Tonal

TEST REPORT FOR

Smart Handle
Model: 110-0016

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(DTS 2400-2483.5 MHz)

Report No.: 106246-5

Date of issue: January 24, 2022

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

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

Test Certificate # 803.01

Testing the Future
CKC LABORATORIES, INC.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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San Francisco CA, 94107

Representative: Nate Pickslay

REPORT PREPARED BY:

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Mariposa, CA 95338

Project Number: 106246

DATE OF EQUIPMENT RECEIPT: November 29, 2021
DATE(S) OF TESTING: November 29,
December 1, 2 and 9 2021

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.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

Site Registration & Accreditation Information

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

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

SUMMARY OF RESULTS

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

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.207	AC Conducted Emissions	NA	NA1

NA = Not Applicable
NA1 = Not applicable because the EUT is operated by an internal Battery.

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

Modifications During Testing

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

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

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

Summary of Conditions
The Test Setup Photos are incorporated by reference 106246-5_Test Setup_Photos.

EQUIPMENT UNDER TEST (EUT)

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

Configuration 1

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

Device Name	Manufacturer	Model #	S/N
Smart Handle	Tonal	110-0016	02000034

Support Devices:

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

Configuration 2

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

Device Name	Manufacturer	Model #	S/N
Smart Handle	Tonal	110-0016	02000033

Support Devices:

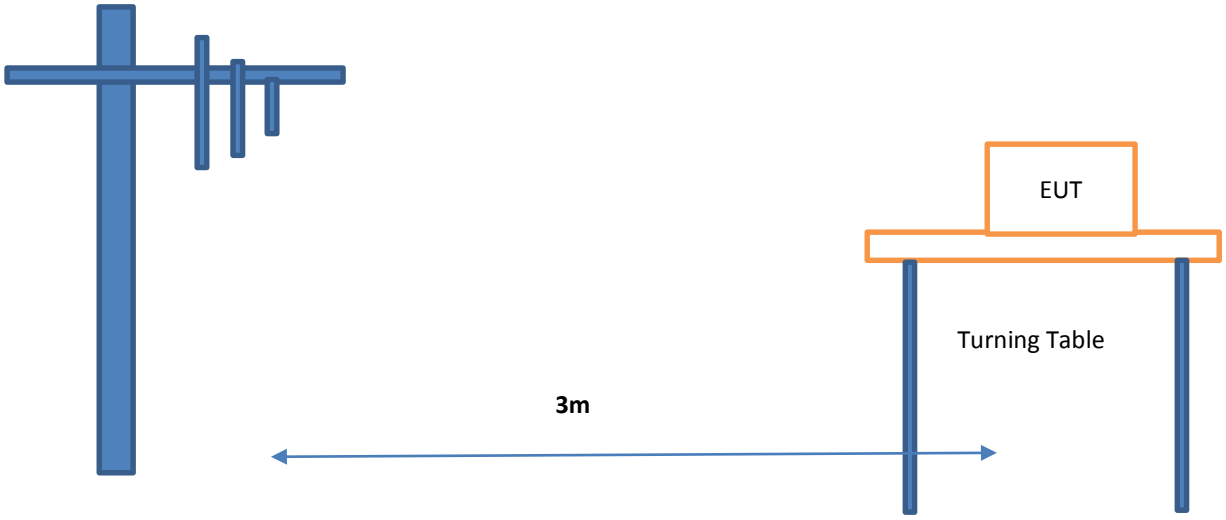
Device Name	Manufacturer	Model #	S/N
Laptop	Apple	MacBook Pro A1278	C1MMF2KDDV30
Laptop Power Supply	Apple	ADP-60AD T	E131881

General Product Information:

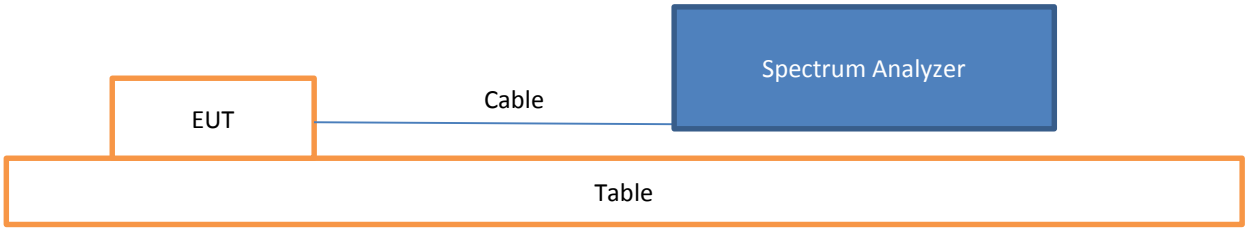
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Bluetooth
Operating Frequency Range:	2402-2480MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral 3.3dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	1.5VDC Battery
Software used for Test:	Putty version 0.74
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

Block Diagram of Test Setup(s)

Radiated Method Setup



Conducted Method Setup



FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

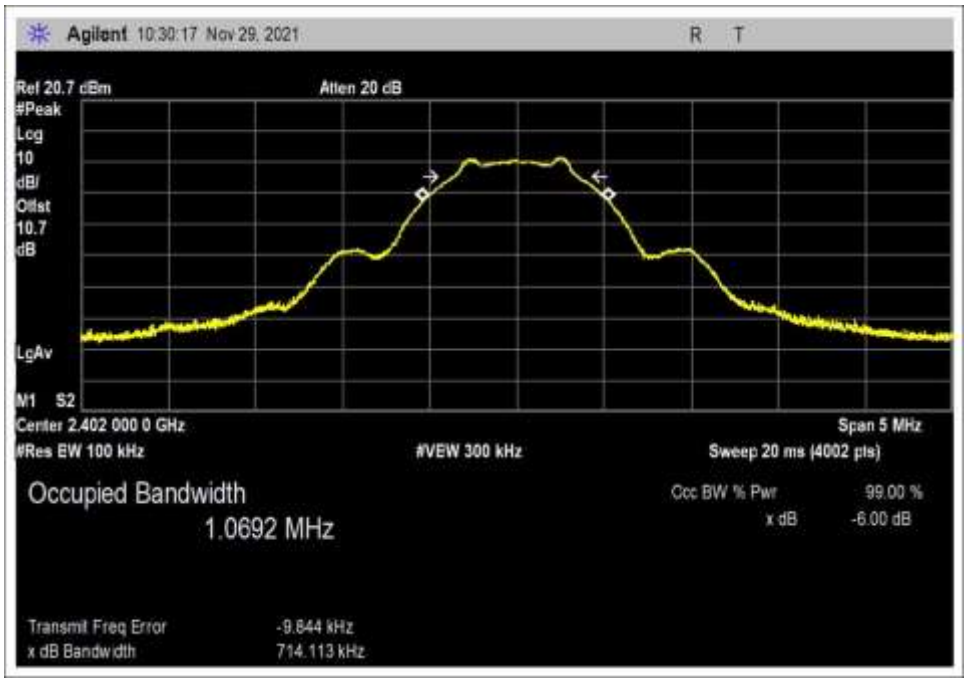
Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	11/29/2021
Configuration:	1		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	21.5	Relative Humidity (%):	41

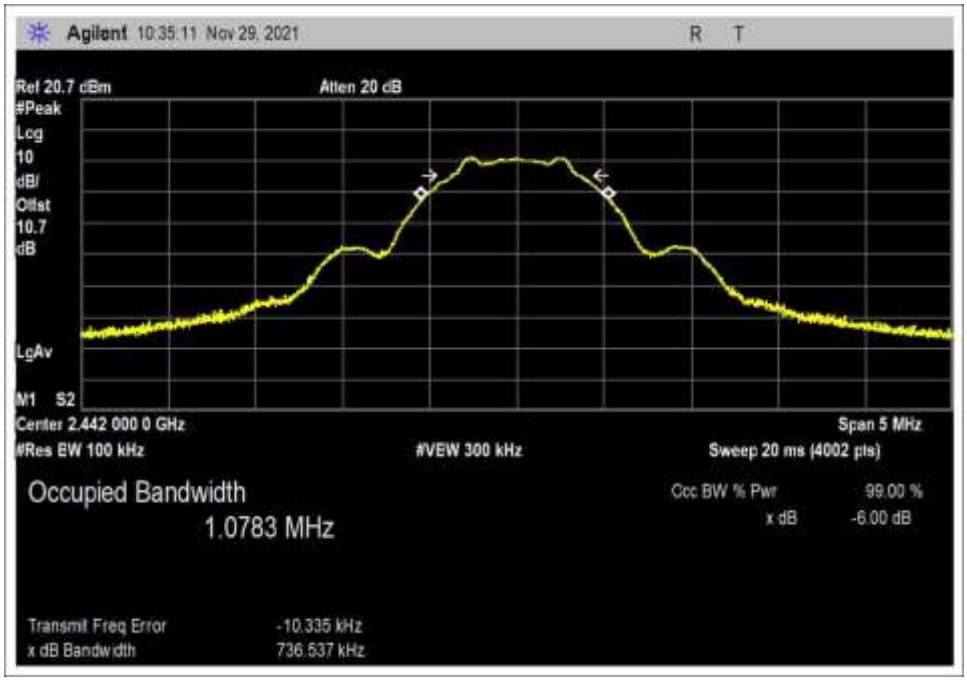
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02660	Spectrum Analyzer	Agilent	E4446A	12/4/2020	12/4/2022
P06904	Cable	Astrolab	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
P07365	Attenuator	Weinschel	54A-10	5/26/2021	5/26/2023

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	GFSK	714.113	≥500	Pass
2442	1	GFSK	736.573	≥500	Pass
2480	1	GFSK	741.051	≥500	Pass

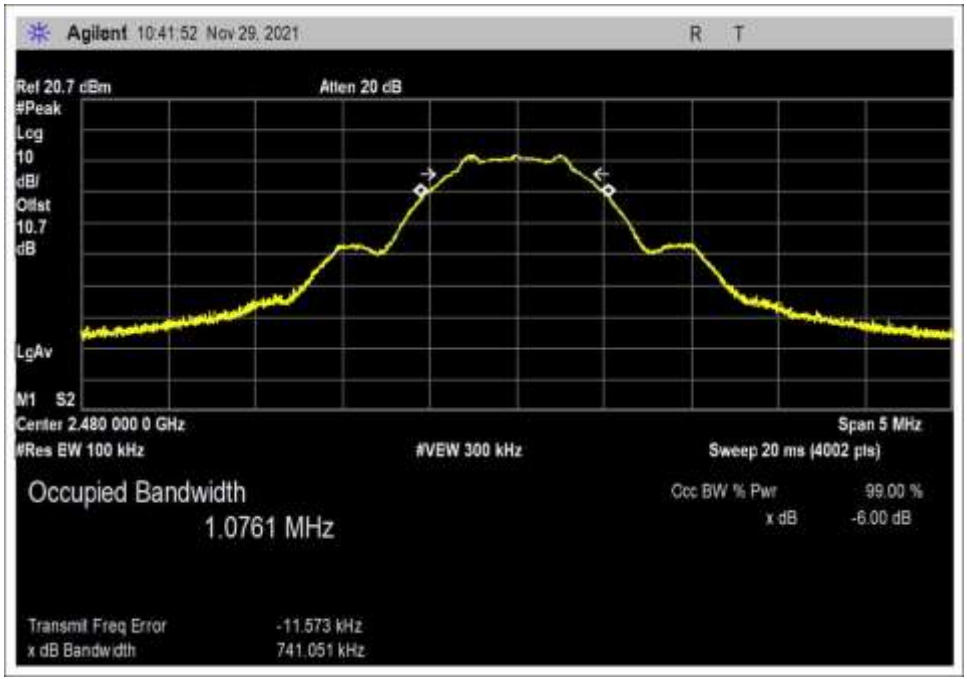
Plot(s)



Low Channel



Middle Channel



High Channel

15.247(b)(3) Output Power

Test Setup / Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/9/2021
Configuration:	1		
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)	22.8	Relative Humidity (%):	43

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02660	Spectrum Analyzer	Agilent	E4446A	12/4/2020	12/4/2022
03013	Cable	Astrolab	32022-2-2909K-36TC	3/25/2020	3/25/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022

Test Data Summary - Voltage Variations

This equipment is battery powered. Power output tests were performed using a fresh battery.

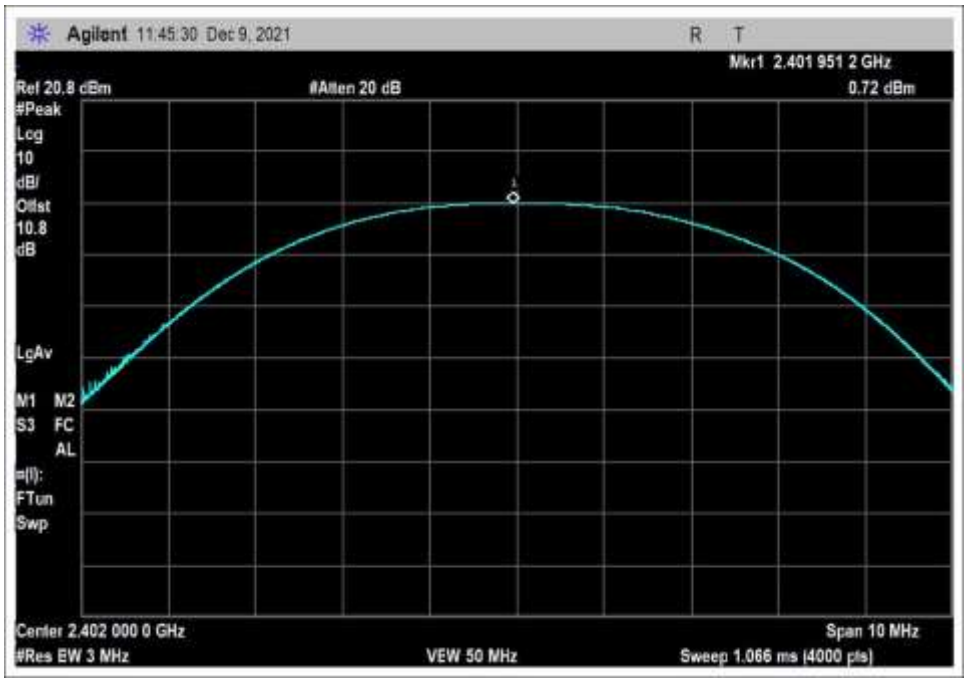
Power Output Test Data Summary - RF Conducted Measurement					
Measurement Option: RBW > DTS Bandwidth					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2402	GFSK	Integral/3.3	0.72	≤30	Pass
2442	GFSK	Integral/3.3	1.19	≤30	Pass
2480	GFSK	Integral/3.3	1.82	≤30	Pass

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

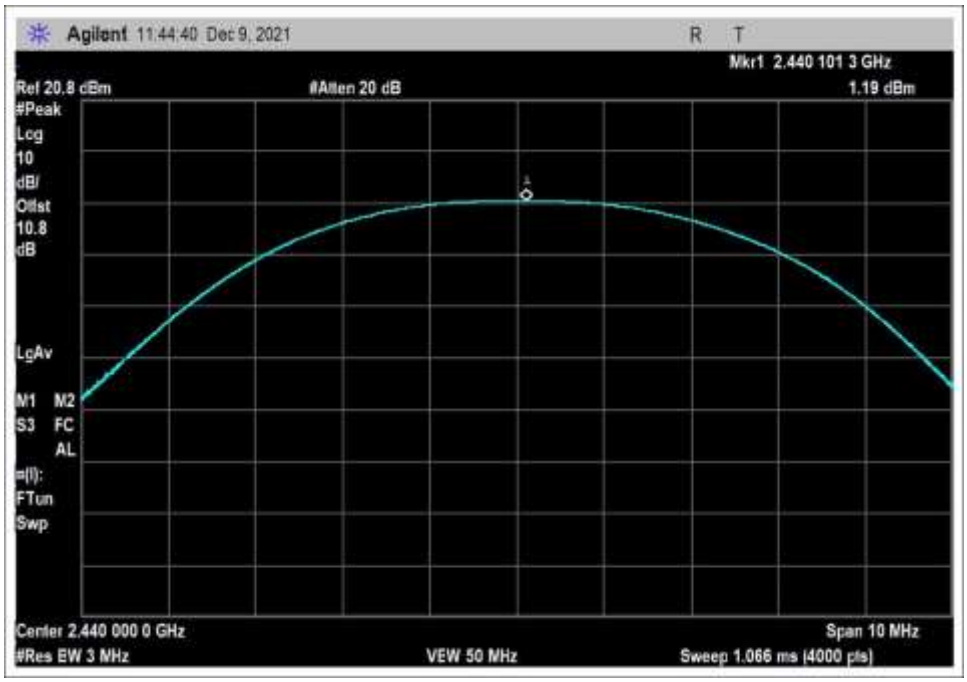
$$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$$

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

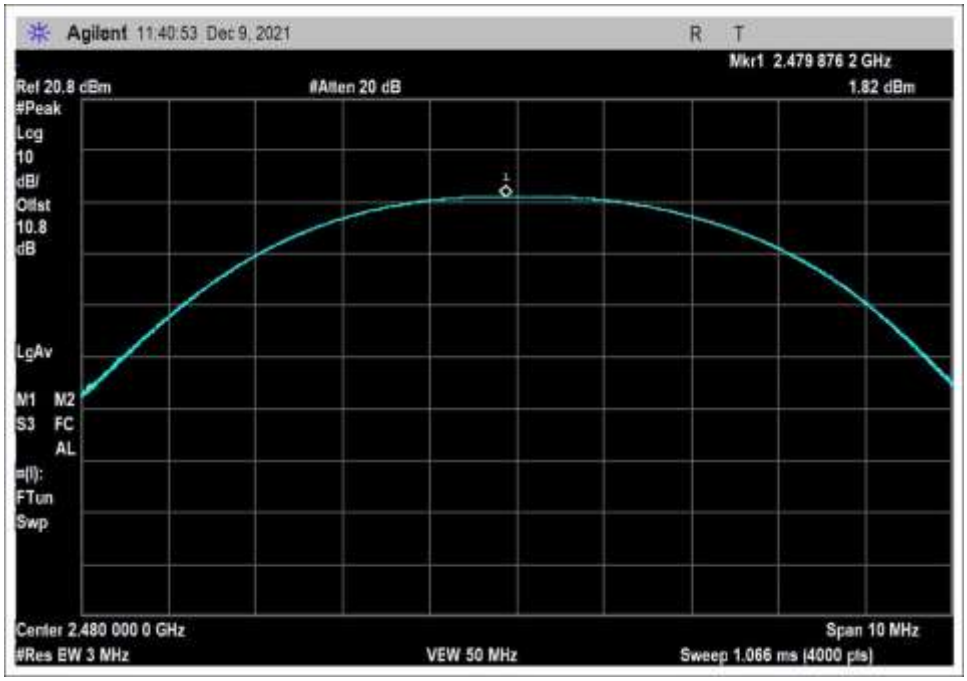
Plots



Low Channel



Middle Channel



High Channel

15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**106246**	Date:	11/29/2021
Test Type:	**Radiated Scan**	Time:	10:55:30 AM
Tested By:	Hoang Cao	Sequence#:	1
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:

Conducted Spurious Emission

Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 20.3°C
Humidity: 42%
Atmospheric Pressure: 102.1kPa

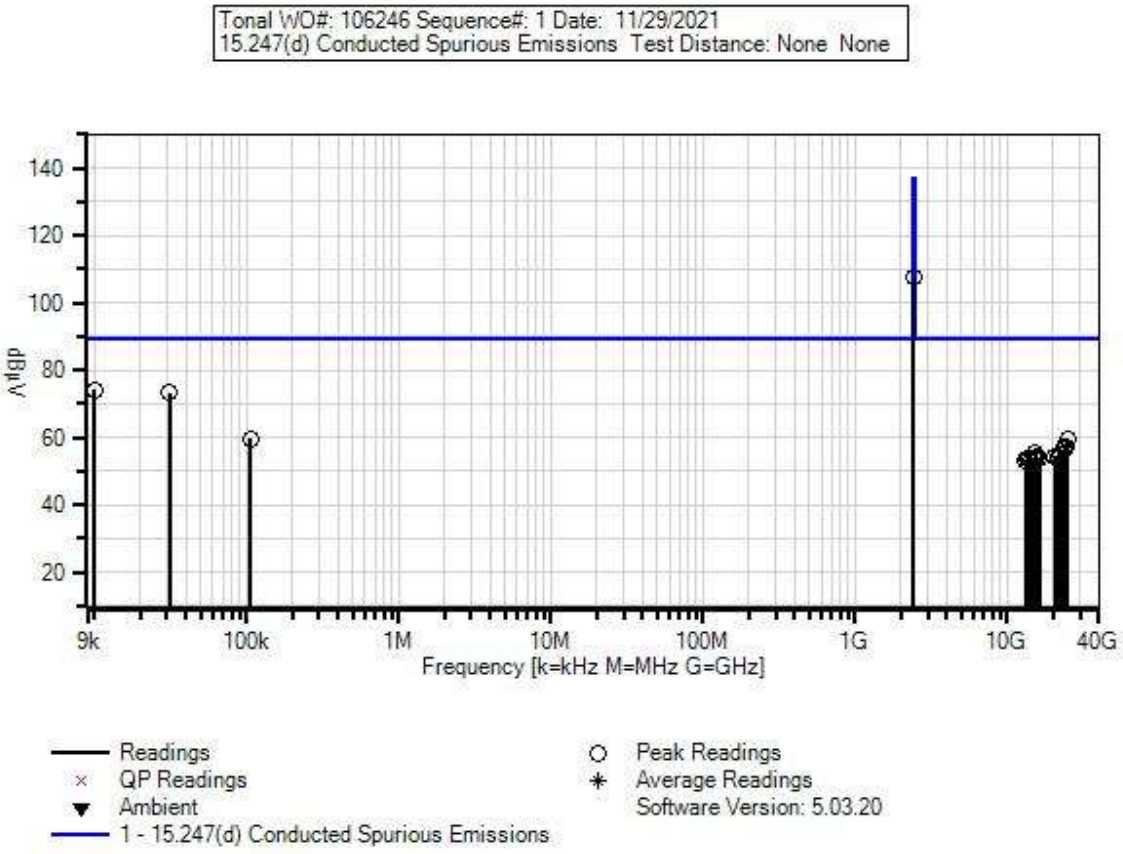
Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

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

Note: Low Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022

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

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	10.121k	64.4	+9.7	+0.0			+0.0	74.1	89.4	-15.3	None
2	31.368k	63.6	+9.7	+0.0			+0.0	73.3	89.4	-16.1	None
3	2400.765M	96.7	+9.9	+0.8			+0.0	107.4	137.0	-29.6	None
4	106.707k	49.9	+9.7	+0.0			+0.0	59.6	89.4	-29.8	None
5	24738.024 M	46.7	+10.1	+2.6			+0.0	59.4	89.4	-30.0	None
6	23815.868 M	44.6	+10.1	+2.5			+0.0	57.2	89.4	-32.2	None
7	23899.700 M	44.6	+10.1	+2.5			+0.0	57.2	89.4	-32.2	None
8	23229.042 M	43.7	+10.1	+2.5			+0.0	56.3	89.4	-33.1	None
9	15327.842 M	43.5	+10.0	+2.0			+0.0	55.5	89.4	-33.9	None
10	22149.700 M	42.4	+10.1	+2.4			+0.0	54.9	89.4	-34.5	None
11	20494.011 M	42.0	+10.1	+2.4			+0.0	54.5	89.4	-34.9	None
12	15443.112 M	42.4	+10.0	+2.0			+0.0	54.4	89.4	-35.0	None
13	21217.065 M	41.6	+10.0	+2.4			+0.0	54.0	89.4	-35.4	None
14	16249.998 M	41.8	+10.0	+2.1			+0.0	53.9	89.4	-35.5	None
15	13943.944 M	41.8	+10.0	+1.9			+0.0	53.7	89.4	-35.7	None
16	13624.526 M	41.7	+10.0	+1.9			+0.0	53.6	89.4	-35.8	None
17	15097.304 M	41.5	+10.0	+1.9			+0.0	53.4	89.4	-36.0	None

18	21730.538 M	41.0	+10.0	+2.4		+0.0	53.4	89.4	-36.0	None
19	14201.539 M	41.3	+10.0	+1.9		+0.0	53.2	89.4	-36.2	None
20	13202.071 M	41.3	+10.0	+1.8		+0.0	53.1	89.4	-36.3	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**106246**	Date:	11/29/2021
Test Type:	**Radiated Scan**	Time:	11:02:44 AM
Tested By:	Hoang Cao	Sequence#:	2
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:

Conducted Spurious Emission

Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 20.3°C
Humidity: 42%
Atmospheric Pressure: 102.1kPa

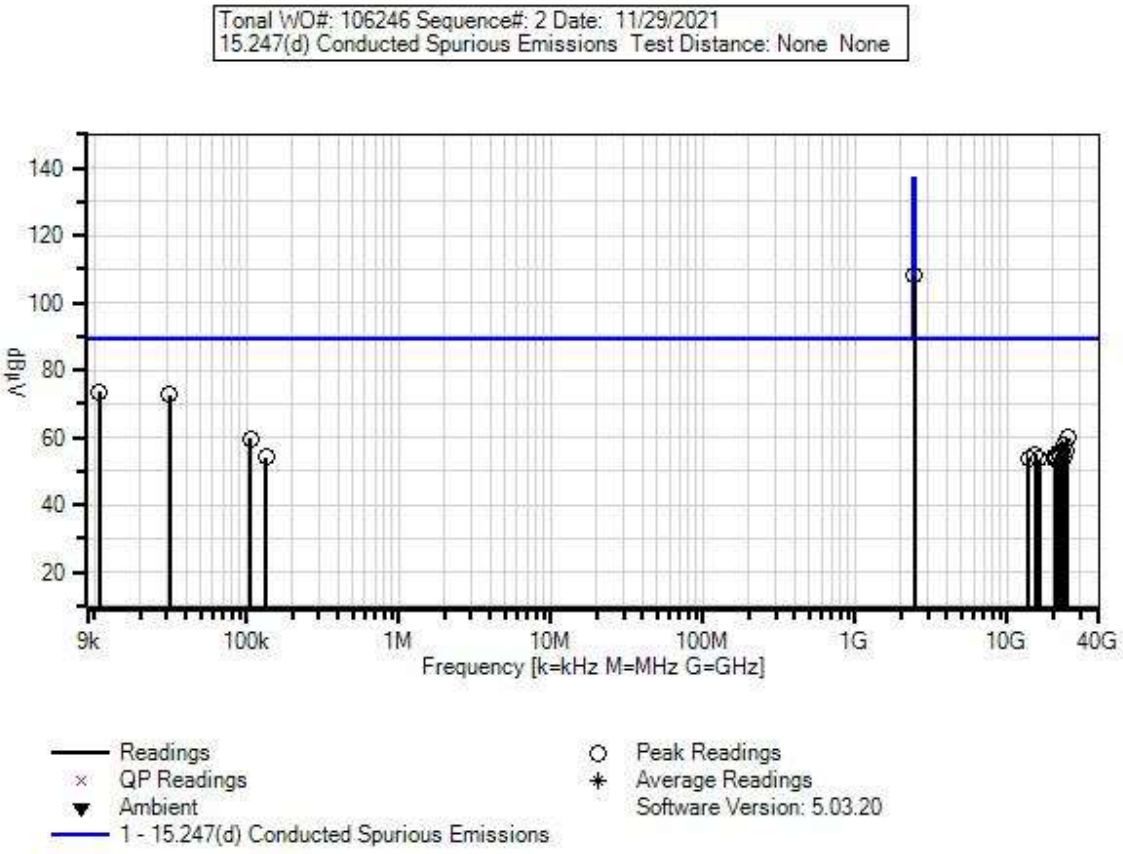
Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

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

Note: Middle Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022

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

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	10.891k	63.9	+9.7	+0.0			+0.0	73.6	89.4	-15.8	None
2	31.217k	63.1	+9.7	+0.0			+0.0	72.8	89.4	-16.6	None
3	2442.659M	97.3	+9.9	+0.8			+0.0	108.0	137.0	-29.0	None
4	24717.066 M	47.1	+10.1	+2.6			+0.0	59.8	89.4	-29.6	None
5	106.707k	49.8	+9.7	+0.0			+0.0	59.5	89.4	-29.9	None
6	23868.263 M	45.4	+10.1	+2.5			+0.0	58.0	89.4	-31.4	None
7	22988.024 M	43.7	+10.0	+2.5			+0.0	56.2	89.4	-33.2	None
8	24035.928 M	43.4	+10.1	+2.5			+0.0	56.0	89.4	-33.4	None
9	21845.808 M	43.0	+10.0	+2.4			+0.0	55.4	89.4	-34.0	None
10	15317.363 M	42.9	+10.0	+2.0			+0.0	54.9	89.4	-34.5	None
11	21908.682 M	42.1	+10.1	+2.4			+0.0	54.6	89.4	-34.8	None
12	22191.616 M	42.0	+10.1	+2.4			+0.0	54.5	89.4	-34.9	None
13	21982.035 M	41.8	+10.1	+2.4			+0.0	54.3	89.4	-35.1	None
14	23459.581 M	41.7	+10.1	+2.5			+0.0	54.3	89.4	-35.1	None
15	134.864k	44.5	+9.7	+0.0			+0.0	54.2	89.4	-35.2	None
16	21164.670 M	41.8	+10.0	+2.4			+0.0	54.2	89.4	-35.2	None
17	20514.969 M	41.5	+10.1	+2.4			+0.0	54.0	89.4	-35.4	None

18	13717.260 M	41.8	+10.0	+1.9		+0.0	53.7	89.4	-35.7	None
19	16229.040 M	41.4	+10.0	+2.1		+0.0	53.5	89.4	-35.9	None
20	20305.388 M	41.0	+10.1	+2.4		+0.0	53.5	89.4	-35.9	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**106246**	Date:	11/29/2021
Test Type:	**Radiated Scan**	Time:	11:08:34 AM
Tested By:	Hoang Cao	Sequence#:	3
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:

Conducted Spurious Emission

Frequency Range: 9kHz to 25GHz

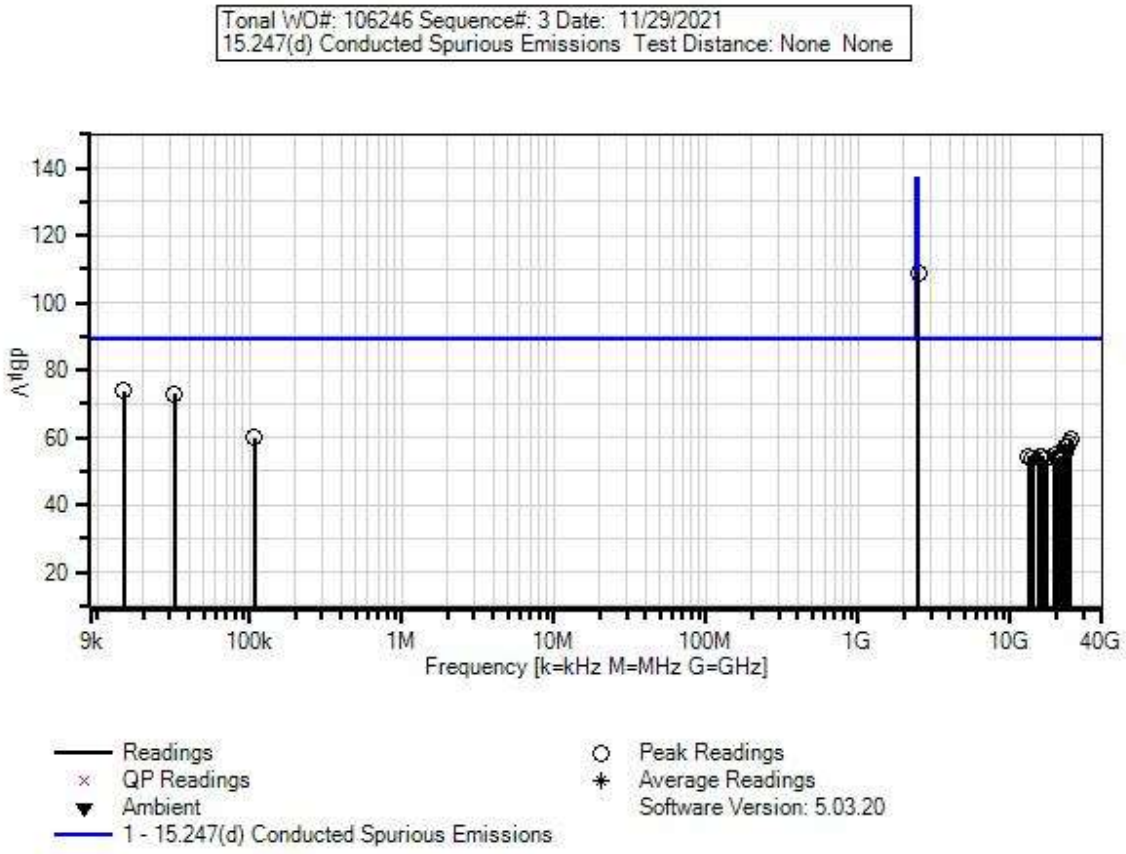
Environmental Conditions:
Temperature: 20.3°C
Humidity: 42%
Atmospheric Pressure: 102.1kPa

Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

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

Note: High Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022

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

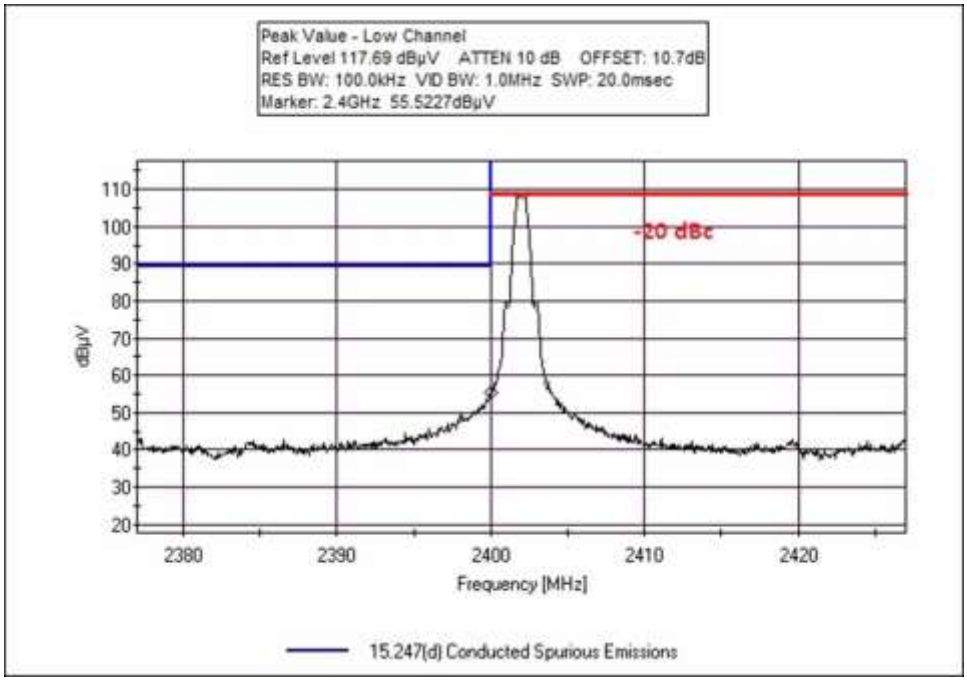
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	14.936k	64.2	+9.7	+0.0			+0.0	73.9	89.4	-15.5	None
2	32.352k	63.3	+9.7	+0.0			+0.0	73.0	89.4	-16.4	None
3	2481.561M	98.3	+9.9	+0.8			+0.0	109.0	137.0	-28.0	None
4	108.532k	50.1	+9.7	+0.0			+0.0	59.8	89.4	-29.6	None
5	24779.940 M	46.9	+10.1	+2.6			+0.0	59.6	89.4	-29.8	None
6	24528.443 M	45.9	+10.1	+2.5			+0.0	58.5	89.4	-30.9	None
7	23805.389 M	44.6	+10.1	+2.5			+0.0	57.2	89.4	-32.2	None
8	23166.167 M	44.5	+10.1	+2.5			+0.0	57.1	89.4	-32.3	None
9	22935.628 M	42.8	+10.0	+2.5			+0.0	55.3	89.4	-34.1	None
10	21919.161 M	42.3	+10.1	+2.4			+0.0	54.8	89.4	-34.6	None
11	19592.813 M	42.3	+10.0	+2.3			+0.0	54.6	89.4	-34.8	None
12	21196.107 M	42.1	+10.0	+2.4			+0.0	54.5	89.4	-34.9	None
13	13222.678 M	42.6	+10.0	+1.8			+0.0	54.4	89.4	-35.0	None
14	16176.645 M	42.3	+10.0	+2.1			+0.0	54.4	89.4	-35.0	None
15	15338.322 M	42.3	+10.0	+2.0			+0.0	54.3	89.4	-35.1	None
16	21290.418 M	41.6	+10.0	+2.4			+0.0	54.0	89.4	-35.4	None
17	20514.969 M	41.4	+10.1	+2.4			+0.0	53.9	89.4	-35.5	None

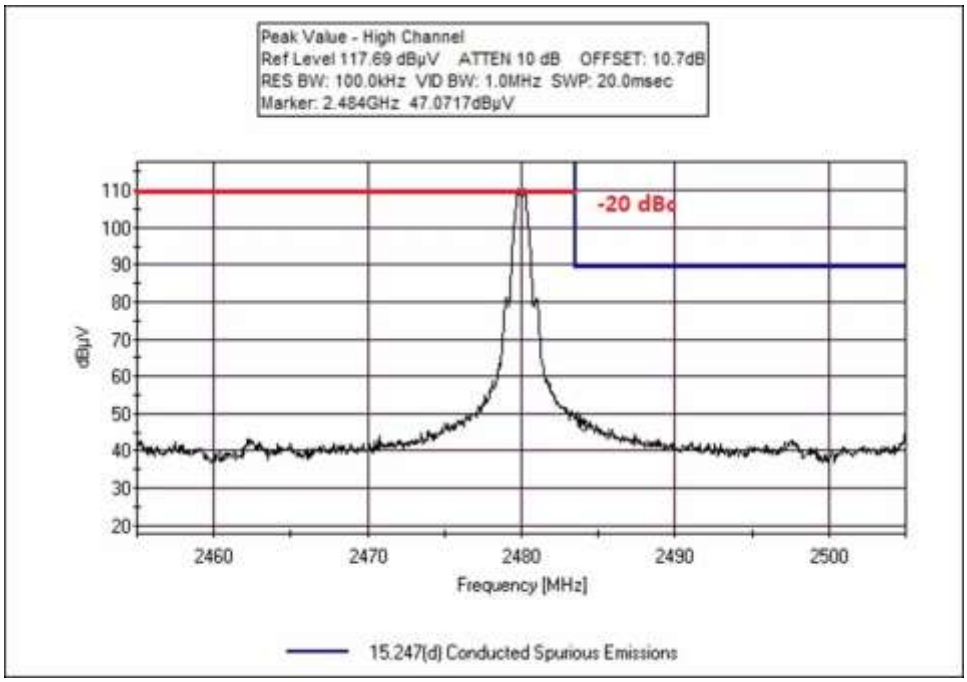
18	21803.892 M	41.5	+10.0	+2.4		+0.0	53.9	89.4	-35.5	None
19	13974.855 M	41.6	+10.0	+1.9		+0.0	53.5	89.4	-35.9	None
20	17098.801 M	41.2	+10.0	+2.2		+0.0	53.4	89.4	-36.0	None

Band Edge

Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB.				
Frequency (MHz)	**Modulation**	**Measured (dBuV)**	**Limit (dBuV)**	**Results**
2400.0	GFSK	55.5227	<85.5	Pass
2483.5	GFSK	47.0717	<85.5	Pass

Band Edge Plots





15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	17:40:15
Tested By:	Jonathan Wharton	Sequence#:	43
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 9kHz to 30MHz

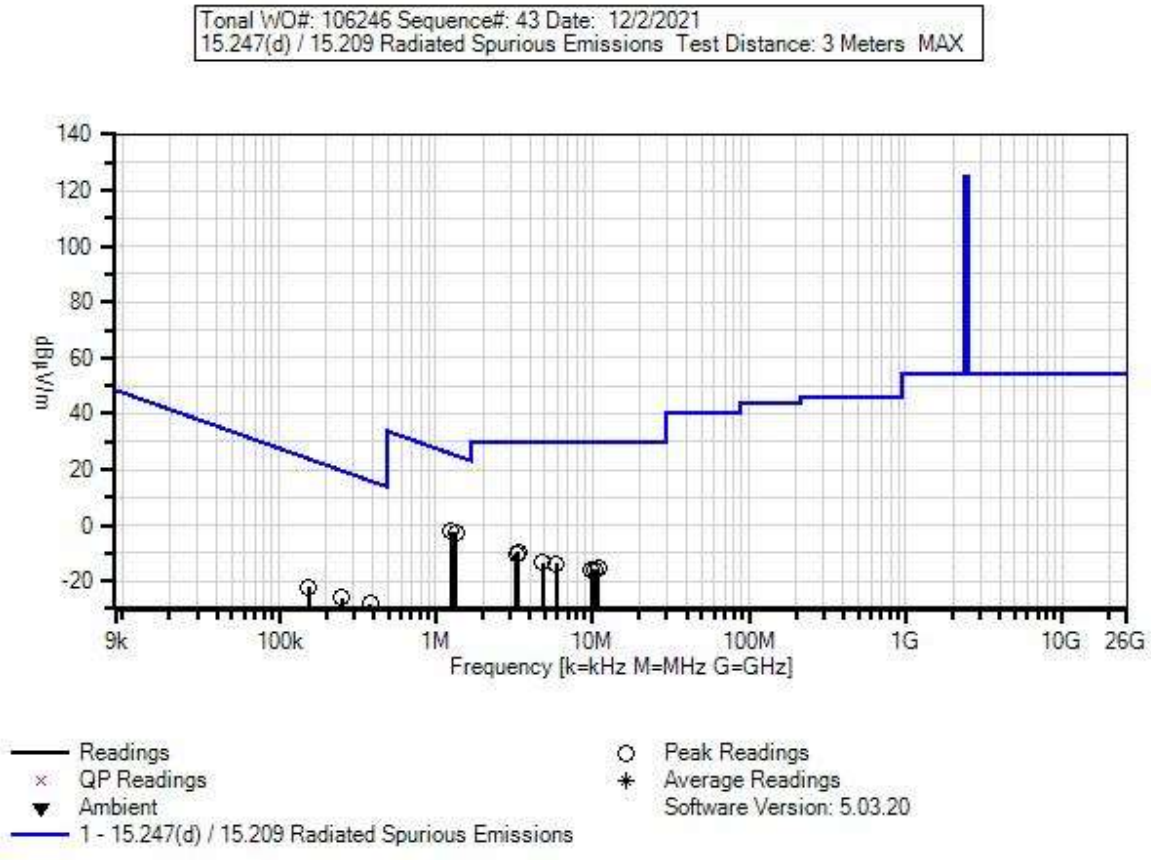
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Low Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T2	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
T3	AN00432	Loop Antenna	6502	7/19/2021	7/19/2023

Measurement Data: Reading listed by margin. 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	1.344M	28.0	+0.0	+0.1	+9.4		-40.0	-2.5	25.1	-27.6	X
2	1.250M	28.3	+0.0	+0.1	+9.4		-40.0	-2.2	25.7	-27.9	Z
3	3.367M	20.8	+0.0	+0.1	+9.4		-40.0	-9.7	29.5	-39.2	Y
4	3.286M	20.1	+0.0	+0.1	+9.4		-40.0	-10.4	29.5	-39.9	X
5	4.835M	16.9	+0.1	+0.2	+9.5		-40.0	-13.3	29.5	-42.8	Z
6	5.898M	16.4	+0.1	+0.2	+9.4		-40.0	-13.9	29.5	-43.4	Y
7	384.158k	42.7	+0.0	+0.0	+9.1		-80.0	-28.2	15.9	-44.1	Y
8	10.907M	14.9	+0.1	+0.3	+9.2		-40.0	-15.5	29.5	-45.0	Y
9	10.277M	14.8	+0.1	+0.2	+9.1		-40.0	-15.8	29.5	-45.3	Z
10	252.444k	45.1	+0.0	+0.0	+9.0		-80.0	-25.9	19.6	-45.5	Z
11	9.943M	14.3	+0.1	+0.2	+9.1		-40.0	-16.3	29.5	-45.8	X
12	154.181k	49.1	+0.0	+0.0	+8.8		-80.0	-22.1	23.8	-45.9	X

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	17:44:30
Tested By:	Jonathan Wharton	Sequence#:	44
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 9kHz to 30MHz

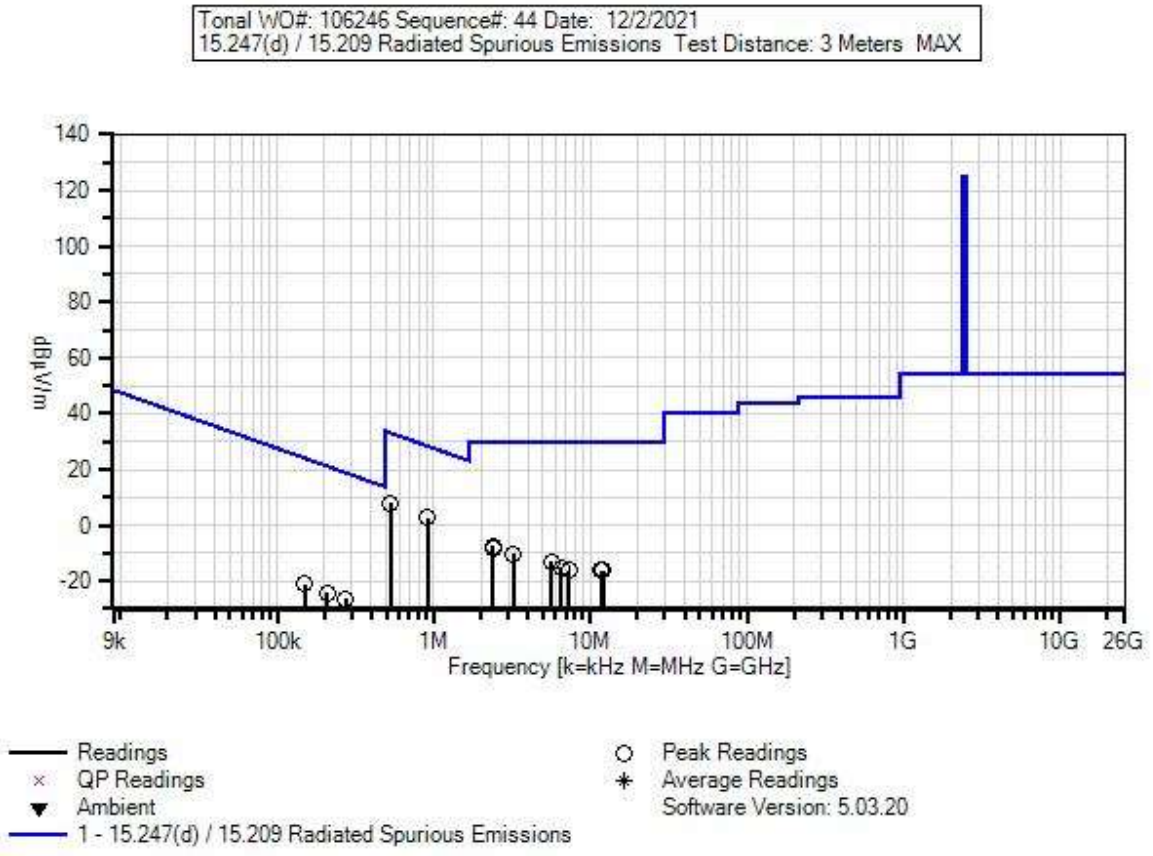
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Mid Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T2	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
T3	AN00432	Loop Antenna	6502	7/19/2021	7/19/2023

Measurement Data: Reading listed by margin. 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	528.417k	38.8	+0.0	+0.1	+9.2		-40.0	8.1	33.1	-25.0	Y
2	921.469k	33.3	+0.0	+0.1	+9.4		-40.0	2.8	28.3	-25.5	X
3	2.376M	22.9	+0.0	+0.1	+9.4		-40.0	-7.6	29.5	-37.1	Y
4	2.385M	22.5	+0.0	+0.1	+9.4		-40.0	-8.0	29.5	-37.5	Z
5	3.232M	20.3	+0.0	+0.1	+9.4		-40.0	-10.2	29.5	-39.7	X
6	5.646M	17.2	+0.1	+0.2	+9.4		-40.0	-13.1	29.5	-42.6	Z
7	6.547M	15.4	+0.1	+0.2	+9.3		-40.0	-15.0	29.5	-44.5	X
8	273.351k	44.8	+0.0	+0.0	+9.0		-80.0	-26.2	18.9	-45.1	Z
9	150.000k	50.0	+0.0	+0.0	+8.8		-80.0	-21.2	24.1	-45.3	X
10	210.630k	46.8	+0.0	+0.0	+8.9		-80.0	-24.3	21.1	-45.4	Y
11	7.313M	14.3	+0.1	+0.2	+9.3		-40.0	-16.1	29.5	-45.6	Y
12	11.997M	14.2	+0.1	+0.3	+9.3		-40.0	-16.1	29.5	-45.6	Z
13	11.817M	14.1	+0.1	+0.3	+9.3		-40.0	-16.2	29.5	-45.7	X

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	17:46:16
Tested By:	Jonathan Wharton	Sequence#:	45
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 9kHz to 30MHz

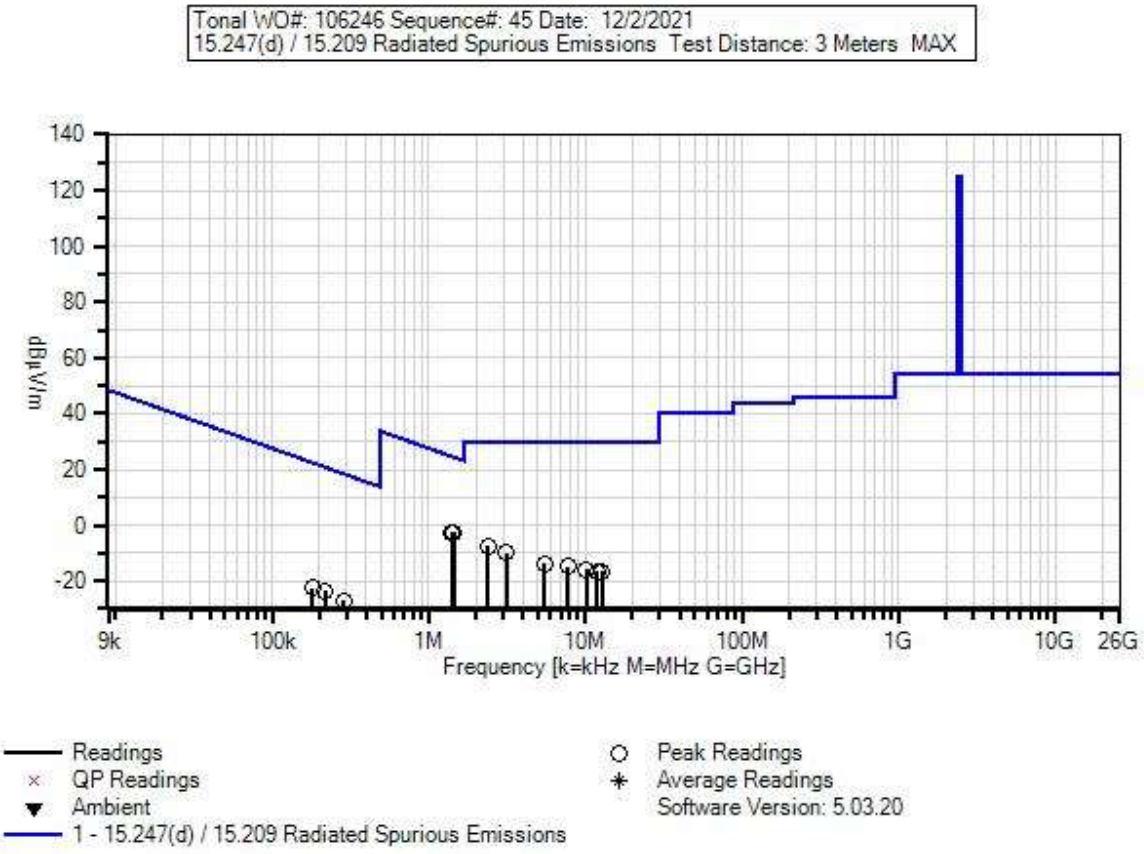
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: High Channel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T2	ANP06694	Cable	PE3062-480	3/25/2020	3/25/2022
T3	AN00432	Loop Antenna	6502	7/19/2021	7/19/2023

Measurement Data: Reading listed by margin. 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	1.444M	27.9	+0.0	+0.1	+9.4		-40.0	-2.6	24.4	-27.0	X
2	1.409M	27.9	+0.0	+0.1	+9.4		-40.0	-2.6	24.7	-27.3	Z
3	2.376M	23.1	+0.0	+0.1	+9.4		-40.0	-7.4	29.5	-36.9	Z
4	3.124M	20.7	+0.0	+0.1	+9.4		-40.0	-9.8	29.5	-39.3	Y
5	5.502M	16.6	+0.1	+0.2	+9.4		-40.0	-13.7	29.5	-43.2	X
6	216.902k	47.6	+0.0	+0.0	+8.9		-80.0	-23.5	20.9	-44.4	Y
7	7.718M	15.6	+0.1	+0.2	+9.2		-40.0	-14.9	29.5	-44.4	Y
8	181.360k	48.5	+0.0	+0.0	+8.9		-80.0	-22.6	22.4	-45.0	X
9	10.106M	14.7	+0.1	+0.2	+9.1		-40.0	-15.9	29.5	-45.4	Z
10	285.895k	44.1	+0.0	+0.0	+9.0		-80.0	-26.9	18.5	-45.4	Z
11	11.988M	13.9	+0.1	+0.3	+9.3		-40.0	-16.4	29.5	-45.9	X
12	12.745M	14.1	+0.1	+0.3	+8.9		-40.0	-16.6	29.5	-46.1	Y

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	20:01:50
Tested By:	Jonathan Wharton	Sequence#:	55
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 30MHz to 1GHz

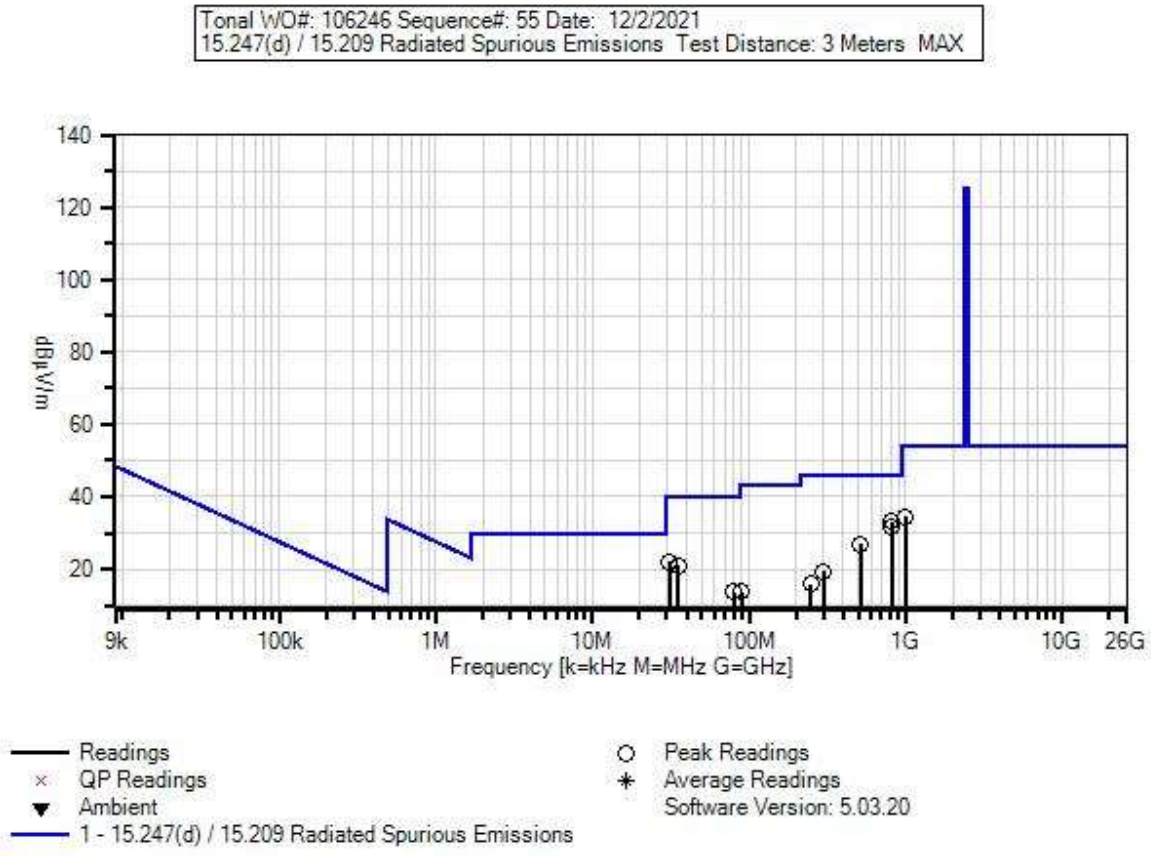
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Low Channel



Test Equipment:

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

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	819.191M	31.4	+0.7 +5.9	-31.8 +22.6	+1.2	+3.1	+0.0	33.1	46.0	-12.9	Vert
2	817.990M	30.3	+0.7 +5.9	-31.8 +22.6	+1.1	+3.0	+0.0	31.8	46.0	-14.2	Horiz
3	30.932M	29.3	+0.0 +5.9	-32.1 +18.3	+0.2	+0.4	+0.0	22.0	40.0	-18.0	Vert
4	517.209M	30.8	+0.5 +5.9	-31.9 +18.5	+0.9	+2.3	+0.0	27.0	46.0	-19.0	Horiz
5	35.324M	30.0	+0.0 +5.9	-32.0 +16.4	+0.2	+0.4	+0.0	20.9	40.0	-19.1	Horiz
6	999.374M	28.9	+0.8 +6.0	-30.3 +24.4	+1.3	+3.5	+0.0	34.6	54.0	-19.4	Vert
7	79.992M	31.0	+0.1 +5.9	-32.0 +7.7	+0.3	+0.7	+0.0	13.7	40.0	-26.3	Vert
8	299.972M	29.6	+0.4 +6.0	-31.9 +13.2	+0.6	+1.6	+0.0	19.5	46.0	-26.5	Vert
9	90.009M	29.3	+0.1 +5.9	-32.0 +9.3	+0.3	+0.8	+0.0	13.7	43.5	-29.8	Horiz
10	249.900M	26.7	+0.3 +6.0	-31.9 +12.6	+0.6	+1.5	+0.0	15.8	46.0	-30.2	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	20:03:47
Tested By:	Jonathan Wharton	Sequence#:	56
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 30MHz to 1GHz

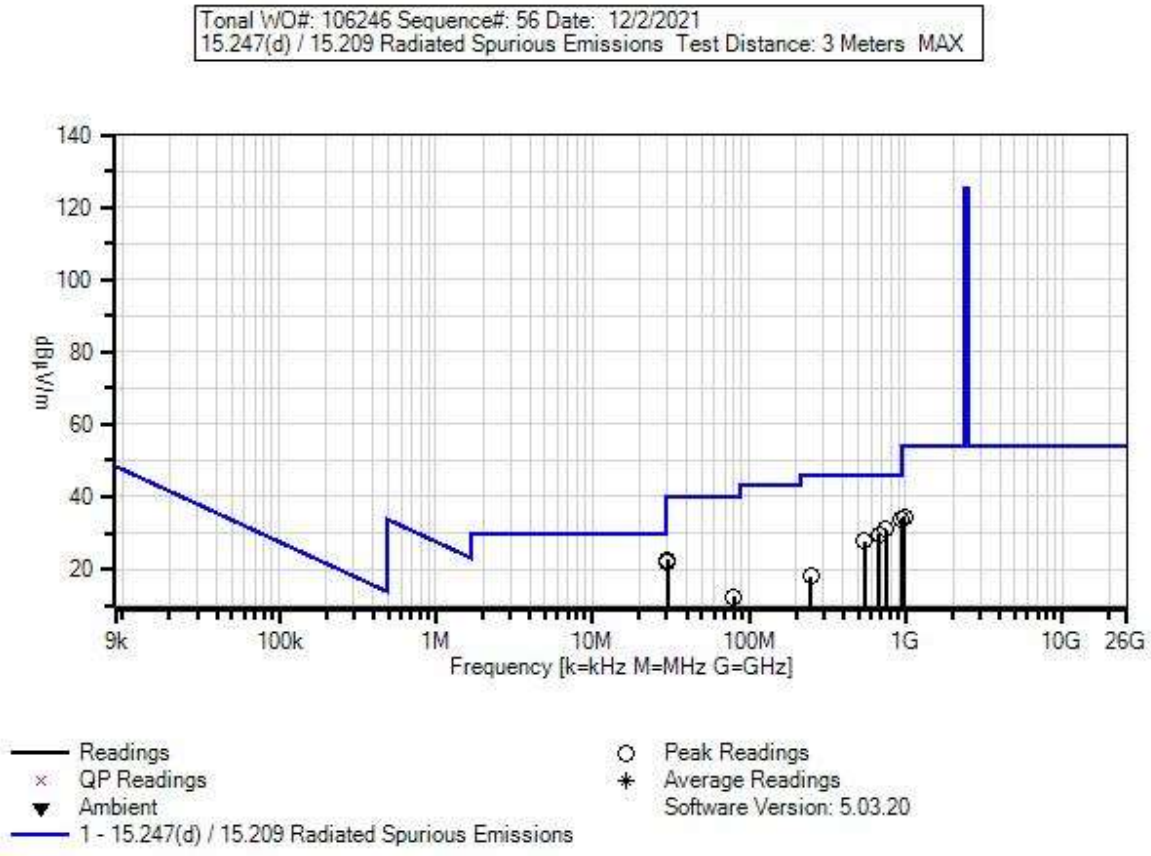
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Middle Channel



Test Equipment:

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

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	935.467M	30.0	+0.7 +5.9	-31.0 +23.6	+1.3	+3.3	+0.0	33.8	46.0	-12.2	Horiz
2	745.197M	30.9	+0.6 +6.0	-32.0 +21.7	+1.1	+2.8	+0.0	31.1	46.0	-14.9	Vert
3	682.134M	30.7	+0.6 +5.9	-32.0 +20.8	+1.0	+2.7	+0.0	29.7	46.0	-16.3	Horiz
4	30.067M	29.6	+0.0 +5.9	-32.1 +18.7	+0.2	+0.4	+0.0	22.7	40.0	-17.3	Vert
5	30.333M	29.1	+0.0 +5.9	-32.1 +18.5	+0.2	+0.4	+0.0	22.0	40.0	-18.0	Horiz
6	548.921M	31.0	+0.5 +5.9	-31.9 +18.9	+0.9	+2.4	+0.0	27.7	46.0	-18.3	Horiz
7	976.771M	29.7	+0.7 +6.0	-30.6 +24.1	+1.3	+3.4	+0.0	34.6	54.0	-19.4	Vert
8	79.926M	29.7	+0.1 +5.9	-32.0 +7.7	+0.3	+0.7	+0.0	12.4	40.0	-27.6	Vert
9	250.100M	28.8	+0.3 +6.0	-31.9 +12.6	+0.6	+1.5	+0.0	17.9	46.0	-28.1	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/2/2021
Test Type:	**Maximized Emissions**	Time:	20:05:07
Tested By:	Jonathan Wharton	Sequence#:	57
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 30MHz to 1GHz

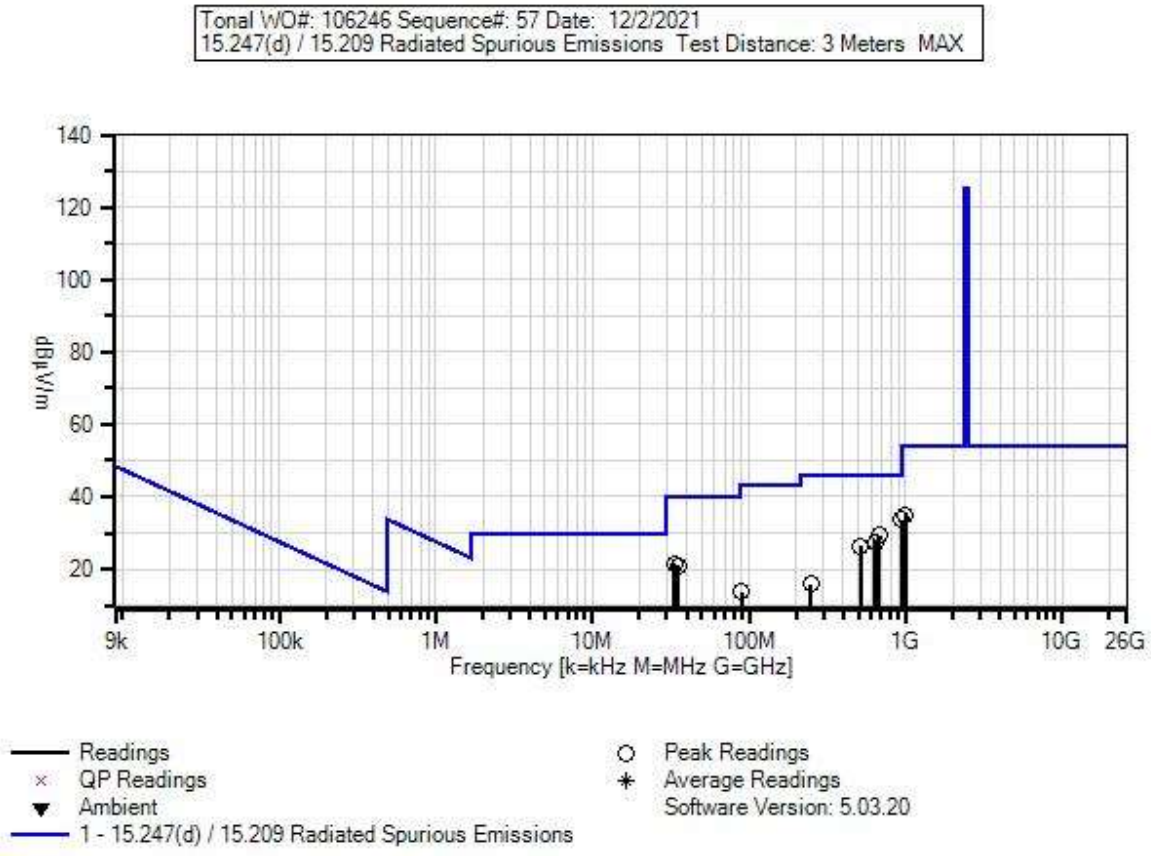
Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: High Channel



Test Equipment:

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

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	948.408M	29.5	+0.7 +5.9	-30.9 +23.8	+1.3	+3.3	+0.0	33.6	46.0	-12.4	Horiz
2	677.689M	30.5	+0.6 +5.9	-32.0 +20.7	+1.0	+2.7	+0.0	29.4	46.0	-16.6	Vert
3	33.461M	29.9	+0.0 +5.9	-32.1 +17.2	+0.2	+0.4	+0.0	21.5	40.0	-18.5	Vert
4	641.413M	29.2	+0.6 +5.9	-32.0 +20.2	+1.0	+2.6	+0.0	27.5	46.0	-18.5	Horiz
5	35.324M	30.0	+0.0 +5.9	-32.0 +16.4	+0.2	+0.4	+0.0	20.9	40.0	-19.1	Horiz
6	997.496M	29.3	+0.8 +6.0	-30.4 +24.4	+1.3	+3.5	+0.0	34.9	54.0	-19.1	Vert
7	519.371M	30.1	+0.5 +5.9	-31.9 +18.5	+0.9	+2.3	+0.0	26.3	46.0	-19.7	Vert
8	90.009M	29.3	+0.1 +5.9	-32.0 +9.3	+0.3	+0.8	+0.0	13.7	43.5	-29.8	Horiz
9	249.900M	26.7	+0.3 +6.0	-31.9 +12.6	+0.6	+1.5	+0.0	15.8	46.0	-30.2	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/1/2021
Test Type:	**Radiated Scan**	Time:	17:25:54
Tested By:	Hoang Cao	Sequence#:	6
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 1GHz to 25GHz

Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Low Channel

Tonal WO#: 106246 Sequence#: 6 Date: 12/1/2021
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters MAX

Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01273	Horn Antenna	3115	11/24/2020	11/24/2022
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T3	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T4	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
T5	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	4/6/2020	4/6/2022
T6	AN03713	Preamp	01001800-221055-202525	5/24/2021	5/24/2023
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	10/26/2021	10/26/2023
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	10/26/2021	10/26/2023
	AN03619	Cable	OKOCQoCQ177.2	9/17/2021	9/17/2023
	ANP07699	Cable	32022-29094K-29094K-72TC	10/5/2020	10/5/2022
	ANP00928	Cable	various	1/9/2020	1/9/2022
	ANP00929	Cable	various	1/9/2020	1/9/2022

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	11918.656 M	53.2	+38.0 +0.8	+3.0 -55.6	+6.0	+1.8	+0.0	47.2	54.0	-6.8	Horiz
2	11243.104 M	54.2	+37.5 +0.6	+2.9 -56.2	+5.9	+1.8	+0.0	46.7	54.0	-7.3	Horiz
3	10480.473 M	54.5	+37.1 +0.9	+2.8 -56.5	+5.7	+1.8	+0.0	46.3	54.0	-7.7	Horiz
4	8539.534M	57.4	+35.4 +0.5	+2.5 -57.4	+5.0	+1.6	+0.0	45.0	54.0	-9.0	Vert
5	8539.534M	57.4	+35.4 +0.5	+2.5 -57.4	+5.0	+1.6	+0.0	45.0	54.0	-9.0	Vert
6	9995.989M	54.3	+36.8 +0.6	+2.7 -56.6	+5.5	+1.7	+0.0	45.0	54.0	-9.0	Vert
7	4803.522M Ave	54.1	+32.2 +0.4	+1.8 -56.1	+3.7	+1.2	+0.0	37.3	54.0	-16.7	Vert
^	4803.522M	63.9	+32.2 +0.4	+1.8 -56.1	+3.7	+1.2	+0.0	47.1	54.0	-6.9	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/1/2021
Test Type:	**Radiated Scan**	Time:	17:50:31
Tested By:	Hoang Cao	Sequence#:	9
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 1GHz to 25GHz

Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: Middle Channel

Tonal WO#: 106246 Sequence#: 9 Date: 12/1/2021
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters MAX

Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01273	Horn Antenna	3115	11/24/2020	11/24/2022
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T3	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T4	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
T5	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	4/6/2020	4/6/2022
T6	AN03713	Preamp	01001800-221055-202525	5/24/2021	5/24/2023
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	10/26/2021	10/26/2023
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	10/26/2021	10/26/2023
	AN03619	Cable	OKOCQoCQ177.2	9/17/2021	9/17/2023
	ANP00928	Cable	various	1/9/2020	1/9/2022
	ANP00929	Cable	various	1/9/2020	1/9/2022
	ANP07699	Cable	32022-29094K-29094K-72TC	10/5/2020	10/5/2022

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	11942.464 M	52.9	+38.0 +0.8	+3.0 -55.6	+6.0	+1.9	+0.0	47.0	54.0	-7.0	Vert
2	11942.464 M	52.9	+38.0 +0.8	+3.0 -55.6	+6.0	+1.9	+0.0	47.0	54.0	-7.0	Vert
3	9318.312M	57.3	+36.3 +0.4	+2.6 -57.1	+5.3	+1.6	+0.0	46.4	54.0	-7.6	Vert
4	10490.483 M	54.5	+37.1 +0.9	+2.8 -56.5	+5.7	+1.8	+0.0	46.3	54.0	-7.7	Horiz
5	11155.808 M	53.6	+37.4 +0.7	+2.9 -56.2	+5.9	+1.8	+0.0	46.1	54.0	-7.9	Vert
6	4883.623M Ave	54.2	+32.4 +0.4	+1.8 -56.1	+3.7	+1.2	+0.0	37.6	54.0	-16.4	Vert
^	4883.623M	63.0	+32.4 +0.4	+1.8 -56.1	+3.7	+1.2	+0.0	46.4	54.0	-7.6	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106246**	Date:	12/1/2021
Test Type:	**Radiated Scan**	Time:	18:15:40
Tested By:	Hoang Cao	Sequence#:	12
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Radiated Spurious Emission

Frequency Range: 1GHz to 25GHz

Environmental Conditions:
Temperature: 22.7°C
Humidity: 45%
Atmospheric Pressure: 101.6kPa

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Note: High Channel

Tonal WO#: 106246 Sequence#: 12 Date: 12/1/2021
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters MAX

Readings
QP Readings
Ambient
1 - 15.247(d) / 15.209 Radiated Spurious Emissions
Peak Readings
Average Readings
Software Version: 5.03.20

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01273	Horn Antenna	3115	11/24/2020	11/24/2022
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T3	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T4	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
T5	AN03386	High Pass Filter	11SH10-3000/T10000-O/O	4/6/2020	4/6/2022
T6	AN03713	Preamp	01001800-221055-202525	5/24/2021	5/24/2023
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	10/26/2021	10/26/2023
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	10/26/2021	10/26/2023
	AN03619	Cable	OKOCQoCQ177.2	9/17/2021	9/17/2023
	ANP00928	Cable	various	1/9/2020	1/9/2022
	ANP00929	Cable	various	1/9/2020	1/9/2022
	ANP07699	Cable	32022-29094K-29094K-72TC	10/5/2020	10/5/2022

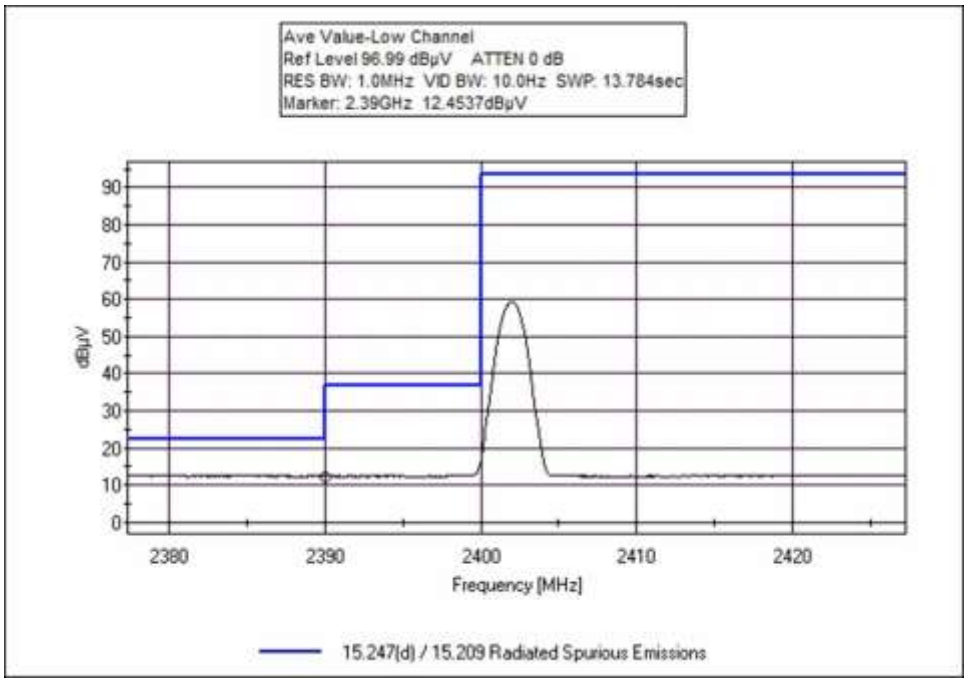
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

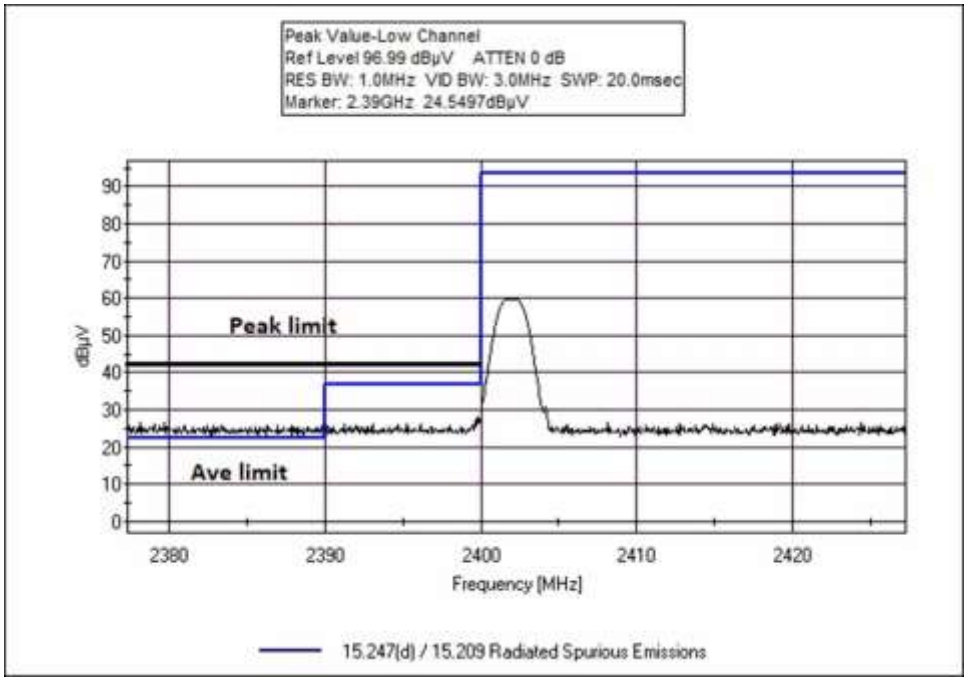
#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	11897.824 M	53.6	+38.0 +0.8	+3.0 -55.7	+6.0	+1.8	+0.0	47.5	54.0	-6.5	Vert
2	11802.592 M	53.2	+38.0 +0.7	+3.0 -55.8	+5.9	+1.8	+0.0	46.8	54.0	-7.2	Horiz
3	11477.216 M	53.4	+38.0 +0.7	+2.9 -56.2	+5.9	+1.8	+0.0	46.5	54.0	-7.5	Horiz
4	10259.252 M	54.8	+37.0 +0.7	+2.7 -56.5	+5.5	+1.7	+0.0	45.9	54.0	-8.1	Vert
5	9320.314M	56.5	+36.3 +0.4	+2.6 -57.1	+5.3	+1.6	+0.0	45.6	54.0	-8.4	Horiz
6	9163.157M	56.3	+36.1 +0.4	+2.5 -57.2	+5.3	+1.6	+0.0	45.0	54.0	-9.0	Vert
7	4960.529M Ave	58.2	+32.6 +0.4	+1.8 -56.1	+3.8	+1.2	+0.0	41.9	54.0	-12.1	Vert
^	4960.529M	66.7	+32.6 +0.4	+1.8 -56.1	+3.8	+1.2	+0.0	50.4	54.0	-3.6	Vert

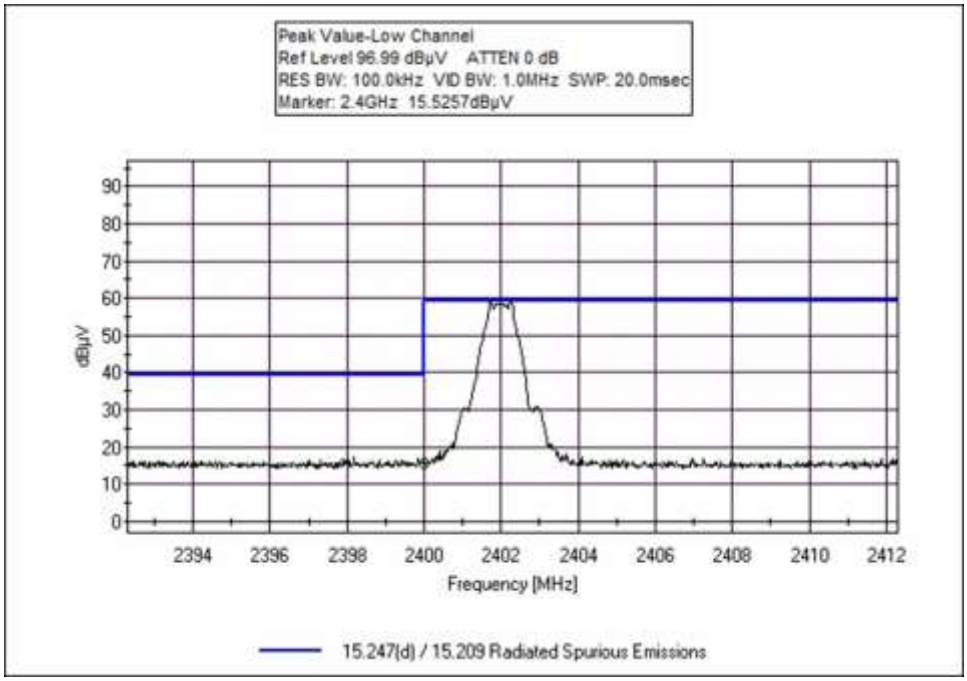
Band Edge

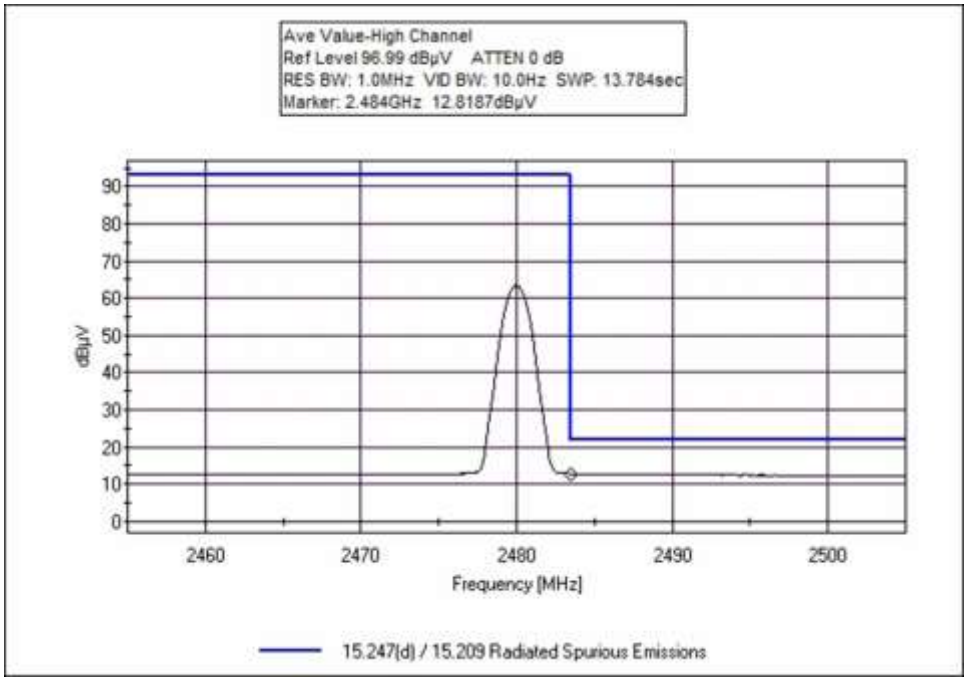
Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	GFSK	Integral	44.2	<54	Pass
2400.0	GFSK	Integral	47.3	<71.2	Pass
2483.5	GFSK	Integral	44.9	<54	Pass

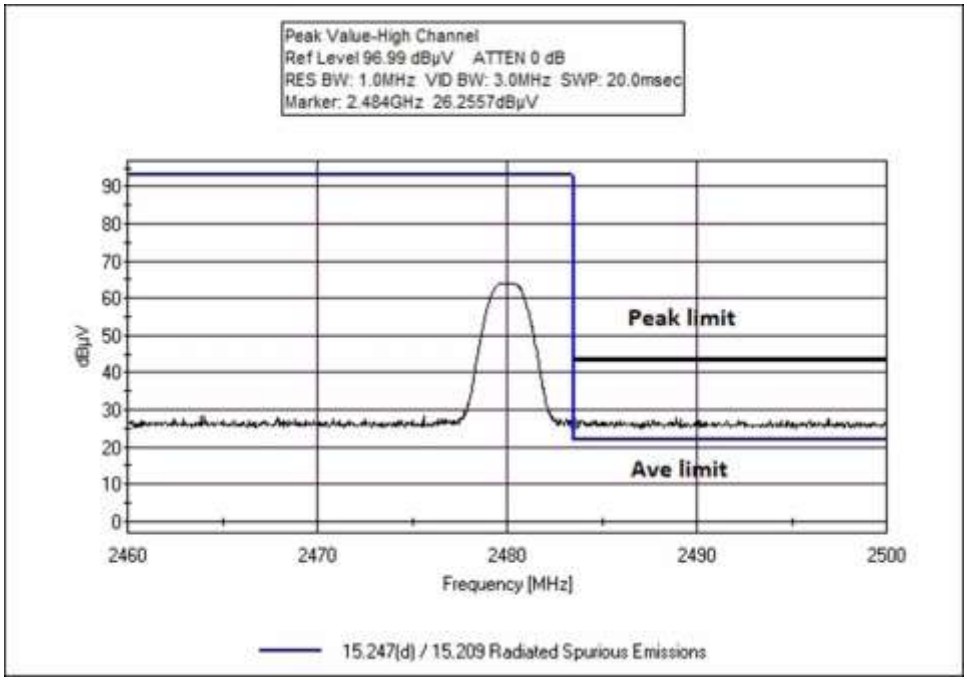
Band Edge Plots




Peak Value-Low Channel
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.39GHz 24.5497dBµV
Peak limit
Ave limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value-Low Channel
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 20.0msec
Marker: 2.4GHz 15.5257dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-High Channel
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.484GHz 12.8187dBµV
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


Peak Value-High Channel
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.484GHz 26.2557dBµV
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

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**106246**	Date:	11/29/2021
Test Type:	**Radiated Emission**	Time:	
Tested By:	Hoang Cao	Sequence#:	
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Band edge

Environmental Conditions:
Temperature: 22.9°C
Humidity: 43%
Atmospheric Pressure: 101.5kPa

Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

The EUT is set up as intended.
The EUT is set up in the worst orthogonal.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T2	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T3	AN01273	Horn Antenna	3115	11/24/2020	11/24/2022

15.247(e) Power Spectral Density

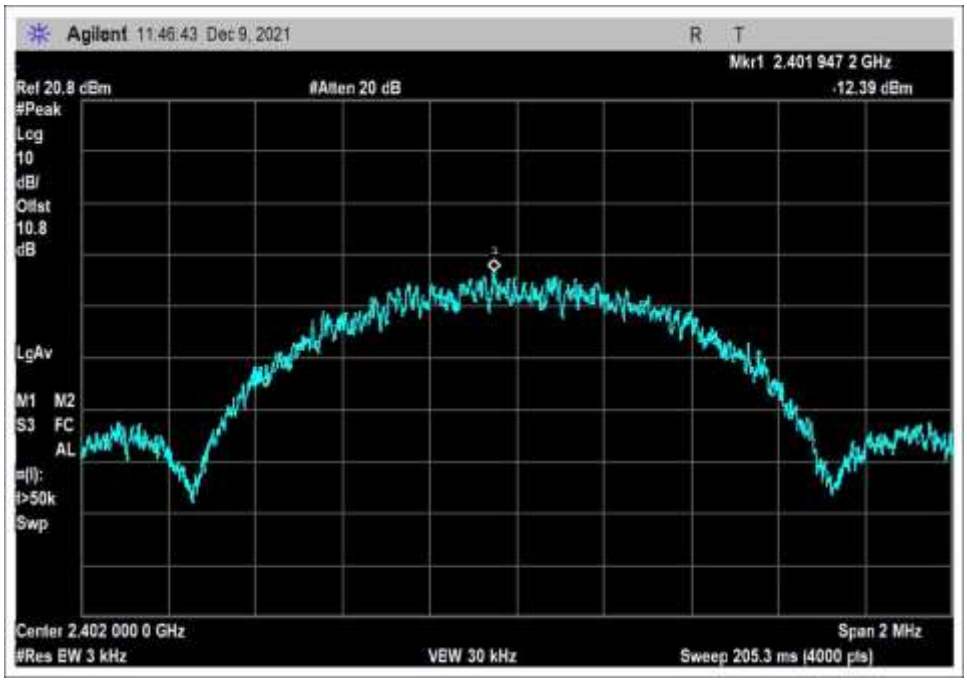
Test Setup / Conditions / Data			
Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/9/2021
Configuration:	1		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	22.3	Relative Humidity (%):	45

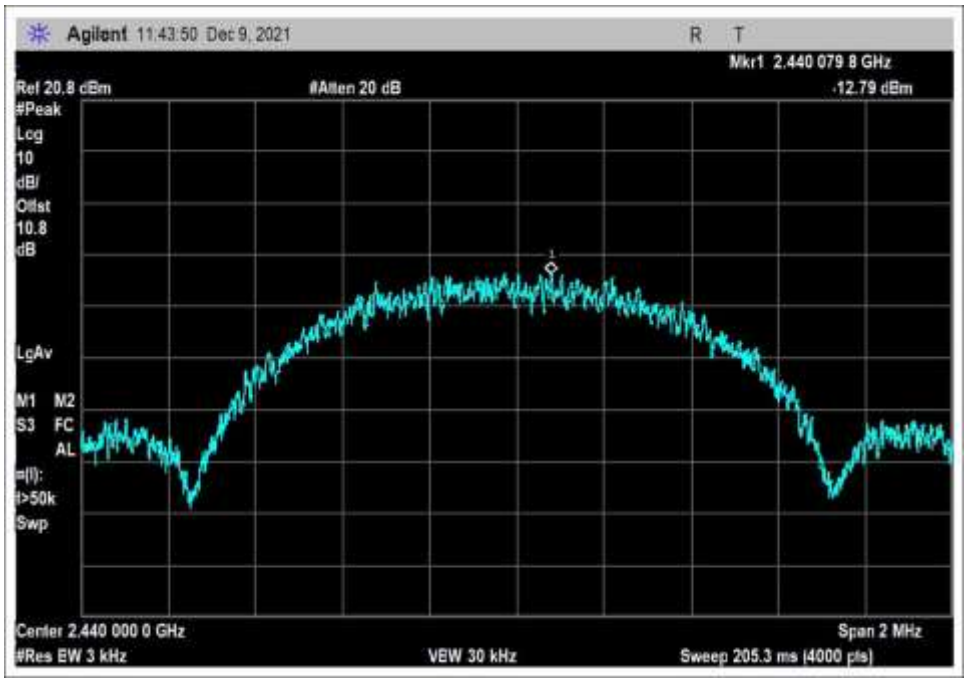
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02660	Spectrum Analyzer	Agilent	E4446A	12/4/2020	12/4/2022
03013	Cable	Astrolab	32022-2-2909K-36TC	3/25/2020	3/25/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022

PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: PKPSD				
Frequency (MHz)	**Modulation**	**Measured (dBm/3kHz)**	**Limit (dBm/3kHz)**	**Results**
2402	GFSK	-12.39	≤8	Pass
2442	GFSK	-12.79	≤8	Pass
2480	GFSK	-10.84	≤8	Pass

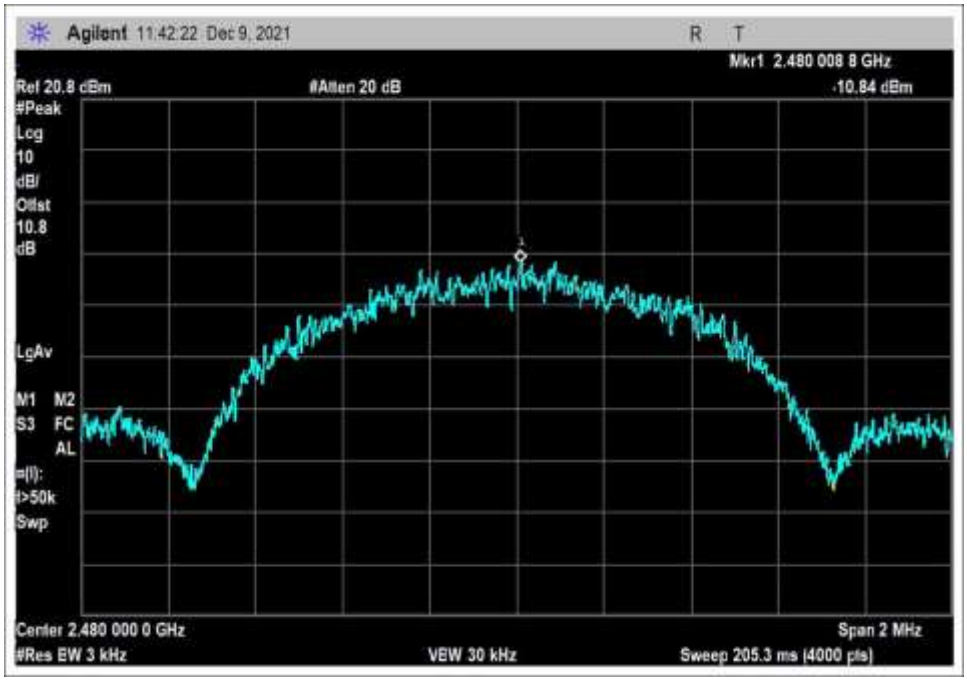
Plots



Low Channel



Middle Channel



High Channel

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

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

Emissions Test Details

TESTING PARAMETERS

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

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

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

CORRECTION FACTORS

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

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

TEST INSTRUMENTATION AND ANALYZER SETTINGS

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

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

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

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

Peak

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

Quasi-Peak

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

Average

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