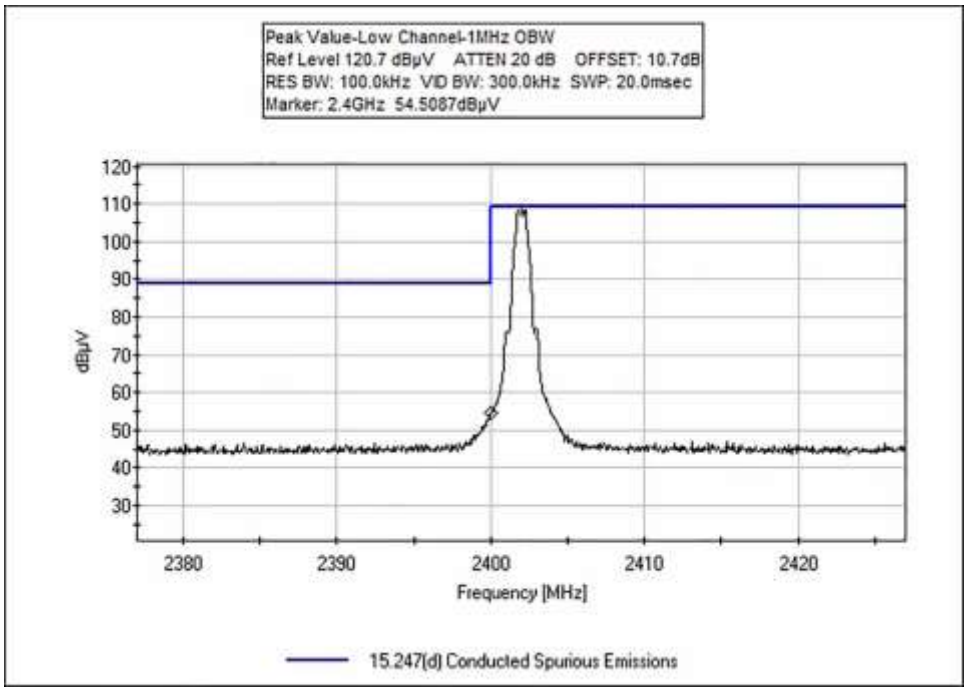
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.131k	60.4	+9.8	+0.1			+0.0	70.3	88.9	-18.6	None
2	33.488k	57.9	+9.8	+0.0			+0.0	67.7	88.9	-21.2	None
3	2.390M	53.6	+9.9	+0.0			+0.0	63.5	88.9	-25.4	None
4	525.422k	50.6	+9.9	+0.0			+0.0	60.5	88.9	-28.4	None
5	99.893k	49.1	+9.9	+0.0			+0.0	59.0	88.9	-29.9	None
6	1.815M	48.3	+9.9	+0.0			+0.0	58.2	88.9	-30.7	None
7	364.555k	47.4	+9.8	+0.0			+0.0	57.2	88.9	-31.7	None
8	107.749k	46.7	+9.8	+0.0			+0.0	56.5	88.9	-32.4	None
9	22411.676 M	43.2	+10.1	+2.6			+0.0	55.9	88.9	-33.0	None

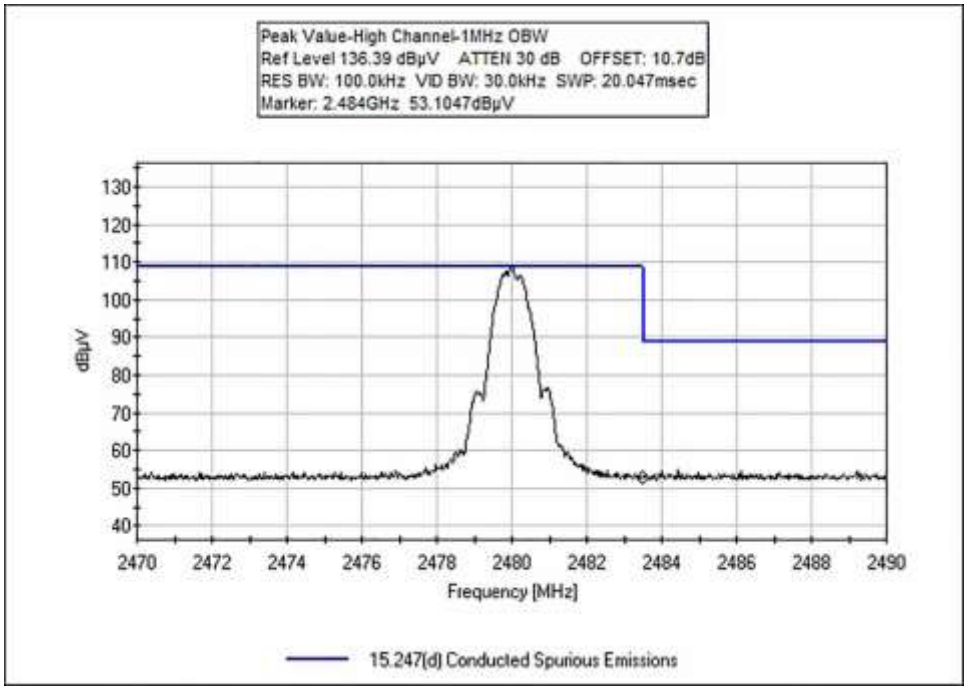
Band Edge

Band Edge Summary					
Limit applied: Max Power/100kHz - 20dB.					
Frequency (MHz)	**OBW (MHz)**	**Modulation**	**Measured (dBuV)**	**Limit (dBuV)**	**Results**
2400	1	GFSK	53.8	<89.1	Pass
2483.5	1	GFSK	53.1	<88.9	Pass
2400	2	GFSK	61.9	<89.1	Pass
2483.5	2	GFSK	51.4	<88.9	Pass

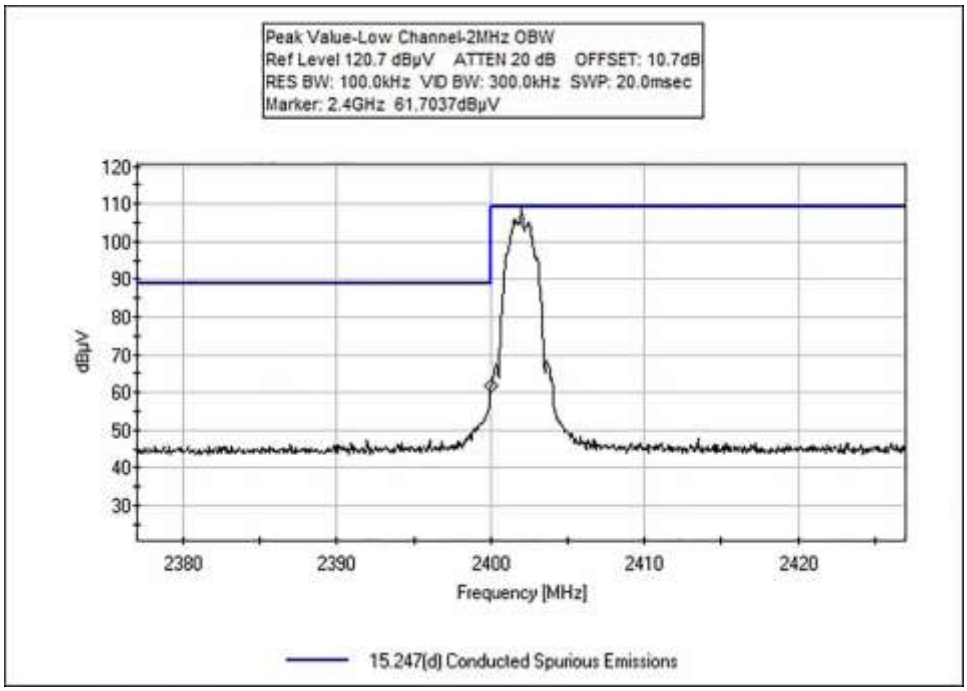
Band Edge Plots

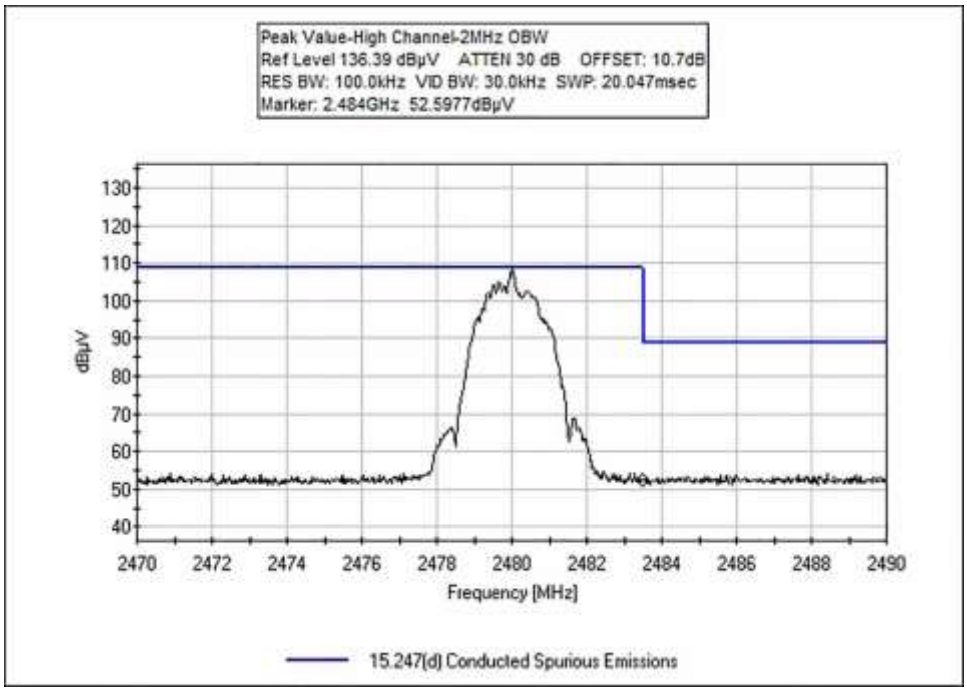
1MHz





2MHz


Peak Value-Low Channel-2MHz OBW
Ref Level 120.7 dBµV ATTEN 20 dB OFFSET: 10.7dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.4GHz 61.7037dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2380
2390
2400
2410
2420
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value-High Channel-2MHz OBW
Ref Level 136.39 dBµV ATTEN 30 dB OFFSET: 10.7dB
RES BW: 100.0kHz VID BW: 30.0kHz SWP: 20.047msec
Marker: 2.484GHz 52.5977dBµV
dBµV
130
120
110
100
90
80
70
60
50
40
2470
2472
2474
2476
2478
2480
2482
2484
2486
2488
2490
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

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:	10/3/2024
Test Type:	**Conducted Scan**	Time:	16:37:17
Tested By:	Hieu Song Nguyenpham	Sequence#:	1
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: 2.48GHz
Test Method: ANSI C63.10 (2020)

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 level = +4dBm

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	53.1					+0.0	53.1	88.9 1MHz OBW	-35.8	None
2	2483.500M	51.4					+0.0	51.4	88.9 2MHz OBW	-37.5	None
3	2400.000M	61.4					+0.0	61.4	89.1 2MHz OBW	-27.7	None
4	2400.000M	53.8					+0.0	53.8	89.1 1MHz OBW	-35.3	None

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.247(d) Radiated Emissions & Band Edge

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 558074	Test Date(s):	10/22/2024 and 11/01/2024
Configuration:	1		
Note	Perform Radiated Emission on the worst case based on the investigation on RF output power for the band edge before measuring Radiated Spurious Emission.		

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: 18:12:18
Tested By: Hieu Song Nguyenpham Sequence#: 161
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
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, LE2Mbps with pattern of 0s and 1s at power level 9 (+4dBm).2442MHz-Middle Channel

Operational mode is representative of worst case.

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

Modification #1 was in place during testing.

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	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	311.943M	52.5	-31.9 +0.6	+19.4	+1.8	+0.5	+0.0	42.9	46.0	-3.1	Horiz
2	360.052M	49.9	-31.9 +0.7	+20.5	+1.9	+0.6	+0.0	41.7	46.0	-4.3	Horiz
3	503.752M	45.2	-32.0 +0.8	+24.5	+2.3	+0.7	+0.0	41.5	46.0	-4.5	Horiz
4	407.918M	43.4	-31.9 +0.7	+22.2	+2.0	+0.7	+0.0	37.1	46.0	-8.9	Vert
5	886.739M	33.1	-31.5 +1.2	+29.2	+3.3	+1.0	+0.0	36.3	46.0	-9.7	Vert
6	455.879M	41.1	-32.0 +0.8	+23.4	+2.2	+0.7	+0.0	36.2	46.0	-9.8	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:	14:23:38
Tested By:	Hieu Song Nguyenpham	Sequence#:	119
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

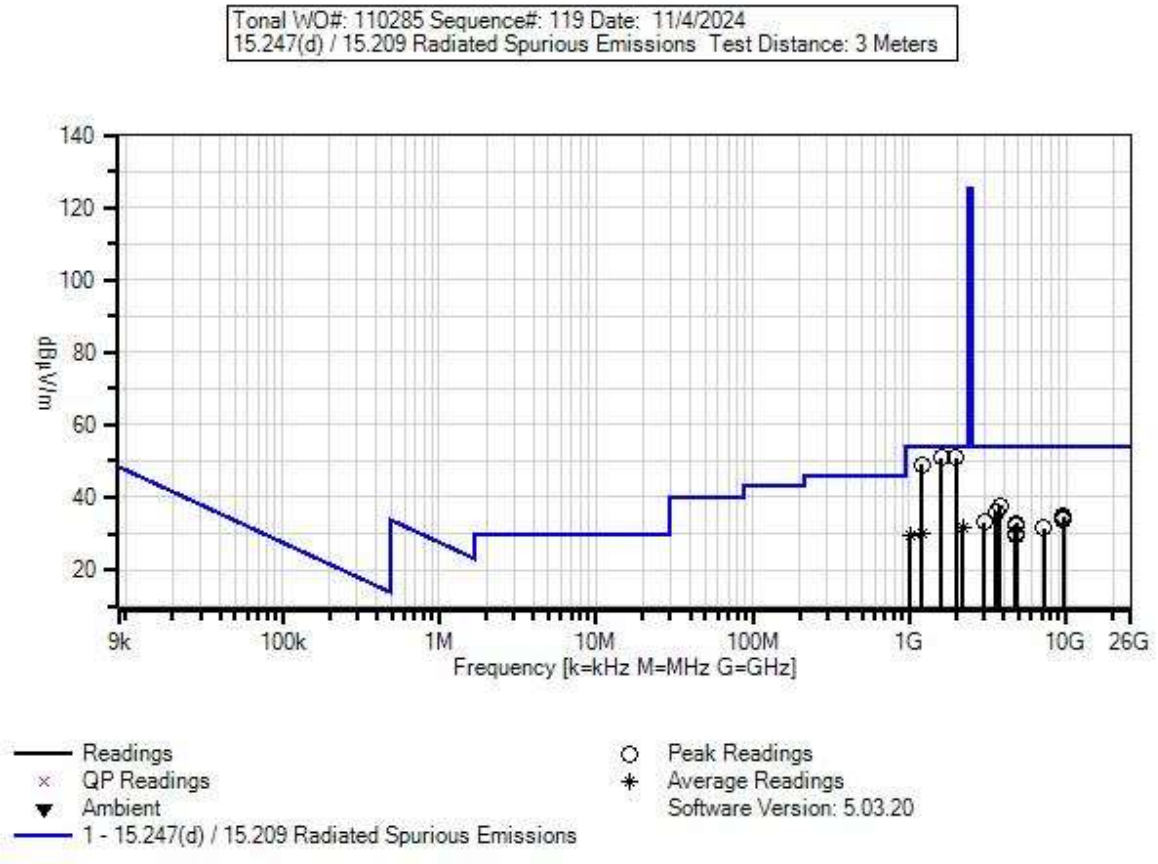
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, LE2Mbps with pattern of 0s and 1s at power level 9 (+4dBm).
Operational mode is representative of worst case.

Low Channel

Modification #1 was in place during testing.



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

	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 T5	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1994.000M	45.6	+28.2 +0.8	+1.3 +0.0	+2.3 +0.0	-27.4 +0.0	+0.0	50.8	54.0	-3.2	Vert
2	1594.000M	49.0	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	50.8	54.0	-3.2	Horiz
3	1195.000M	49.5	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	49.0	54.0	-5.0	Horiz
4	3782.000M	59.5	+32.0 +1.0	+1.7 -34.2	+3.2 +0.3	-26.6 +0.7	+0.0	37.6	54.0	-16.4	Vert
5	3595.000M	58.6	+31.7 +1.0	+1.7 -34.4	+3.2 +0.5	-26.8 +0.7	+0.0	36.2	54.0	-17.8	Vert
6	9609.010M	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
7	9607.270M	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
8	9602.000M	44.4	+39.3 +1.6	+3.0 -33.6	+5.9 +0.2	-28.2 +1.3	+0.0	33.9	54.0	-20.1	Horiz
9	2996.800M	57.7	+30.1 +0.9	+1.5 -34.6	+2.8 +0.7	-26.7 +0.6	+0.0	33.0	54.0	-21.0	Horiz
10	4799.870M	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
11	4790.200M	51.6	+33.3 +1.1	+2.0 -34.1	+3.6 +0.3	-26.4 +0.8	+0.0	32.2	54.0	-21.8	Vert
12	2192.800M Ave	26.3	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	31.8	54.0	-22.2	Vert
^	2192.800M	54.5	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	60.0	54.0	+6.0	Vert
14	7205.880M	45.3	+36.0 +1.5	+2.5 -34.4	+4.5 +0.2	-25.6 +1.4	+0.0	31.4	54.0	-22.6	Vert
15	7200.000M	45.3	+36.0 +1.5	+2.5 -34.3	+4.4 +0.2	-25.6 +1.4	+0.0	31.4	54.0	-22.6	Vert
16	4804.150M	49.3	+33.4 +1.1	+2.0 -34.1	+3.6 +0.3	-26.4 +0.8	+0.0	30.0	54.0	-24.0	Horiz
17	1197.400M Ave	30.4	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	29.9	54.0	-24.1	Vert
^	1197.400M	54.9	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	54.4	54.0	+0.4	Vert
19	4803.060M	49.0	+33.4 +1.1	+2.0 -34.1	+3.6 +0.3	-26.4 +0.8	+0.0	29.7	54.0	-24.3	Vert
20	1009.000M Ave	30.7	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	29.4	54.0	-24.6	Horiz
^	1009.000M	52.6	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.7 +0.0	+0.0	51.3	54.0	-2.7	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:	14:11:50
Tested By:	Hieu Song Nguyenpham	Sequence#:	120
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

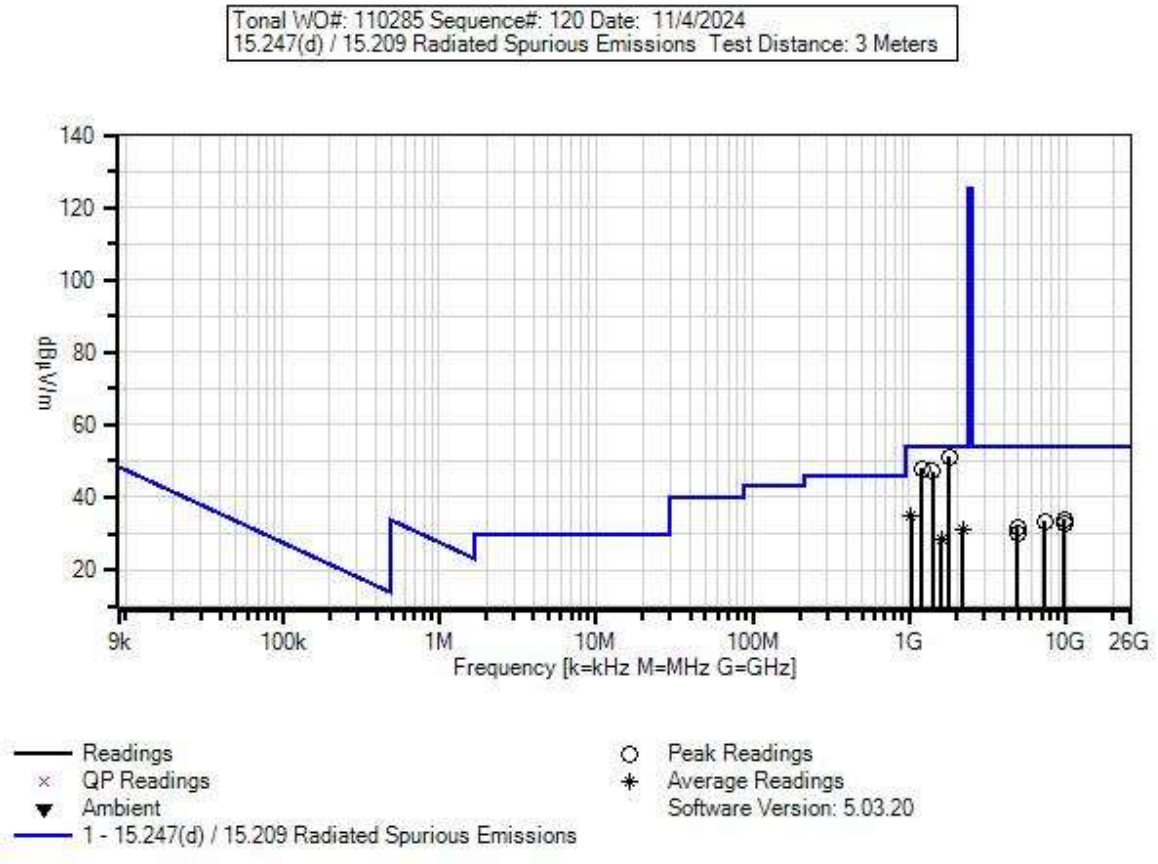
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, LE2Mbps with pattern of 0s and 1s at power level 9 (+4dBm).
Operational mode is representative of worst case.

Middle Channel

Modification #1 was in place during testing.



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

	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
			T5	T6	T7	T8					
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1798.000M	47.7	+27.2	+1.2	+2.2	-27.7	+0.0	51.3	54.0	-2.7	Vert
			+0.7	+0.0	+0.0	+0.0					
2	1197.400M	48.4	+24.8	+0.9	+1.7	-28.5	+0.0	47.9	54.0	-6.1	Horiz
			+0.6	+0.0	+0.0	+0.0					
3	1400.400M	46.6	+25.3	+1.0	+1.9	-28.2	+0.0	47.2	54.0	-6.8	Horiz
			+0.6	+0.0	+0.0	+0.0					
4	1025.500M	35.9	+24.3	+1.0	+1.6	-28.7	+0.0	34.7	54.0	-19.3	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1025.500M	57.0	+24.3	+1.0	+1.6	-28.7	+0.0	55.8	54.0	+1.8	Vert
			+0.6	+0.0	+0.0	+0.0					
6	9768.130M	44.2	+39.5	+3.0	+5.9	-28.4	+0.0	33.8	54.0	-20.2	Vert
			+1.6	-33.5	+0.2	+1.3					
7	7326.070M	46.8	+36.3	+2.6	+4.6	-25.6	+0.0	33.4	54.0	-20.6	Vert
			+1.5	-34.5	+0.2	+1.5					
8	9768.130M	43.3	+39.5	+3.0	+5.9	-28.4	+0.0	32.9	54.0	-21.1	Horiz
			+1.6	-33.5	+0.2	+1.3					
9	4882.970M	50.8	+33.6	+2.0	+3.6	-26.4	+0.0	31.8	54.0	-22.2	Vert
			+1.1	-34.0	+0.2	+0.9					
10	2198.400M	25.5	+28.2	+1.3	+2.4	-27.2	+0.0	31.0	54.0	-23.0	Horiz
	Ave		+0.8	+0.0	+0.0	+0.0					
^	2198.400M	51.8	+28.2	+1.3	+2.4	-27.2	+0.0	57.3	54.0	+3.3	Horiz
			+0.8	+0.0	+0.0	+0.0					
12	4883.080M	49.2	+33.6	+2.0	+3.6	-26.4	+0.0	30.2	54.0	-23.8	Horiz
			+1.1	-34.0	+0.2	+0.9					
13	1595.500M	26.7	+26.1	+1.1	+2.0	-28.0	+0.0	28.5	54.0	-25.5	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1595.500M	53.9	+26.1	+1.1	+2.0	-28.0	+0.0	55.7	54.0	+1.7	Vert
			+0.6	+0.0	+0.0	+0.0					

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:	13:47:34
Tested By:	Hieu Song Nguyenpham	Sequence#:	121
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

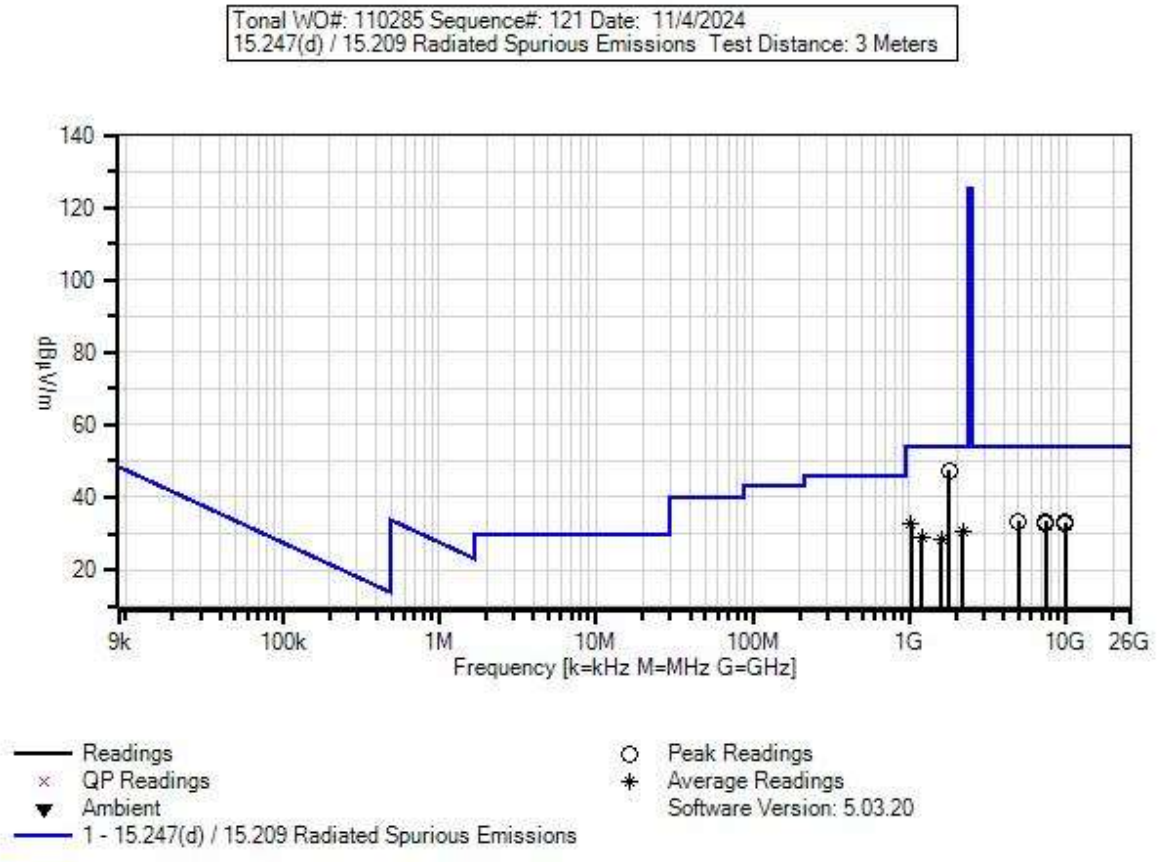
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, LE2Mbps with pattern of 0s and 1s at power level 9 (+4dBm).
Operational mode is representative of worst case.

High Channel

Modification #1 was in place during testing.



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

	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
			T5	T6	T7	T8					
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1795.200M	43.8	+27.2	+1.2	+2.1	-27.7	+0.0	47.3	54.0	-6.7	Horiz
			+0.7	+0.0	+0.0	+0.0					
2	7440.210M	46.7	+36.6	+2.6	+4.6	-25.7	+0.0	33.4	54.0	-20.6	Vert
			+1.5	-34.6	+0.2	+1.5					
3	4961.010M	52.0	+33.8	+2.0	+3.6	-26.4	+0.0	33.3	54.0	-20.7	Vert
			+1.2	-34.0	+0.2	+0.9					
4	9919.360M	43.5	+39.6	+3.0	+5.8	-28.6	+0.0	33.0	54.0	-21.0	Horiz
			+1.7	-33.5	+0.2	+1.3					
5	7439.360M	46.2	+36.6	+2.6	+4.6	-25.7	+0.0	32.9	54.0	-21.1	Horiz
			+1.5	-34.6	+0.2	+1.5					
6	1025.200M	34.1	+24.3	+1.0	+1.6	-28.7	+0.0	32.9	54.0	-21.1	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1025.200M	54.8	+24.3	+1.0	+1.6	-28.7	+0.0	53.6	54.0	-0.4	Vert
			+0.6	+0.0	+0.0	+0.0					
8	9920.210M	43.2	+39.6	+3.0	+5.8	-28.6	+0.0	32.7	54.0	-21.3	Vert
			+1.7	-33.5	+0.2	+1.3					
9	2197.000M	25.3	+28.2	+1.3	+2.4	-27.2	+0.0	30.8	54.0	-23.2	Horiz
	Ave		+0.8	+0.0	+0.0	+0.0					
^	2197.000M	51.4	+28.2	+1.3	+2.4	-27.2	+0.0	56.9	54.0	+2.9	Horiz
			+0.8	+0.0	+0.0	+0.0					
11	1198.800M	29.7	+24.8	+0.9	+1.7	-28.5	+0.0	29.2	54.0	-24.8	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1198.800M	53.8	+24.8	+0.9	+1.7	-28.5	+0.0	53.3	54.0	-0.7	Vert
			+0.6	+0.0	+0.0	+0.0					
13	1597.810M	26.8	+26.1	+1.1	+2.0	-28.0	+0.0	28.6	54.0	-25.4	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1597.810M	53.8	+26.1	+1.1	+2.0	-28.0	+0.0	55.6	54.0	+1.6	Vert
			+0.6	+0.0	+0.0	+0.0					

Band Edge

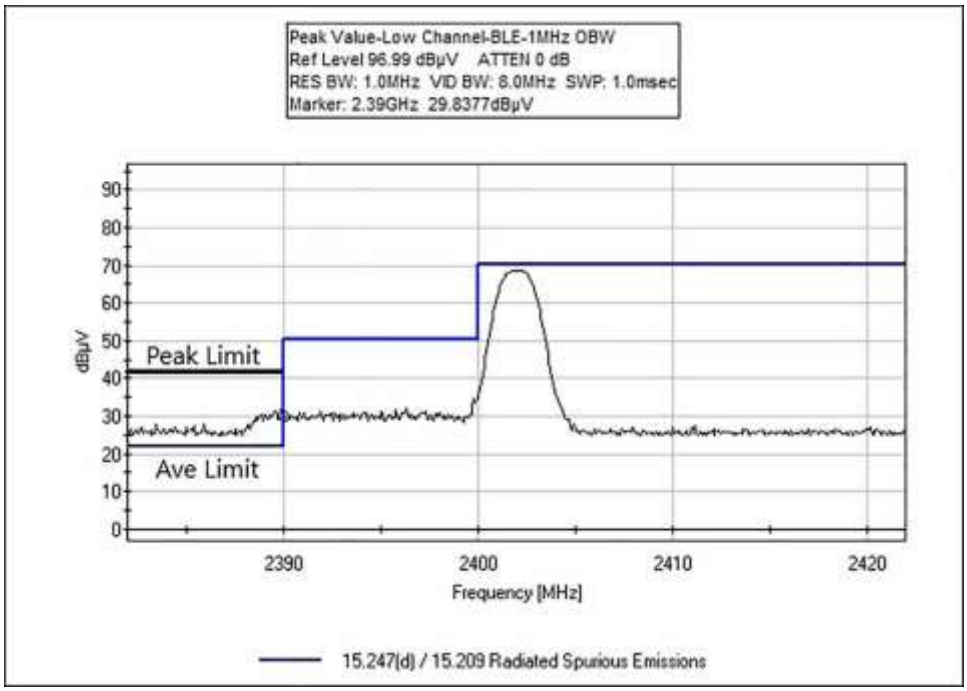
Band Edge Summary								
Limit applied at restricted bands: 15.209 Limit applied for other than restricted bands: Max Power/100kHz - 20dB.								
Frequency (MHz)	**OBW (MHz)**	**Modulation**	**Ant. Type / Gain (dBi)**	**Average (dBuV/m @3m)**		**Peak (dBuV/m @3m)**		**Results**
				Measured	**Limit**	**Measured**	**Limit**	
2390.0	1	GFSK	External/3.67	45.2	≤54	61.9	≤74	Pass
2400.0	1	GFSK	External/3.67	NA2	NA2	50.3	≤80.5	Pass
2483.5	1	GFSK	External/3.67	45.5	≤54	59.3	≤74	Pass
2390.0	2	GFSK	External/3.67	45.3	≤54	60.5	≤74	Pass
2400.0	2	GFSK	External/3.67	NA2	NA2	54.7	≤80.5	Pass
2483.5	2	GFSK	External/3.67	45.6	≤54	59.3	≤74	Pass

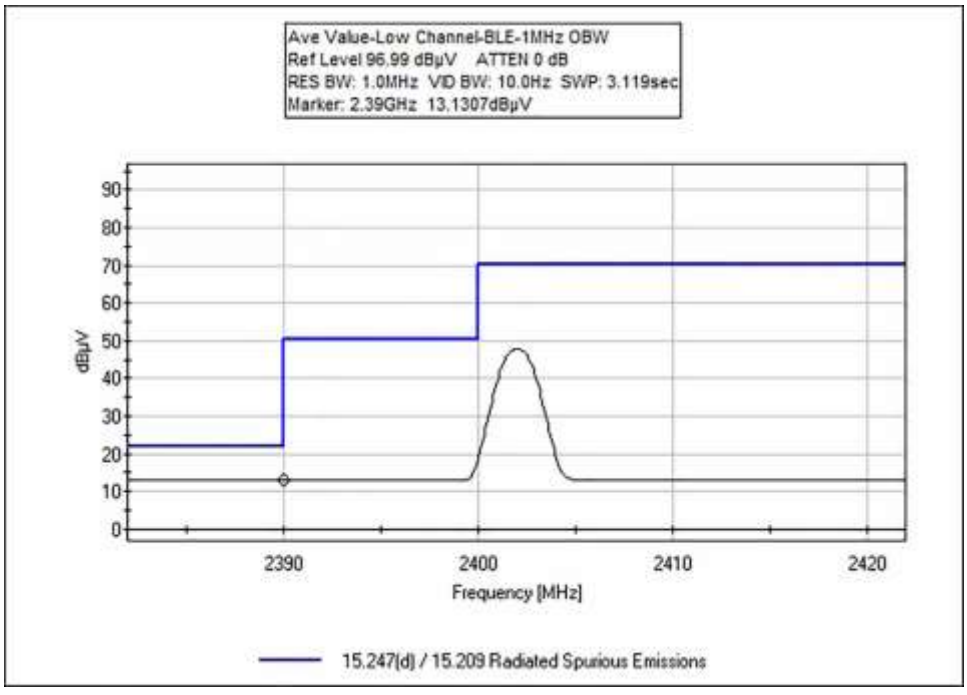
Notes:

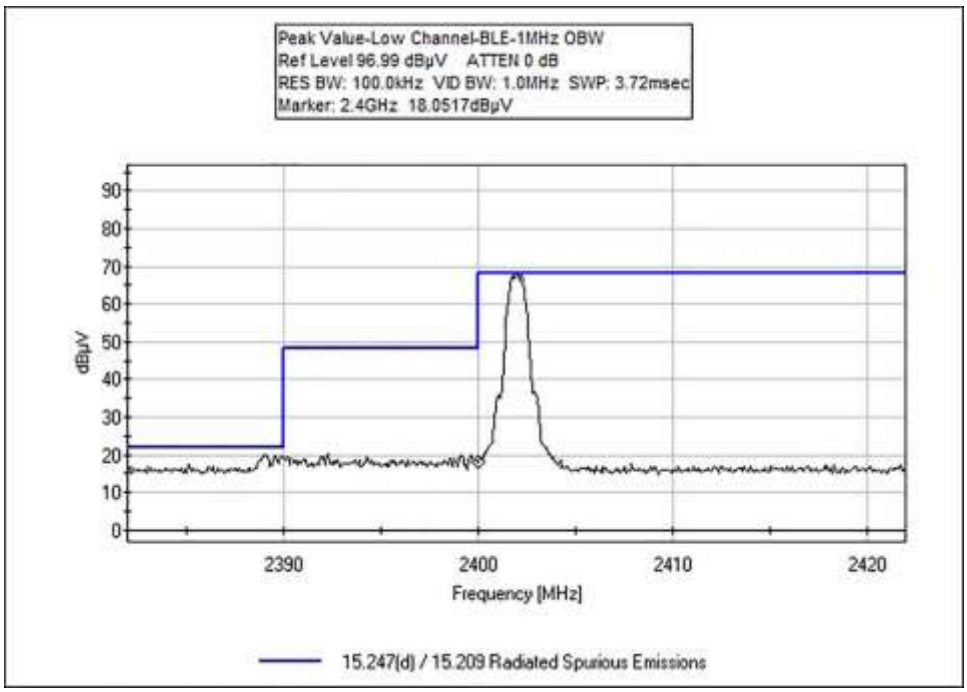
NA2	Average limit not applicable when applying 20dBc limit.

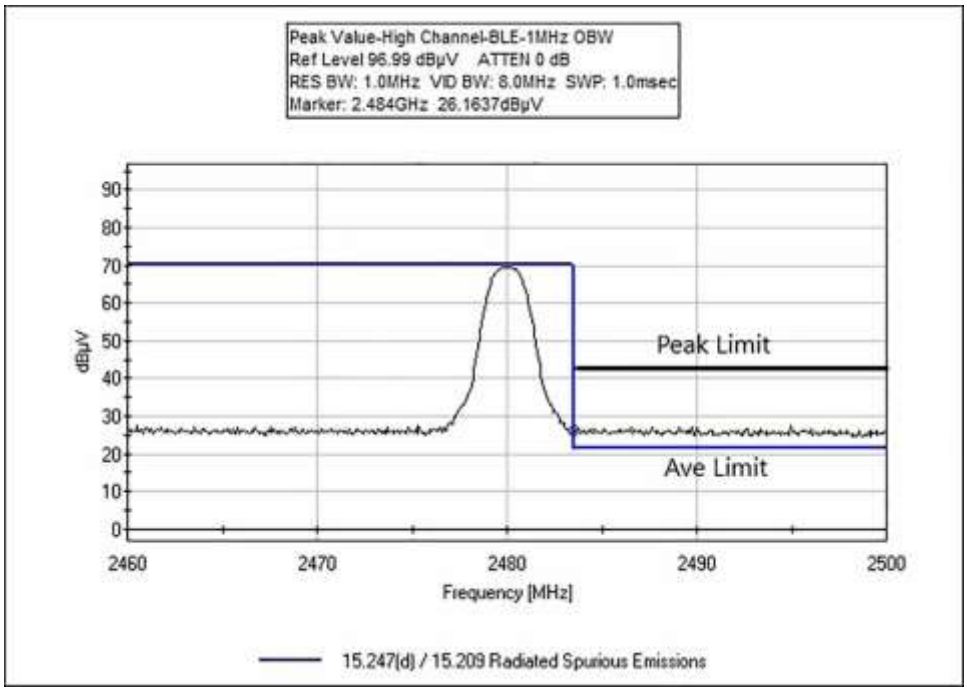
Band Edge Plots

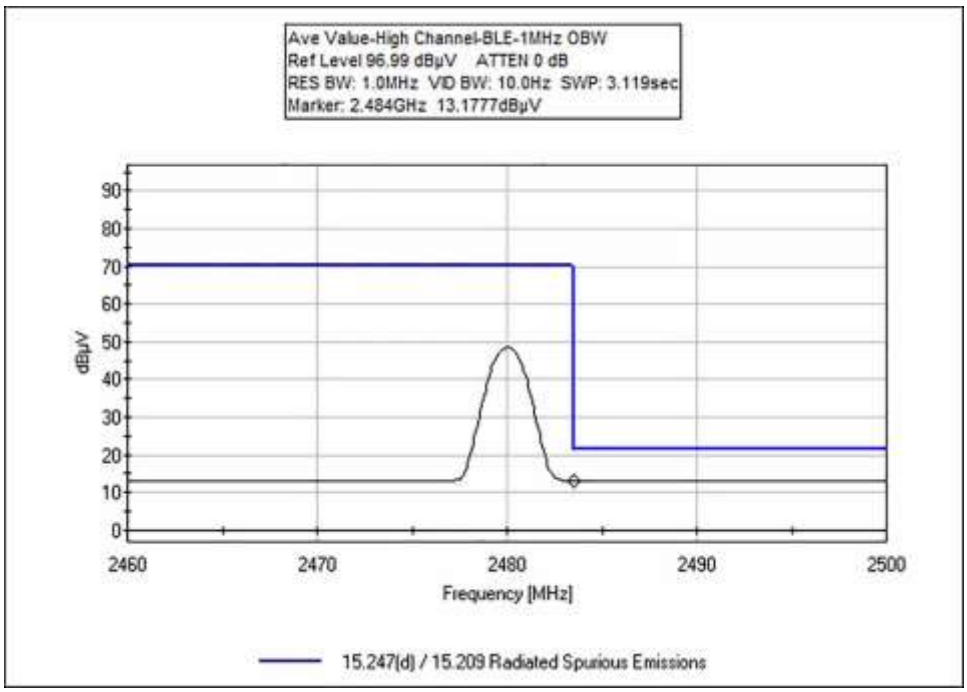
1MHz



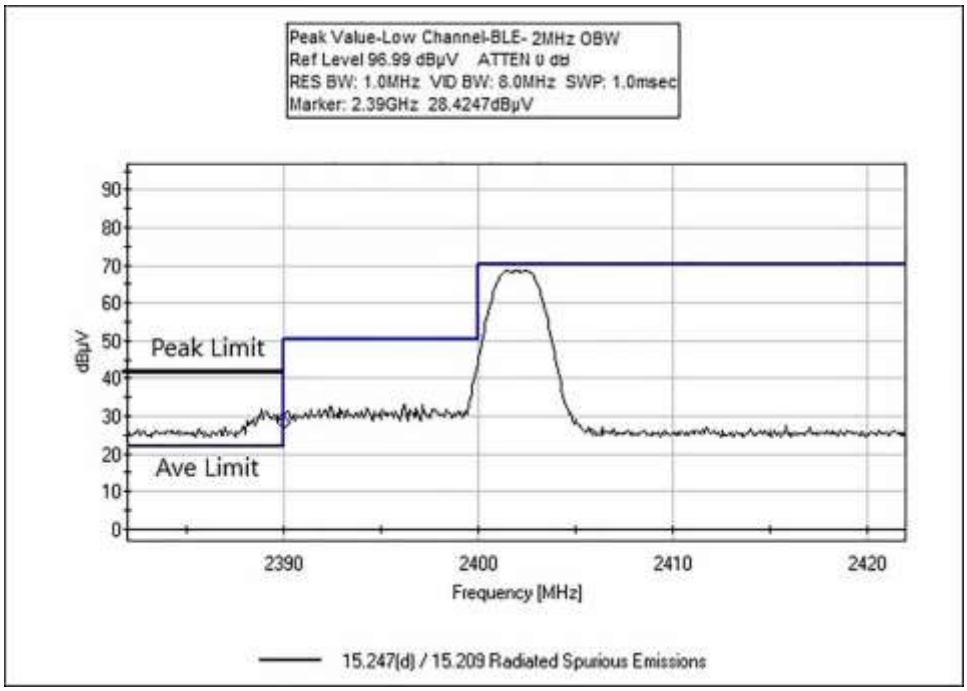


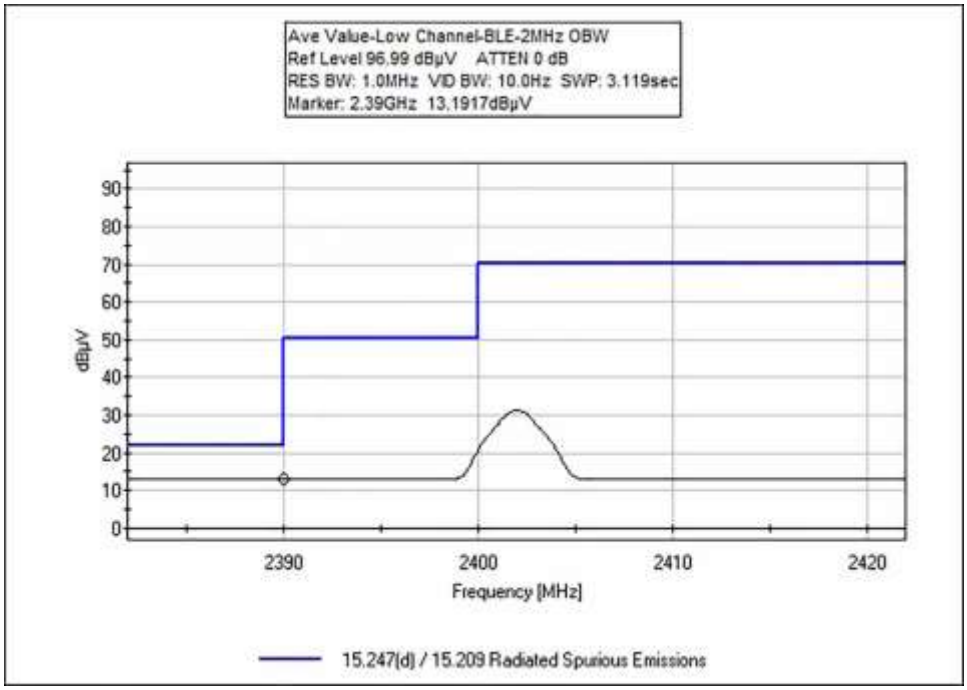

Peak Value-Low Channel-BLE-1MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 3.72msec
Marker: 2.4GHz 18.0517dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

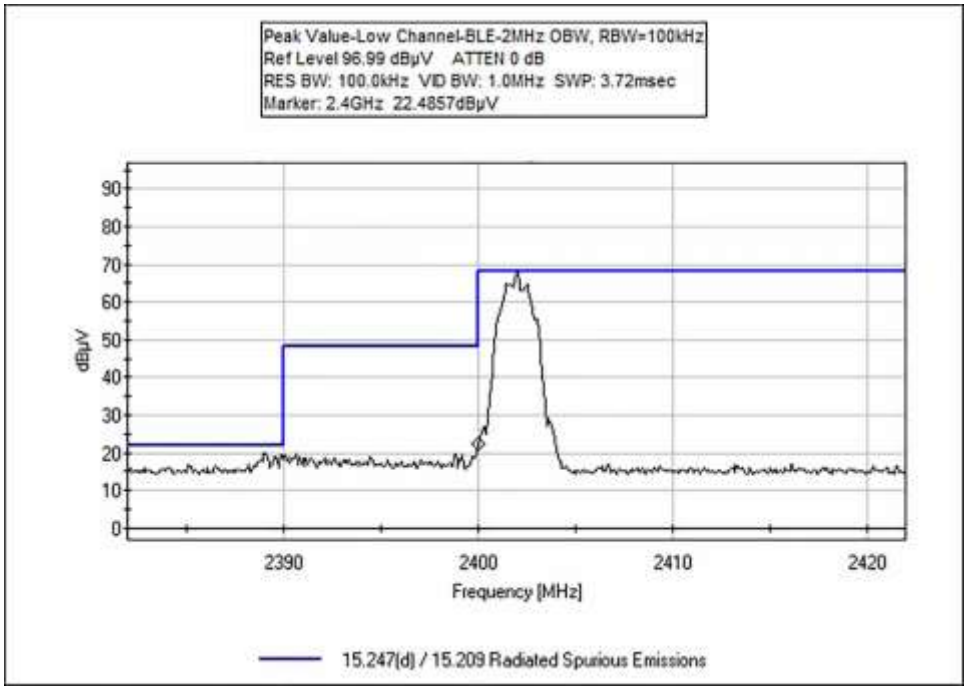

Peak Value-High Channel-BLE-1MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.484GHz 26.1637dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
Peak Limit
Ave Limit
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

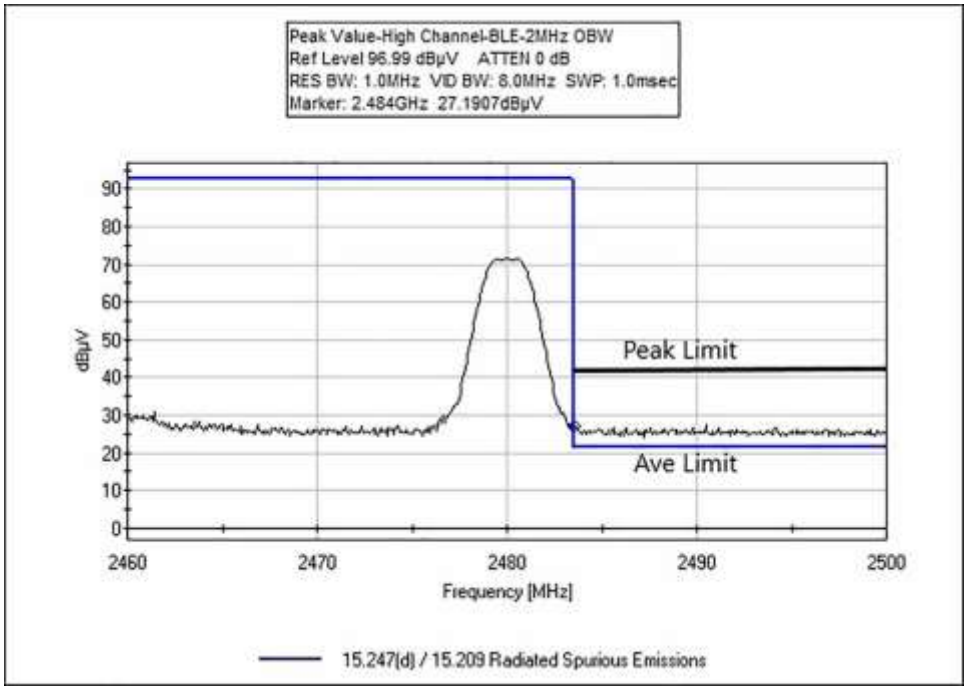

Ave Value-High Channel-BLE-1MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.484GHz 13.1777dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

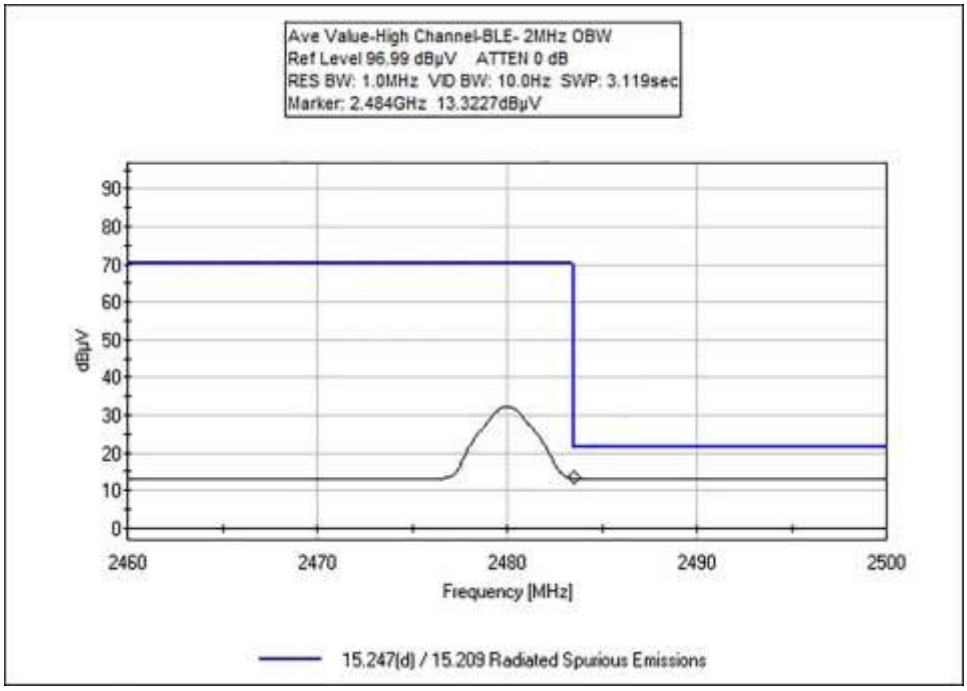
2MHz


Peak Value-Low Channel-BLE- 2MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.39GHz 28.4247dBµV
dBµV
Peak Limit
Ave Limit
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-Low Channel-BLE-2MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.39GHz 13.1917dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value-Low Channel-BLE-2MHz OBW, RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 3.72msec
Marker: 2.4GHz 22.4857dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value-High Channel-BLE-2MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.484GHz 27.1907dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
Peak Limit
Ave Limit
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-High Channel-BLE- 2MHz OBW
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.484GHz 13.3227dBµV
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

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:	15:36:32
Tested By:	Hieu Song Nguyenpham	Sequence#:	11
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: 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.

Test Equipment:

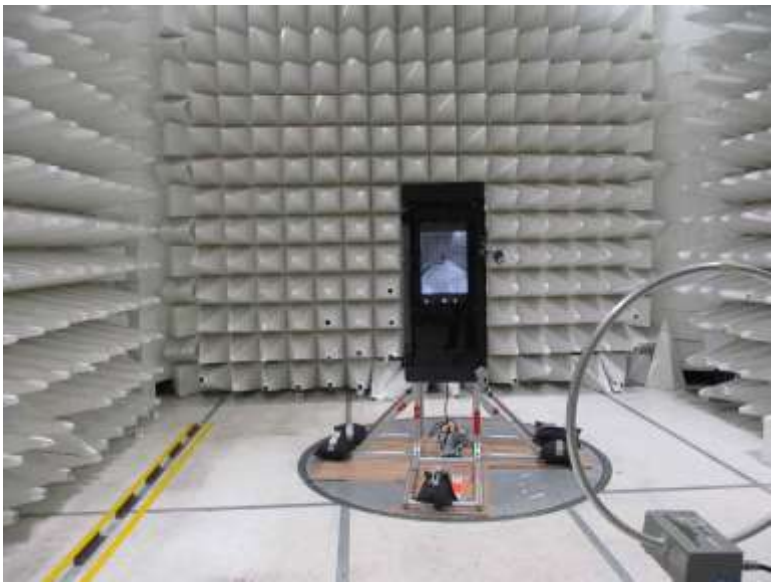
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

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	29.8	+28.3	+1.3	+2.5		+0.0	61.9	54.0 1MHz OBW	+7.9	Vert
2	2390.000M Ave	13.1	+28.3	+1.3	+2.5		+0.0	45.2	54.0 1MHz OBW	-8.8	Vert
3	2400.000M	18.1	+28.3	+1.4	+2.5		+0.0	50.3	80.5 1MHz OBW, RBW=100kHz	-30.2	Vert
4	2483.500M	26.2	+28.3	+1.4	+2.6		+0.0	58.5	54.0 1MHz OBW	+4.5	Vert
5	2483.500M Ave	13.2	+28.3	+1.4	+2.6		+0.0	45.5	54.0 1MHz OBW	-8.5	Vert
6	2483.500M	27.0	+28.3	+1.4	+2.6		+0.0	59.3	54.0 2MHz OBW	+5.3	Vert
7	2483.500M	13.3	+28.3	+1.4	+2.6		+0.0	45.6	54.0 2MHz OBW	-8.4	Vert
8	2390.000M	28.4	+28.3	+1.3	+2.5		+0.0	60.5	54.0 2MHz OBW	+6.5	Vert
9	2390.000M	13.2	+28.3	+1.3	+2.5		+0.0	45.3	54.0 2MHz OBW	-8.7	Vert
10	2400.000M	22.5	+28.3	+1.4	+2.5		+0.0	54.7	80.5 2MHz OBW, RBW=100kHz	-25.8	Vert

Test Setup Photo(s)

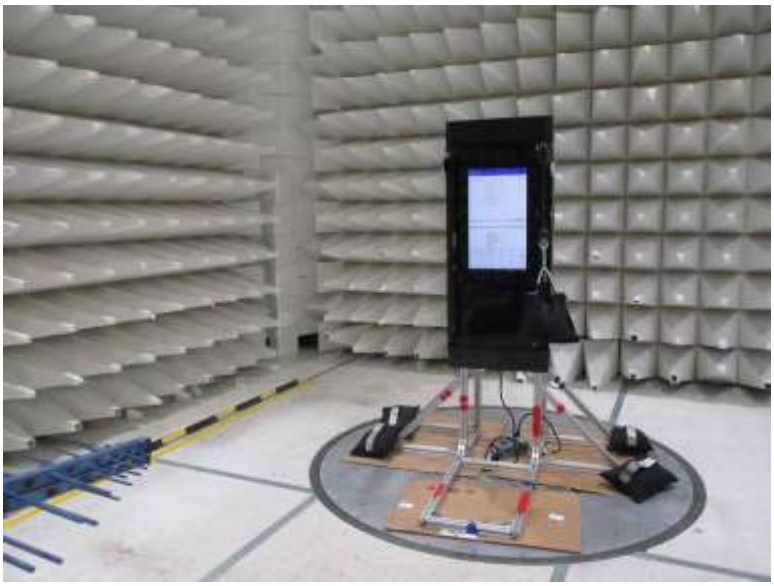
9kHz-1GHz



Front View

Back View

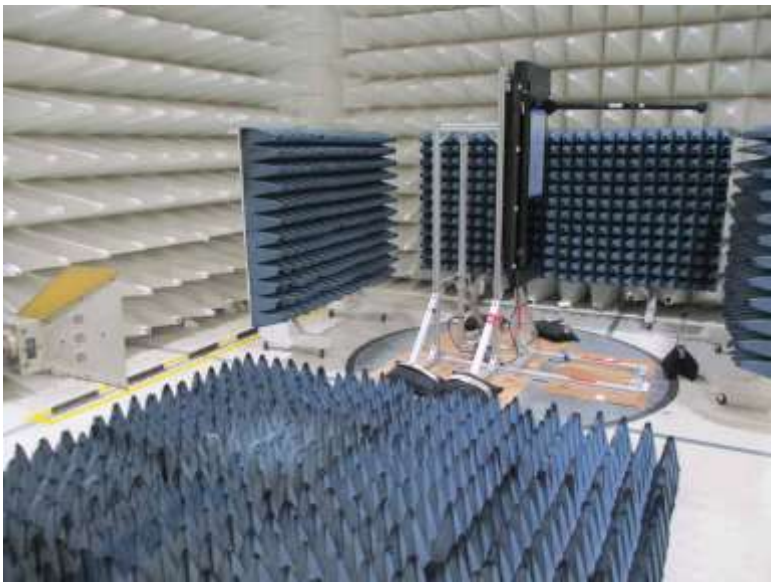
30MHz-1GHz



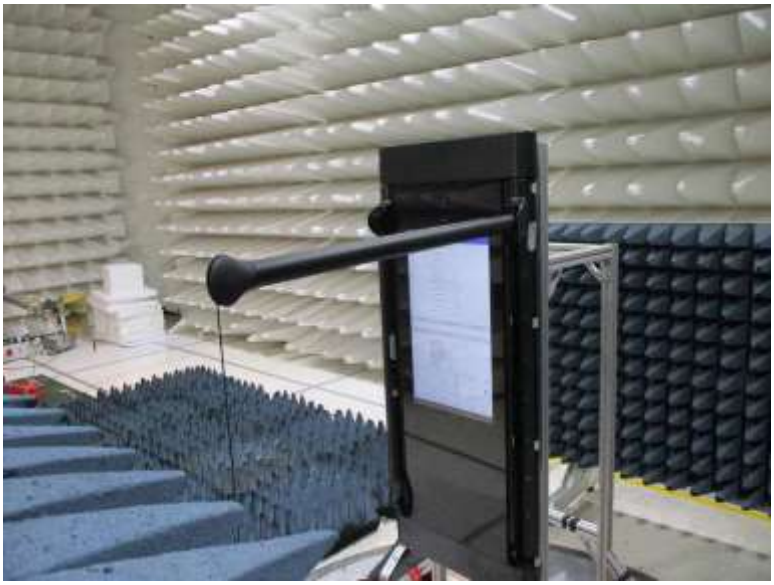
Front View

Back View

1GHz-12GHz

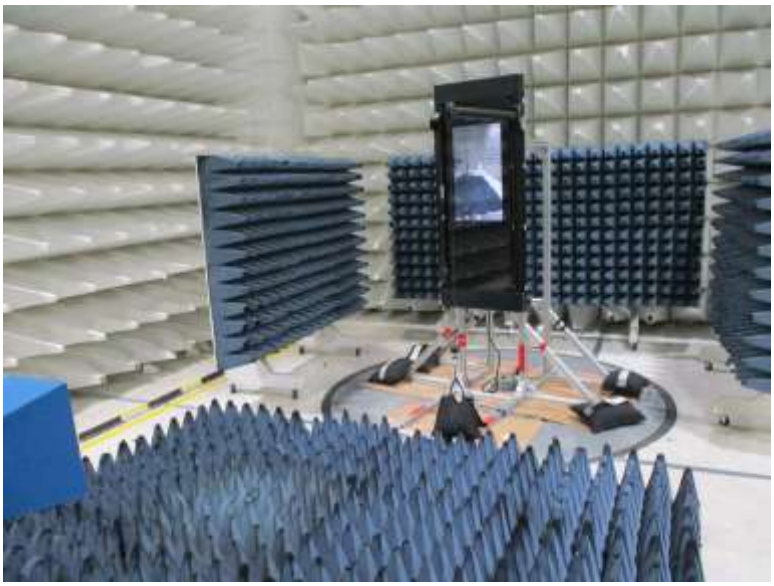


Front View

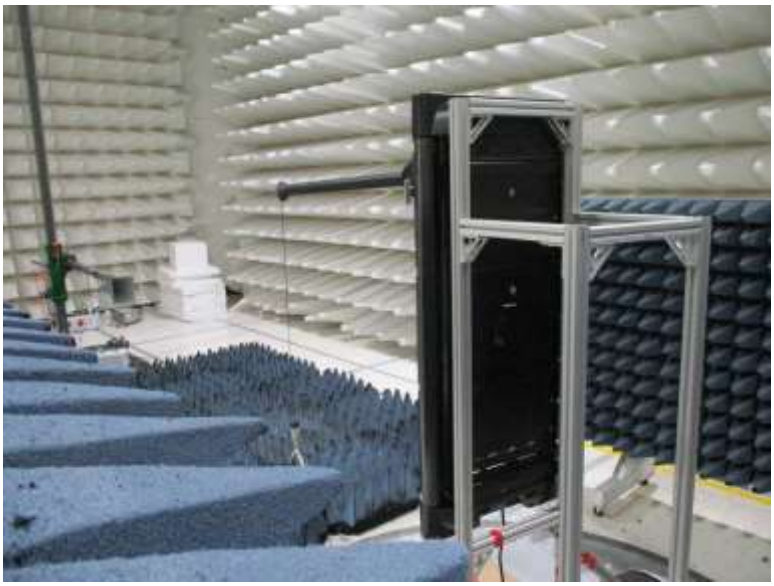


Back View

12GHz-26GHz



Front View



Back 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):	10/3/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer		

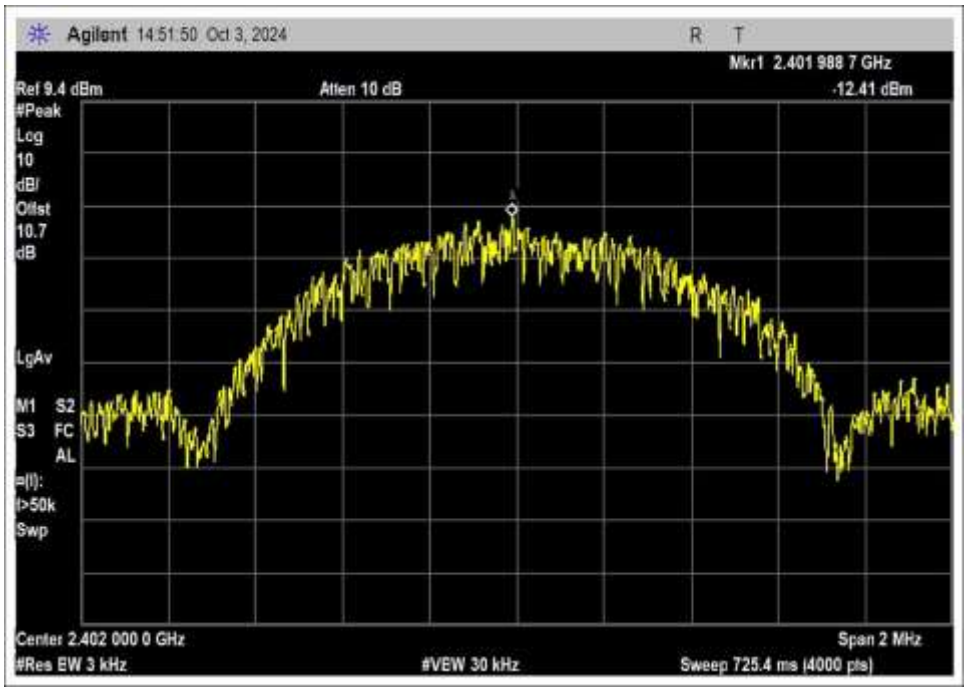
Environmental Conditions			
Temperature (ºC)	22.3	Relative Humidity (%):	43

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

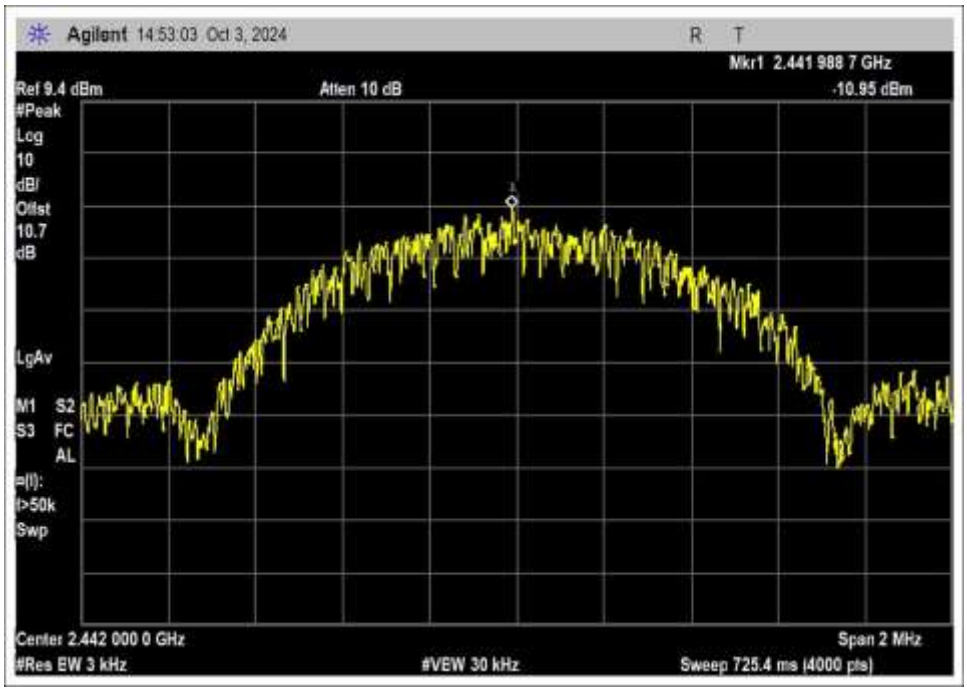
Test Data Summary - RF Conducted Measurement					
Measurement Method: PKPSD					
Frequency (MHz)	**OBW (MHz)**	**Modulation**	**Measured (dBm/3kHz)**	**Limit (dBm/3kHz)**	**Results**
2402	1	GFSK	-12.41	≤8	Pass
2442	1	GFSK	-10.95	≤8	Pass
2480	1	GFSK	-11.27	≤8	Pass
2402	2	GFSK	-16.14	≤8	Pass
2442	2	GFSK	-14.57	≤8	Pass
2480	2	GFSK	-14.88	≤8	Pass

Plots

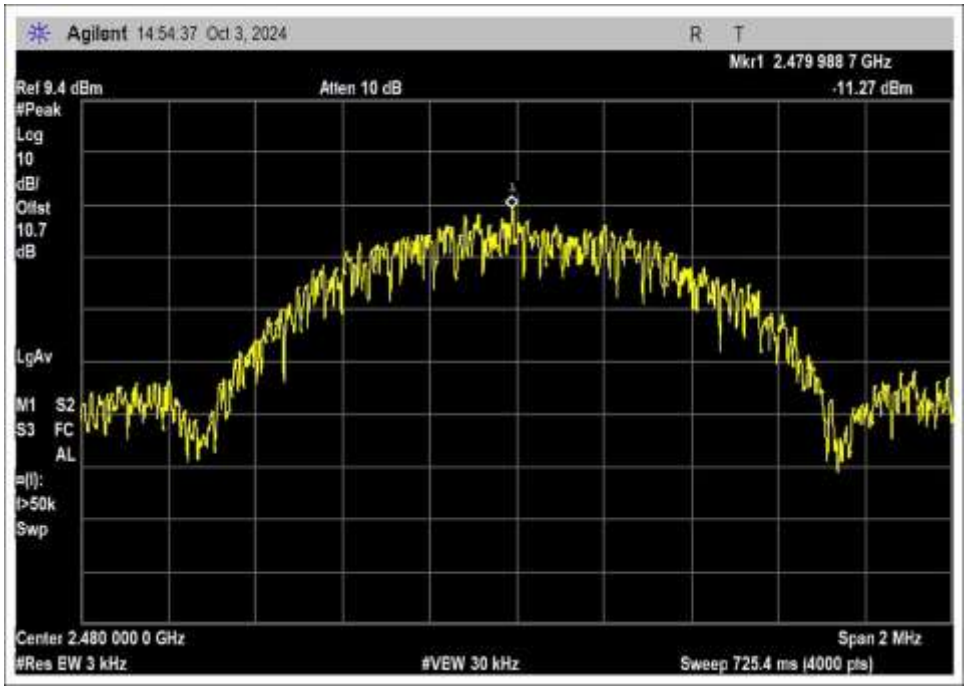
1MHz



Low Channel

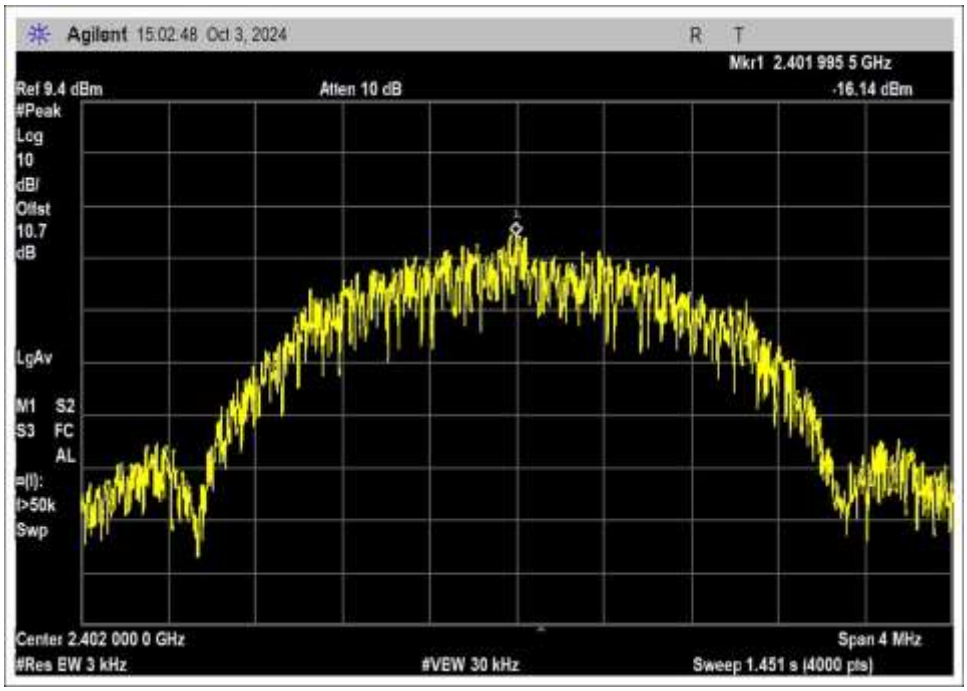


Middle Channel

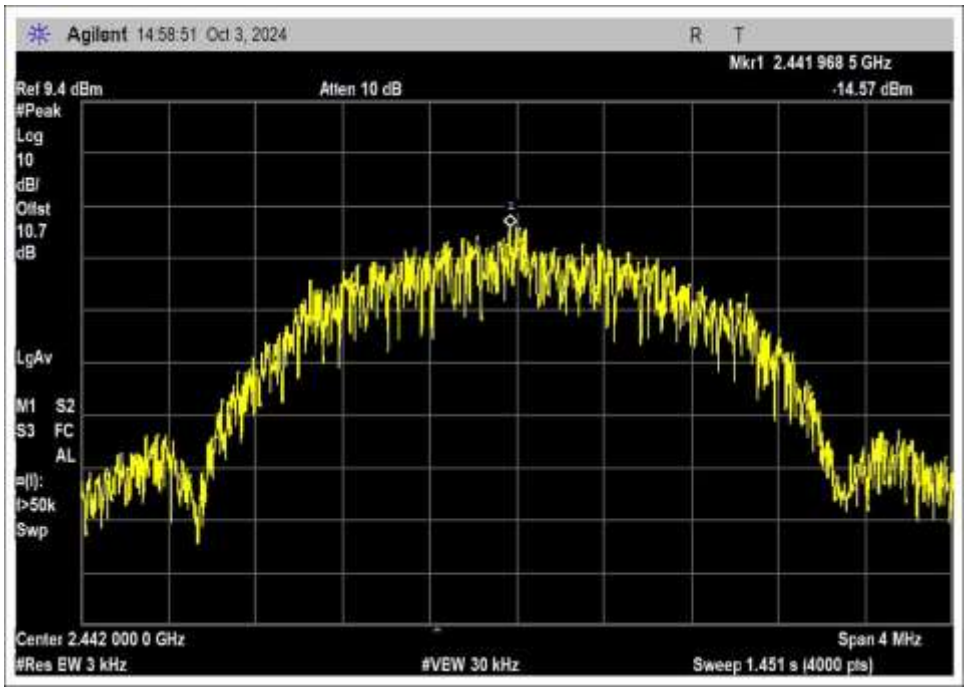


High Channel

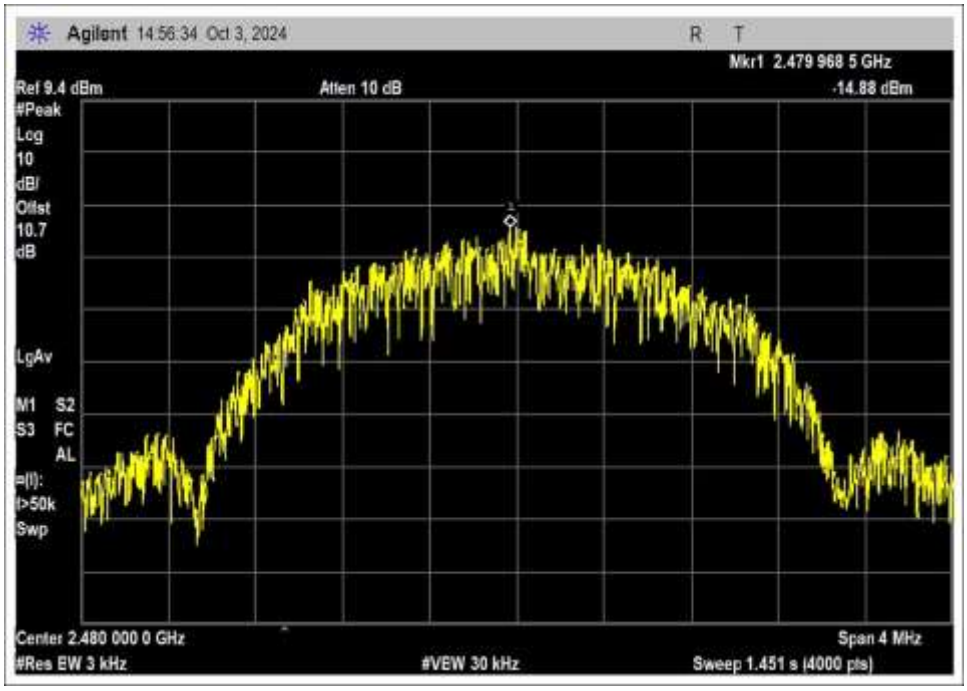
2MHz



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)

Test Setup

Test Setup, Close 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:

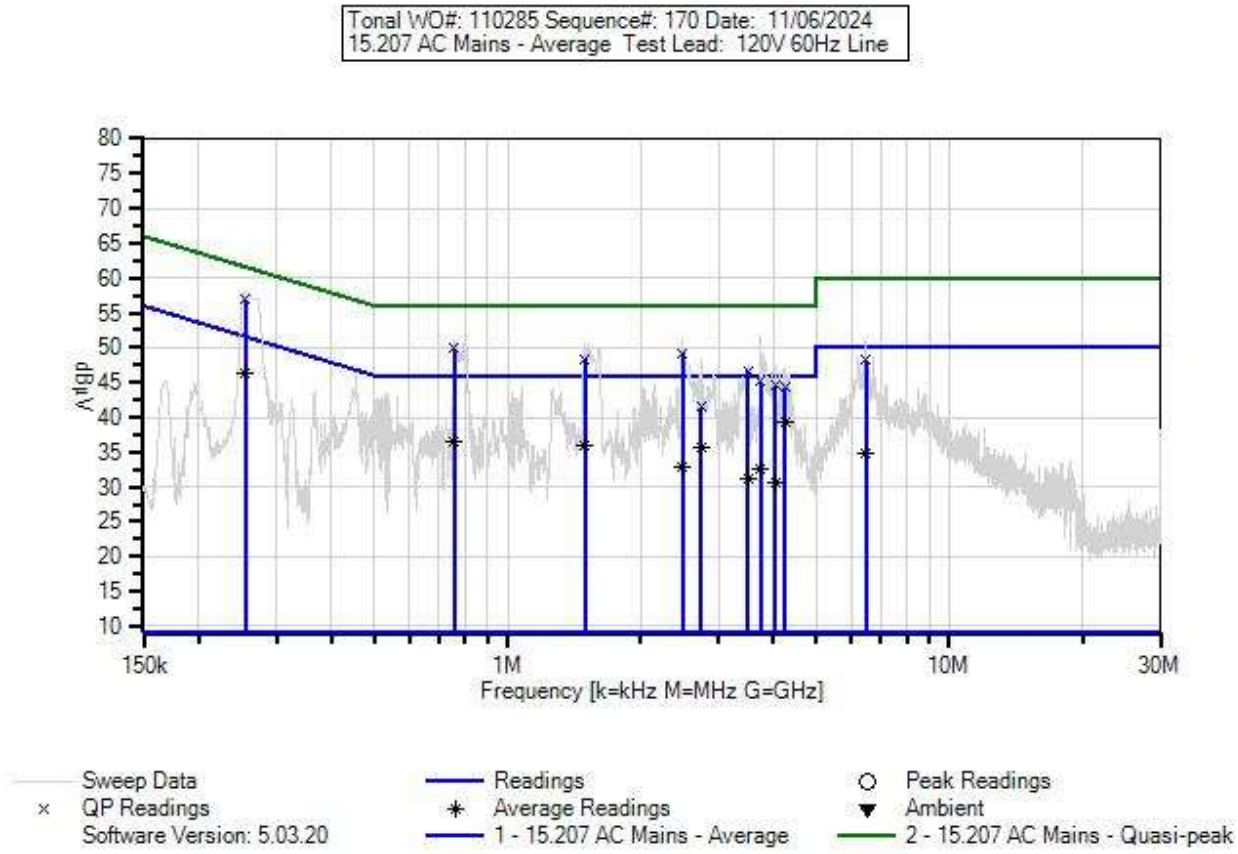
Conducted Emission
Frequency Range: 150kHz to 30MHz

Test Environment Conditions:
Temperature: 21.6°C
Humidity: 49%
Atmospheric Pressure: 101.4kPa

Highest Generation Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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 was in place during testing.



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 QP	46.8	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	56.9	61.6	-4.7	Line
2	254.718k Ave	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 QP	39.7	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	50.0	56.0	-6.0	Line
5	4.237M Ave	29.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	39.4	46.0	-6.6	Line
6	2.485M QP	39.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	49.2	56.0	-6.8	Line
7	1.494M QP	38.2	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	48.4	56.0	-7.6	Line
8	3.501M QP	36.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	46.6	56.0	-9.4	Line
9	758.671k Ave	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 Ave	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 Ave	25.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	35.8	46.0	-10.2	Line
14	3.739M QP	34.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	45.1	56.0	-10.9	Line
15	4.041M QP	34.1	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	44.5	56.0	-11.5	Line
16	4.237M QP	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 QP	37.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	48.2	60.0	-11.8	Line
19	2.485M Ave	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 Ave	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 QP	2.744M	31.3	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	41.5	56.0	-14.5	Line
^	2.744M	36.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	46.8	46.0	+0.8	Line
25 Ave	3.501M	20.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	31.3	46.0	-14.7	Line
^	3.501M	39.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	50.2	46.0	+4.2	Line
27 Ave	6.463M	24.3	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	34.7	50.0	-15.3	Line
^	6.463M	41.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.1	50.0	+2.1	Line
29 Ave	4.041M	20.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	30.6	46.0	-15.4	Line
^	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:

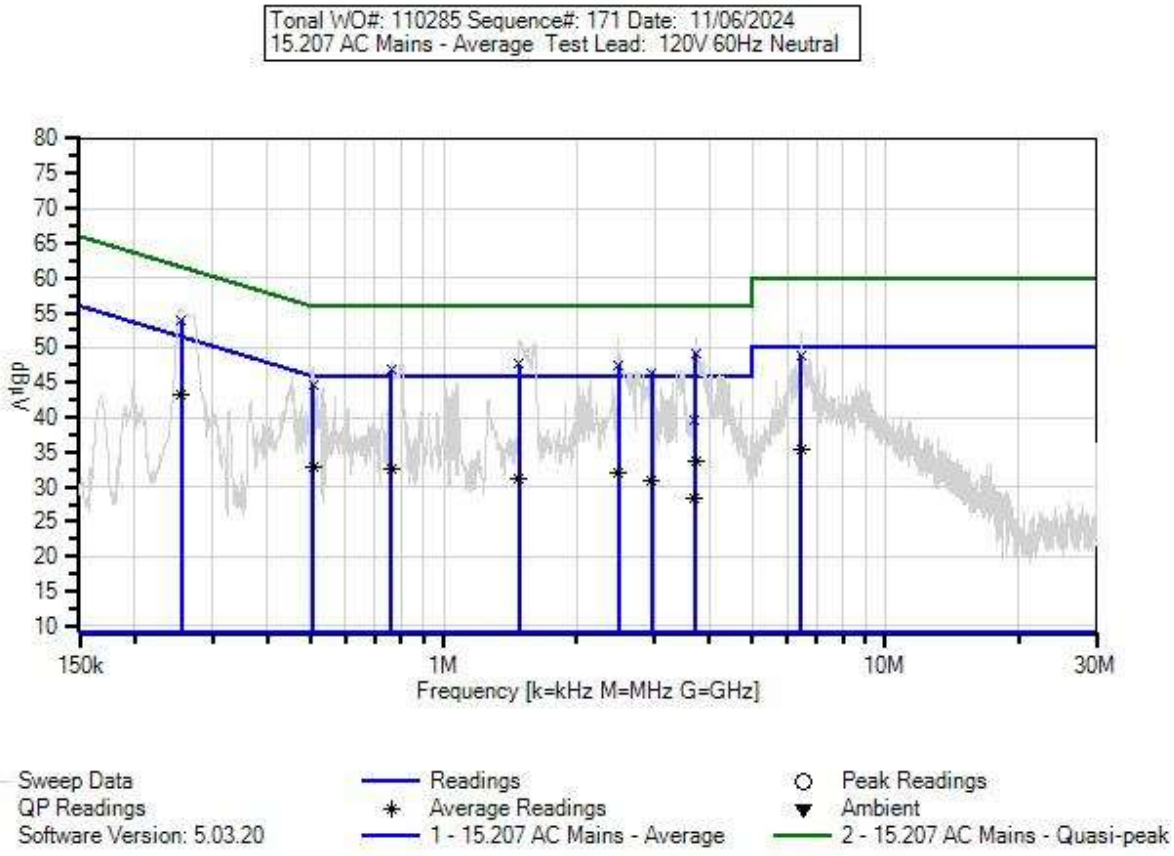
Conducted Emission
Frequency Range: 150kHz to 30MHz

Test Environment Conditions:
Temperature: 21.6°C
Humidity: 49%
Atmospheric Pressure: 101.4kPa

Highest Generation Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

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 was in place during testing.



Test Equipment:

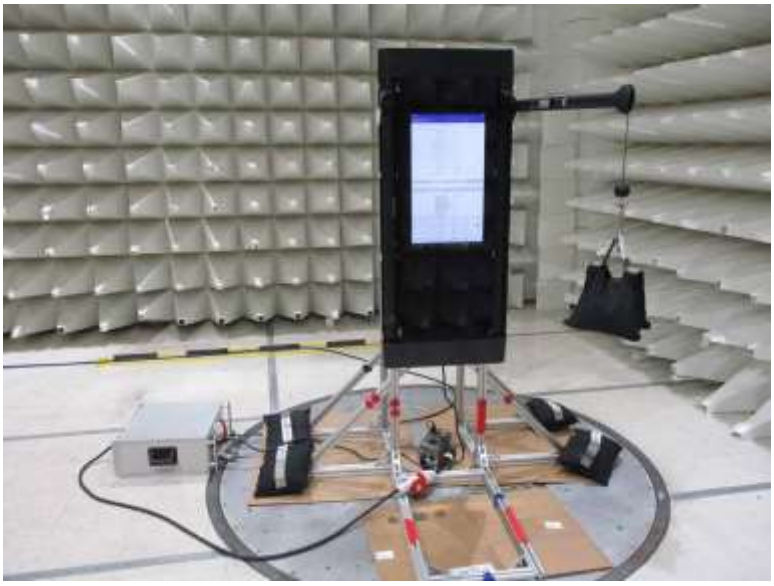
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	12/2/2022	12/2/2024
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
T4	AN03814	50uH LISN-1PH-Neutral (dB)	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

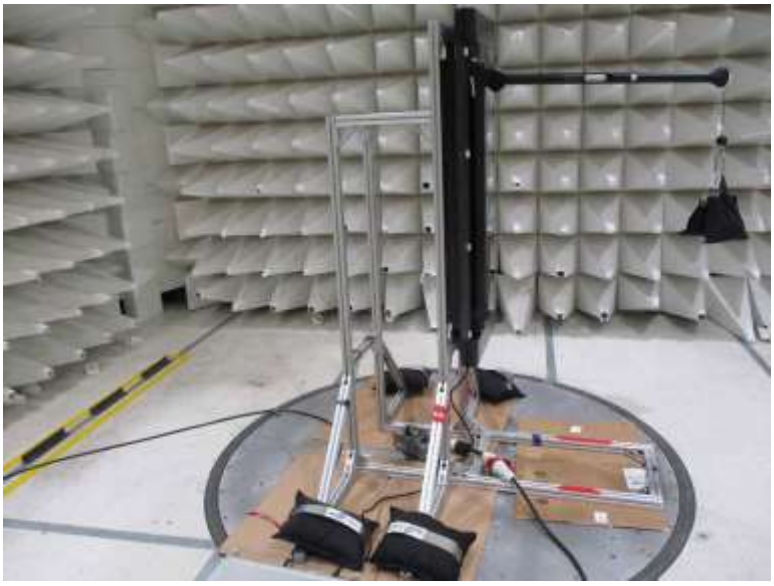
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	3.722M	38.8	+9.9	+0.2	+0.1	+0.1	+0.0	49.2	56.0	-6.8	Neutr
	QP		+0.1								
2	255.445k	44.0	+9.8	+0.1	+0.0	+0.0	+0.0	54.0	61.6	-7.6	Neutr
	QP		+0.1								
3	255.445k	33.3	+9.8	+0.1	+0.0	+0.0	+0.0	43.3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

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

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 (Wurth: 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 x 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 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.

End of Report