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
(FHSS 2400-2483.5 MHz)

Report No.: 110285-36

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

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Administrative Information

Test Report Information

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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 (FHSS 2400-2483.5GHz)

Test Procedure	Description	Modifications	Results
15.247(a)(1)	Occupied Bandwidth	NA	PASS
15.247(a)(1)	Carrier Separation	NA	PASS
15.247(a)(1)(iii)	Number of Hopping Channels	NA	PASS
15.247(a)(1)(iii)	Average Time of Occupancy	NA	PASS
15.247(b)(1)	Output Power	NA	PASS
15.247(d)	RF Conducted Emissions & Band Edge	NA	PASS
15.247(d)	Radiated Emissions & Band Edge	Mod. #1	PASS
15.207	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:

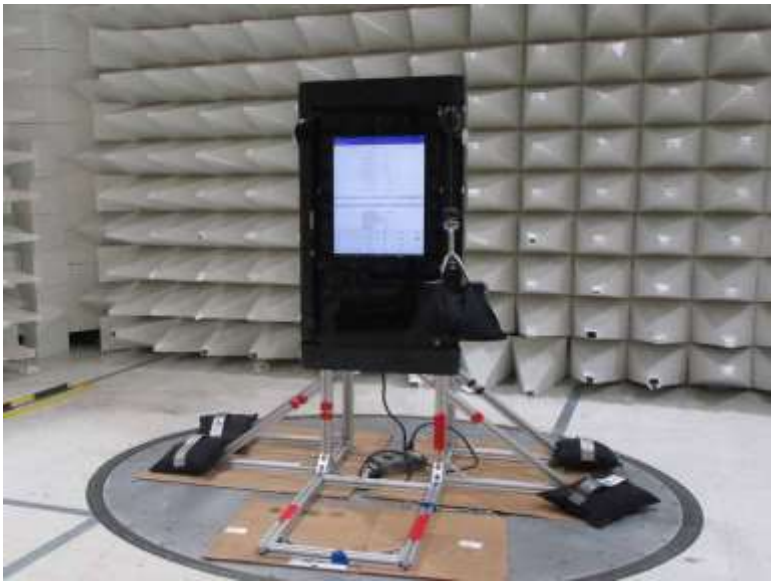
Device Name	Manufacturer	Model #	S/N
Laptop	Dell	XPS	22E00911
AC/DC Adapter for Laptop	Dell	DA130PM130	CN-06TTY6-48661-4CO-27M7-A00

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 Classic
Maximum Duty Cycle:	100%
Modulation Type(s):	GFSK, π/4-DQPSK and 8-DQPSK
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
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
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)

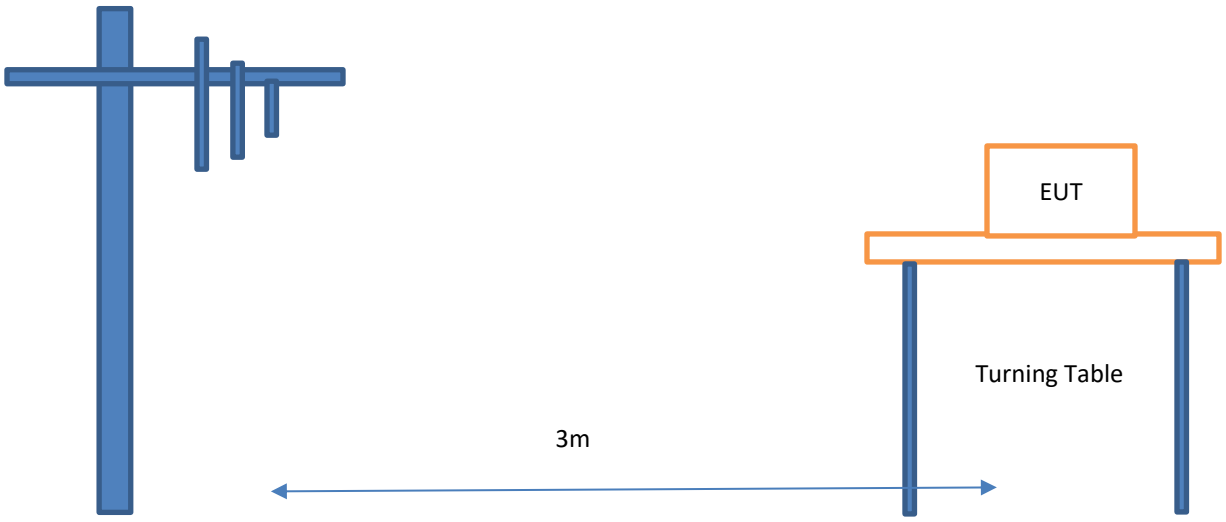


Support Equipment Photo(s)

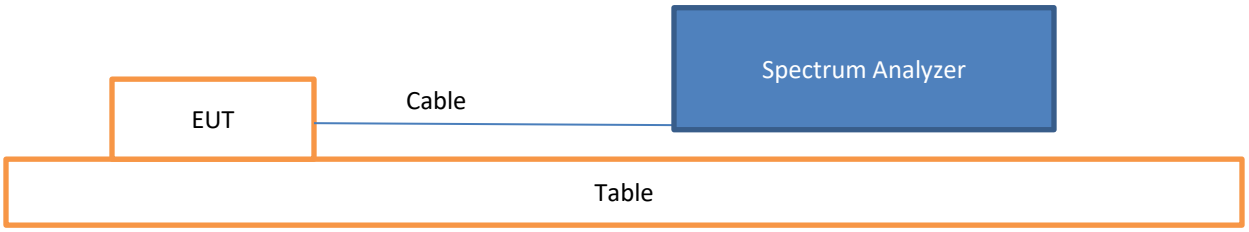
Block Diagram of Test Setup(s)

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) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020)	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

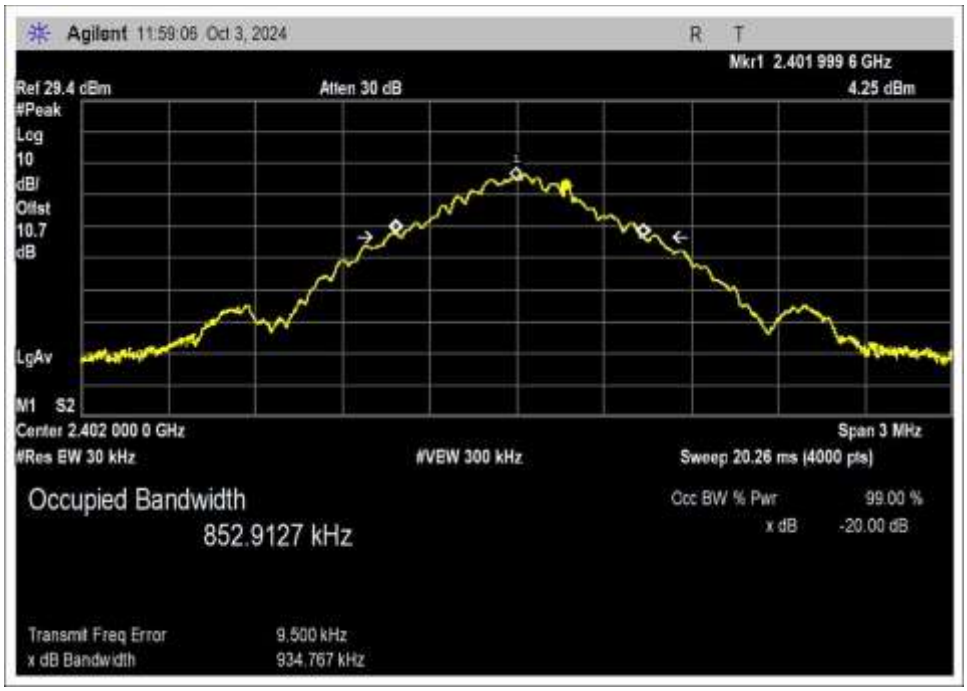
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

15.247(a)(1) 20 dB Bandwidth

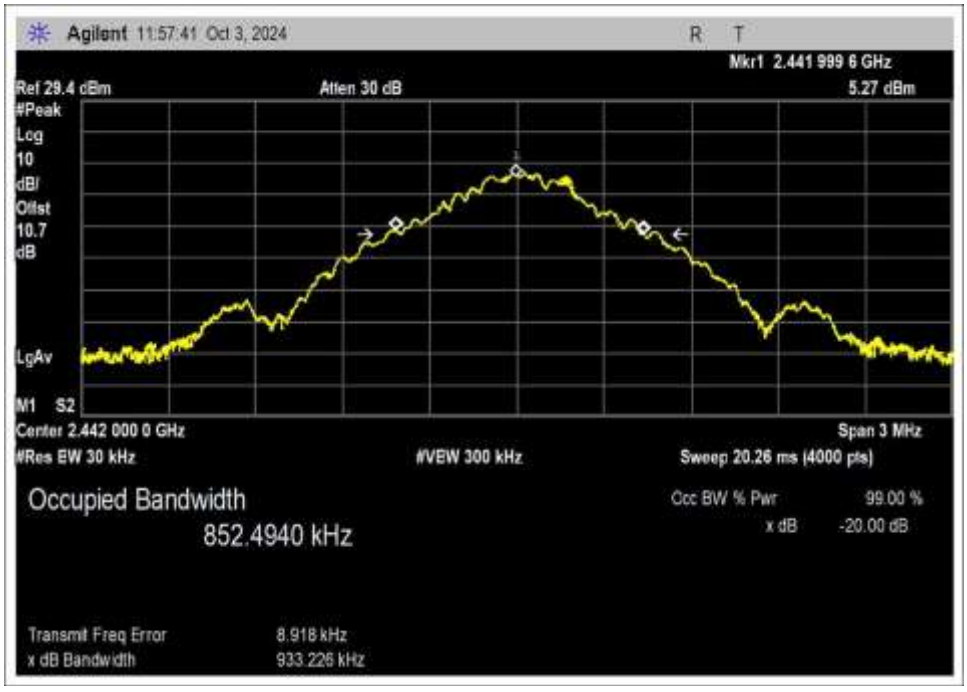
Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	GFSK	934.767	None	NA
2442	1	GFSK	933.226		
2480	1	GFSK	934.824		
2402	1	π/4-DQPSK	1277		
2442	1	π/4-DQPSK	1278		
2480	1	π/4-DQPSK	1277		
2402	1	8-DQPSK	1284		
2442	1	8-DQPSK	1283		
2480	1	8-DQPSK	1284		

Plot(s)

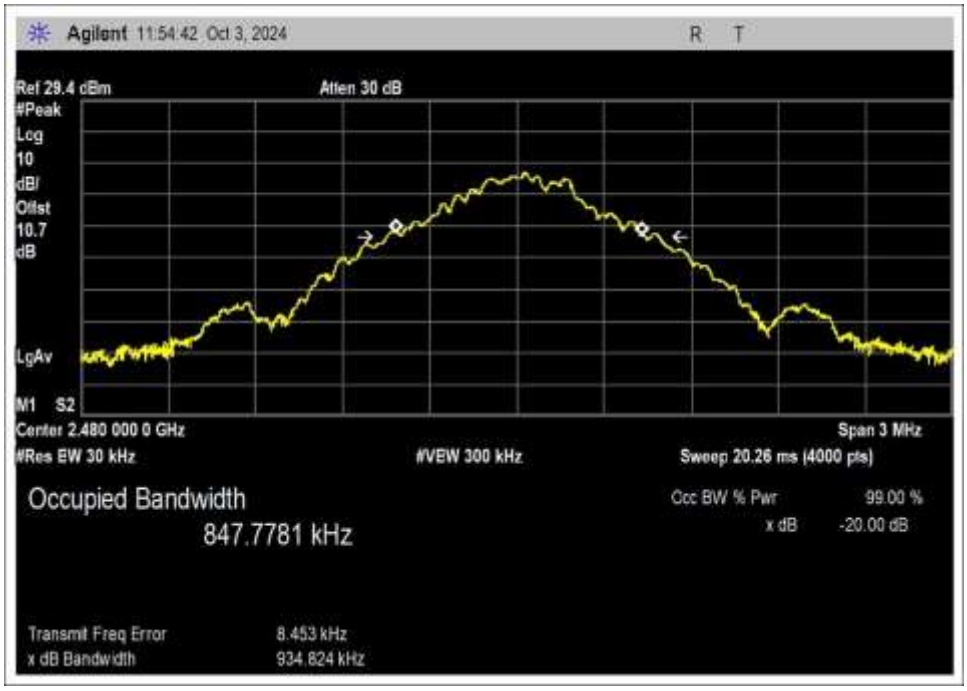
GFSK



Low Channel

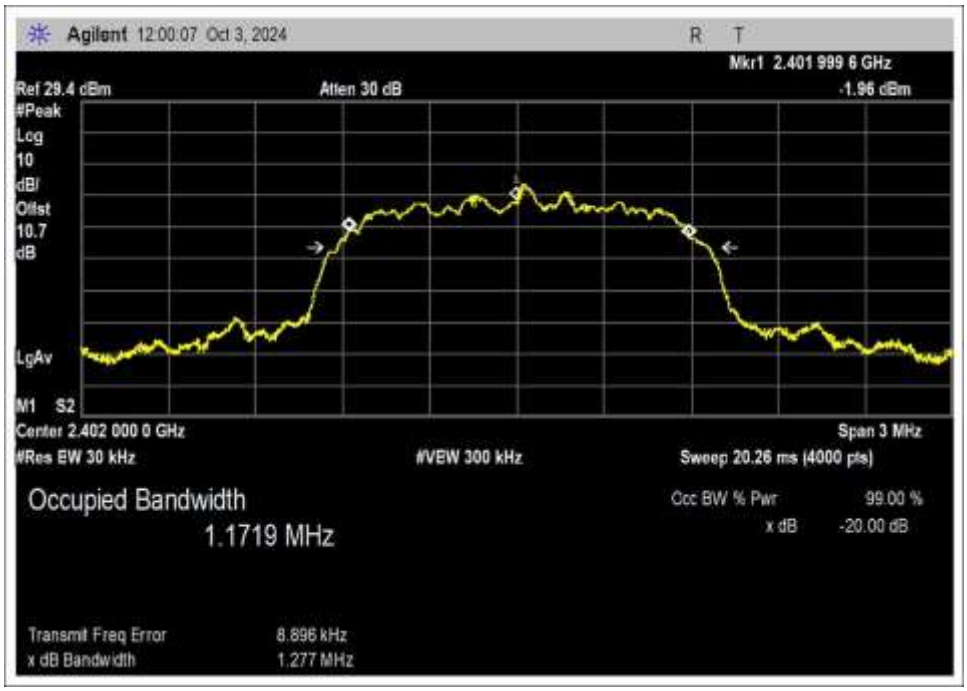


Middle Channel

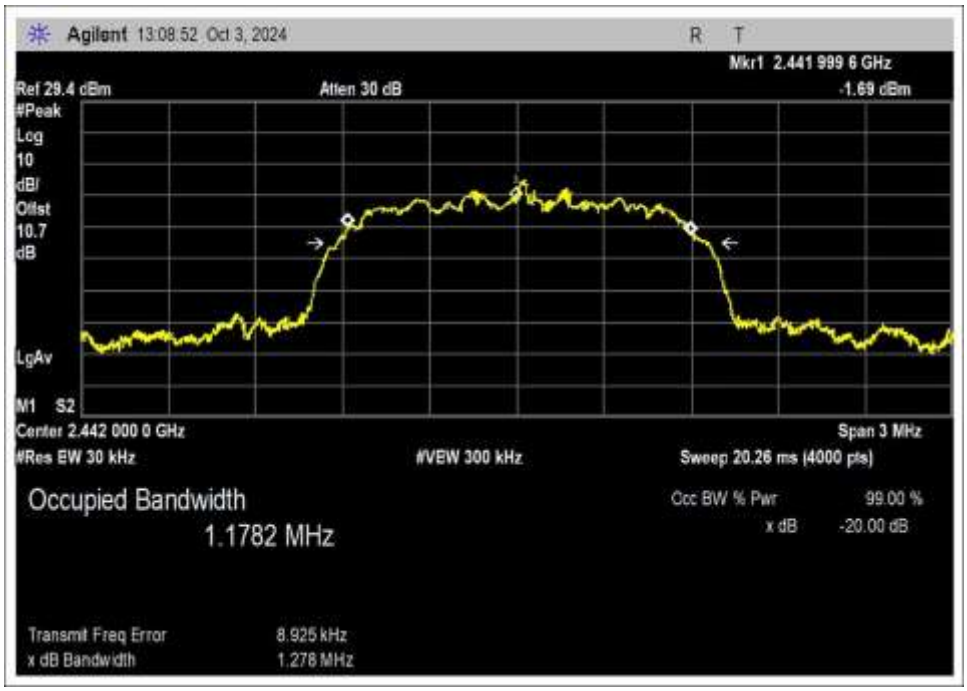


High Channel

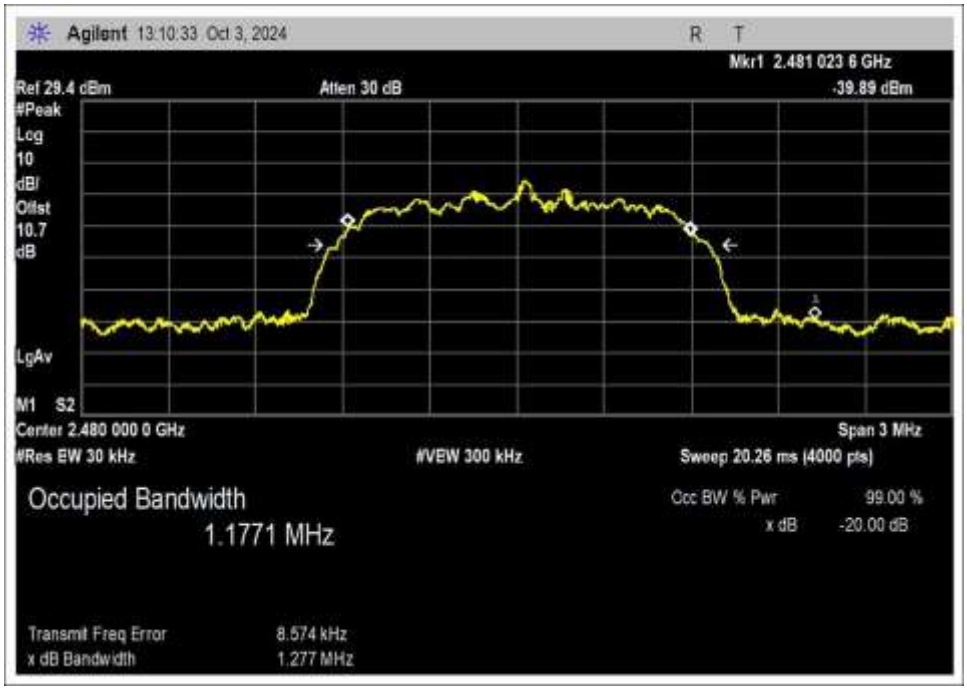
4-DQPSK



Low Channel

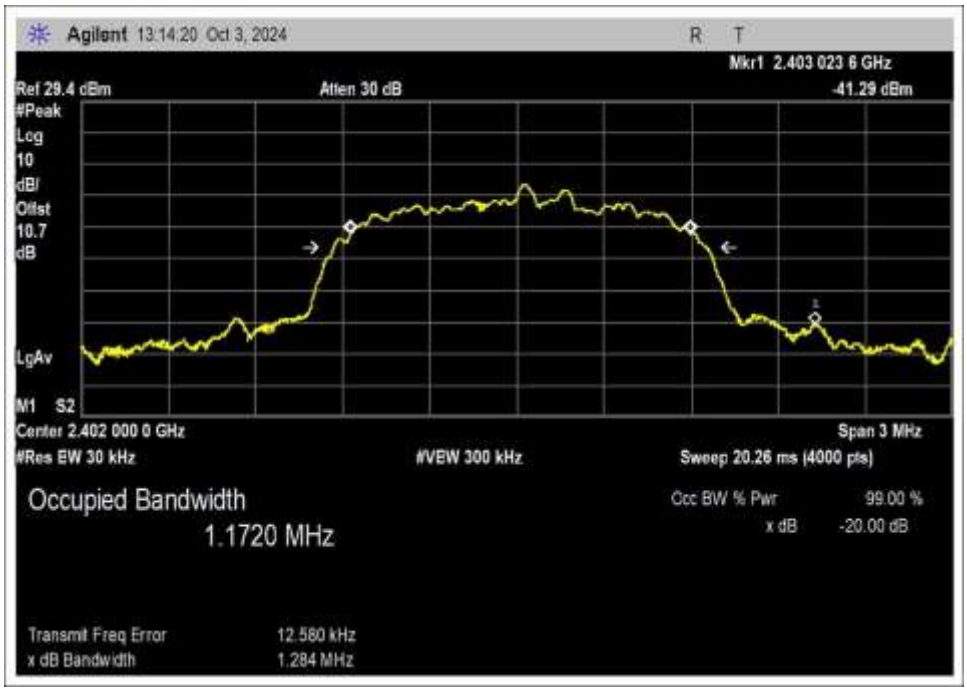


Middle Channel

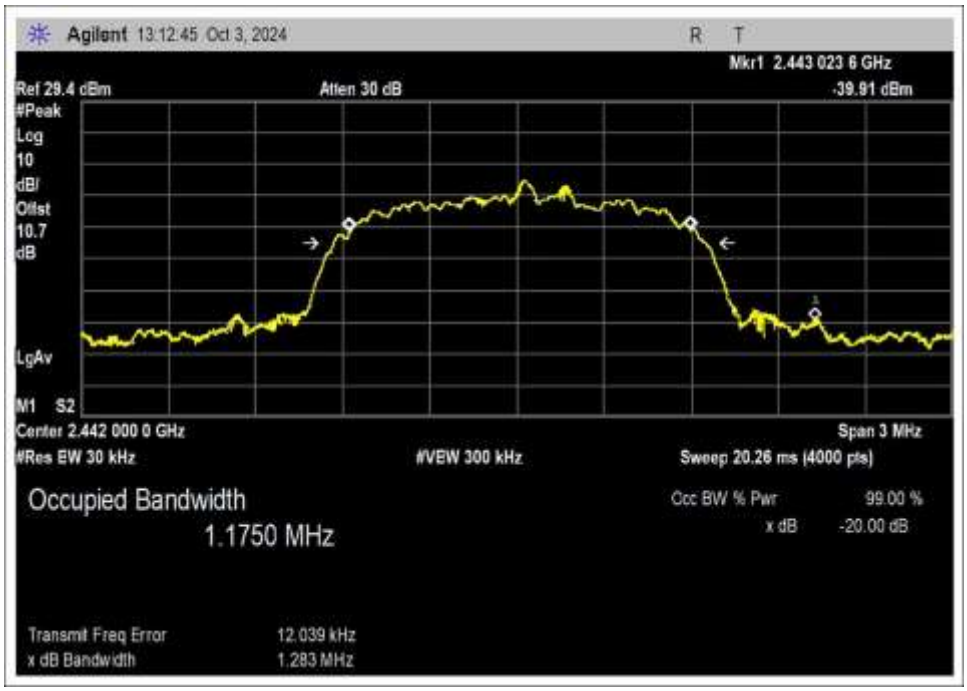


High Channel

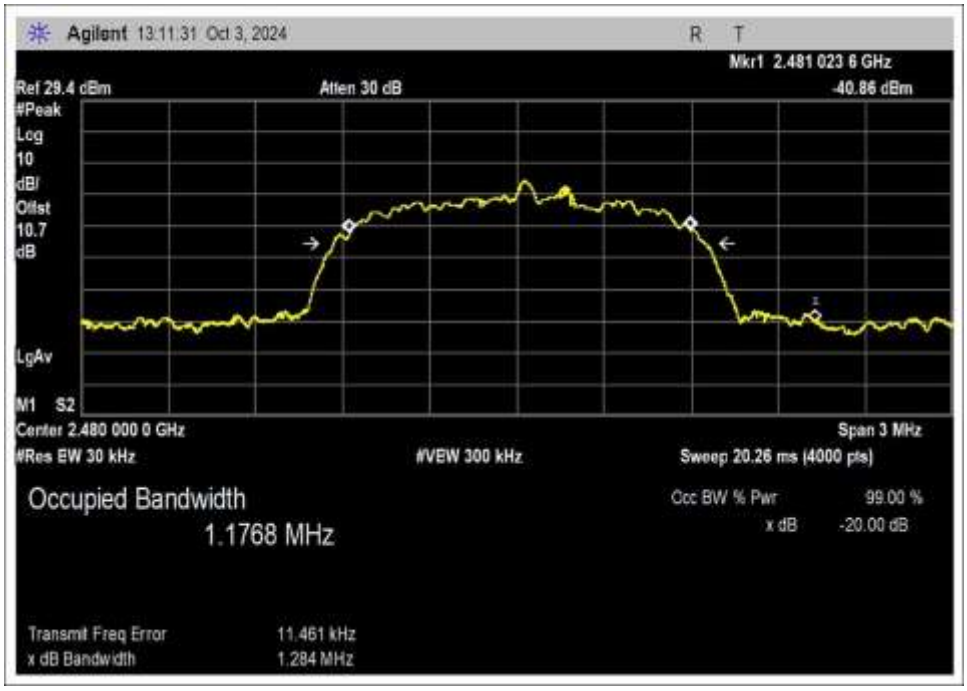
8-DQPSK



Low Channel



Middle Channel

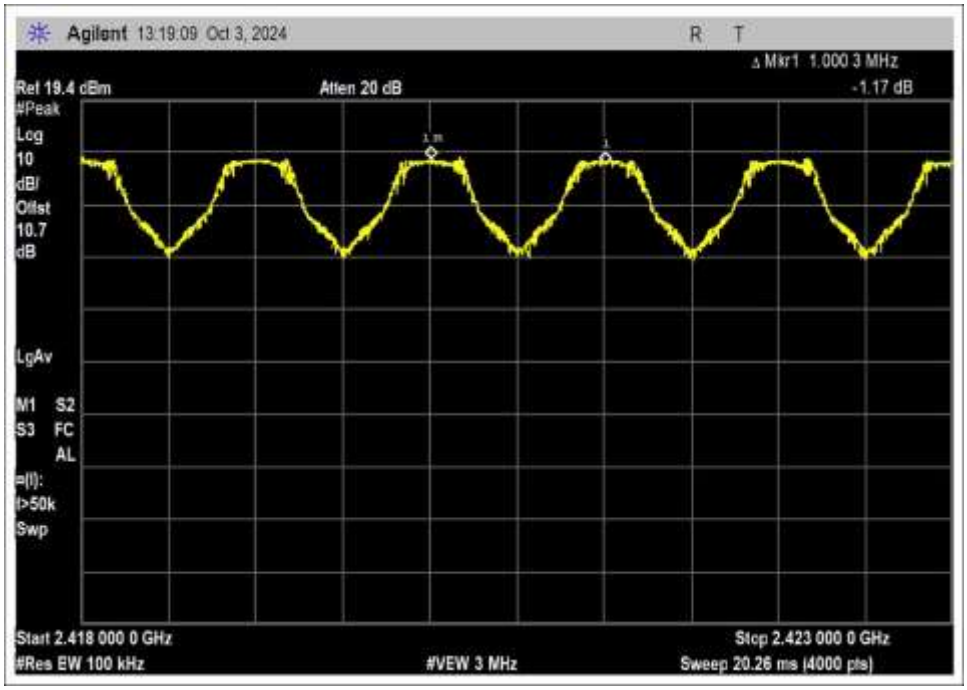


High Channel

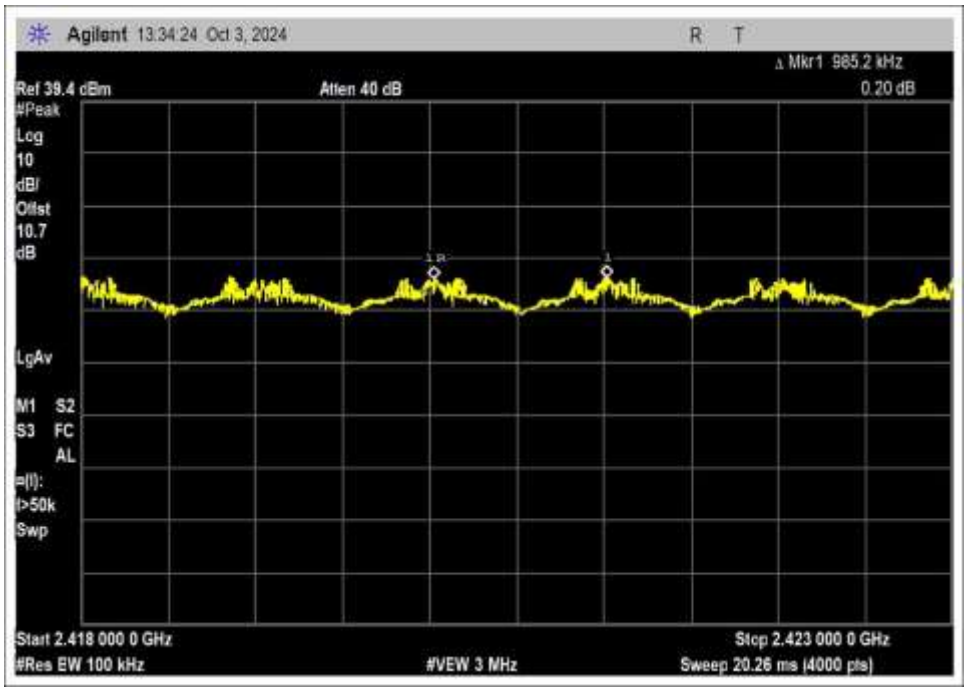
15.247(a)(1) Carrier Separation

Test Data Summary				
Limit applied: minimum 25kHz.				
Antenna Port	**Operational Mode**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	Normal	GFSK	1000.3	≥25
1	Normal	π/4-DQPSK	985.2	≥25
1	Normal	8-DQPSK	1011.5	≥25

Plot(s)



GFSK



4-DQPSK

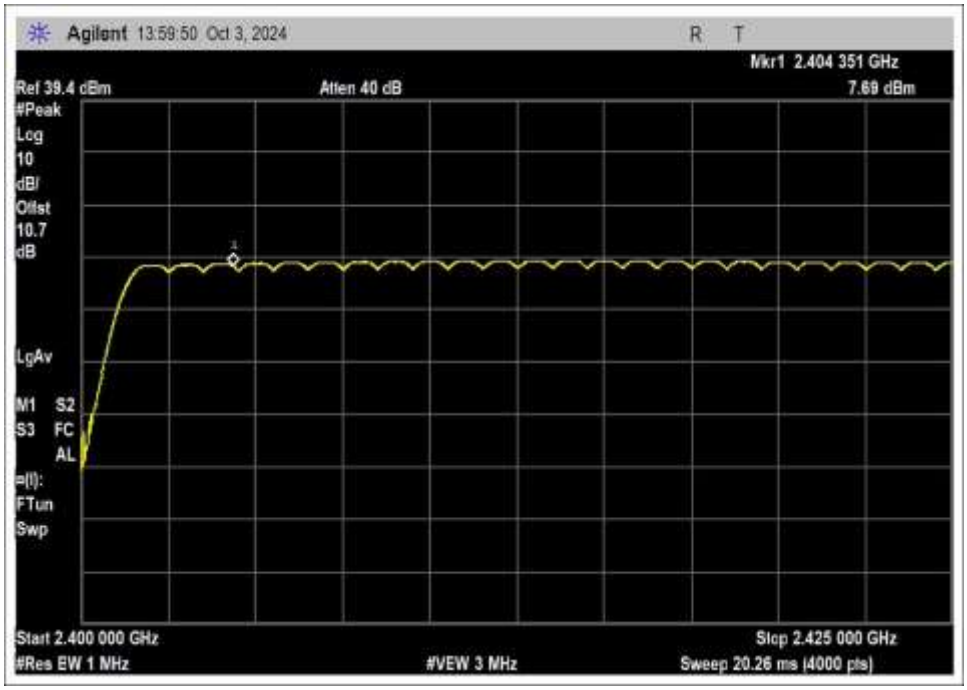
8-DQPSK

15.247(a)(1)(iii) Number of Channels

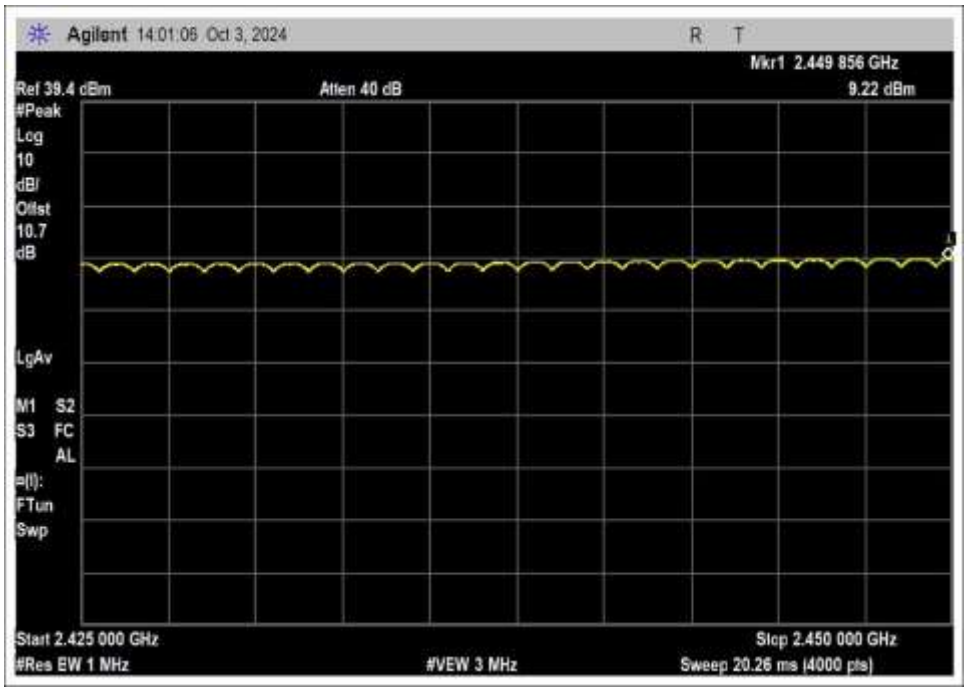
Test Data Summary				
Limit applied: 75; for equipment with power output >125 mW..				
Antenna Port	**Operational Mode**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	Hopping	GFSK	79	≥75
1	Hopping	π/4-DQPSK	79	≥75
1	Hopping	8-DQPSK	79	≥75

Plot(s)

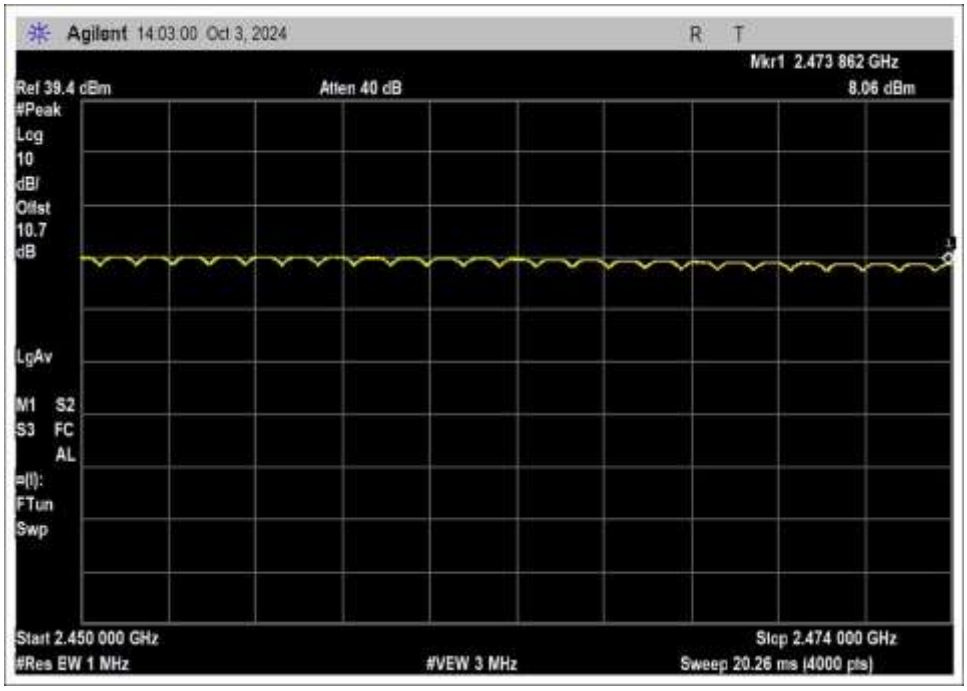
GFSK



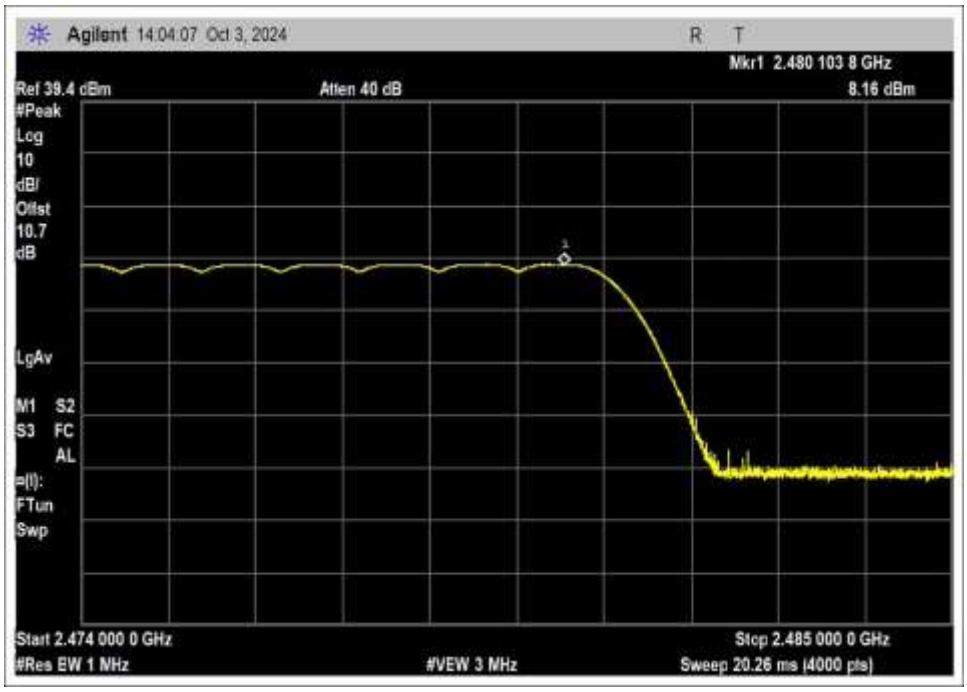
Number Channel 1-24



Number Channel 24-49

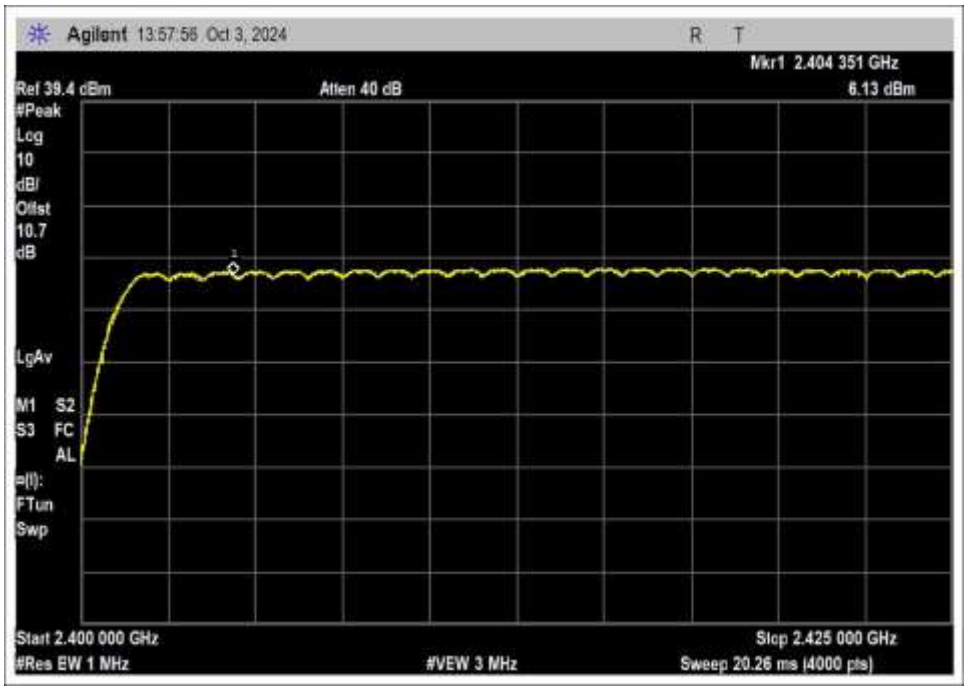


Number Channel 49-73

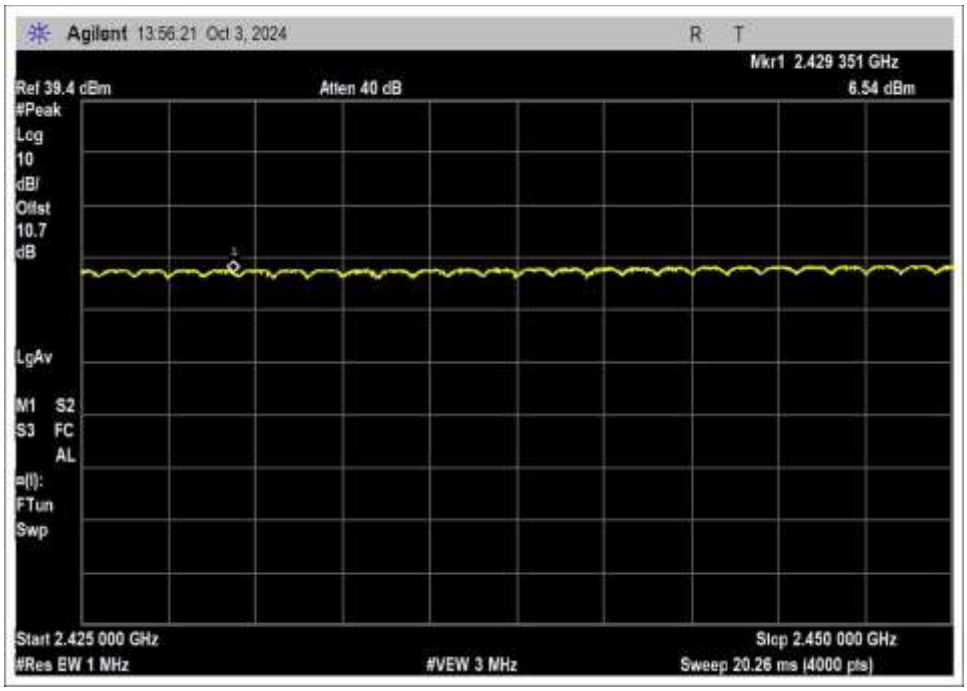


Number Channel 73-79

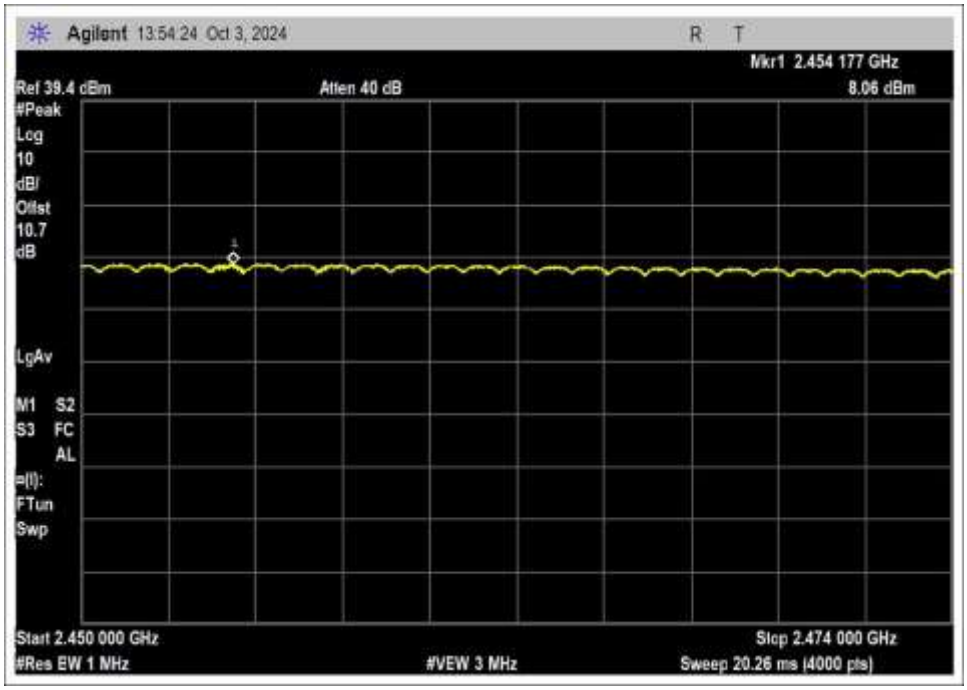
4-DQPSK



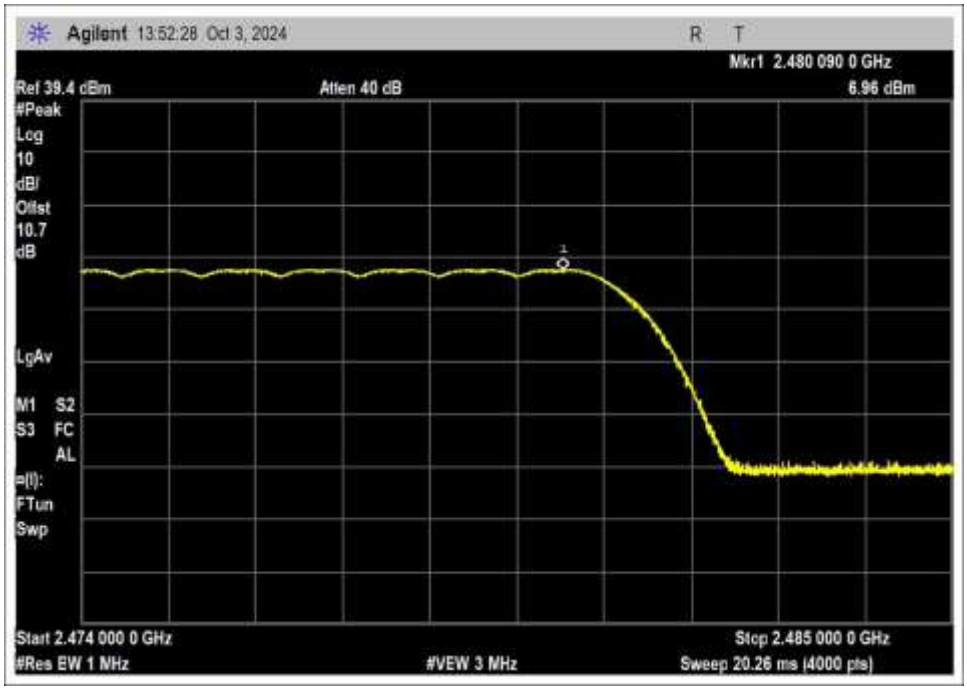
Number Channel 1-24



Number Channel 24-49

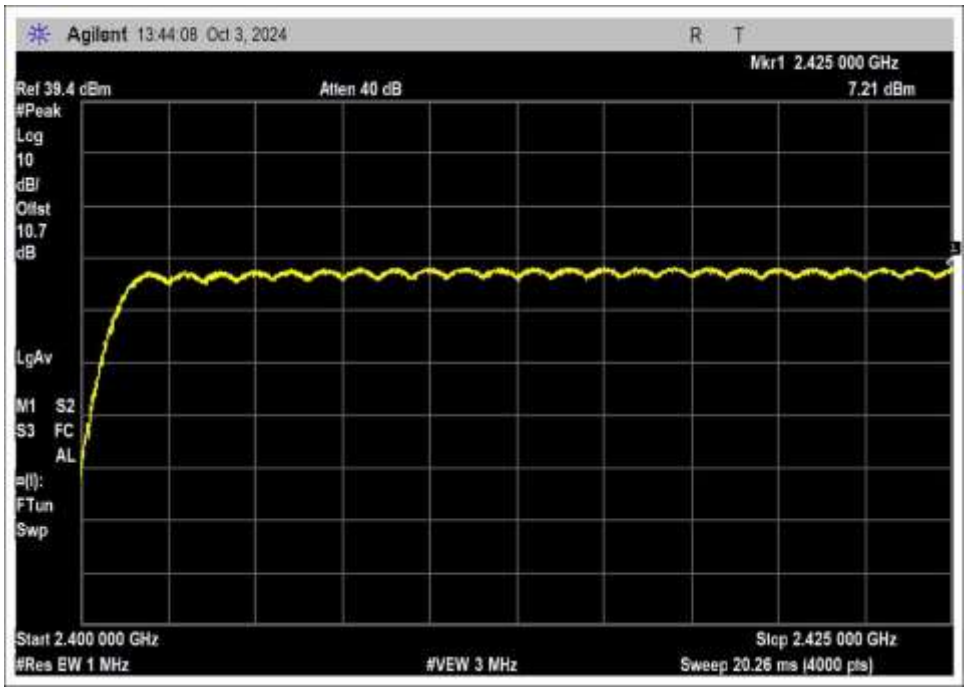


Number Channel 49-73

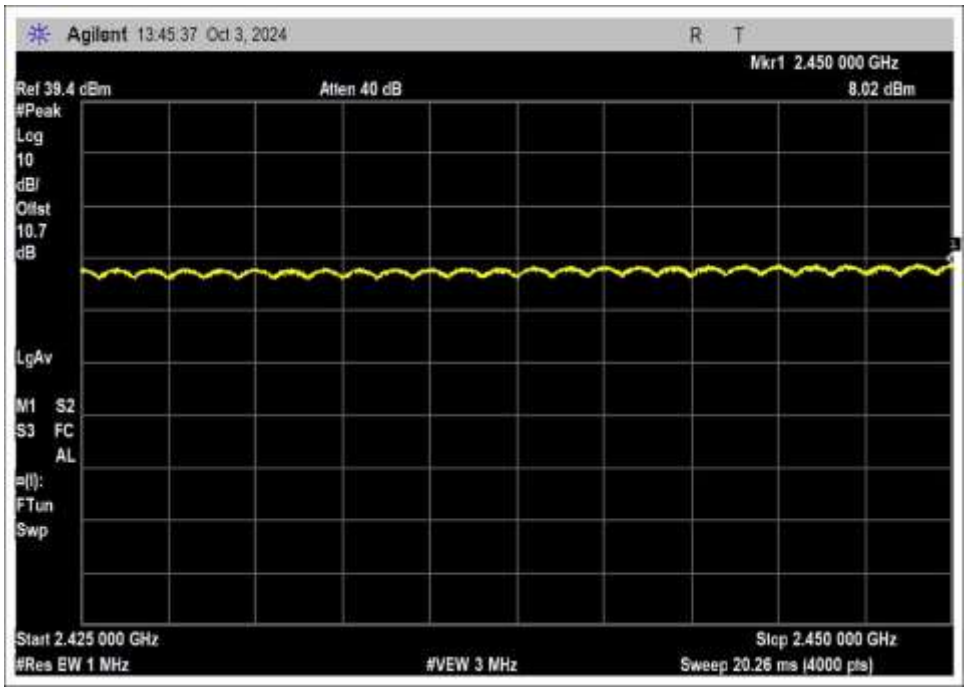


Number Channel 73-79

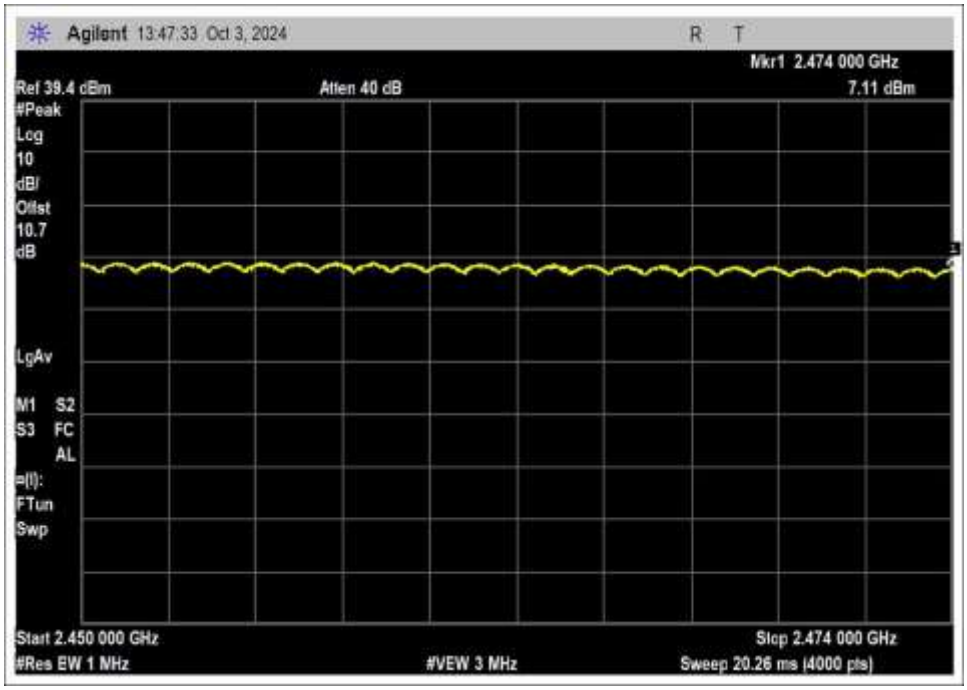
8-DQPSK



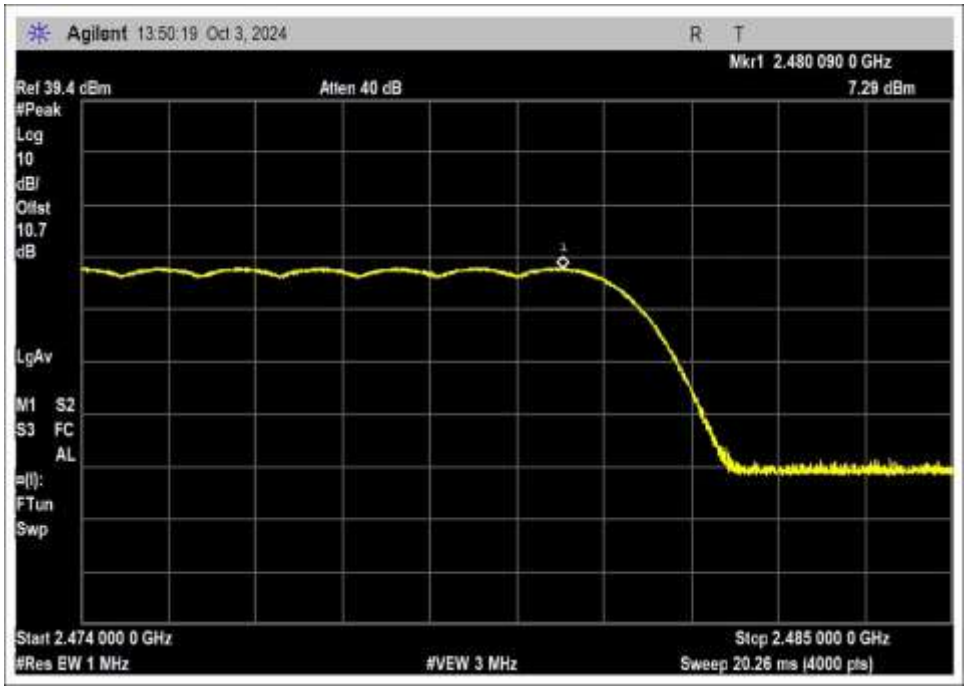
Number Channel 1-24



Number Channel 24-49



Number Channel 49-73



Number Channel 73-79

15.247(a)(1)(iii) Time of Occupancy

Test Data Summary				
Observation Period, P_{obs} is derived from the following: $P_{Obs} = 0.4\ x \max number\ of\ hopping\ channels$				
Antenna Port	**Operational Mode**	**Measured (ms)**	**Limit (ms/P_{obs})**	**Results**
1	Normal	GFSK	360.1	≤400
1	Normal	π/4-DQPSK	266.3	≤400
1	Normal	8-DQPSK	267.3	≤400

Measured results are calculated as follows:

$$Dwell\ time = \left(\sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right) \Big|_{P_{obs}}$$

Actual Calculated Values: GFSK

Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	126.4
On time of RF Burst:	0.002849
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.3601

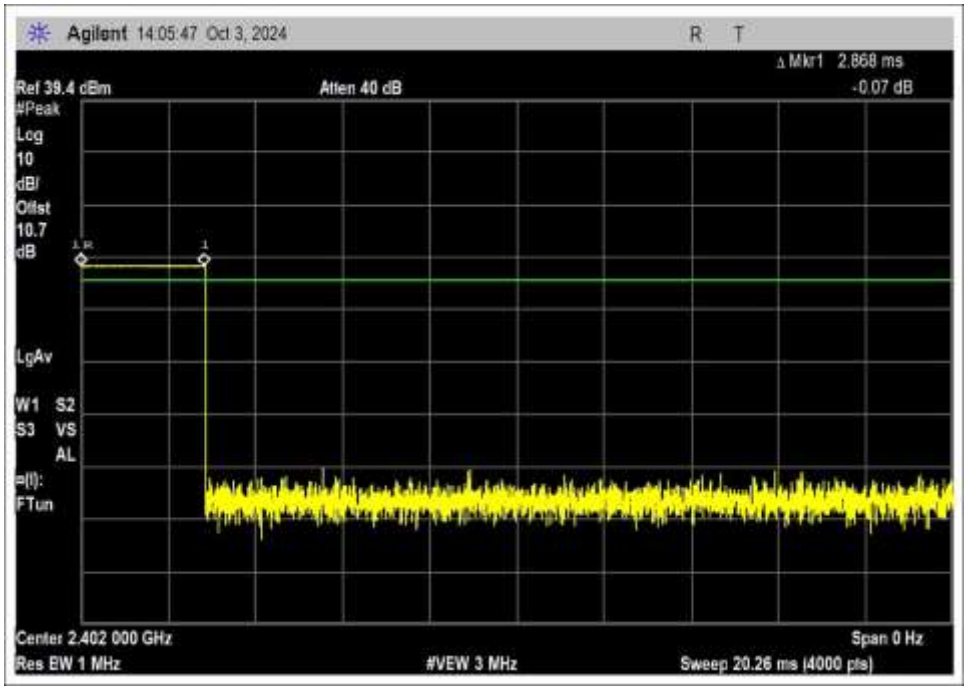
Actual Calculated Values: π/4-DQPSK

Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	94.8
On time of RF Burst:	0.002809
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.2663

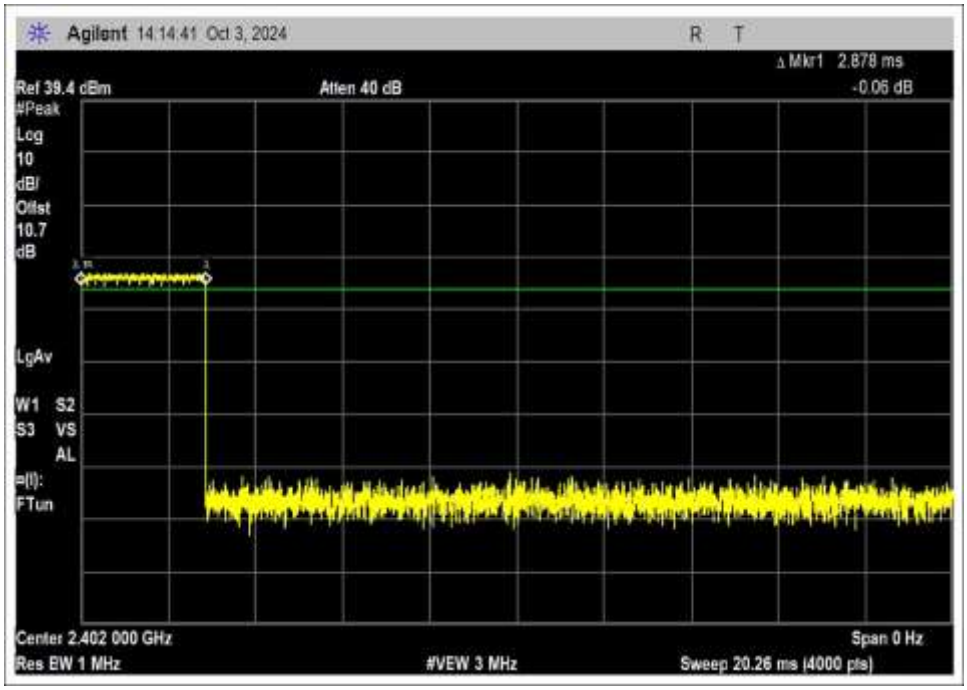
Actual Calculated Values: 8-DQPSK

Parameter	Value
Observation Period (P_{obs}):	31.6s
Number of RF Bursts / P_{obs}:	94.8
On time of RF Burst:	0.002820
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	0.2673

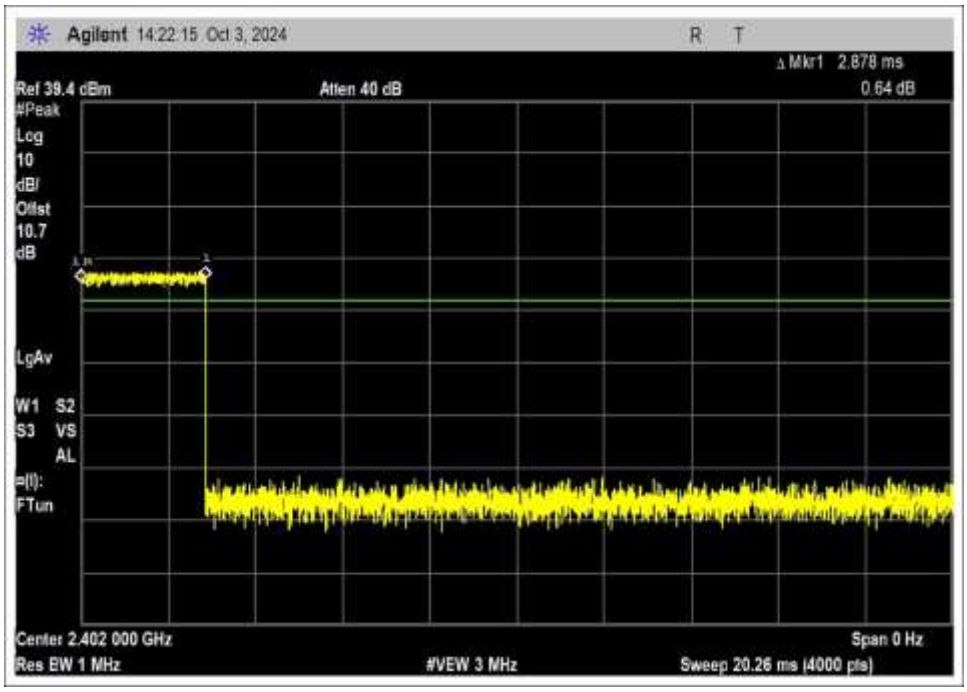
Plot(s)



GFSK



4-DQPSK


Agilent 14:22:15 Oct 3, 2024
R T
Δ Mkr1 2.878 ms
0.64 dB
Ref 39.4 dBm
Atten 40 dB
#Peak
Log
10
dB/
Offst
10.7
dB
LgAv
W1 S2
S3 VS
AL
#VBW 3 MHz
Center 2.402 000 GHz
Res BW 1 MHz
Span 0 Hz
Sweep 20.26 ms (4000 pts)

8-DQPSK

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.247(b)(1) Output Power

Test Setup/Conditions			
Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020)	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 - Voltage Variations					
Frequency (MHz)	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
2402	GFSK	7.87	7.90	7.88	0.03
2442	GFSK	8.90	8.91	8.92	0.02
2480	GFSK	8.19	8.24	8.23	0.05

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

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

Test Data Summary - RF Conducted Measurement							
$Limit = \begin{cases} 30dBm\ Conducted/36dBm\ EIRP \mid \geq 75\ Channels \\ 21dBm\ Conducted/27dBm\ EIRP \mid < 75\ Channels\ (\min 15) \end{cases}$							
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**RF Conducted (dBm)**		**EIRP (dBm)**		**Results**
			Measured	**Limit**	**Calculated**	**Limit**	
2402	GFSK	External Connector /3.67	7.90	≤30	11.57	≤36	Pass
2442	GFSK	External Connector /3.67	8.91	≤30	12.58	≤36	Pass
2480	GFSK	External Connector /3.67	8.24	≤30	11.91	≤36	Pass
2402	π/4-DQPSK	External Connector /3.67	6.89	≤30	10.56	≤36	Pass
2442	π/4-DQPSK	External Connector /3.67	8.04	≤30	11.71	≤36	Pass
2480	π/4-DQPSK	External Connector /3.67	7.44	≤30	11.11	≤36	Pass
2402	8-DQPSK	External Connector /3.67	7.39	≤30	11.06	≤36	Pass
2442	8-DQPSK	External Connector /3.67	8.43	≤30	12.1	≤36	Pass
2480	8-DQPSK	External Connector /3.67	7.80	≤30	11.47	≤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):

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

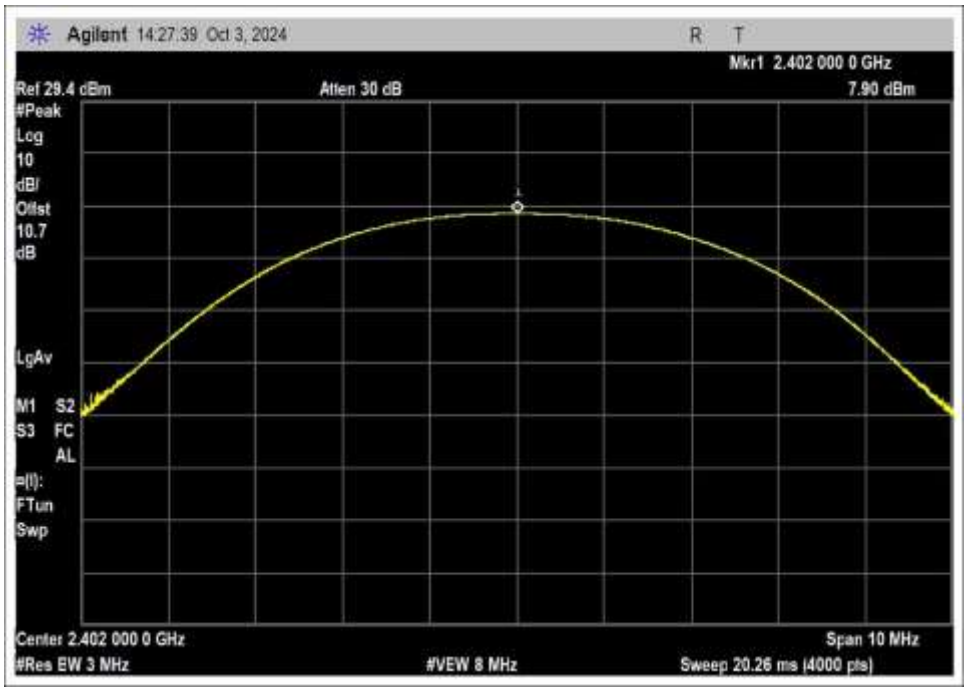
For all other antennas, the limit is calculated according to a maximum of 1W (30 dBm) or 0.25W (21 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

$Limit = 30\ [or\ 21] - Roundup(G - 6)$

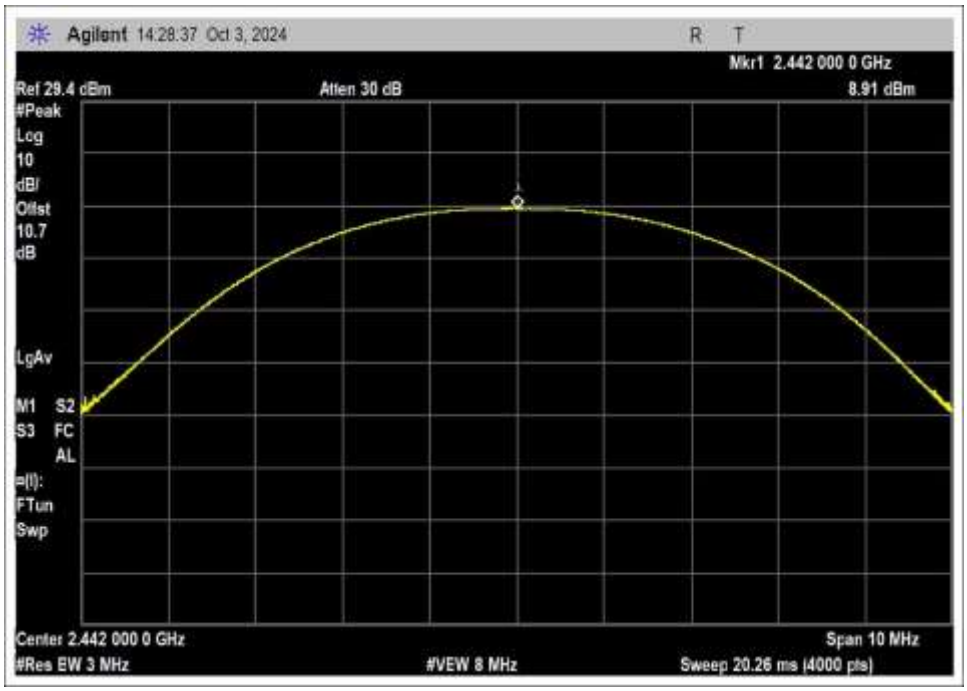
For directional beamforming antennas, the limit is calculated in accordance with 15.247(c)(2) and KDB 662911.

Plot(s)

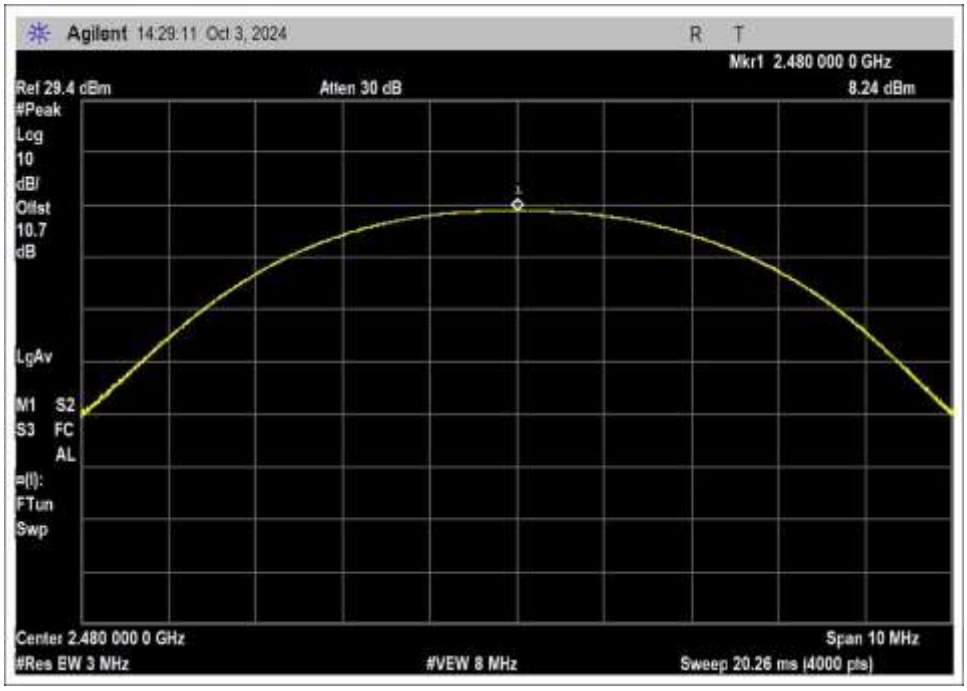
GFSK



Low Channel

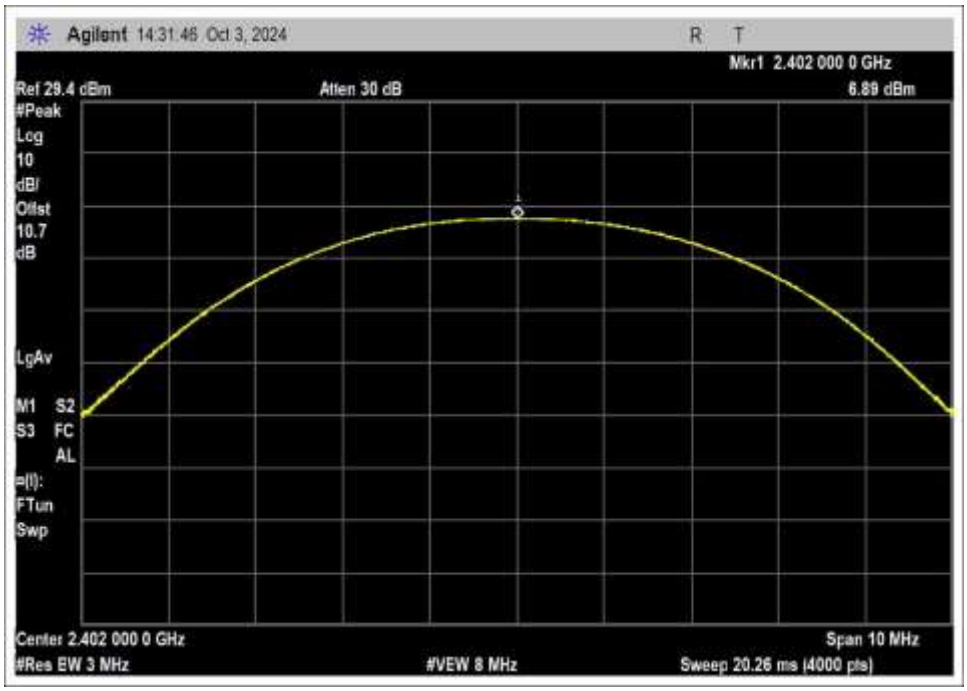


Middle Channel

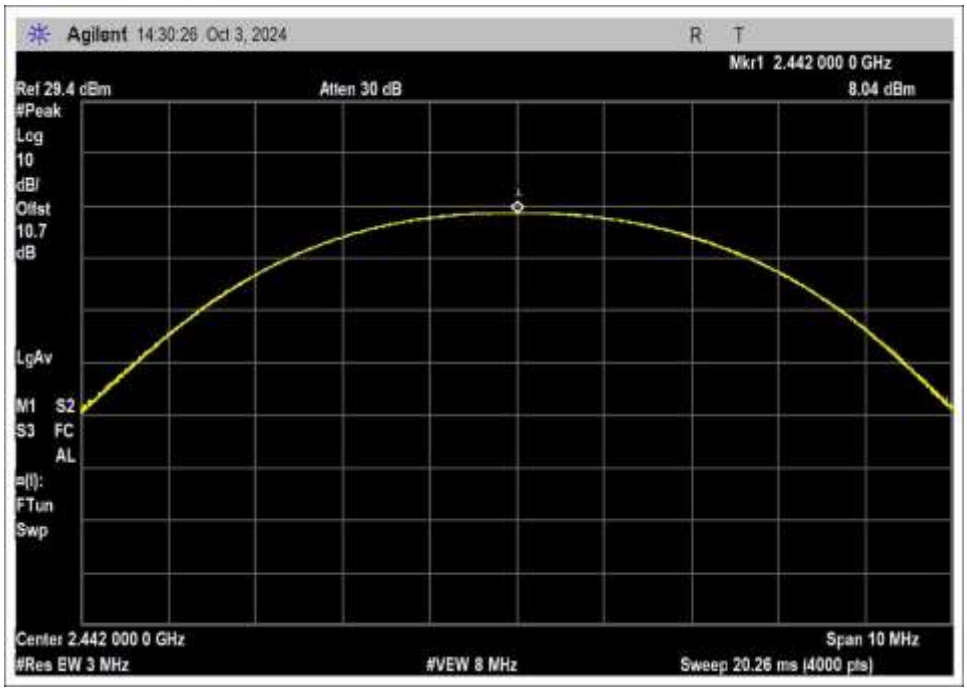


High Channel

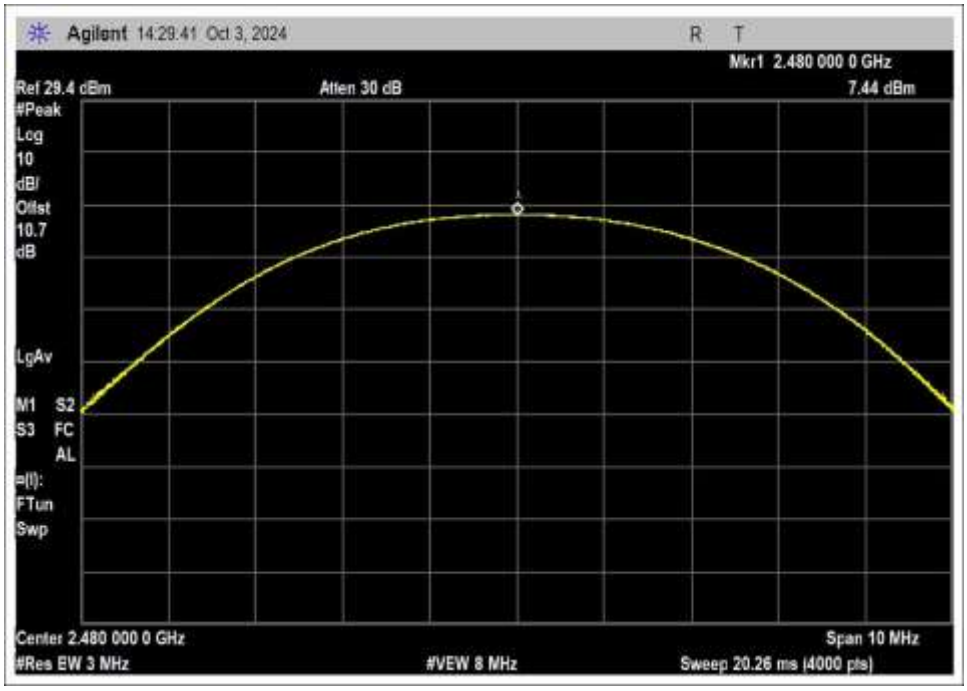
4-DQPSK



Low Channel

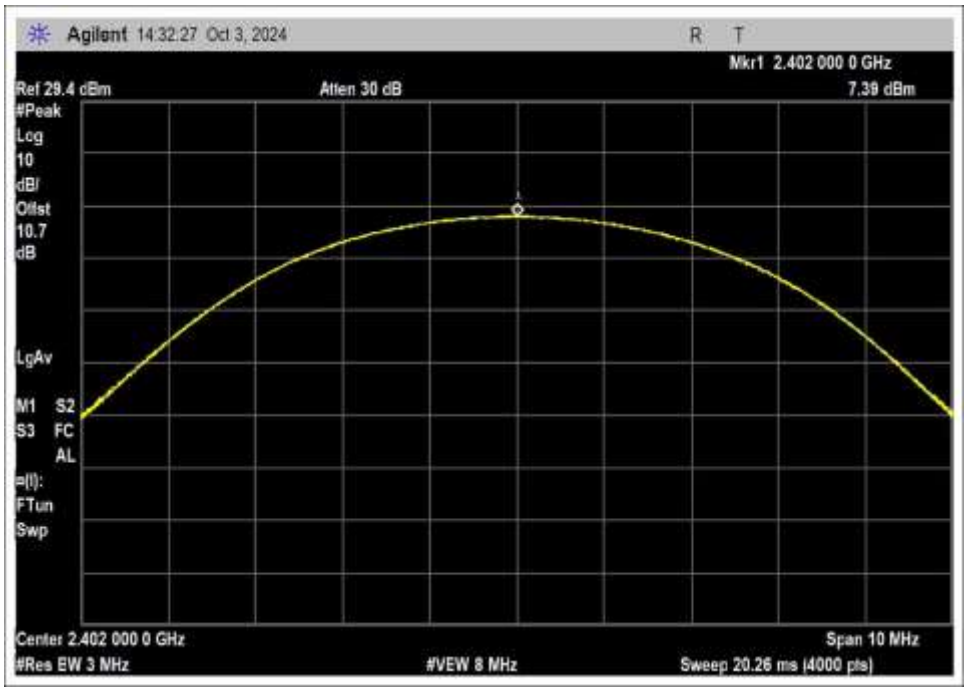


Middle Channel

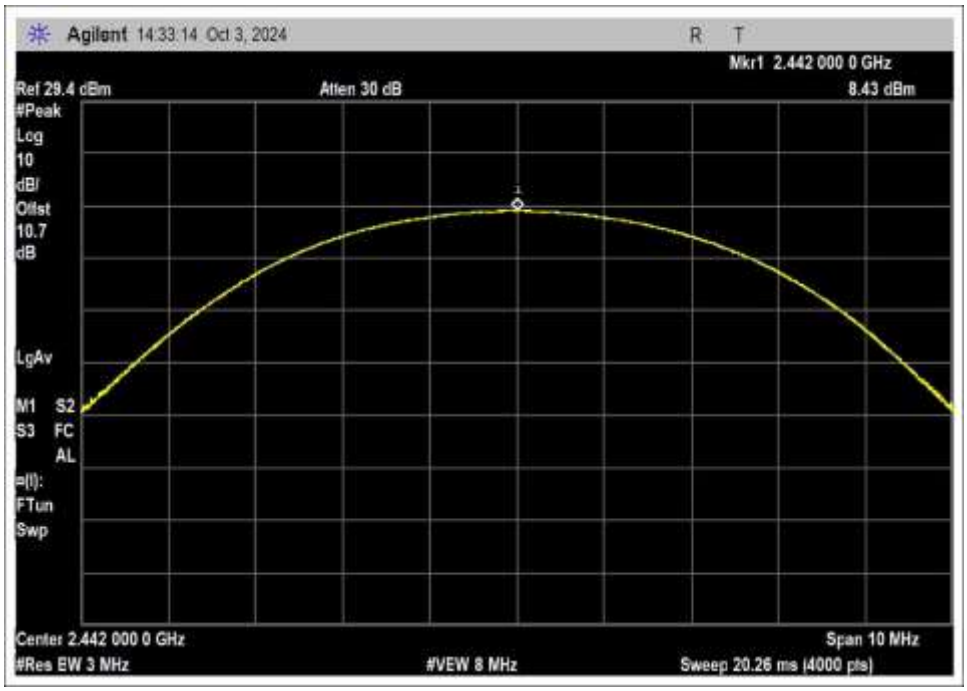


High Channel

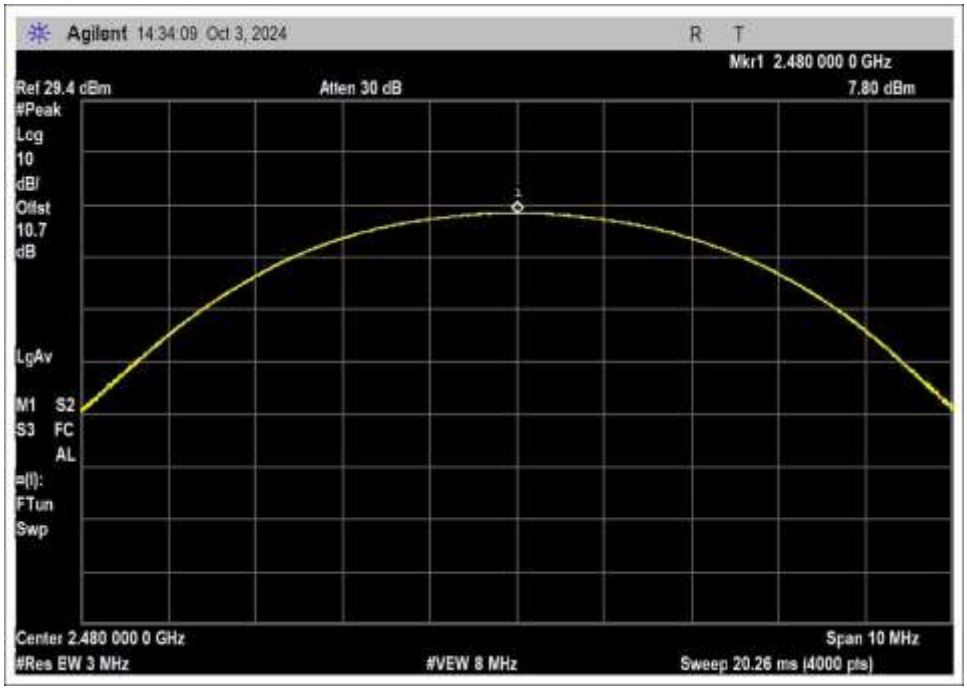
8-DQSPK



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 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	9:08:22 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	8
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

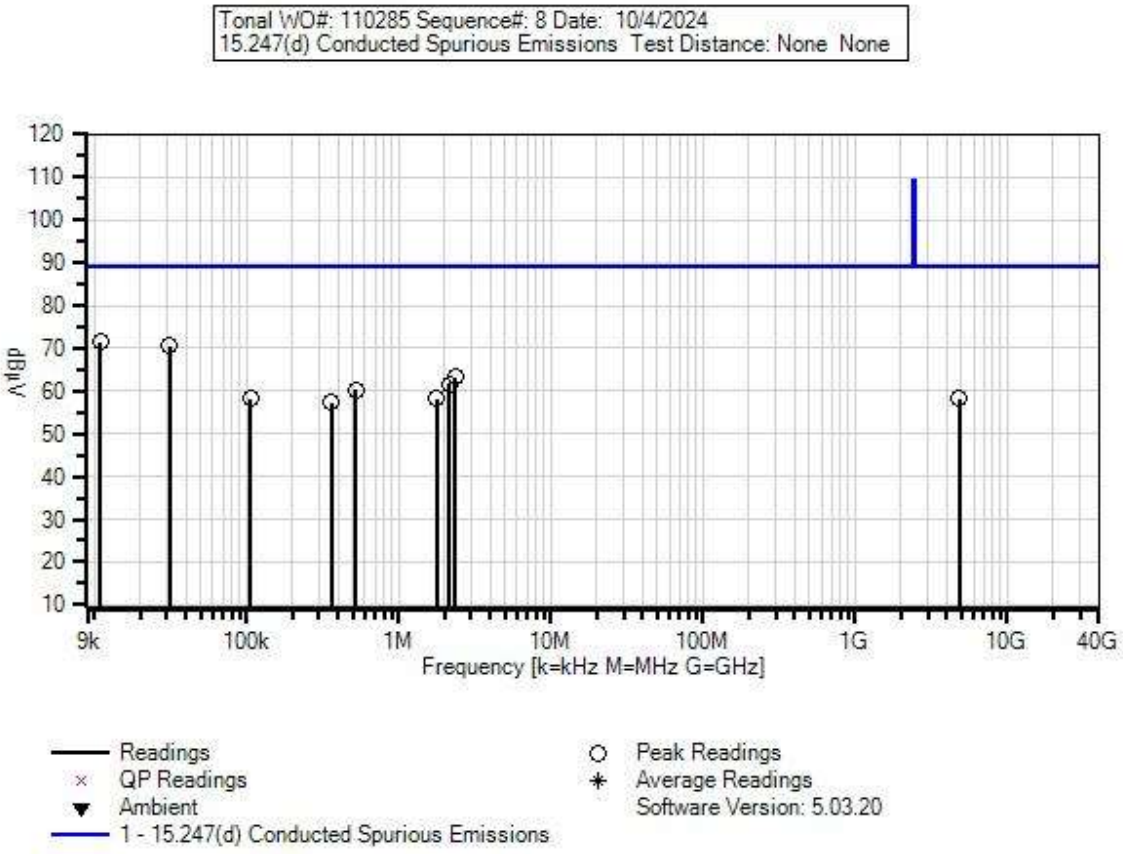
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-GFSK



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	11.023k	61.5	+9.8	+0.1			+0.0	71.4	89.1	-17.7	None
2	31.292k	60.7	+9.8	+0.0			+0.0	70.5	89.1	-18.6	None
3	2.363M	53.4	+9.9	+0.0			+0.0	63.3	89.1	-25.8	None
4	2.146M	51.7	+9.9	+0.0			+0.0	61.6	89.1	-27.5	None
5	520.934k	50.3	+9.9	+0.0			+0.0	60.2	89.1	-28.9	None
6	1.788M	48.4	+9.9	+0.0			+0.0	58.3	89.1	-30.8	None
7	106.707k	48.4	+9.8	+0.0			+0.0	58.2	89.1	-30.9	None
8	4804.480M	47.2	+9.9	+1.1			+0.0	58.2	89.1	-30.9	None
9	359.340k	47.6	+9.8	+0.0			+0.0	57.4	89.1	-31.7	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	9:17:59 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	9
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

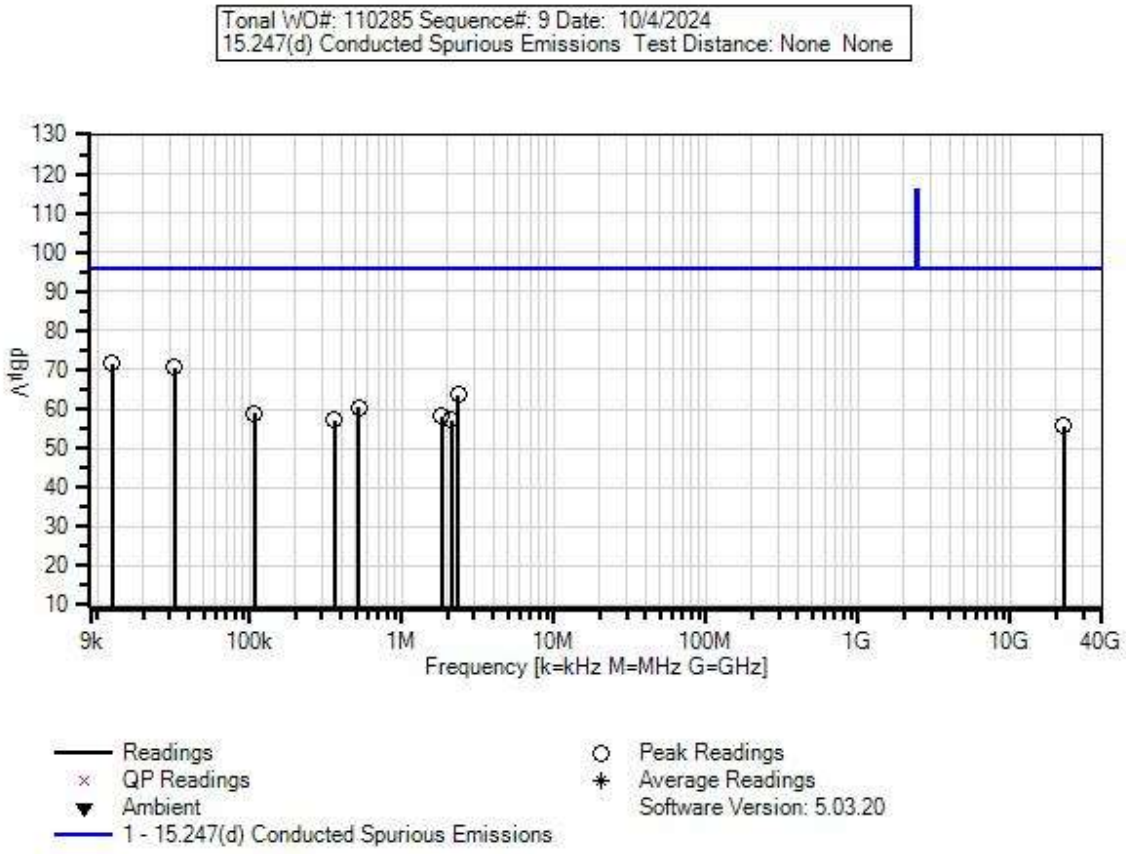
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-GFSK



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	12.518k	61.7	+9.9	+0.1			+0.0	71.7	95.7	-24.0	None
2	32.352k	60.7	+9.8	+0.0			+0.0	70.5	95.7	-25.2	None
3	2.363M	53.7	+9.9	+0.0			+0.0	63.6	95.7	-32.1	None
4	522.729k	50.4	+9.9	+0.0			+0.0	60.3	95.7	-35.4	None
5	108.532k	49.1	+9.8	+0.0			+0.0	58.9	95.7	-36.8	None
6	1.825M	48.2	+9.9	+0.0			+0.0	58.1	95.7	-37.6	None
7	360.383k	47.3	+9.8	+0.0			+0.0	57.1	95.7	-38.6	None
8	2.124M	47.2	+9.9	+0.0			+0.0	57.1	95.7	-38.6	None
9	22432.634 M	42.9	+10.1	+2.6			+0.0	55.6	95.7	-40.1	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	9:27:35 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	10
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

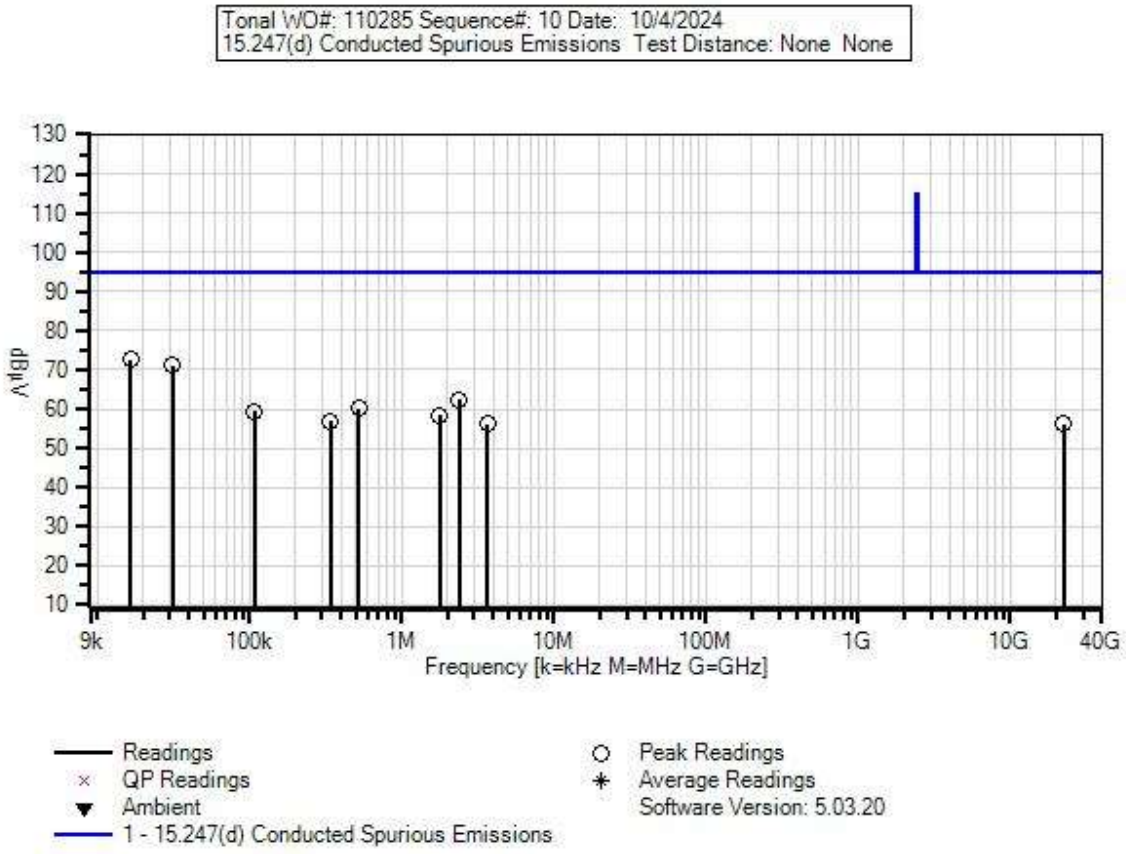
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-GFSK



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	16.696k	62.5	+9.9	+0.1			+0.0	72.5	95.0	-22.5	None
2	31.292k	61.4	+9.8	+0.0			+0.0	71.2	95.0	-23.8	None
3	2.393M	52.6	+9.9	+0.0			+0.0	62.5	95.0	-32.5	None
4	524.525k	50.2	+9.9	+0.0			+0.0	60.1	95.0	-34.9	None
5	107.228k	49.5	+9.8	+0.0			+0.0	59.3	95.0	-35.7	None
6	1.769M	48.4	+9.9	+0.0			+0.0	58.3	95.0	-36.7	None
7	340.308k	47.1	+9.8	+0.0			+0.0	56.9	95.0	-38.1	None
8	3.652M	46.4	+9.9	+0.0			+0.0	56.3	95.0	-38.7	None
9	22306.886 M	43.5	+10.1	+2.6			+0.0	56.2	95.0	-38.8	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	10:08:13 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	13
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

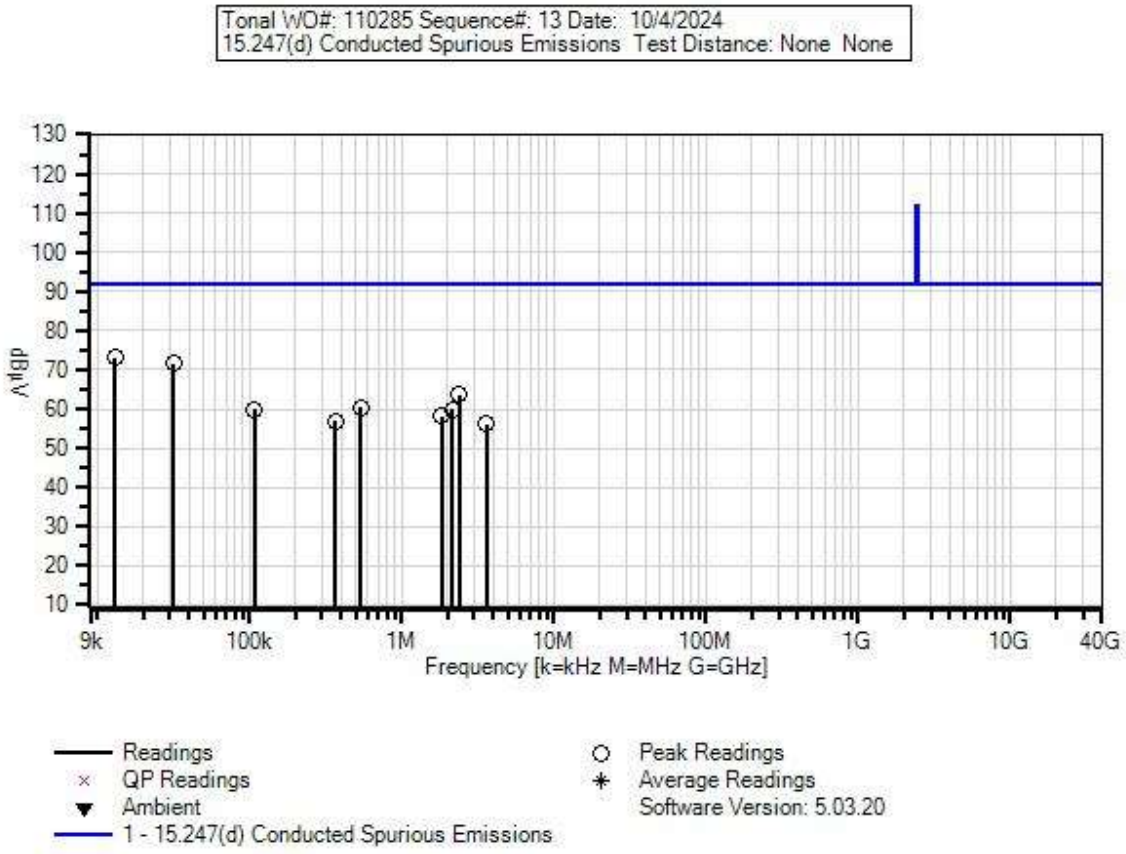
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-pie/4 DQPSK



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	13.156k	63.0	+9.9	+0.1			+0.0	73.0	91.7	-18.7	None
2	31.520k	61.9	+9.8	+0.0			+0.0	71.7	91.7	-20.0	None
3	2.378M	53.7	+9.9	+0.0			+0.0	63.6	91.7	-28.1	None
4	535.297k	50.4	+9.9	+0.0			+0.0	60.3	91.7	-31.4	None
5	2.171M	50.1	+9.9	+0.0			+0.0	60.0	91.7	-31.7	None
6	108.010k	50.0	+9.8	+0.0			+0.0	59.8	91.7	-31.9	None
7	1.825M	48.3	+9.9	+0.0			+0.0	58.2	91.7	-33.5	None
8	366.380k	47.2	+9.8	+0.0			+0.0	57.0	91.7	-34.7	None
9	3.608M	46.3	+9.9	+0.0			+0.0	56.2	91.7	-35.5	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	9:57:04 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	12
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

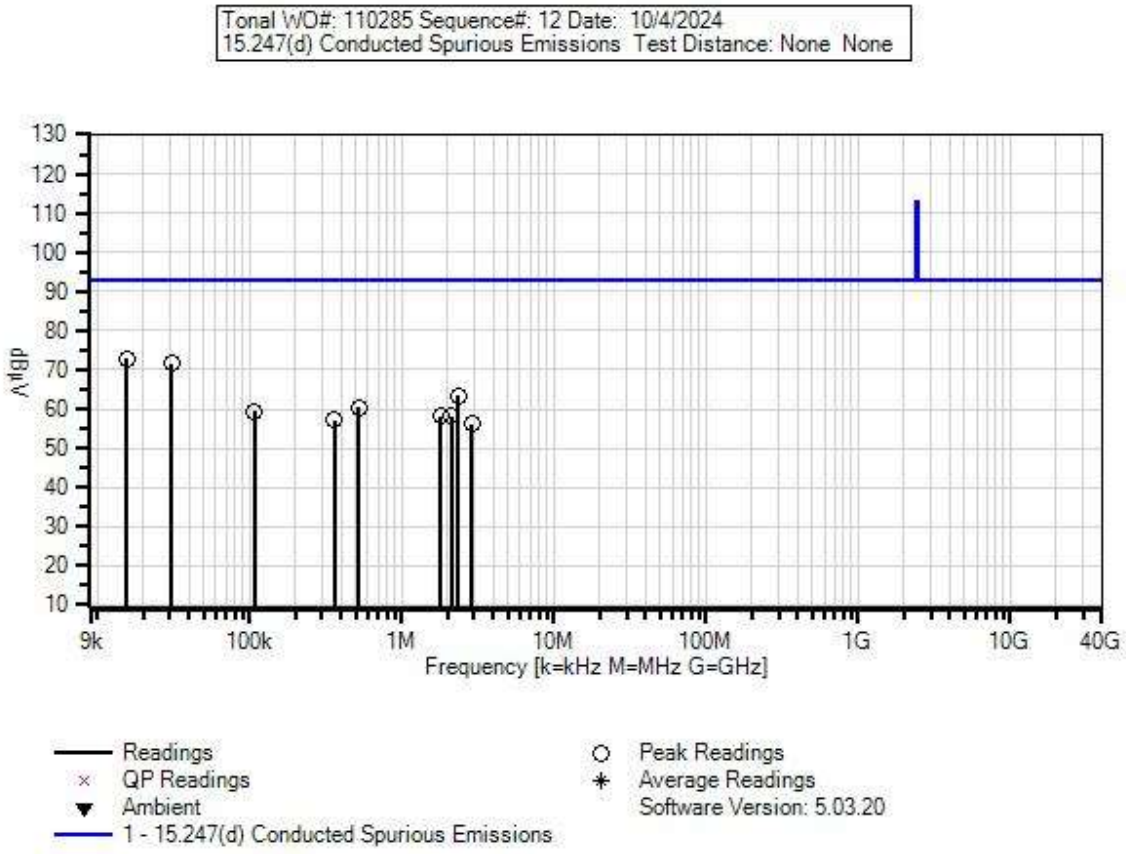
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-pie/4 DQPSK



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	15.575k	62.8	+9.9	+0.1			+0.0	72.8	92.9	-20.1	None
2	30.990k	61.7	+9.8	+0.0			+0.0	71.5	92.9	-21.4	None
3	2.372M	53.5	+9.9	+0.0			+0.0	63.4	92.9	-29.5	None
4	525.422k	50.5	+9.9	+0.0			+0.0	60.4	92.9	-32.5	None
5	107.228k	49.5	+9.8	+0.0			+0.0	59.3	92.9	-33.6	None
6	1.806M	48.3	+9.9	+0.0			+0.0	58.2	92.9	-34.7	None
7	2.112M	48.3	+9.9	+0.0			+0.0	58.2	92.9	-34.7	None
8	364.294k	47.3	+9.8	+0.0			+0.0	57.1	92.9	-35.8	None
9	2.903M	46.4	+9.9	+0.0			+0.0	56.3	92.9	-36.6	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	9:46:40 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	11
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

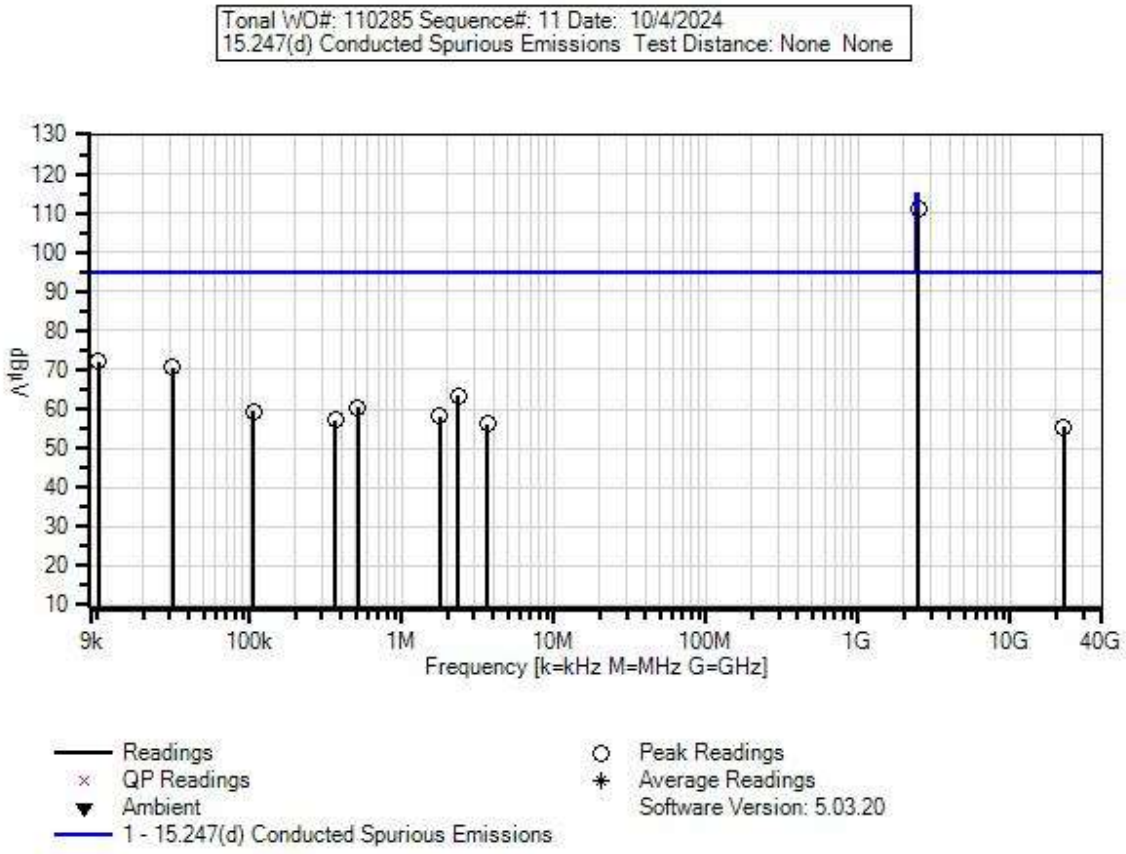
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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-pie/4 DQPSK



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	2481.561M	100.3	+9.9	+0.8			+0.0	111.0	115.0	-4.0	None
2	10.187k	62.2	+9.8	+0.1			+0.0	72.1	95.0	-22.9	None
3	31.065k	60.9	+9.8	+0.0			+0.0	70.7	95.0	-24.3	None
4	2.341M	53.6	+9.9	+0.0			+0.0	63.5	95.0	-31.5	None
5	518.240k	50.4	+9.9	+0.0			+0.0	60.3	95.0	-34.7	None
6	106.707k	49.5	+9.8	+0.0			+0.0	59.3	95.0	-35.7	None
7	1.791M	48.3	+9.9	+0.0			+0.0	58.2	95.0	-36.8	None
8	366.119k	47.3	+9.8	+0.0			+0.0	57.1	95.0	-37.9	None
9	3.645M	46.2	+9.9	+0.0			+0.0	56.1	95.0	-38.9	None
10	22327.844 M	42.8	+10.1	+2.6			+0.0	55.5	95.0	-39.5	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	11:10:39 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	14
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

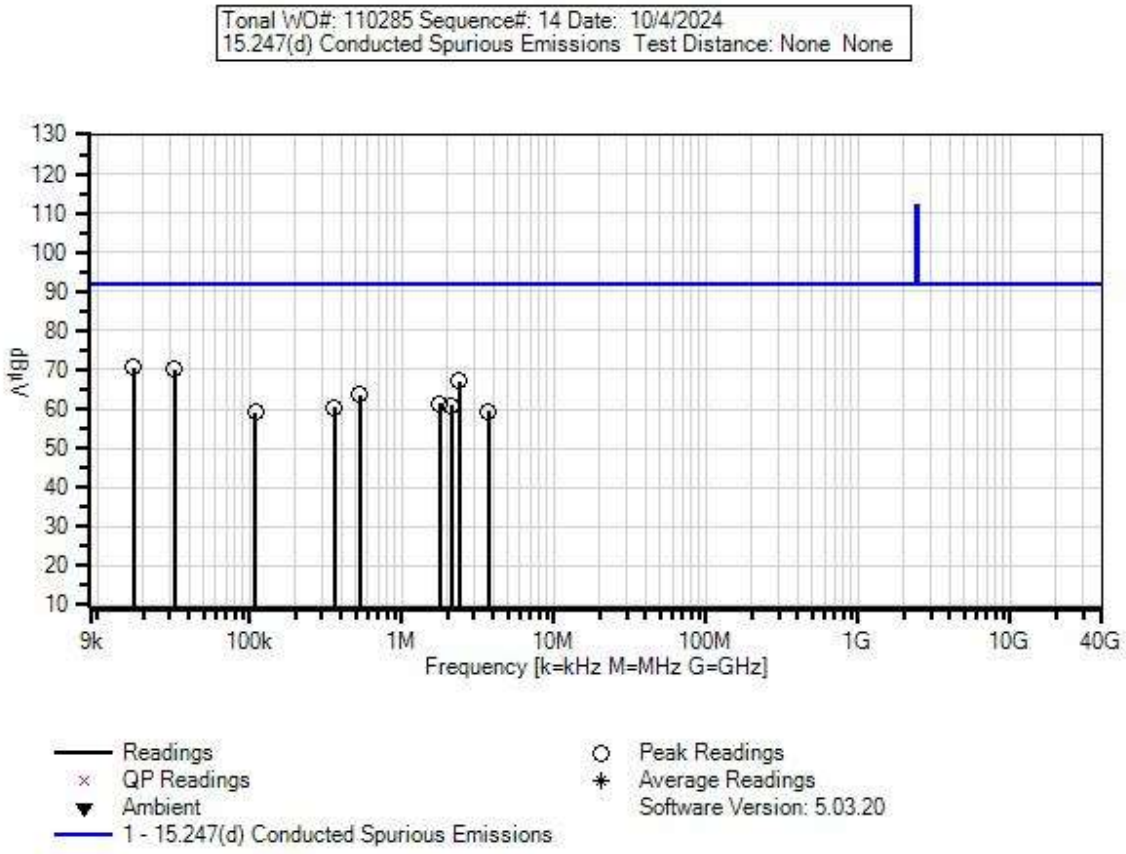
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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- 8 DQPSK



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	17.267k	60.7	+9.9	+0.1			+0.0	70.7	91.7	-21.0	None
2	32.125k	60.3	+9.8	+0.0			+0.0	70.1	91.7	-21.6	None
3	2.390M	57.3	+9.9	+0.0			+0.0	67.2	91.7	-24.5	None
4	528.115k	53.8	+9.9	+0.0			+0.0	63.7	91.7	-28.0	None
5	1.781M	51.5	+9.9	+0.0			+0.0	61.4	91.7	-30.3	None
6	2.109M	50.9	+9.9	+0.0			+0.0	60.8	91.7	-30.9	None
7	364.033k	50.6	+9.8	+0.0			+0.0	60.4	91.7	-31.3	None
8	3.707M	49.4	+9.9	+0.0			+0.0	59.3	91.7	-32.4	None
9	108.792k	49.3	+9.8	+0.0			+0.0	59.1	91.7	-32.6	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	11:17:10 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	15
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

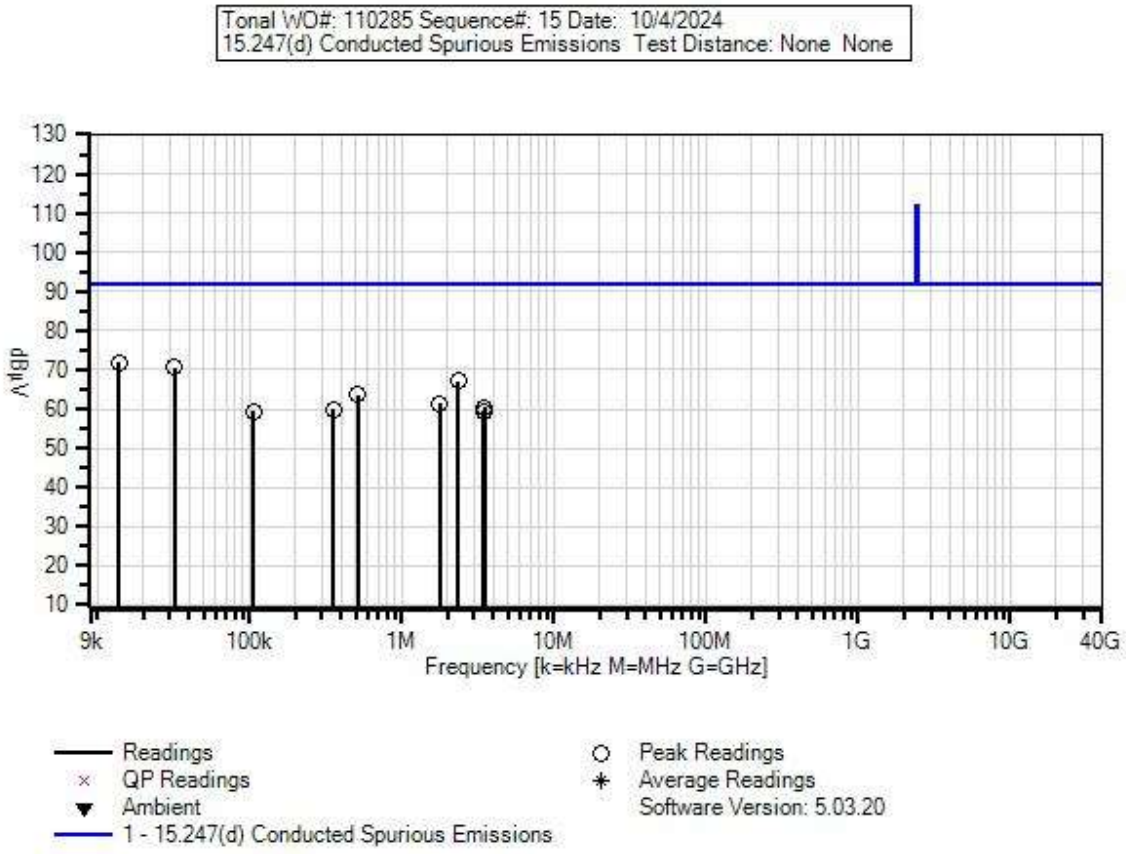
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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- 8 DQPSK



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	13.991k	61.9	+9.9	+0.1			+0.0	71.9	91.7	-19.8	None
2	32.201k	60.7	+9.8	+0.0			+0.0	70.5	91.7	-21.2	None
3	2.353M	57.2	+9.9	+0.0			+0.0	67.1	91.7	-24.6	None
4	519.138k	53.7	+9.9	+0.0			+0.0	63.6	91.7	-28.1	None
5	1.788M	51.5	+9.9	+0.0			+0.0	61.4	91.7	-30.3	None
6	3.503M	50.6	+9.9	+0.0			+0.0	60.5	91.7	-31.2	None
7	357.515k	50.1	+9.8	+0.0			+0.0	59.9	91.7	-31.8	None
8	106.707k	49.5	+9.8	+0.0			+0.0	59.3	91.7	-32.4	None
9	3.475M	49.4	+9.9	+0.0			+0.0	59.3	91.7	-32.4	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Scan**	Time:	11:26:36 AM
Tested By:	Hieu Song Nguyenpham	Sequence#:	16
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

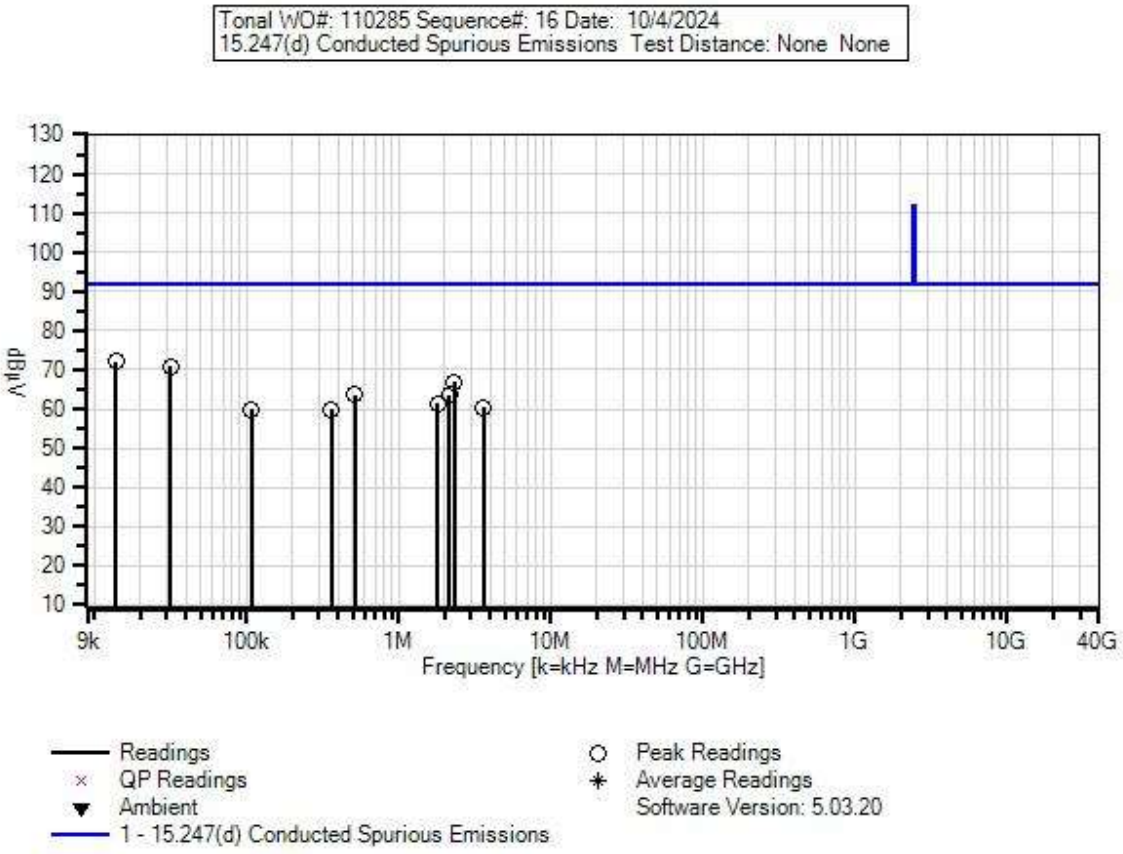
Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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

RF Out Set at = +9dBm

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- 8 DQPSK



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	13.881k	62.1	+9.9	+0.1			+0.0	72.1	91.7	-19.6	None
2	31.671k	61.0	+9.8	+0.0			+0.0	70.8	91.7	-20.9	None
3	2.325M	57.1	+9.9	+0.0			+0.0	67.0	91.7	-24.7	None
4	2.162M	53.7	+9.9	+0.0			+0.0	63.6	91.7	-28.1	None
5	516.445k	53.7	+9.9	+0.0			+0.0	63.6	91.7	-28.1	None
6	1.800M	51.5	+9.9	+0.0			+0.0	61.4	91.7	-30.3	None
7	3.611M	50.4	+9.9	+0.0			+0.0	60.3	91.7	-31.4	None
8	360.905k	50.2	+9.8	+0.0			+0.0	60.0	91.7	-31.7	None
9	107.489k	50.0	+9.8	+0.0			+0.0	59.8	91.7	-31.9	None

Band Edge

Band Edge Summary – Single Channel Mode				
Frequency (MHz)	**Modulation**	**Measured (dBuV)**	**Limit (dBuV)**	**Results**
2400	GFSK	59.1	<94.6	Pass
2483.5	GFSK	49.0	<95.0	Pass
2400	π/4-DQPSK	55.7	<91.7	Pass
2483.5	π/4-DQPSK	49.7	<92.5	Pass
2400	8-DQPSK	55.8	<91.7	Pass
2483.5	8-DQPSK	47.5	<92.4	Pass

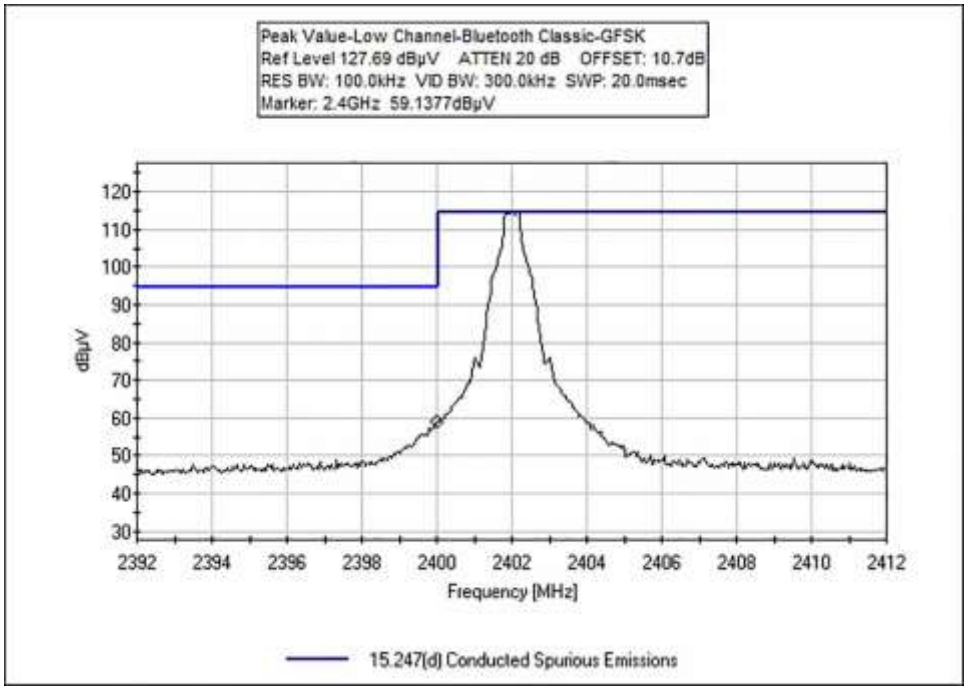
Limit applied: Max Power/100kHz - 20dB.

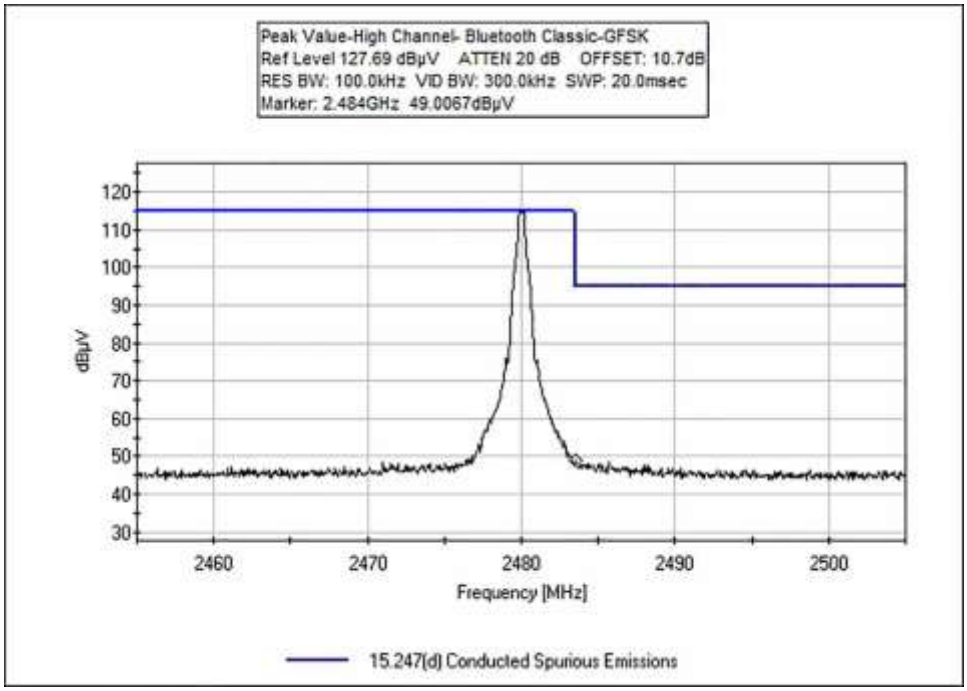
Band Edge Summary – Hopping Mode				
Frequency (MHz)	**Modulation**	**Measured (dBuV)**	**Limit (dBuV)**	**Results**
2400	GFSK	59.8	<94.6	Pass
2483.5	GFSK	49.5	<95.0	Pass
2400	π/4-DQPSK	56.0	<91.7	Pass
2483.5	π/4-DQPSK	50.1	<92.5	Pass
2400	8-DQPSK	55.7	<91.7	Pass
2483.5	8-DQPSK	46.8	<92.4	Pass

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

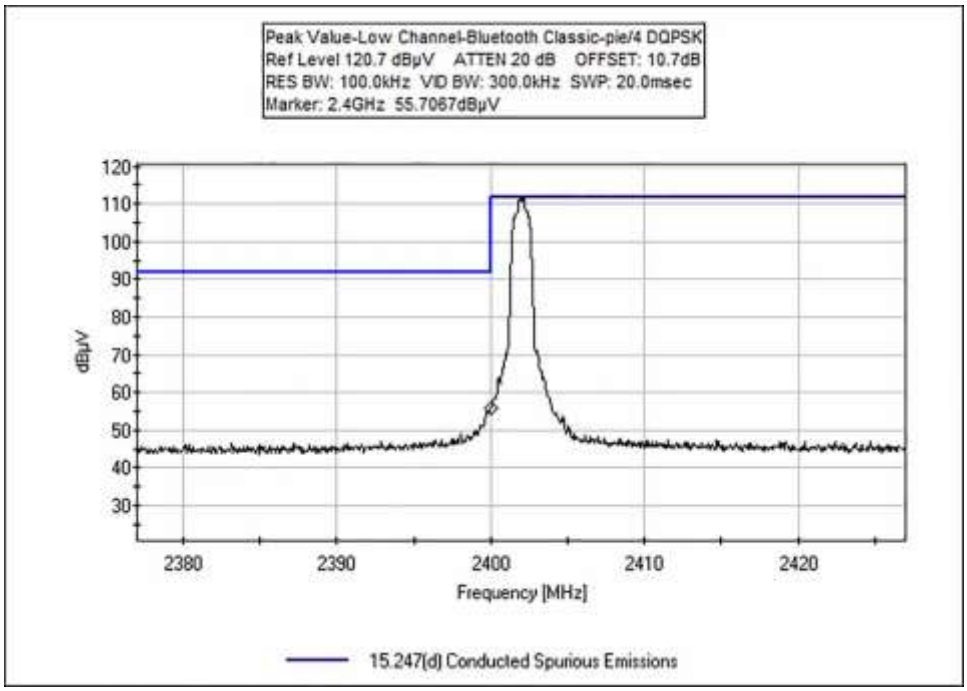
Band Edge Plots

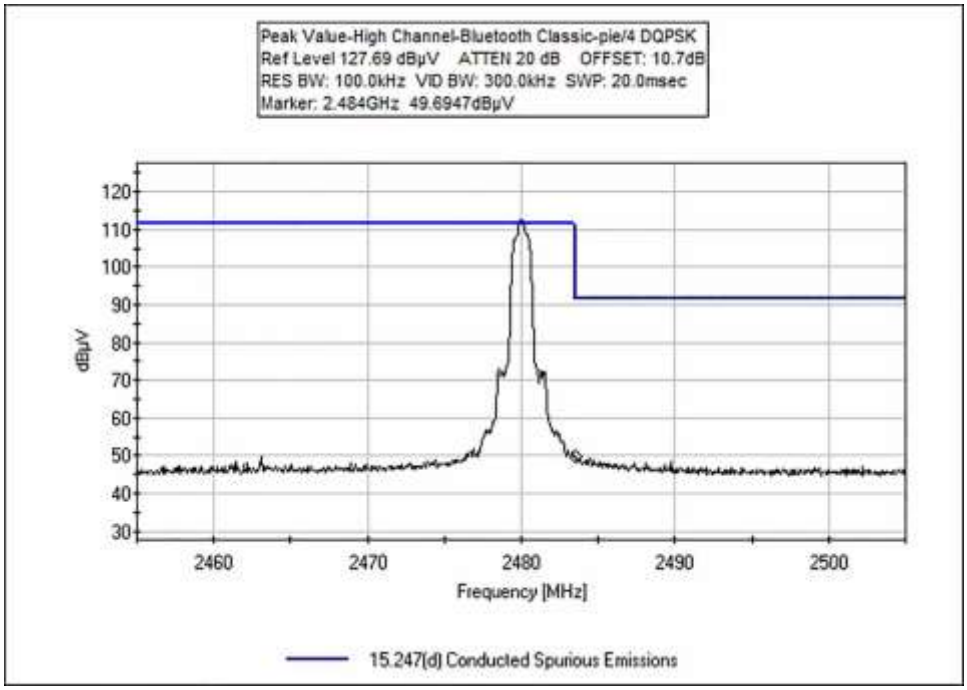
Single Channel
GFSK



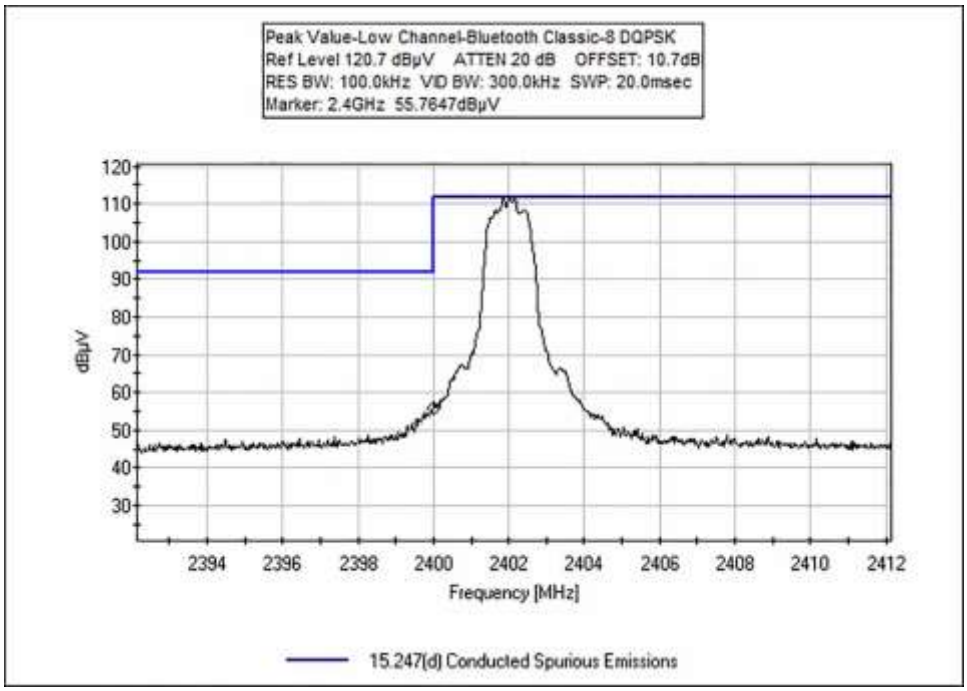


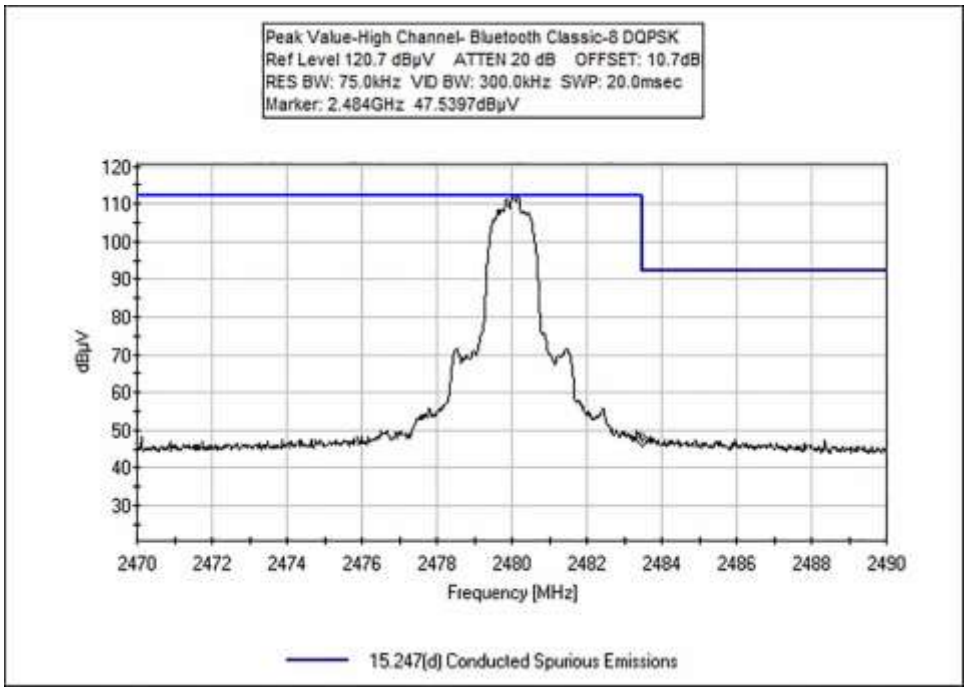
4-DQPSK


Peak Value-Low Channel-Bluetooth Classic-pie/4 DQPSK
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 55.7067dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2380
2390
2400
2410
2420
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

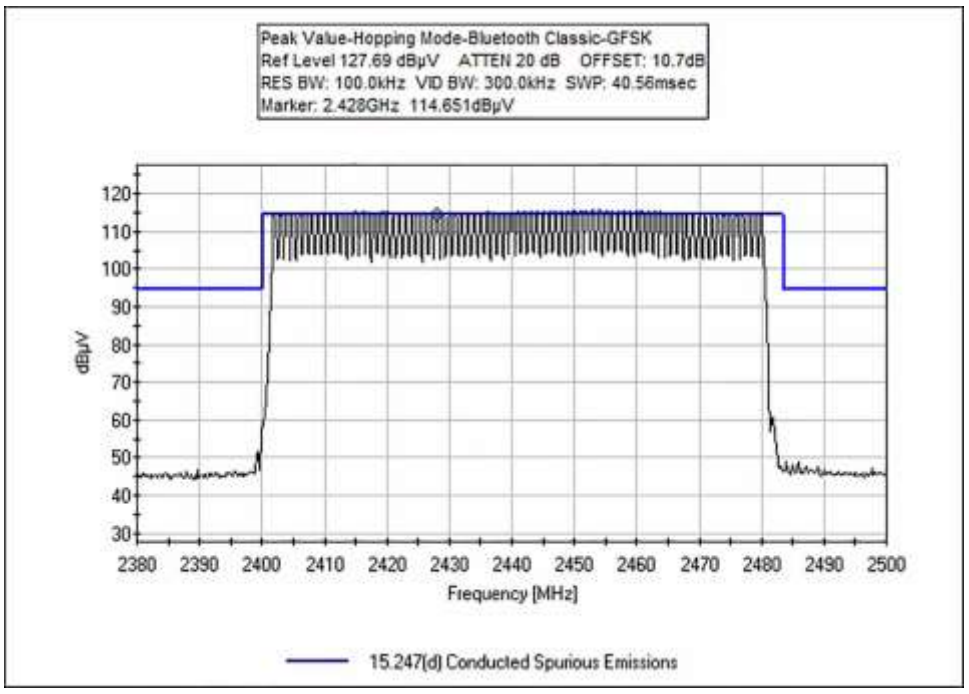

Peak Value-High Channel-Bluetooth Classic-pie/4 DQPSK
Ref Level 127.69 dBµV ATTEN 20 dB OFFSET: 10.7dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.484GHz 49.6947dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

8-DQPSK

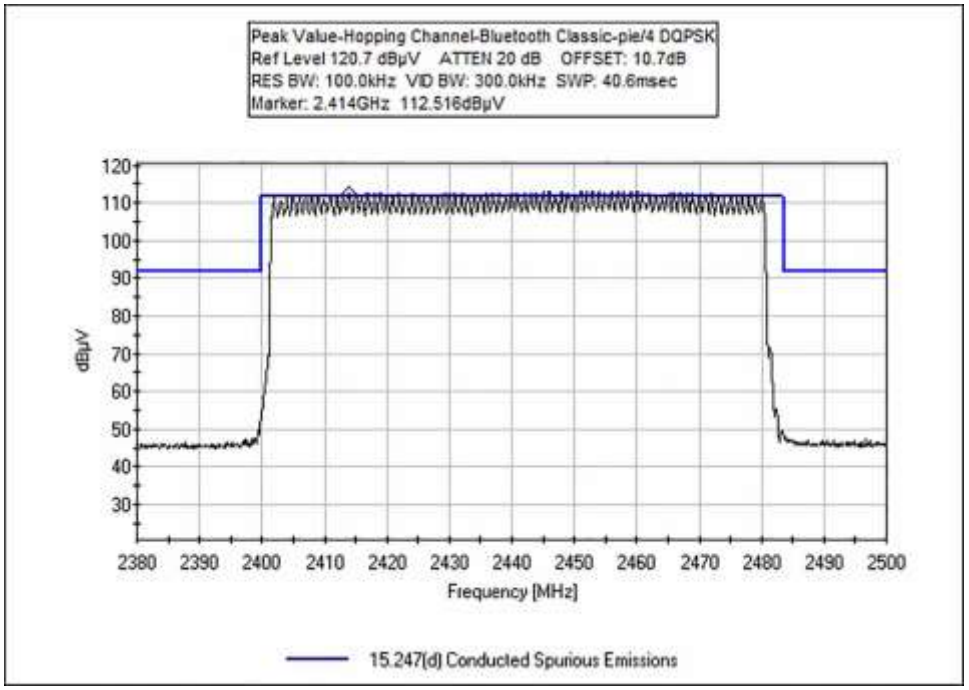

Peak Value-Low Channel-Bluetooth Classic-8 DQPSK
Ref Level 120.7 dBµV ATTEN 20 dB OFFSET: 10.7dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.4GHz 55.7647dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2394
2396
2398
2400
2402
2404
2406
2408
2410
2412
Frequency [MHz]
15.247(d) Conducted Spurious Emissions


Peak Value-High Channel- Bluetooth Classic-8 DQPSK
Ref Level 120.7 dBµV ATTEN 20 dB OFFSET: 10.7dB
RES BW: 75.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.484GHz 47.5397dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2470
2472
2474
2476
2478
2480
2482
2484
2486
2488
2490
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

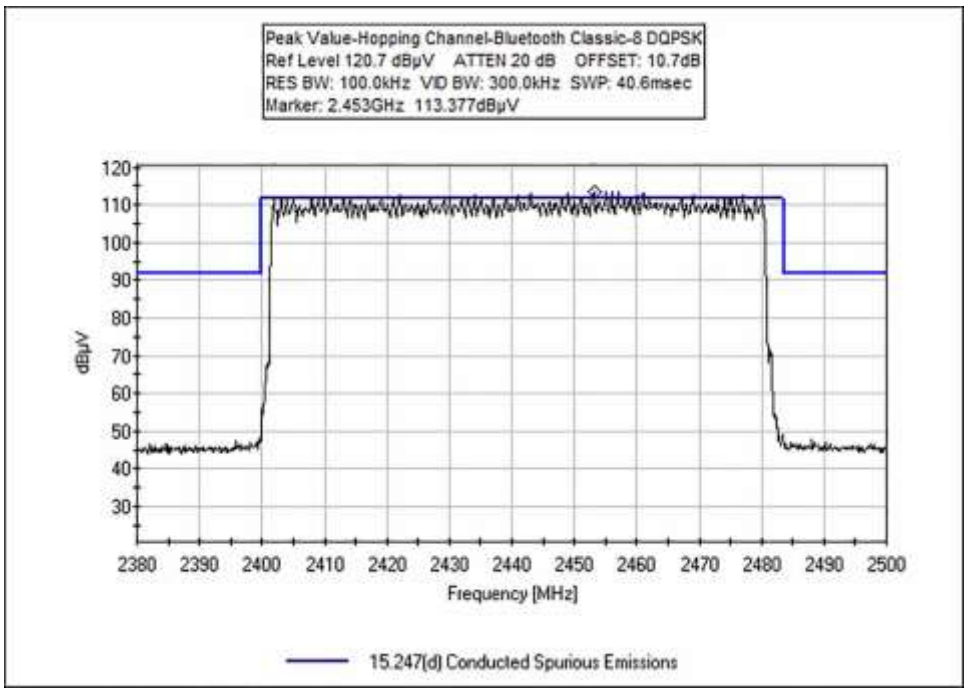
Hopping Channel
GFSK



4-DQPSK



8-DQPSK


Peak Value-Hopping Channel-Bluetooth Classic-8 DQPSK
Ref Level 120.7 dBµV ATTEN 20 dB OFFSET: 10.7dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 40.6msec
Marker: 2.453GHz 113.377dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
2380 2390 2400 2410 2420 2430 2440 2450 2460 2470 2480 2490 2500
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Emission on Antenna Port**	Time:	09:36:11
Tested By:	Hieu Song Nguyenpham	Sequence#:	8
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= +9dBm

GFSK

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	2400.000M	59.1					+0.0	59.1	94.6	-35.5	None
									Single Channel Mode		
2	2483.500M	49.0					+0.0	49.0	95.0	-46.0	None
									Single Channel Mode		
3	2400.000M	59.8					+0.0	59.8	94.6	-34.8	None
									Hopping Mode		
4	2483.500M	49.5					+0.0	49.5	95.0	-45.5	None
									Hopping Mode		

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Emission at Antenna Port**	Time:	10:19:36
Tested By:	Hieu Song Nguyenpham	Sequence#:	9
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= +9dBm

4-DQPSK

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	92.5	-42.8	None
									Single Channel Mode		
2	2400.000M	55.7					+0.0	55.7	91.7	-36.0	None
									Single Channel Mode		
3	2400.000M	56.0					+0.0	56.0	91.7	-35.7	None
									Hopping Mode		
4	2483.500M	50.1					+0.0	50.1	92.5	-42.4	None
									Hopping Mode		

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**110285**	Date:	10/4/2024
Test Type:	**Conducted Emission on Antenna Port**	Time:	11:35:16
Tested By:	Hieu Song Nguyenpham	Sequence#:	10
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= +9dBm

4-DQPSK

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	2400.000M	55.8					+0.0	55.8	91.7 Single Mode	-35.9	None
2	2483.500M	47.5					+0.0	47.5	92.4 Single Mode	-44.9	None
3	2400.000M	55.7					+0.0	55.7	91.7 Hopping Mode	-36.0	None
4	2483.500M	46.8					+0.0	46.8	92.4 Hopping Mode	-45.6	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	1: Perform Radiated Emission on the worst case based on the investigation on RF output power for the band edge before measuring Radiated Spurious Emission. 2: Comparing the hopping mode at 100kHz RBW and the single mode at 100kHz RBW, there is no different emission generating between them; therefore, the hopping mode at 1MHz RBW will not generate any different emission when comparing to a single mode at 1MHz RBW.		

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170
Customer: **Tonal**
Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
Work Order #: **110285** Date: 11/6/2024
Test Type: **Radiated Scan** Time: 18:29:54
Tested By: Hieu Song Nguyenpham Sequence#: 164
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)

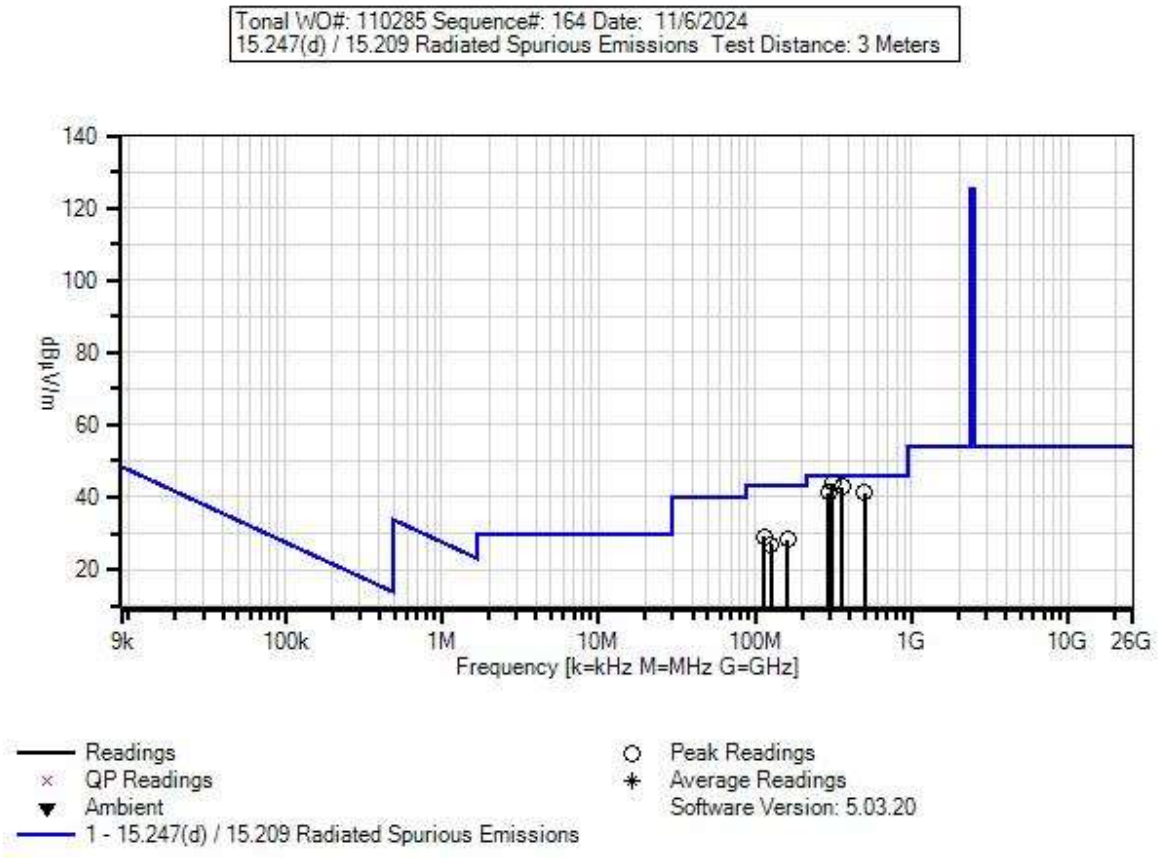
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
BT transmitting continuously with GFSK modulation type, with pattern of 0s and 1s at power level 9 (+9dBm).

2442MHz-Middle Channel

Operational mode is representative of worst case.

No emissions from EUT has 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	53.6	-31.9 +0.6	+19.4	+1.8	+0.5	+0.0	44.0	46.0	-2.0	Horiz
2	360.052M	51.0	-31.9 +0.7	+20.5	+1.9	+0.6	+0.0	42.8	46.0	-3.2	Horiz
3	503.752M	44.9	-32.0 +0.8	+24.5	+2.3	+0.7	+0.0	41.2	46.0	-4.8	Horiz
4	297.122M	50.8	-31.9 +0.6	+19.4	+1.8	+0.5	+0.0	41.2	46.0	-4.8	Horiz
5	113.966M	42.2	-32.0 +0.4	+17.3	+1.0	+0.3	+0.0	29.2	43.5	-14.3	Vert
6	162.014M	41.8	-32.0 +0.4	+16.5	+1.2	+0.3	+0.0	28.2	43.5	-15.3	Vert
7	125.978M	39.4	-32.1 +0.4	+17.7	+1.1	+0.3	+0.0	26.8	43.5	-16.7	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/4/2024
Test Type:	**Radiated Scan**	Time:	10:42:51
Tested By:	Hieu Song Nguyenpham	Sequence#:	110
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

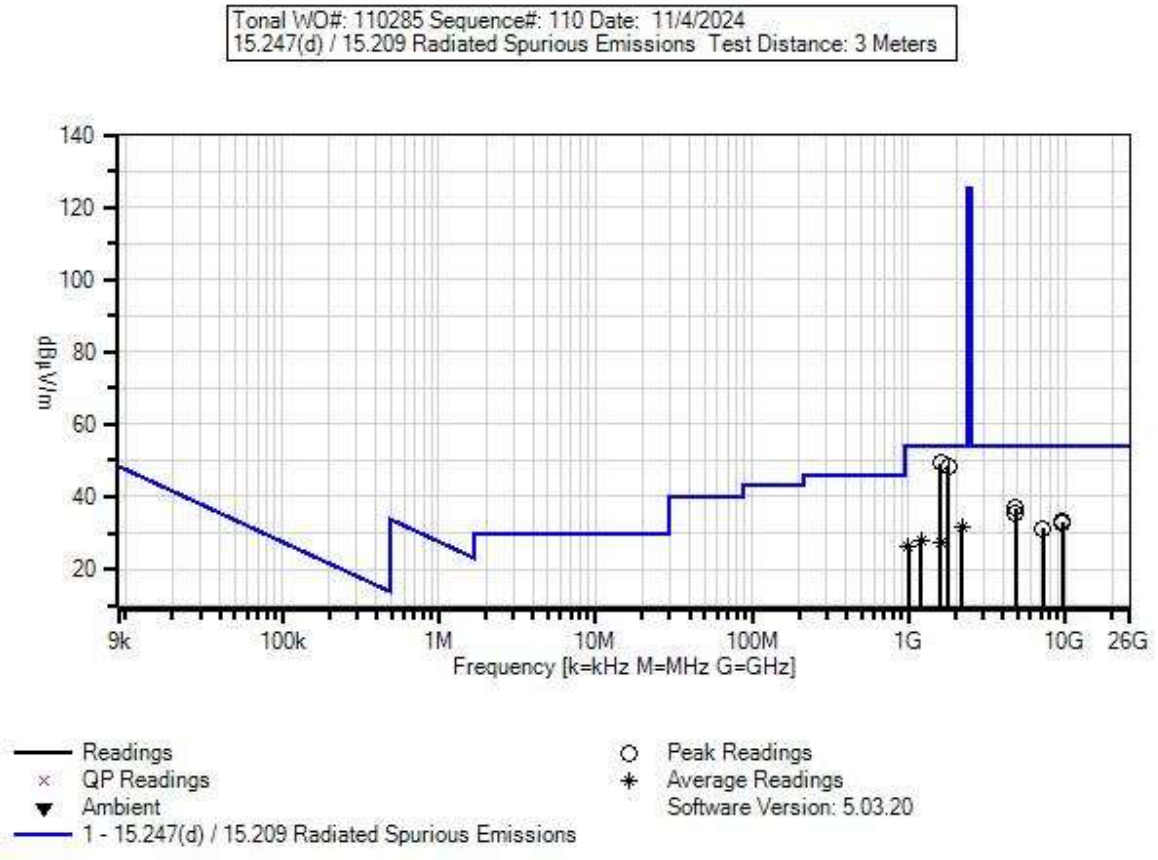
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, with pattern of 0s and 1s at power level 9 (+9dBm).
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	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025
T7	ANP07938	Preamp	83017A	6/14/2023	6/14/2025
T8	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	3/22/2024	3/22/2026

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	1594.279M	47.6	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	49.4	54.0	-4.6	Horiz
2	1793.535M	45.0	+27.2 +0.7	+1.2 +0.0	+2.1 +0.0	-27.7 +0.0	+0.0	48.5	54.0	-5.5	Horiz
3	4804.060M	56.2	+33.4 +1.1	+2.0 +0.8	+3.6 -34.1	-26.4 +0.3	+0.0	36.9	54.0	-17.1	Vert
4	4803.970M	54.5	+33.4 +1.1	+2.0 +0.8	+3.6 -34.1	-26.4 +0.3	+0.0	35.2	54.0	-18.8	Horiz
5	9608.060M	43.5	+39.3 +1.6	+3.0 +1.3	+5.9 -33.6	-28.2 +0.2	+0.0	33.0	54.0	-21.0	Vert
6	9607.970M	43.4	+39.3 +1.6	+3.0 +1.3	+5.9 -33.6	-28.2 +0.2	+0.0	32.9	54.0	-21.1	Horiz
7	2196.011M 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
^	2196.011M	56.1	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	61.6	54.0	+7.6	Vert
9	7206.060M	45.1	+36.0 +1.5	+2.5 +1.4	+4.5 -34.4	-25.6 +0.2	+0.0	31.2	54.0	-22.8	Vert
10	1197.894M Ave	28.6	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	28.1	54.0	-25.9	Vert
^	1197.894M	52.9	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	52.4	54.0	-1.6	Vert
12	1599.127M Ave	25.3	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	27.1	54.0	-26.9	Vert
^	1599.127M	51.2	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	53.0	54.0	-1.0	Vert
14	1000.000M Ave	27.4	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.8 +0.0	+0.0	26.0	54.0	-28.0	Horiz
^	1000.000M	57.6	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.8 +0.0	+0.0	56.2	54.0	+2.2	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/4/2024
Test Type:	**Radiated Scan**	Time:	10:28:23
Tested By:	Hieu Song Nguyenpham	Sequence#:	113
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

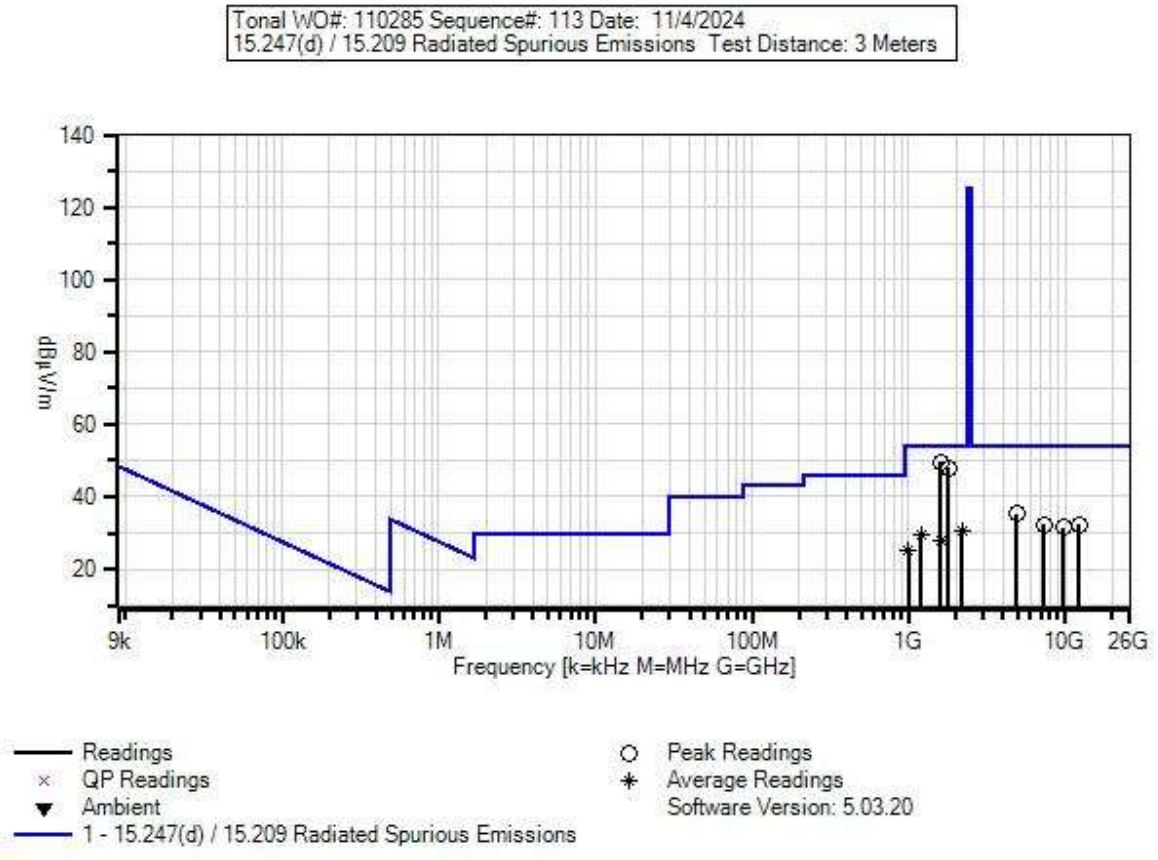
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, with pattern of 0s and 1s at power level 9 (+9dBm).
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	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025
T7	ANP07938	Preamp	83017A	6/14/2023	6/14/2025
T8	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	3/22/2024	3/22/2026

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	1594.279M	47.9	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	49.7	54.0	-4.3	Horiz
2	1798.383M	44.3	+27.2 +0.7	+1.2 +0.0	+2.2 +0.0	-27.7 +0.0	+0.0	47.9	54.0	-6.1	Horiz
3	4884.010M	54.3	+33.6 +1.1	+2.0 +0.9	+3.6 -34.0	-26.4 +0.2	+0.0	35.3	54.0	-18.7	Vert
4	4884.050M	54.3	+33.6 +1.1	+2.0 +0.9	+3.6 -34.0	-26.4 +0.2	+0.0	35.3	54.0	-18.7	Horiz
5	7325.770M	45.7	+36.3 +1.5	+2.6 +1.5	+4.6 -34.5	-25.6 +0.2	+0.0	32.3	54.0	-21.7	Vert
6	12210.050 M	42.4	+40.0 +1.8	+3.3 +1.4	+6.5 -34.1	-29.6 +0.6	+0.0	32.3	54.0	-21.7	Horiz
7	9767.770M	41.9	+39.5 +1.6	+3.0 +1.3	+5.9 -33.5	-28.4 +0.2	+0.0	31.5	54.0	-22.5	Vert
8	2186.142M Ave	25.3	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	30.8	54.0	-23.2	Vert
^	2186.142M	53.8	+28.2 +0.8	+1.3 +0.0	+2.4 +0.0	-27.2 +0.0	+0.0	59.3	54.0	+5.3	Vert
10	1195.393M Ave	29.9	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	29.4	54.0	-24.6	Vert
^	1195.393M	55.1	+24.8 +0.6	+0.9 +0.0	+1.7 +0.0	-28.5 +0.0	+0.0	54.6	54.0	+0.6	Vert
12	1598.643M Ave	26.0	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	27.8	54.0	-26.2	Vert
^	1598.643M	52.9	+26.1 +0.6	+1.1 +0.0	+2.0 +0.0	-28.0 +0.0	+0.0	54.7	54.0	+0.7	Vert
14	1000.040M Ave	26.4	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.8 +0.0	+0.0	25.0	54.0	-29.0	Horiz
^	1000.040M	56.1	+24.2 +0.6	+1.0 +0.0	+1.6 +0.0	-28.8 +0.0	+0.0	54.7	54.0	+0.7	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/4/2024
Test Type:	**Radiated Scan**	Time:	09:36:39
Tested By:	Hieu Song Nguyenpham	Sequence#:	116
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

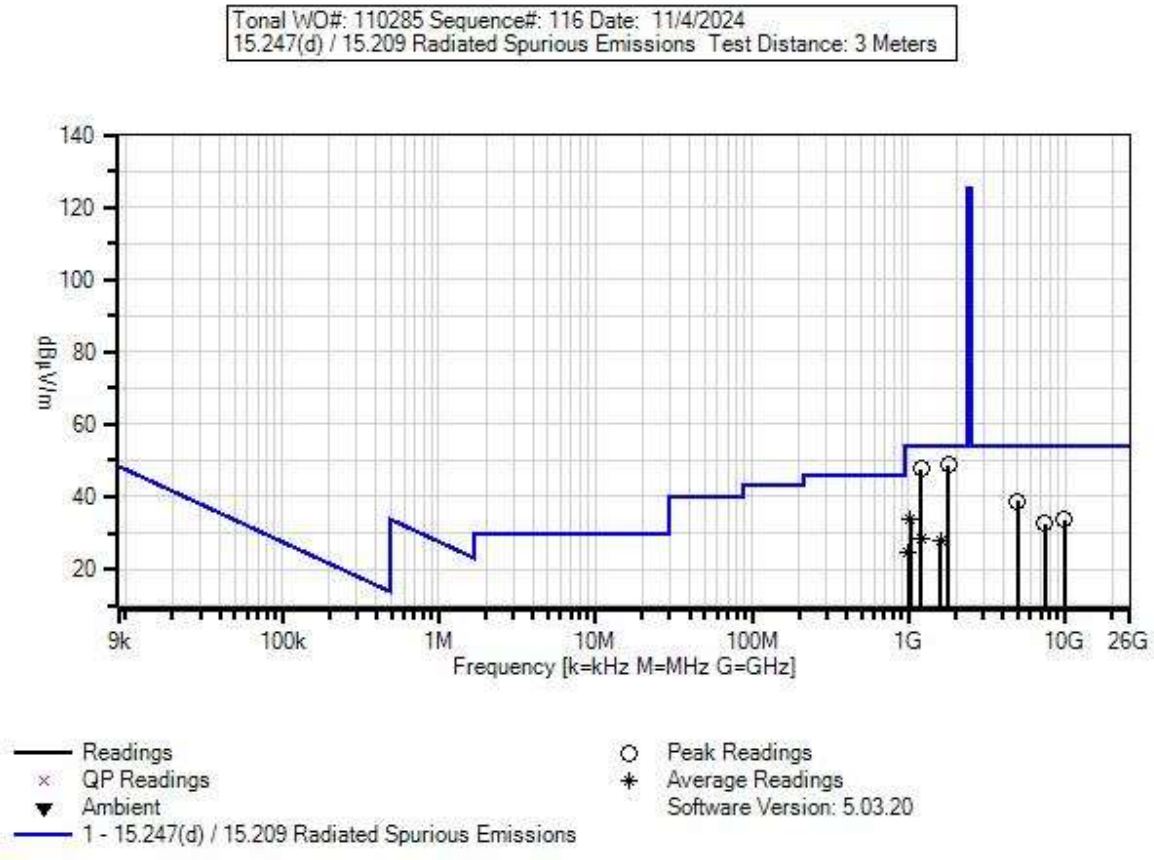
Test Environment Conditions:
Temperature: 22.0°C
Humidity: 37%
Atmospheric Pressure: 101.5kPa

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, with pattern of 0s and 1s at power level 9 (+9dBm).
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	1797.898M	45.2	+27.2	+1.2	+2.2	-27.7	+0.0	48.8	54.0	-5.2	Horiz
			+0.7	+0.0	+0.0	+0.0					
2	1195.393M	48.3	+24.8	+0.9	+1.7	-28.5	+0.0	47.8	54.0	-6.2	Horiz
			+0.6	+0.0	+0.0	+0.0					
3	4960.083M	57.4	+33.8	+2.0	+3.6	-26.4	+0.0	38.7	54.0	-15.3	Vert
			+1.2	-34.0	+0.2	+0.9					
4	1022.504M	35.1	+24.3	+1.0	+1.6	-28.7	+0.0	33.9	54.0	-20.1	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1022.504M	55.0	+24.3	+1.0	+1.6	-28.7	+0.0	53.8	54.0	-0.2	Vert
			+0.6	+0.0	+0.0	+0.0					
6	9919.870M	44.2	+39.6	+3.0	+5.8	-28.6	+0.0	33.7	54.0	-20.3	Vert
			+1.7	-33.5	+0.2	+1.3					
7	7440.180M	46.0	+36.6	+2.6	+4.6	-25.7	+0.0	32.7	54.0	-21.3	Vert
			+1.5	-34.6	+0.2	+1.5					
8	1194.679M	29.1	+24.8	+0.9	+1.7	-28.5	+0.0	28.6	54.0	-25.4	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1194.679M	55.7	+24.8	+0.9	+1.7	-28.5	+0.0	55.2	54.0	+1.2	Vert
			+0.6	+0.0	+0.0	+0.0					
10	1597.188M	26.0	+26.1	+1.1	+2.0	-28.0	+0.0	27.8	54.0	-26.2	Vert
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1597.188M	52.6	+26.1	+1.1	+2.0	-28.0	+0.0	54.4	54.0	+0.4	Vert
			+0.6	+0.0	+0.0	+0.0					
12	1000.357M	26.1	+24.2	+1.0	+1.6	-28.8	+0.0	24.7	54.0	-29.3	Horiz
	Ave		+0.6	+0.0	+0.0	+0.0					
^	1000.357M	54.7	+24.2	+1.0	+1.6	-28.8	+0.0	53.3	54.0	-0.7	Horiz
			+0.6	+0.0	+0.0	+0.0					

Band Edge

Band Edge Summary – Single Channel Mode							
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 Connector /3.67	45.2	≤54	61.8	≤74	Pass
2400.0	GFSK	External Connector /3.67	NA2	NA2	52.2	≤86	Pass
2483.5	GFSK	External Connector /3.67	45.6	≤54	60.9	≤74	Pass
2390.0	π/4-DQPSK	External Connector /3.67	45.3	≤54	62.1	≤74	Pass
2400.0	π/4-DQPSK	External Connector /3.67	NA2	NA2	50.6	≤82.6	Pass
2483.5	π/4-DQPSK	External Connector /3.67	45.7	≤54	59.8	≤74	Pass
2390.0	8-DQPSK	External Connector /3.67	45.3	≤54	62.0	≤74	Pass
2400.0	8-DQPSK	External Connector /3.67	NA2	NA2	49.5	≤82.6	Pass
2483.5	8-DQPSK	External Connector /3.67	45.8	≤54	58.3	≤74	Pass

Notes:

NA1	Peak measurement meets average limit.
NA2	Average limit not applicable when applying 20dBc limit.

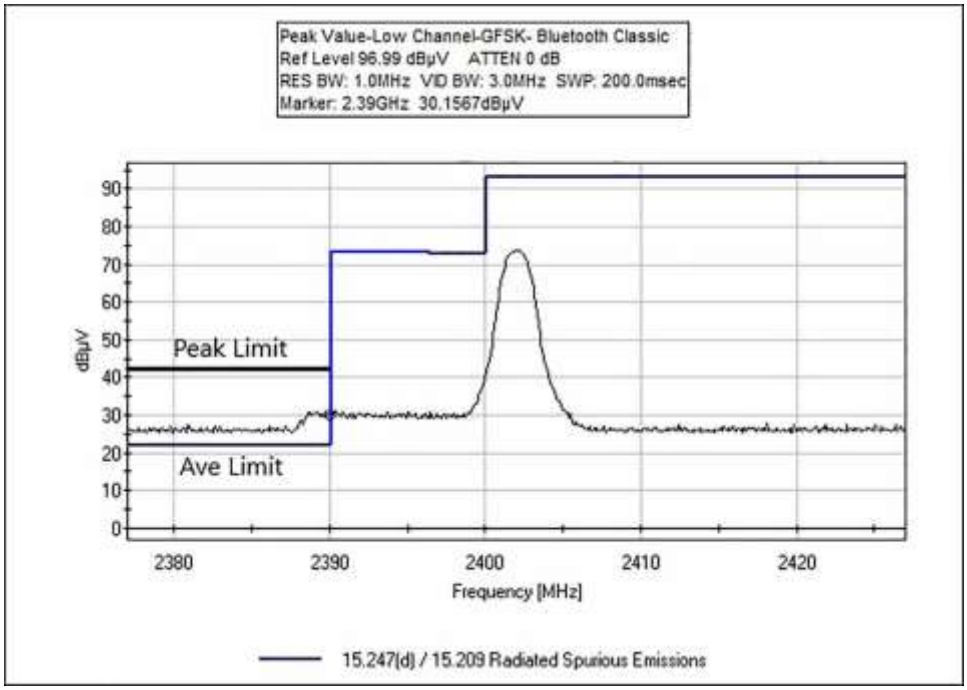
Band Edge Summary – Hopping Mode							
Limit applied at restricted bands: 15.209 Limit applied for other than restricted bands: Max Power/100kHz - 20dB.							
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Average (dBuV/m @3m)**		**Peak (dBuV/m @3m)**		**Results**
			Measured	**Limit**	**Measured**	**Limit**	
2390.0	GFSK	External Connector /3.67	52.3	≤54	NA1	≤74	Pass
2400.0	GFSK	External Connector /3.67	NA2	NA2	51.2	≤86	Pass
2483.5	GFSK	External Connector /3.67	48.5	≤54	NA1	≤74	Pass
2390.0	π/4-DQPSK	External Connector /3.67	53.1	≤54	NA1	≤74	Pass
2400.0	π/4-DQPSK	External Connector /3.67	NA2	NA2	51.7	≤82.6	Pass
2483.5	π/4-DQPSK	External Connector /3.67	48.7	≤54	NA1	≤74	Pass
2390.0	8-DQPSK	External Connector /3.67	52.8	≤54	NA1	≤74	Pass
2400.0	8-DQPSK	External Connector /3.67	NA2	NA2	50.9	≤82.6	Pass
2483.5	8-DQPSK	External Connector /3.67	49.1	≤54	NA1	≤74	Pass

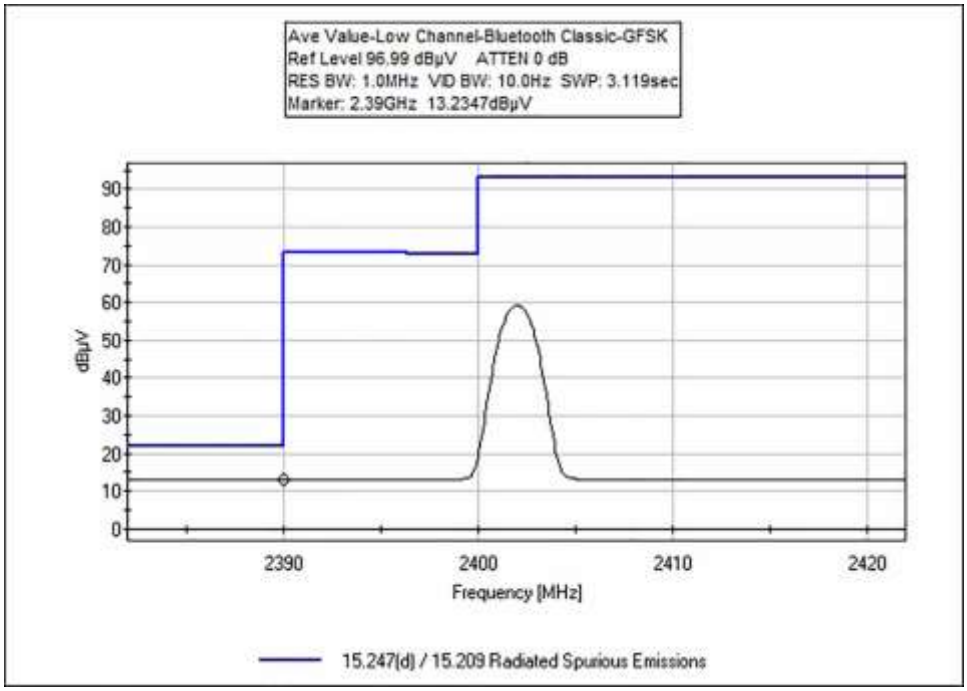
Notes:

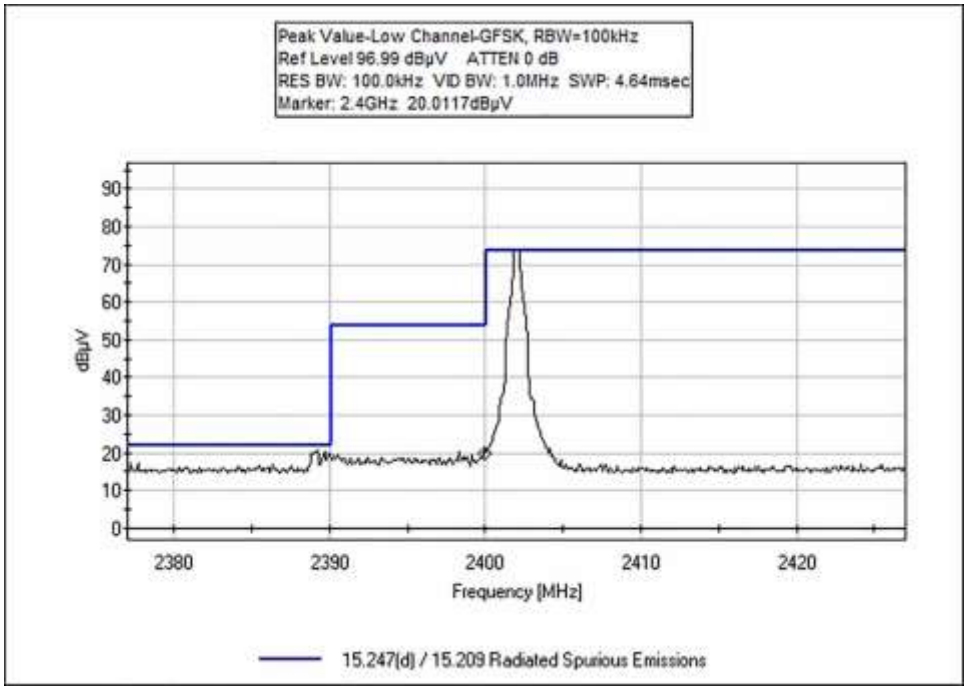
NA1	Peak measurement meets average limit.
NA2	Average limit not applicable when applying 20dBc limit.

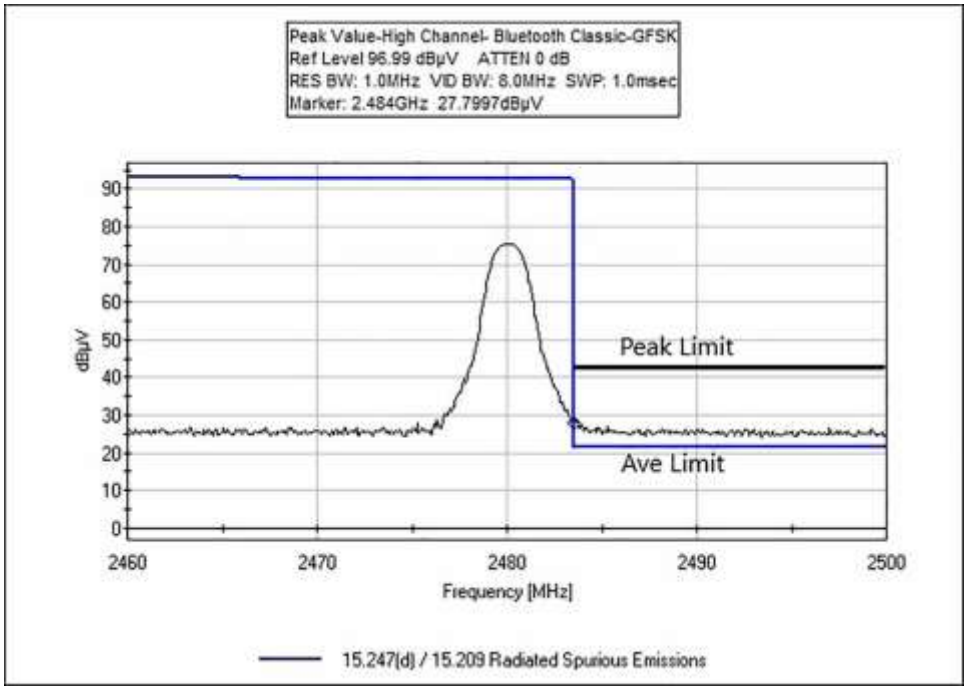
Band Edge Plots

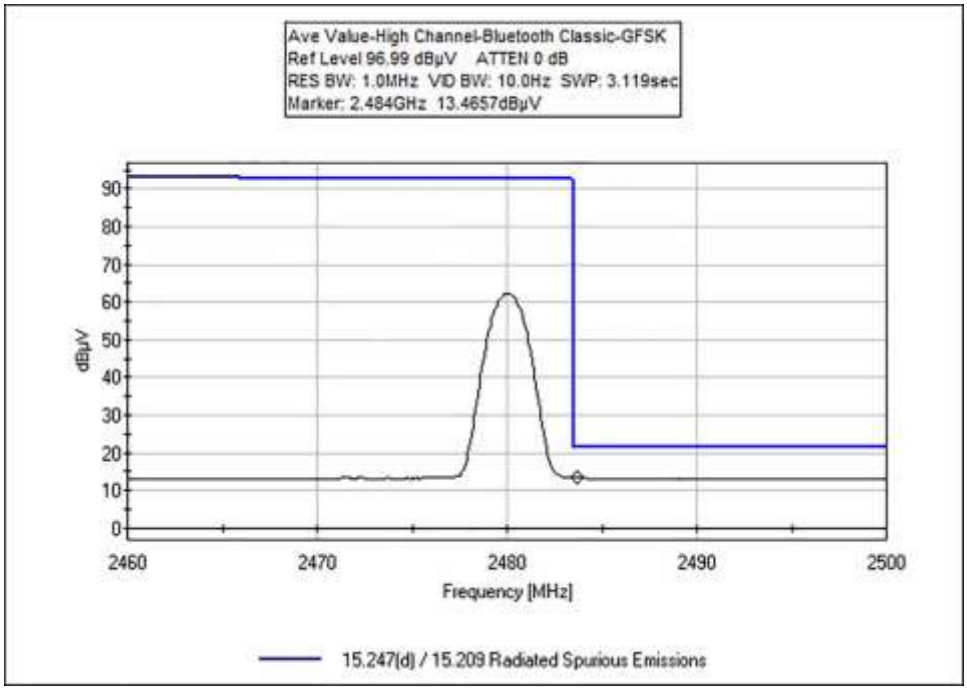
Single Channel
GFSK



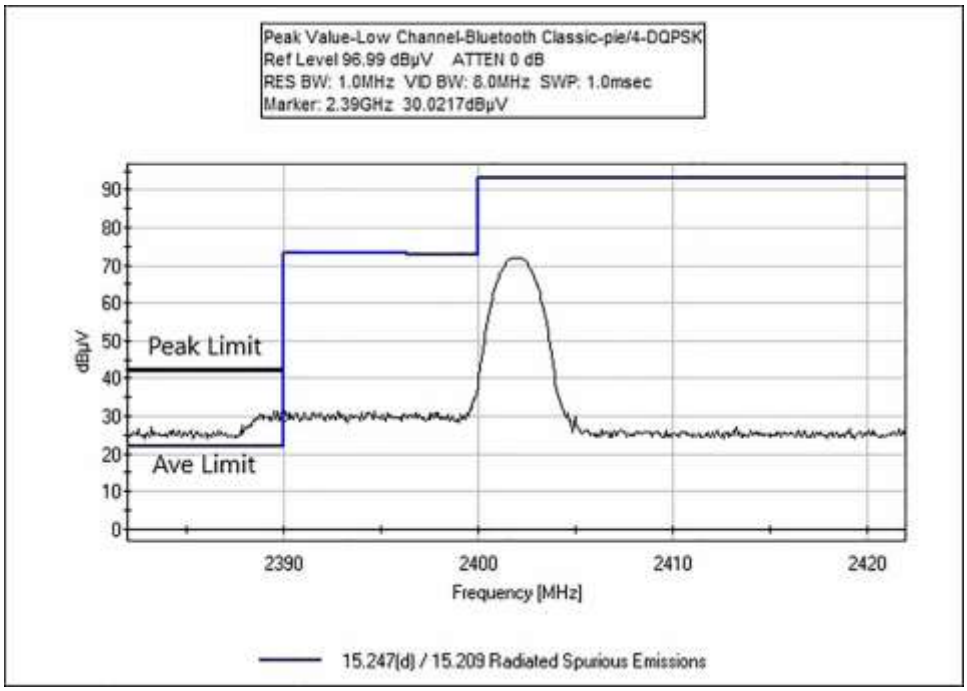


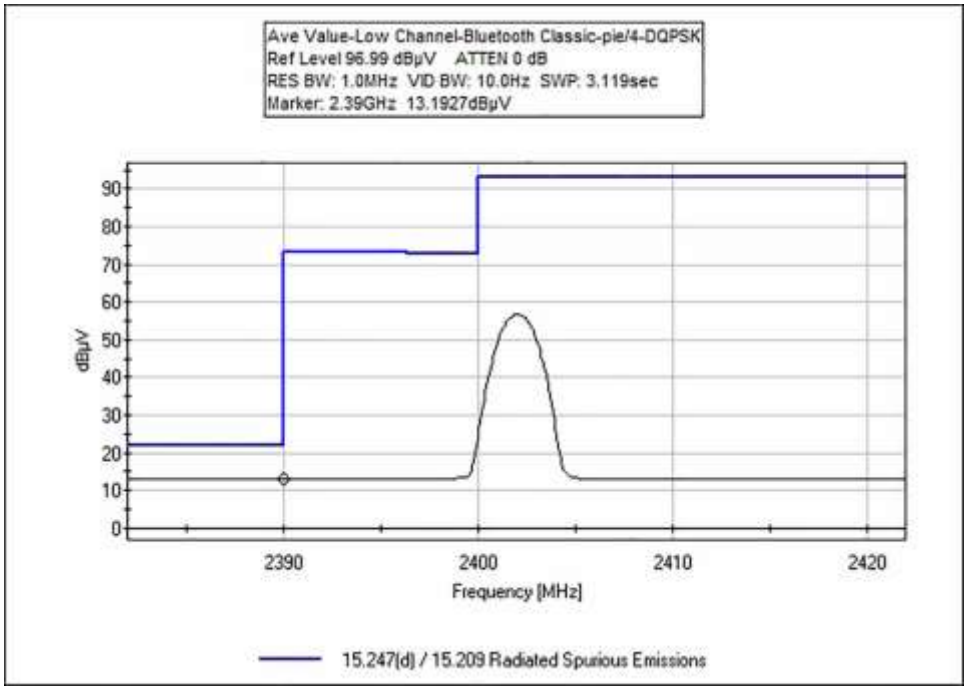

Peak Value-Low Channel-GFSK, RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 4.64msec
Marker: 2.4GHz 20.0117dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2380
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

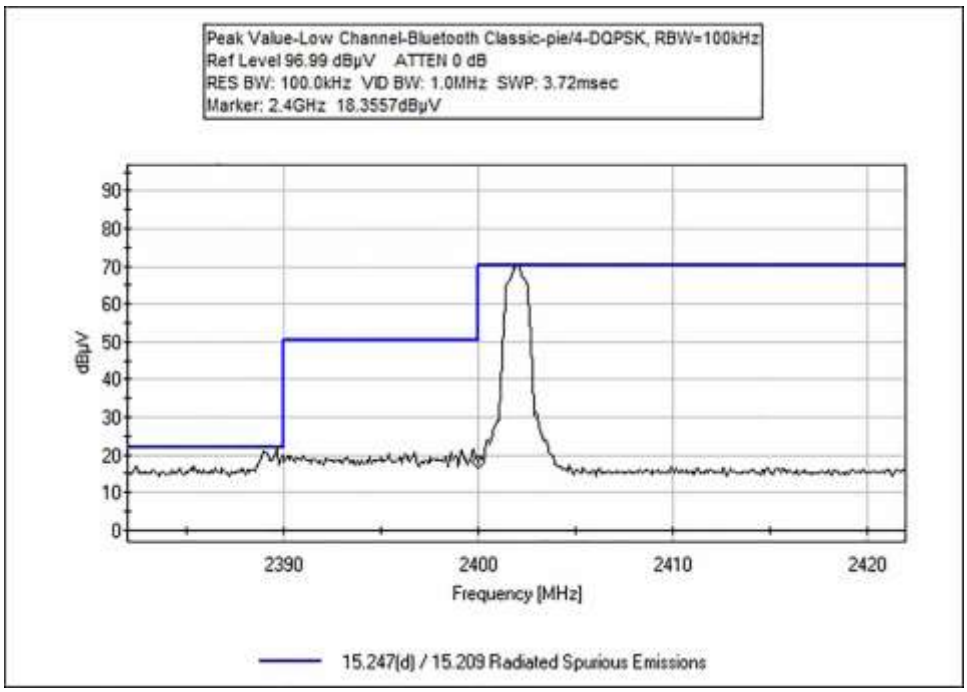

Peak Value-High Channel- Bluetooth Classic-GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.484GHz 27.7997dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
Peak Limit
Ave Limit
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

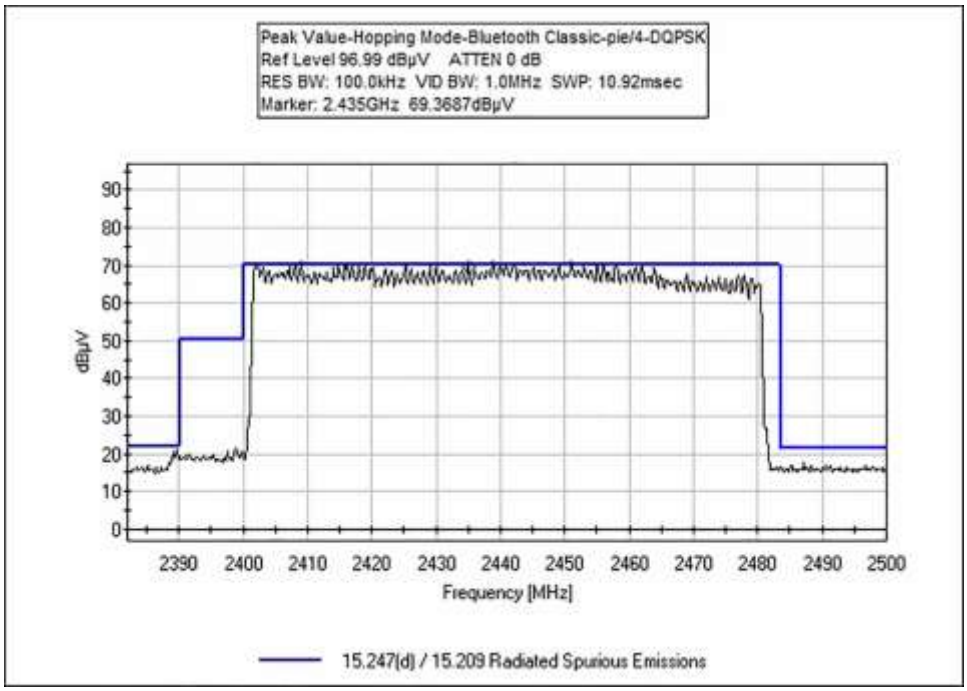

Ave Value-High Channel-Bluetooth Classic-GFSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.484GHz 13.4657dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

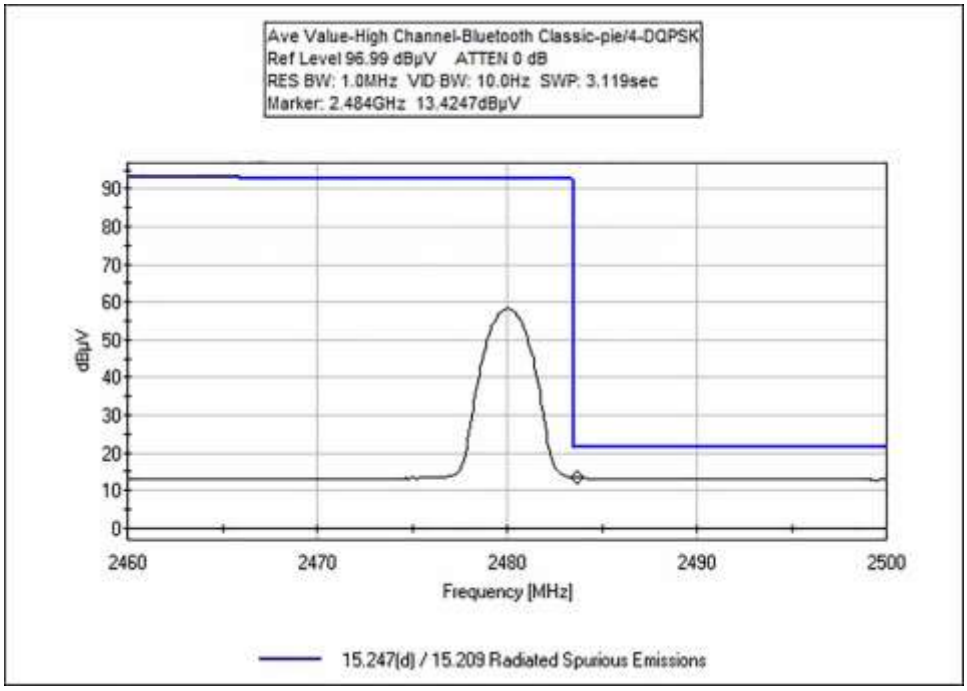
4-DQPSK


Peak Value-Low Channel-Bluetooth Classic-pie/4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.39GHz 30.0217dBµV
dBµV
Peak Limit
Ave Limit
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

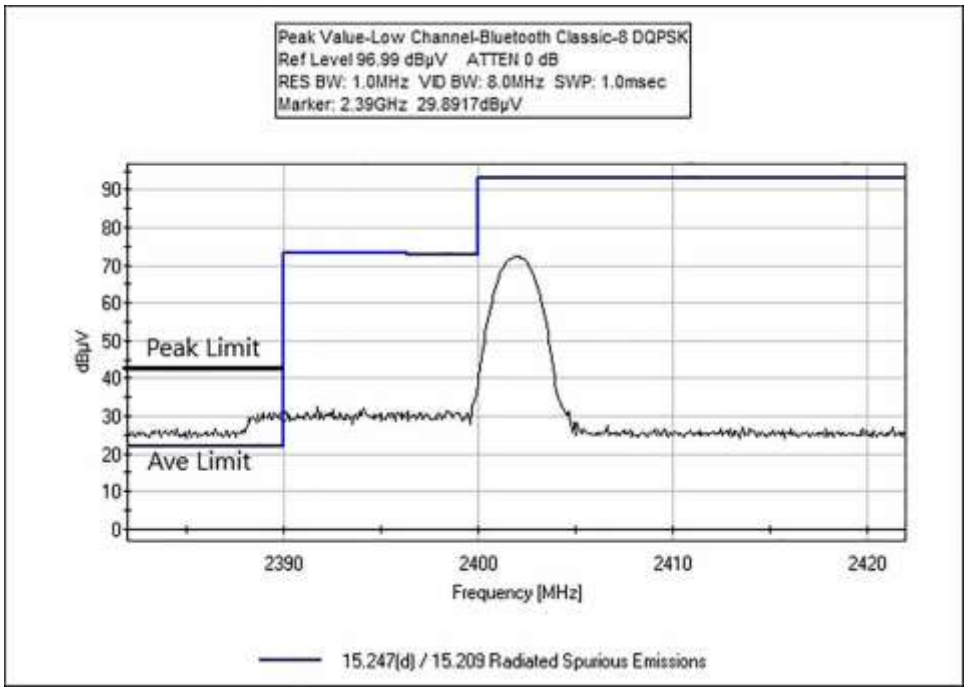

Ave Value-Low Channel-Bluetooth Classic-pie/4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.39GHz 13.1927dBµV
dBµV
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

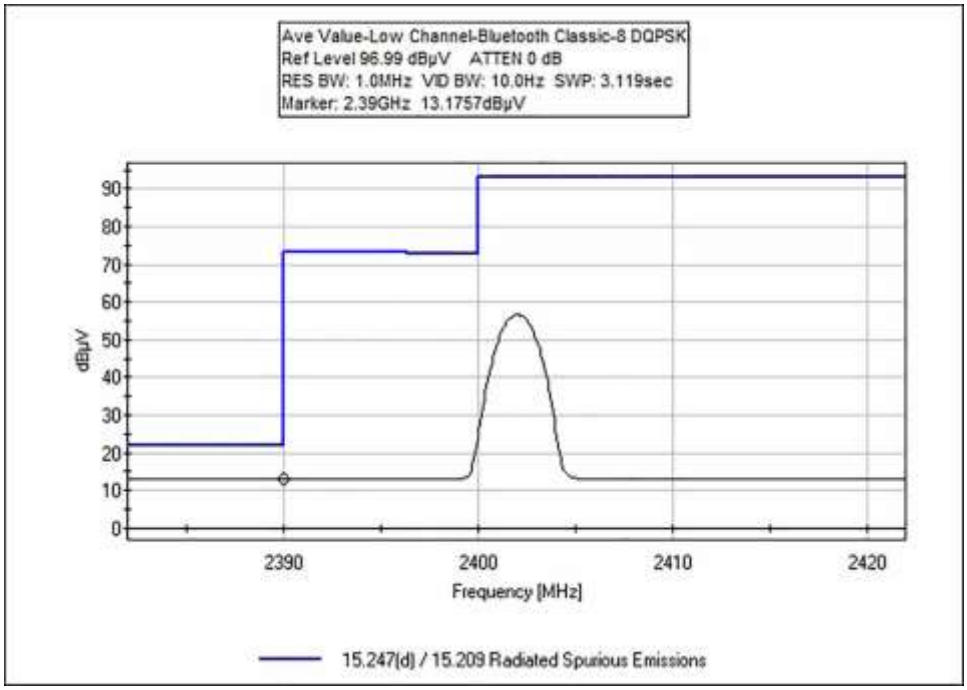

Peak Value-Low Channel-Bluetooth Classic-pie/4-DQPSK, RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 3.72msec
Marker: 2.4GHz 18.3557dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

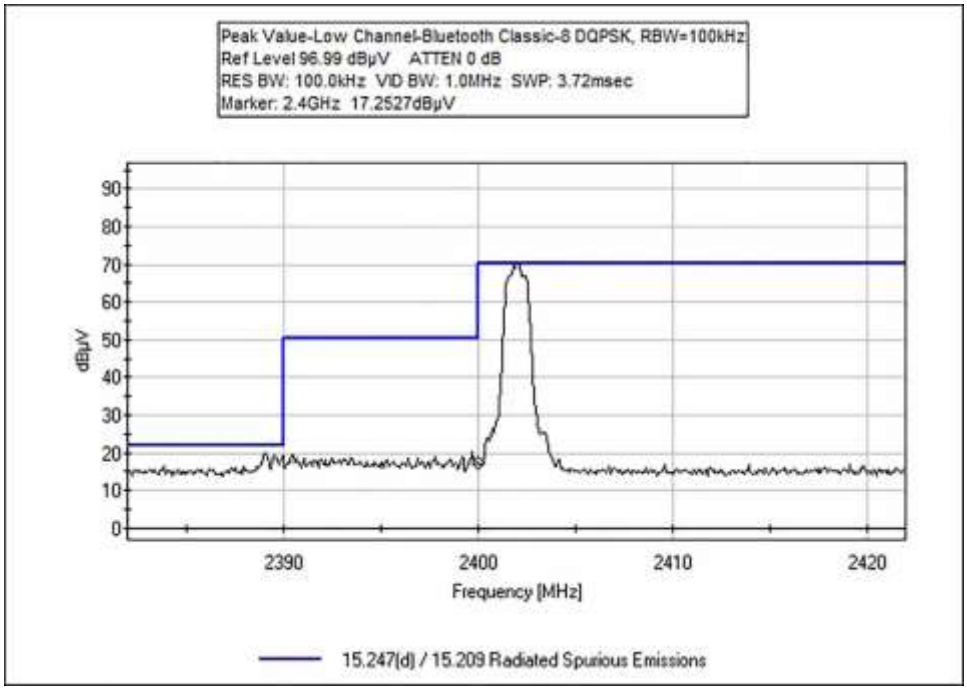

Peak Value-Hopping Mode-Bluetooth Classic-pie/4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 10.92msec
Marker: 2.435GHz 69.3687dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

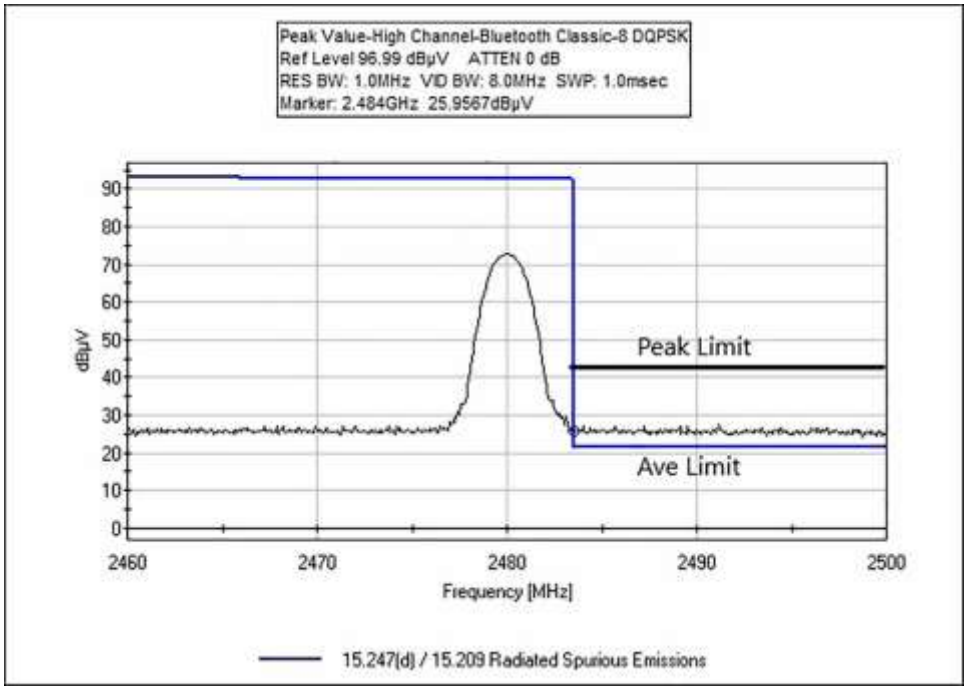

Ave Value-High Channel-Bluetooth Classic-pie/4-DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.484GHz 13.4247dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

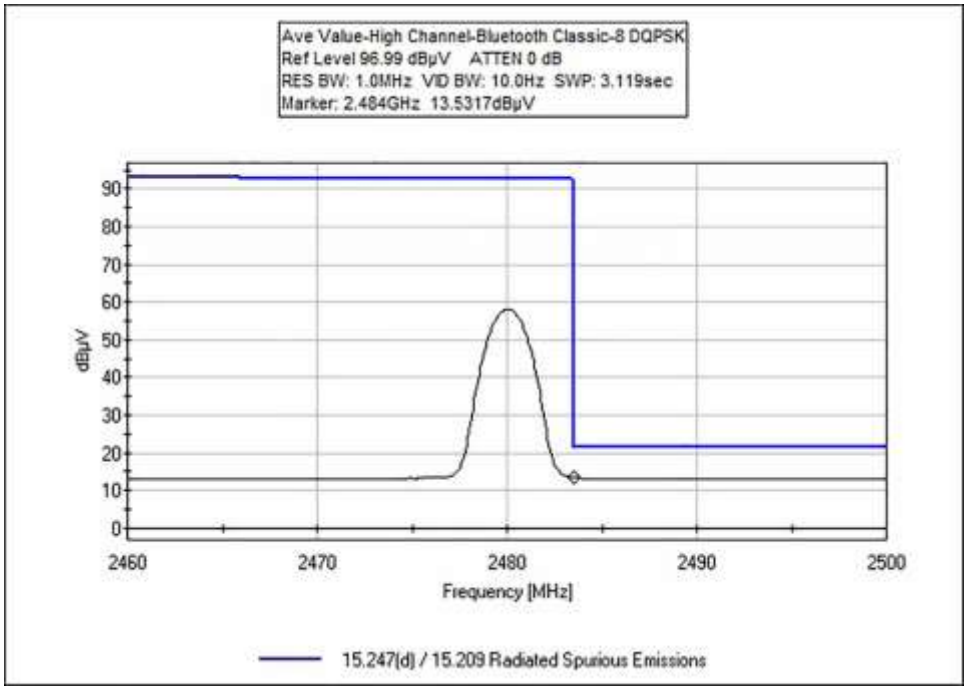
8-DQPSK


Peak Value-Low Channel-Bluetooth Classic-8 DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.39GHz 29.8917dBµV
dBµV
Peak Limit
Ave Limit
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

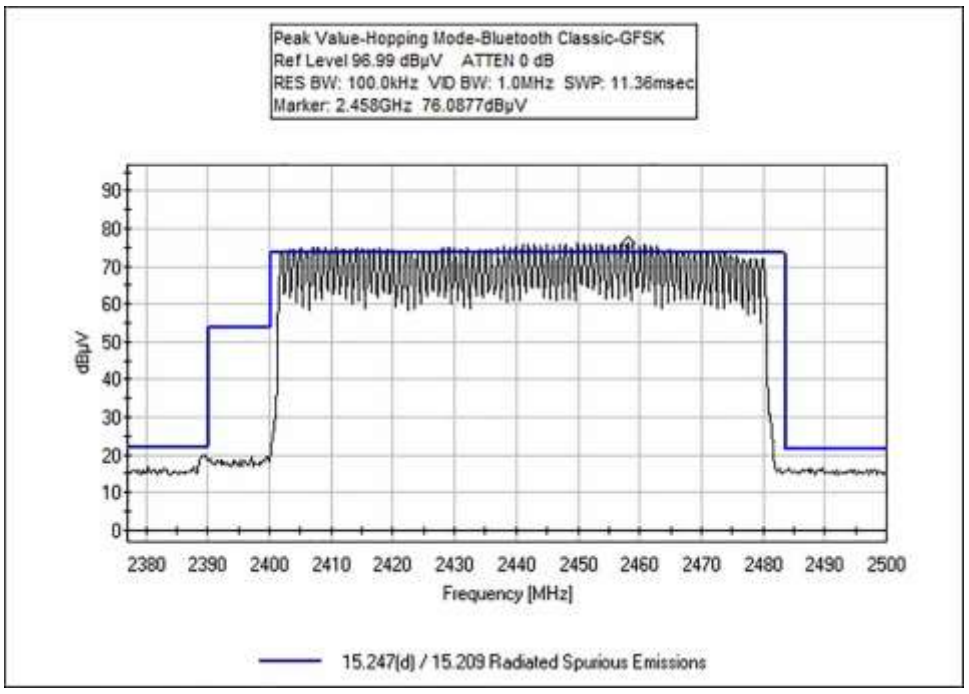

Ave Value-Low Channel-Bluetooth Classic-8 DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.39GHz 13.1757dBµV
dBµV
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value-Low Channel-Bluetooth Classic-8 DQPSK, RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 3.72msec
Marker: 2.4GHz 17.2527dBµV
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

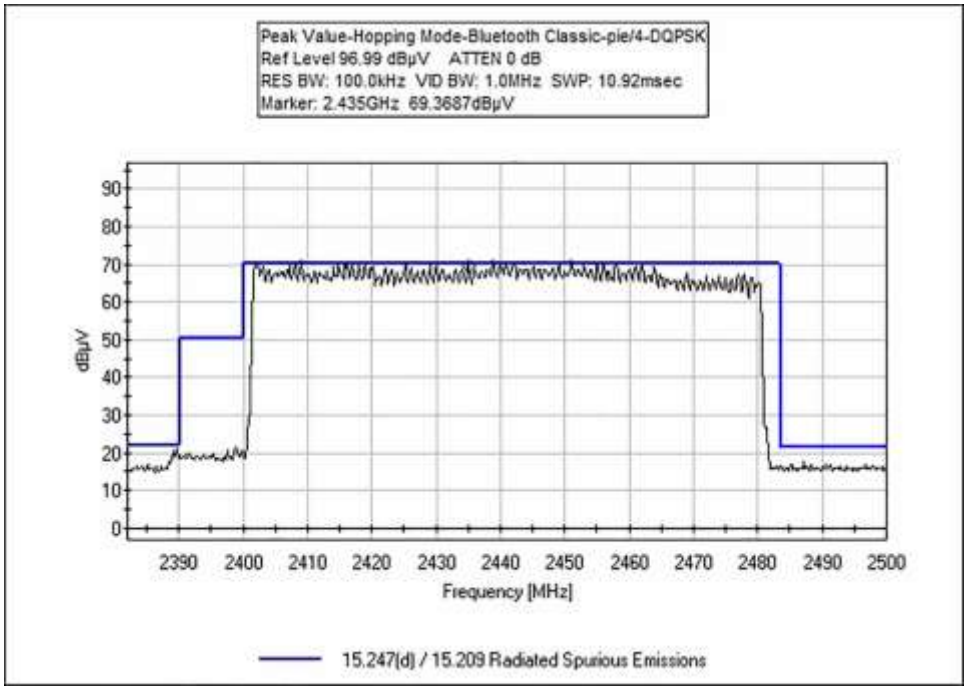

Peak Value-High Channel-Bluetooth Classic-8 DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 1.0msec
Marker: 2.484GHz 25.9567dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
Peak Limit
Ave Limit
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-High Channel-Bluetooth Classic-8 DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.119sec
Marker: 2.484GHz 13.5317dBµV
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

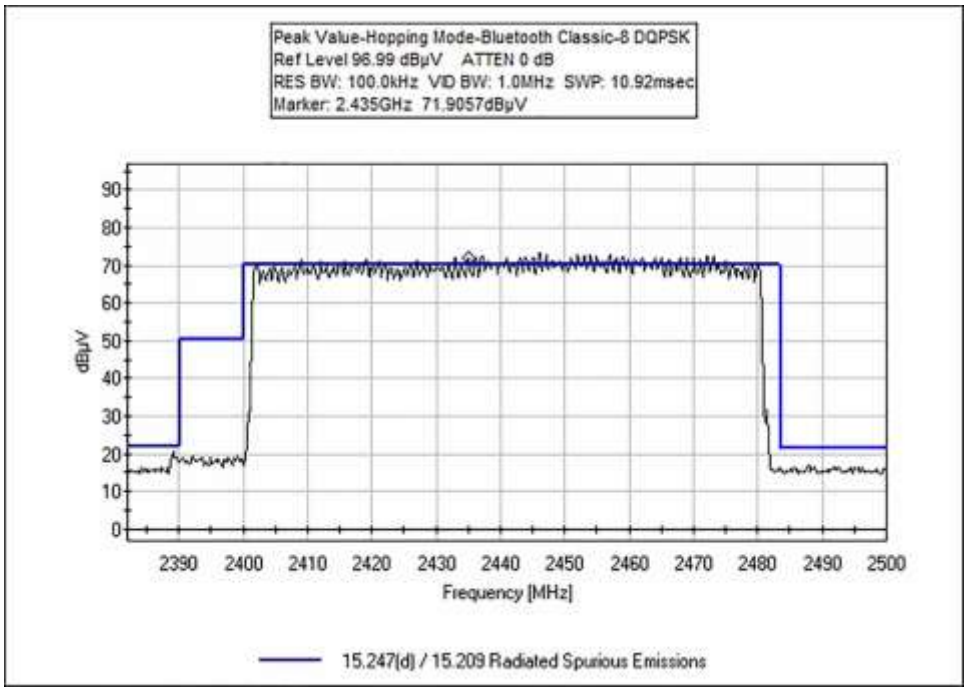
Hopping Channel
GFSK



4-DQPSK



8-DQPSK


Peak Value-Hopping Mode-Bluetooth Classic-8 DQPSK
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 10.92msec
Marker: 2.435GHz 71.9057dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2390 2400 2410 2420 2430 2440 2450 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 • 5102491170		
Customer:	**Tonal**		
Specification:	Band Edge		
Work Order #:	**110285**	Date:	10/22/2024
Test Type:	**Radiated Scan**	Time:	14:36:23
Tested By:	Hieu Song Nguyenpham	Sequence#:	10
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.

Single Channel

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	29.7	+28.3	+1.3	+2.5		+0.0	61.8	54.0 GFSK	+7.8	Vert
2	2390.000M Ave	13.1	+28.3	+1.3	+2.5		+0.0	45.2	54.0 GFSK	-8.8	Vert
3	2400.000M	20.0	+28.3	+1.4	+2.5		+0.0	52.2	86.0 GSFK, RBW=100kHz	-33.8	Vert
4	2483.500M	28.6	+28.3	+1.4	+2.6		+0.0	60.9	54.0 GFSK	+6.9	Vert
5	2483.500M Ave	13.3	+28.3	+1.4	+2.6		+0.0	45.6	54.0 GFSK	-8.4	Vert
6	2483.700M	27.5	+28.3	+1.4	+2.6		+0.0	59.8	54.0 pie/4-DQPSK	+5.8	Vert
7	2483.700M Ave	13.4	+28.3	+1.4	+2.6		+0.0	45.7	54.0 pie/4-DQPSK	-8.3	Vert
8	2390.000M	30.0	+28.3	+1.3	+2.5		+0.0	62.1	54.0 pie/4-DQPSK	+8.1	Vert
9	2390.000M	13.2	+28.3	+1.3	+2.5		+0.0	45.3	54.0 pie/4-DQPSK	-8.7	Vert
10	2400.000M	18.4	+28.3	+1.4	+2.5		+0.0	50.6	82.6 pie/4-DQPSK,RBW=100 kHz	-32.0	Vert
11	2390.000M	29.9	+28.3	+1.3	+2.5		+0.0	62.0	54.0 8 DQPSK	+8.0	Vert
12	2390.000M	13.2	+28.3	+1.3	+2.5		+0.0	45.3	54.0 8 DQPSK	-8.7	Vert
13	2400.000M	17.3	+28.3	+1.4	+2.5		+0.0	49.5	82.6 8 DQPSK,RBW=100 kHz	-33.1	Vert
14	2483.500M	26.0	+28.3	+1.4	+2.6		+0.0	58.3	54.0 8 DQPSK	+4.3	Vert
15	2483.500M	13.5	+28.3	+1.4	+2.6		+0.0	45.8	54.0 8 DQPSK	-8.2	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
Customer:	**Tonal**		
Specification:	Band Edge		
Work Order #:	**110285**	Date:	10/22/2024
Test Type:	**Radiated Scan**	Time:	14:36:23
Tested By:	Hieu Song Nguyenpham	Sequence#:	10
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.

Note
Hopping Mode
RBW=100kHz, VBW=1MHz

Test Equipment:

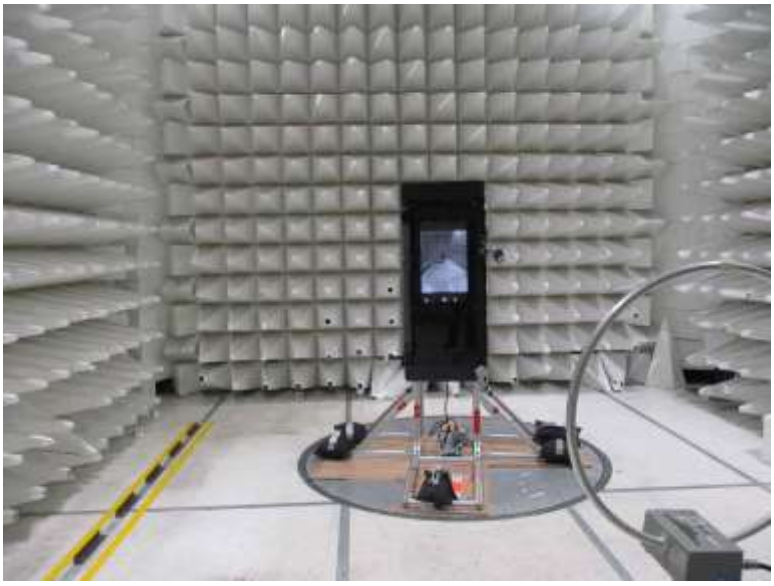
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

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

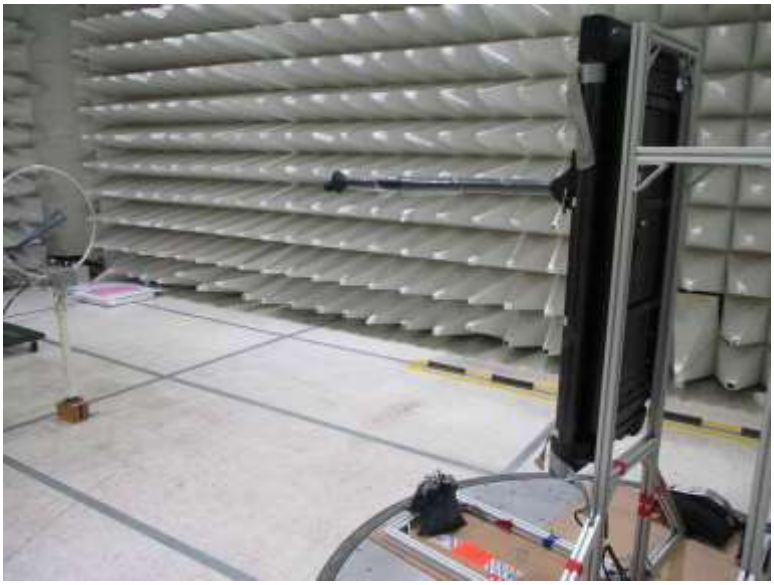
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2390.000M	20.2	+28.3	+1.3	+2.5		+0.0	52.3	54.0 GFSK	-1.7	Vert
2	2400.000M	19.0	+28.3	+1.4	+2.5		+0.0	51.2	86.0 GSFK,	-34.8	Vert
3	2483.500M	16.2	+28.3	+1.4	+2.6		+0.0	48.5	54.0 GFSK	-5.5	Vert
4	2483.500M	16.4	+28.3	+1.4	+2.6		+0.0	48.7	54.0 pie/4-DQPSK	-5.3	Vert
5	2400.000M	19.5	+28.3	+1.4	+2.5		+0.0	51.7	82.6 pie/4-DQPSK	-30.9	Vert
6	2390.000M	21.0	+28.3	+1.3	+2.5		+0.0	53.1	54.0 pie/4-DQPSK	-0.9	Vert
7	2390.000M	20.7	+28.3	+1.3	+2.5		+0.0	52.8	54.0 8 DQPSK	-1.2	Vert
8	2400.000M	18.7	+28.3	+1.4	+2.5		+0.0	50.9	82.6 8 DQPSK	-31.7	Vert
9	2483.500M	16.8	+28.3	+1.4	+2.6		+0.0	49.1	54.0 8 DQPSK	-4.9	Vert

Test Setup Photo(s)

9kHz-1GHz

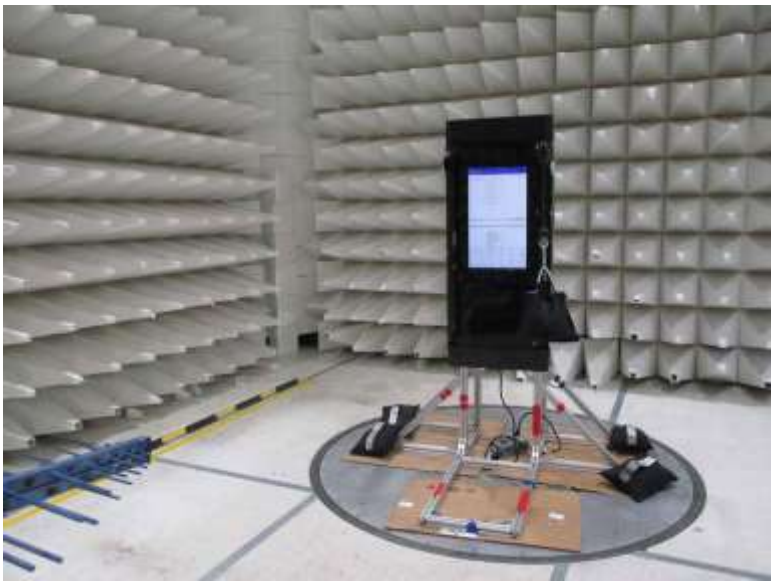


Front View



Back View

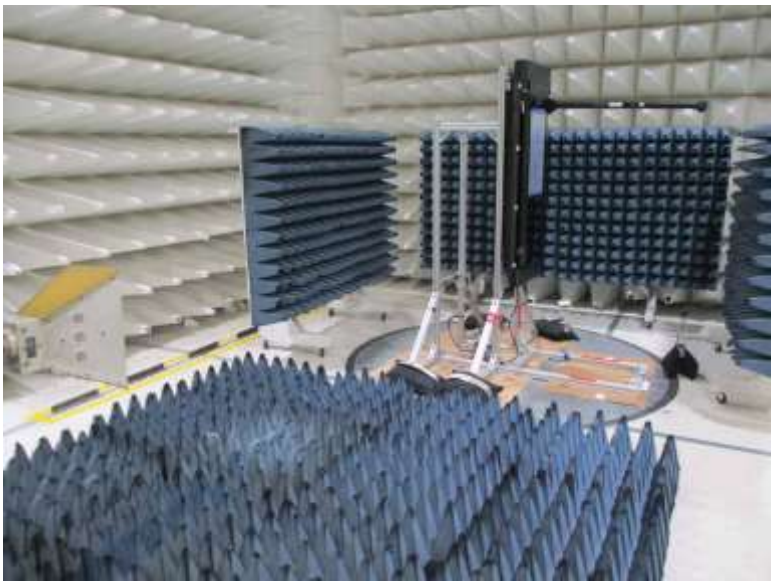
30MHz-1GHz



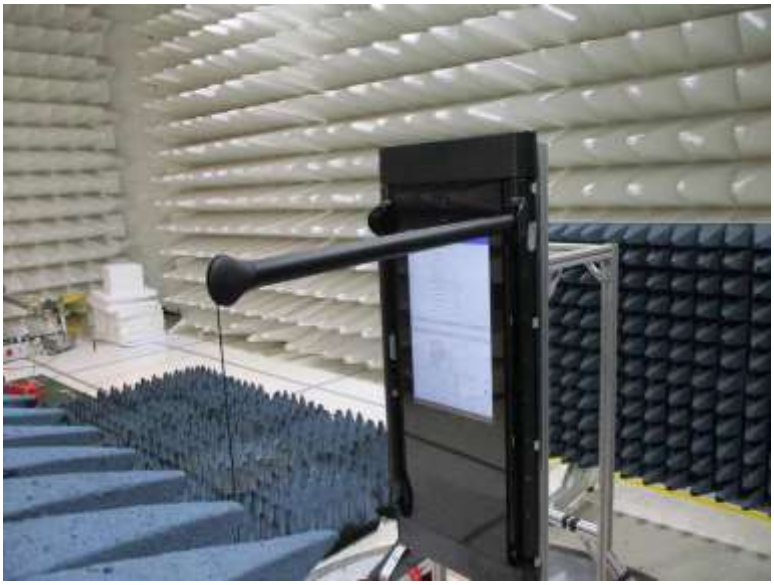
Front View

Back View

1GHz-12GHz

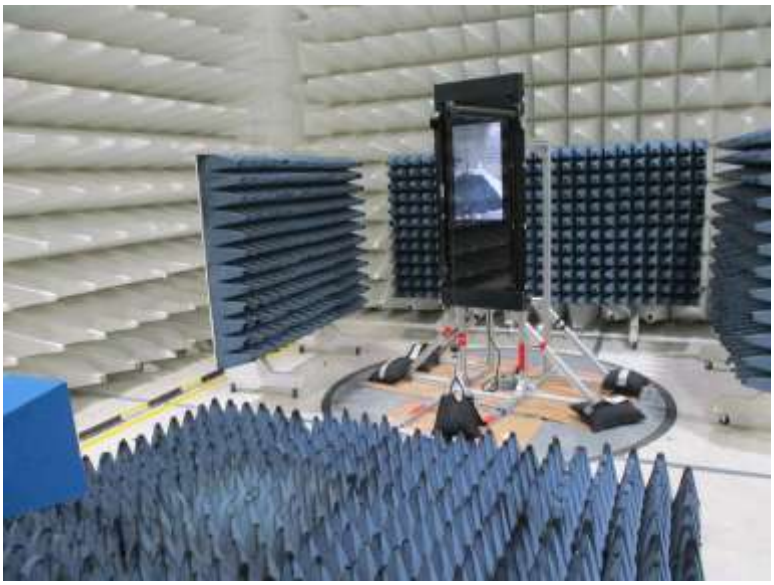


Front View

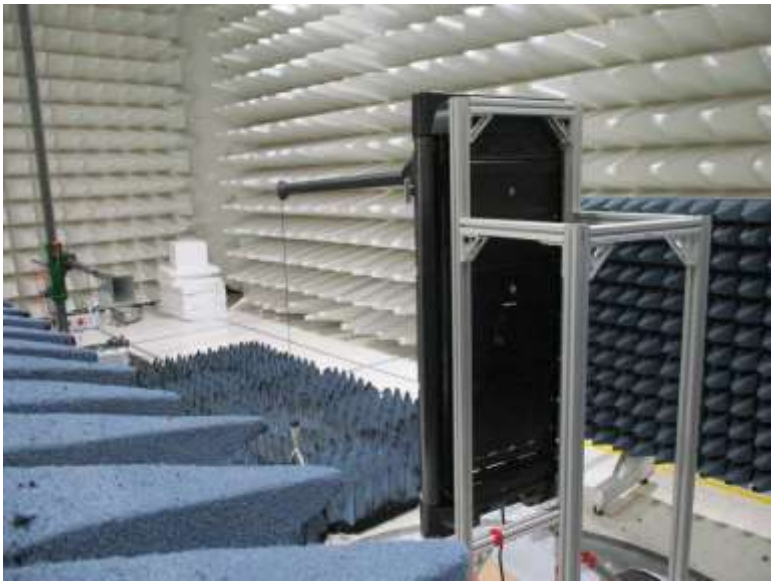


Back View

12GHz-26GHz



Front View



Back View

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 5102491170		
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:

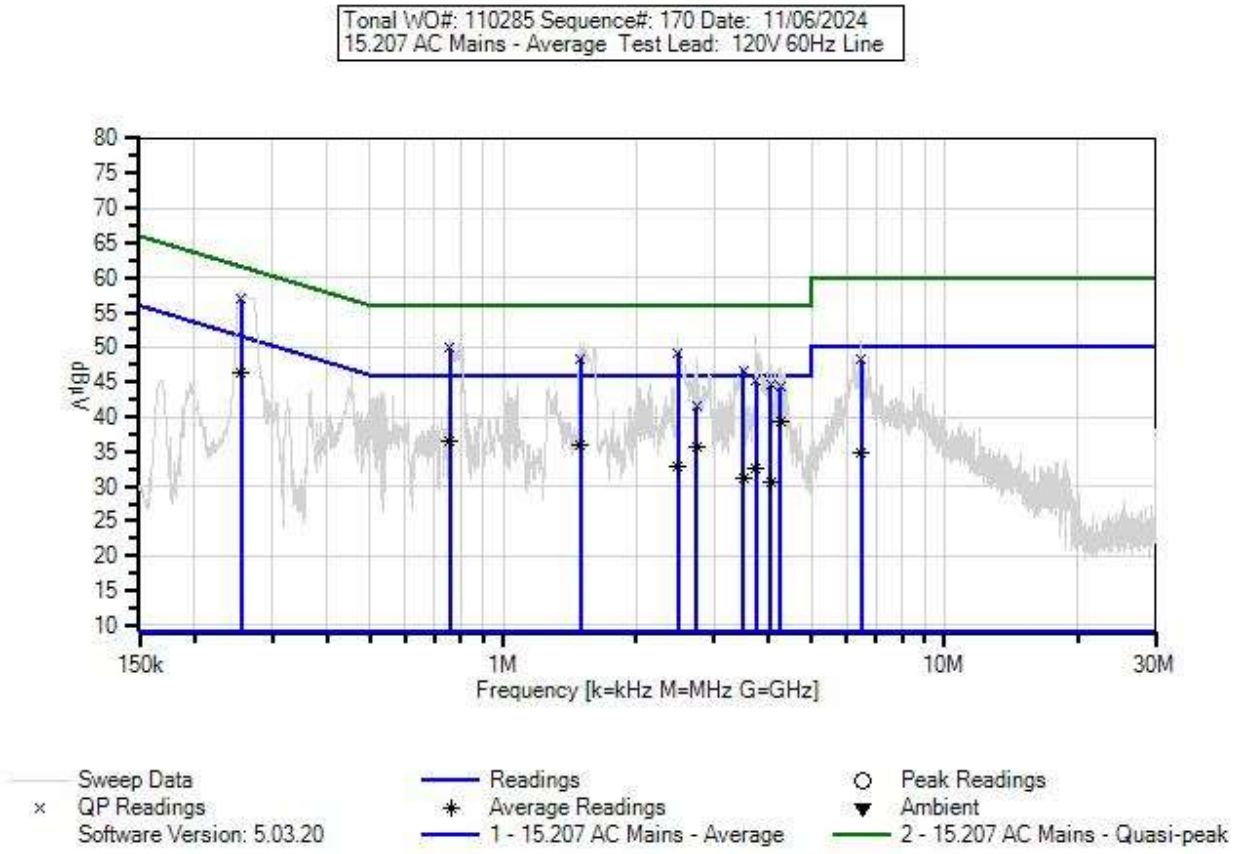
Conducted Emission
Frequency Range: 150kHz to 30MHz

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 • 5102491170		
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:

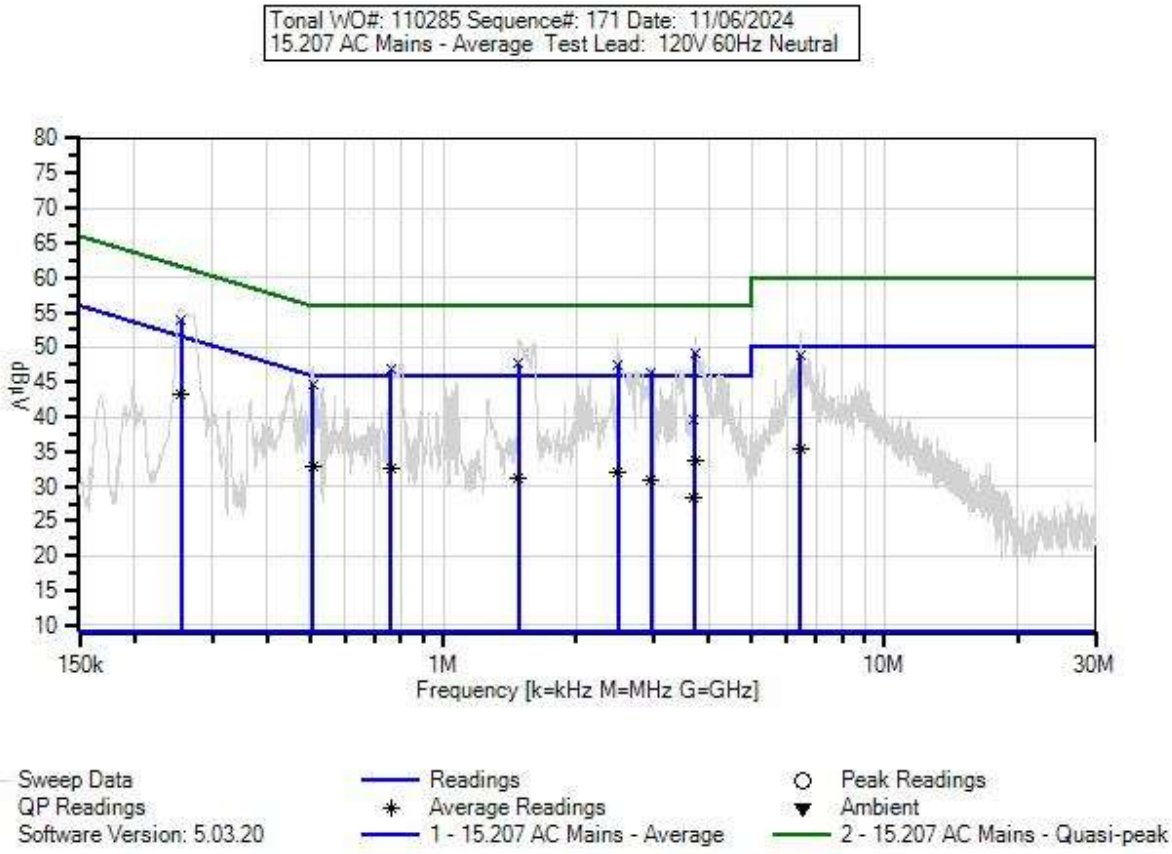
Conducted Emission
Frequency Range: 150kHz to 30MHz

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
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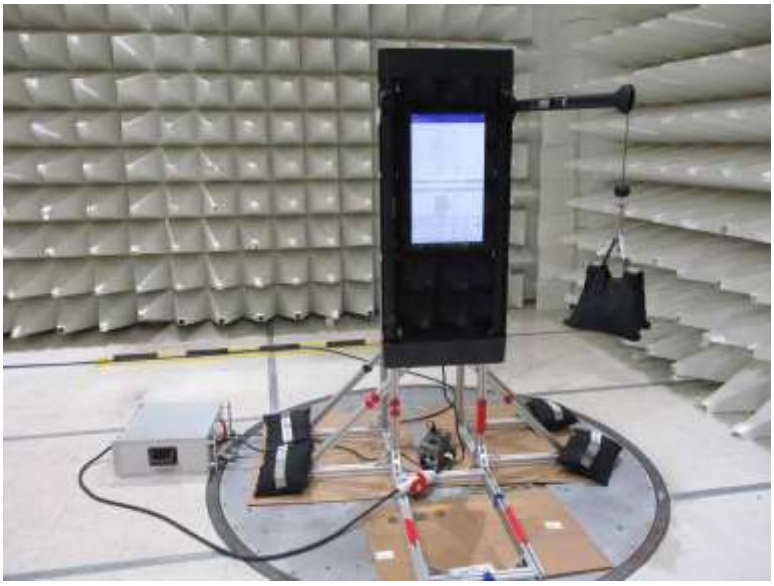
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
T4	AN03814	50uH LISN-1PH-Neutral (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	5/6/2024	5/6/2026

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

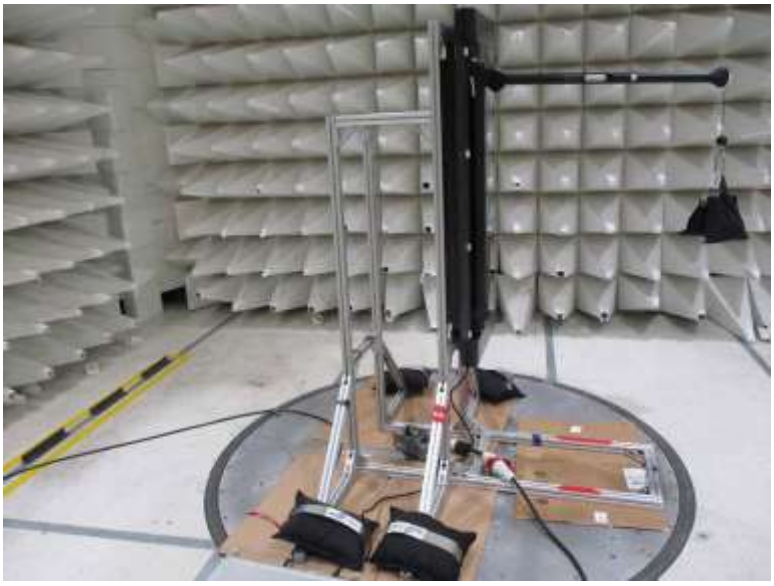
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5								
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	3.722M	38.8	+9.9	+0.2	+0.1	+0.1	+0.0	49.2	56.0	-6.8	Neutr
	QP		+0.1								
2	255.445k	44.0	+9.8	+0.1	+0.0	+0.0	+0.0	54.0	61.6	-7.6	Neutr
	QP		+0.1								
3	255.445k	33.3	+9.8	+0.1	+0.0	+0.0	+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