Tonal

TEST REPORT FOR

Trainer
Model: T1522

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(DTS 2400-2483.5MHz)
Bluetooth DTS for Hydra Board for Main System

Report No.: 105488-34

Date of issue: February 15, 2022

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

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

Test Certificate # 803.01

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Tonal
617 Bryant Street
San Francisco, CA 94107

Representative: Lars Gilstrom
Customer Reference Number: PO1203

REPORT PREPARED BY:

Lisa Bevington
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 105488

DATE OF EQUIPMENT RECEIPT: December 6, 2021
DATE(S) OF TESTING: December 6-10, 13, 17-21, 23-24, 2021
January 3-5. 7, 25-26, 2022

Report Authorization

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

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

Test Facility Information

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

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

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

Site Registration & Accreditation Information

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

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

SUMMARY OF RESULTS

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

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

NA = Not Applicable

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

Modifications During Testing

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

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

Modifications listed above must be incorporated into all production units.

Conditions During Testing

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

Summary of Conditions
The Test Setup Photos are incorporated by reference 105488-34_Test Setup_Photos

EQUIPMENT UNDER TEST (EUT)

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

Configuration 1

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

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
None			

Configuration 2

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

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM

Configuration 3

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

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal System	T1522	02016558
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476
Internal Power Supply	Artesyn Embedded Tech.	LCM1500W-T	K510UN001BBVC-8-416 Revision: BV Firmware 6/2/2021
Direct Bond 2312 Touch screen display	BOE	380-0015 Rev. 1-1 CJ238FSB-TG21	00000015

Support Equipment:

Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM
Laptop Power Supply	Lenovo	SA10R16922	8SSA10R16922C2TJ-19M0G0G

Configuration 9

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

Device Name	Manufacturer	Model #	S/N
Hydra Board	Tonal System	500-0801 Rev 008	080100702000476

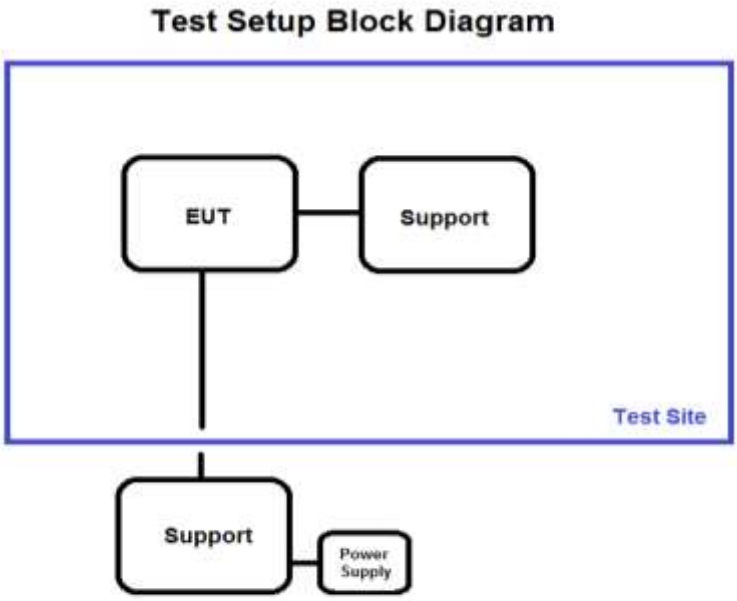
Support Equipment:

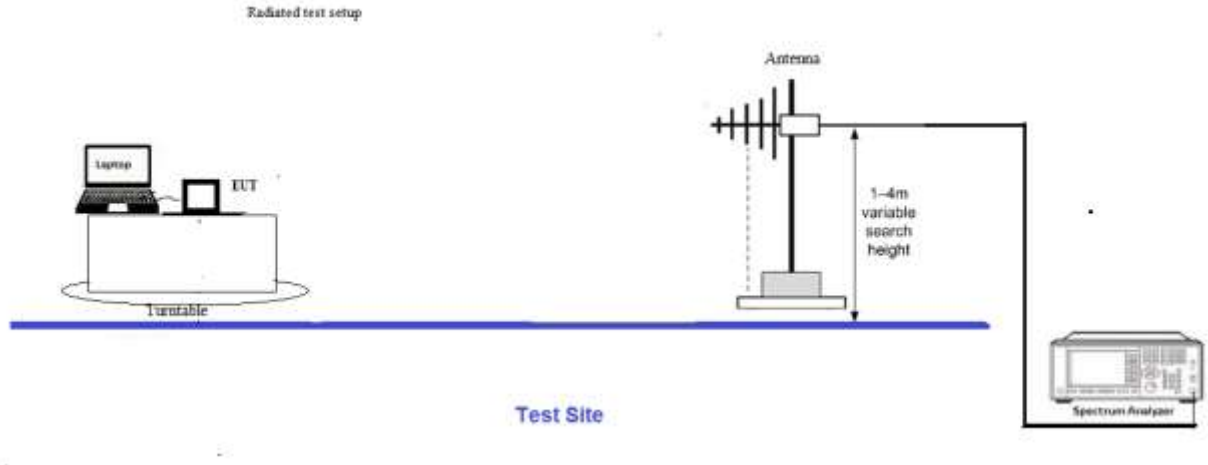
Device Name	Manufacturer	Model #	S/N
Laptop	Lenovo	X1 Carbon Gen 9	PF-37KBYM
Laptop Power Supply	Lenovo	SA10R16922	8SSA10R16922C2TJ-19M0G0G

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Bluetooth DTS for Hydra Board for Main System
Operating Frequency Range:	2402-2480MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	External 3.42dBi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	15VDC
Firmware / Software used for Test:	QRCT (Qualcomm Radio Control Toolkit) Version 4
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

Block Diagram of Test Setup(s)





Rev. C

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/7/2021
Configuration:	9		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

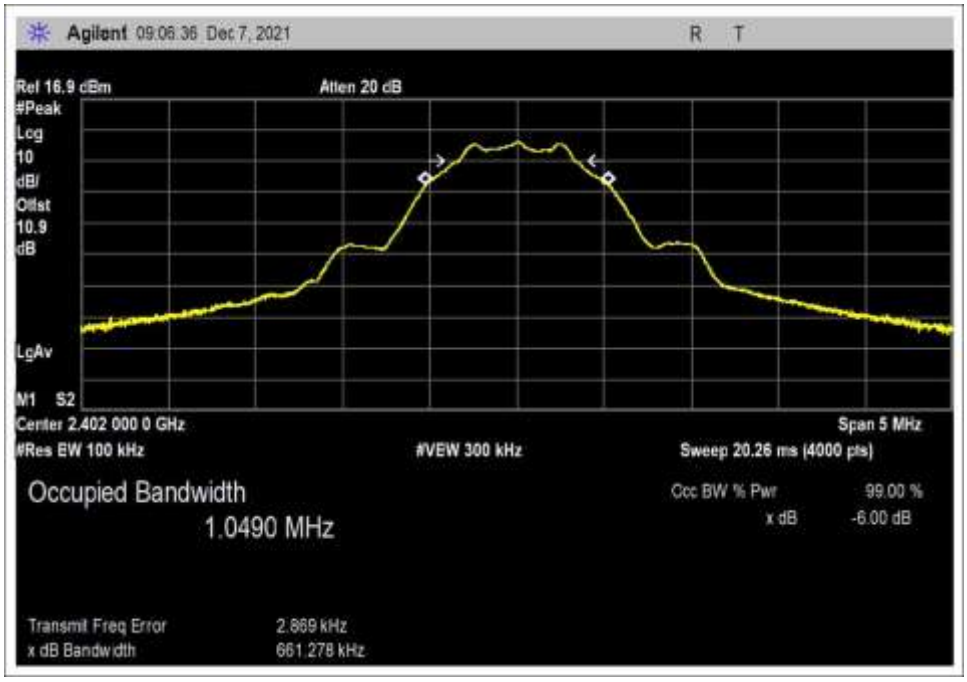
Environmental Conditions			
Temperature (ºC)	22.5	Relative Humidity (%):	45

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

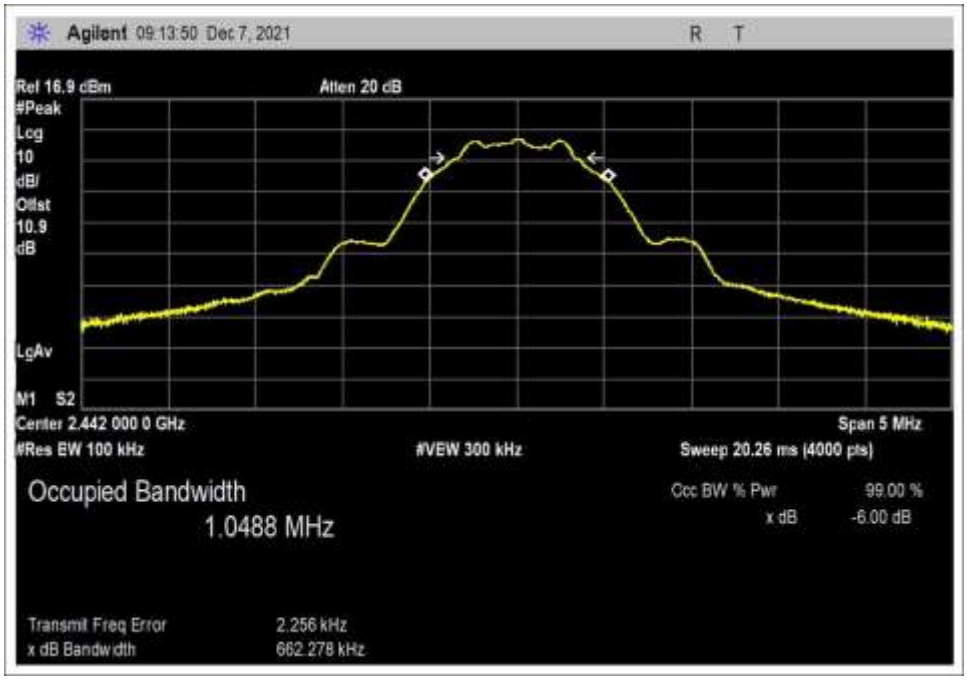
Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	GFSK	661.278	≥500	Pass
2442	1	GFSK	662.278	≥500	Pass
2480	1	GFSK	662.163	≥500	Pass

Plot(s)

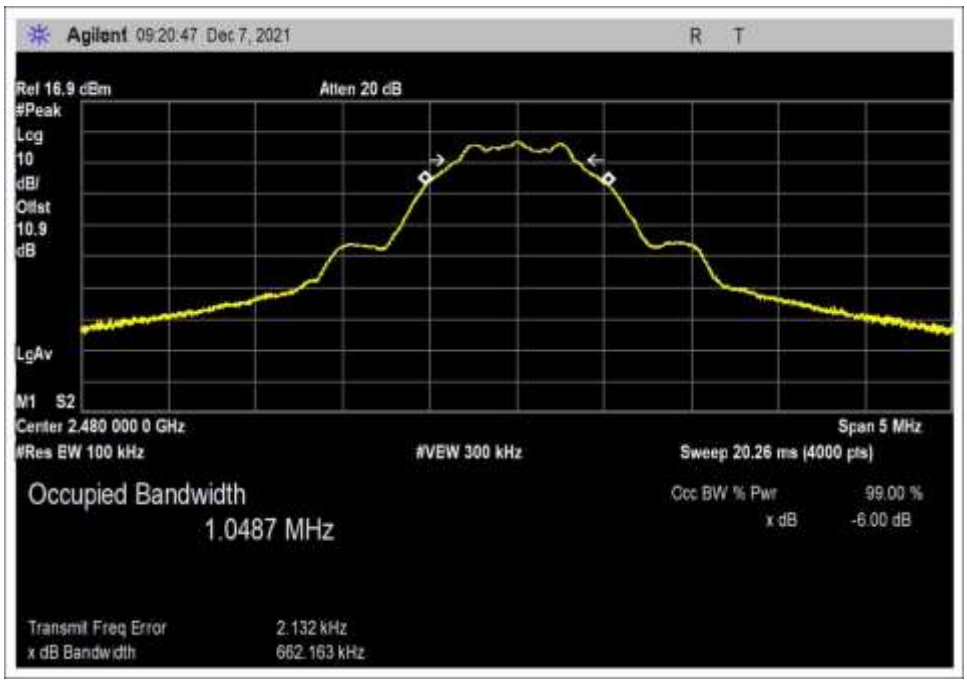
6dB Occupied Bandwidth



Low Channel



Middle Channel



High Channel

15.247(b)(3) Output Power

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/7/2021
Configuration:	9		
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)	22.5	Relative Humidity (%):	45

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

Test Data Summary - Voltage Variations					
Frequency (MHz)	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
2402	GFSK	3.46	3.54	3.47	0.08
2442	GFSK	4.61	4.61	4.60	0.01
2480	GFSK	4.23	4.22	4.23	0.01

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

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

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	External Connector /3.42	3.28	≤30	Pass
2442	GFSK	External Connector /3.42	4.34	≤30	Pass
2480	GFSK	External Connector /3.42	3.99	≤30	Pass

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

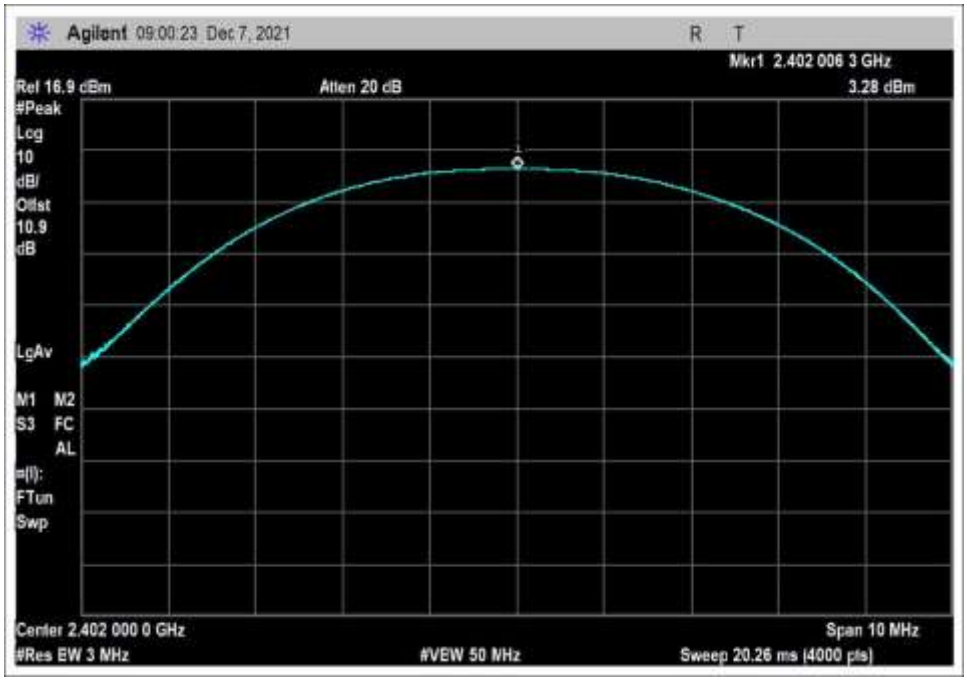
$$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$$

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

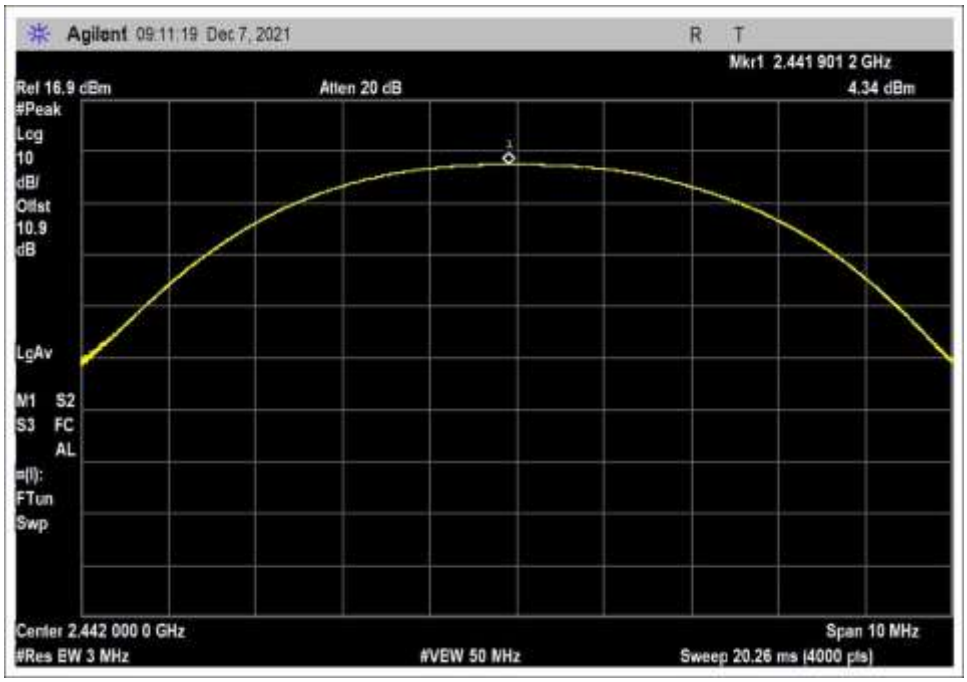
For all other antennas, the limit is calculated according to a maximum of 1W (30 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

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

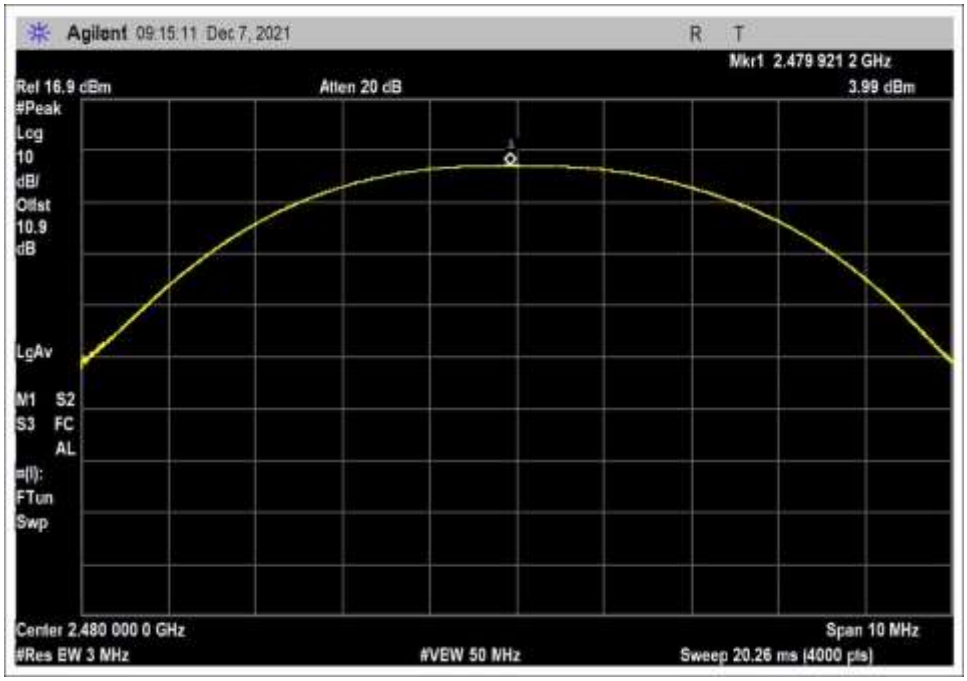
Plot(s)



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 #:	**105488**	Date:	12/7/2021
Test Type:	**Conducted Scan**	Time:	9:45:17 AM
Tested By:	Hoang Cao	Sequence#:	1
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

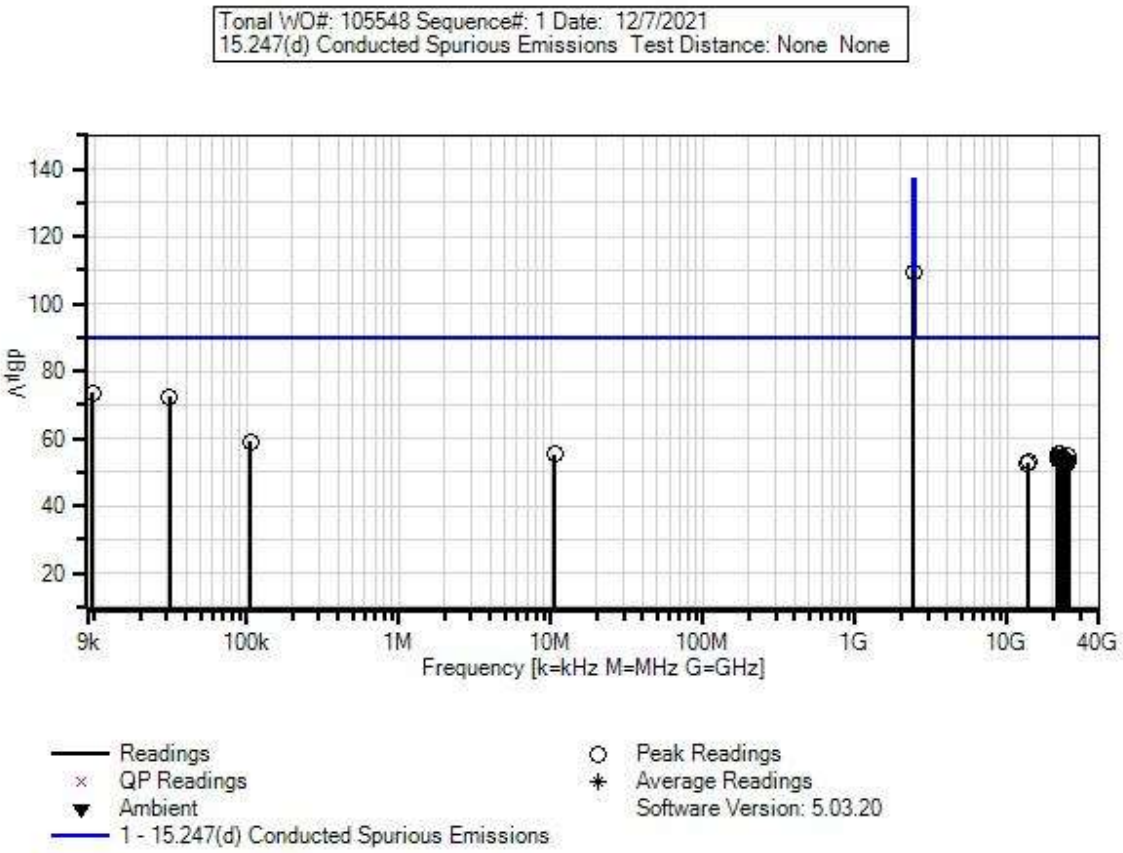
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

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

RF output level: PL8 (+4dBm)

Note:
Low Channel



Test Equipment:

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

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

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	9.747k	63.8	+9.7	+0.0			+0.0	73.5	89.9	-16.4	None
2	31.217k	62.6	+9.7	+0.0			+0.0	72.3	89.9	-17.6	None
3	2400.765M	98.9	+9.9	+0.8			+0.0	109.6	137.0	-27.4	None
4	106.707k	49.3	+9.7	+0.0			+0.0	59.0	89.9	-30.9	None
5	10.540M	45.6	+9.7	+0.0			+0.0	55.3	89.9	-34.6	None
6	21803.892 M	42.8	+10.0	+2.4			+0.0	55.2	89.9	-34.7	None
7	21919.161 M	42.7	+10.1	+2.4			+0.0	55.2	89.9	-34.7	None
8	21971.556 M	42.7	+10.1	+2.4			+0.0	55.2	89.9	-34.7	None
9	24968.563 M	42.0	+10.1	+2.6			+0.0	54.7	89.9	-35.2	None
10	21730.538 M	41.7	+10.0	+2.4			+0.0	54.1	89.9	-35.8	None
11	22736.527 M	41.6	+10.0	+2.4			+0.0	54.0	89.9	-35.9	None
12	23491.018 M	41.0	+10.1	+2.5			+0.0	53.6	89.9	-36.3	None
13	22904.191 M	41.0	+10.0	+2.5			+0.0	53.5	89.9	-36.4	None
14	21279.939 M	41.0	+10.0	+2.4			+0.0	53.4	89.9	-36.5	None
15	24622.754 M	40.6	+10.1	+2.5			+0.0	53.2	89.9	-36.7	None
16	23857.784 M	40.5	+10.1	+2.5			+0.0	53.1	89.9	-36.8	None
17	24193.114 M	40.4	+10.1	+2.5			+0.0	53.0	89.9	-36.9	None

18	13645.134 M	41.0	+10.0	+1.9		+0.0	52.9	89.9	-37.0	None
19	13614.222 M	40.9	+10.0	+1.9		+0.0	52.8	89.9	-37.1	None
20	24444.611 M	40.1	+10.1	+2.5		+0.0	52.7	89.9	-37.2	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 #:	**105488**	Date:	12/7/2021
Test Type:	**Conducted Scan**	Time:	9:53:34 AM
Tested By:	Hoang Cao	Sequence#:	2
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

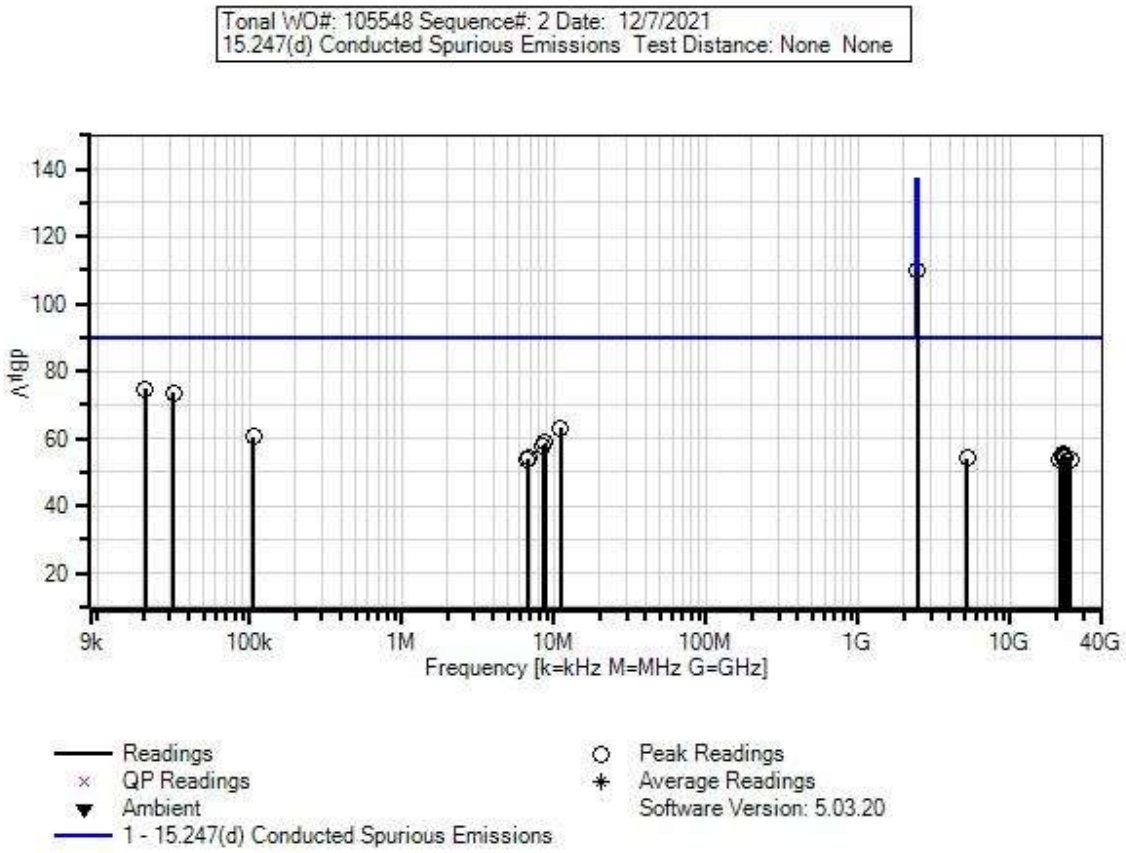
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

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

RF output level: PL8 (+4dBm)

Note:
Middle Channel



Test Equipment:

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

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

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	20.808k	64.9	+9.7	+0.0			+0.0	74.6	89.9	-15.3	None
2	31.822k	63.8	+9.7	+0.0			+0.0	73.5	89.9	-16.4	None
3	11.041M	53.5	+9.7	+0.0			+0.0	63.2	89.9	-26.7	None
4	2442.659M	99.1	+9.9	+0.8			+0.0	109.8	137.0	-27.2	None
5	106.707k	50.7	+9.7	+0.0			+0.0	60.4	89.9	-29.5	None
6	8.741M	49.1	+9.7	+0.0			+0.0	58.8	89.9	-31.1	None
7	8.497M	48.3	+9.7	+0.0			+0.0	58.0	89.9	-31.9	None
8	21908.682 M	42.8	+10.1	+2.4			+0.0	55.3	89.9	-34.6	None
9	22422.155 M	42.2	+10.1	+2.4			+0.0	54.7	89.9	-35.2	None
10	22296.407 M	42.0	+10.1	+2.4			+0.0	54.5	89.9	-35.4	None
11	22128.742 M	41.6	+10.1	+2.4			+0.0	54.1	89.9	-35.8	None
12	6.804M	44.4	+9.7	+0.0			+0.0	54.1	89.9	-35.8	None
13	23155.688 M	41.5	+10.1	+2.5			+0.0	54.1	89.9	-35.8	None
14	22767.964 M	41.7	+10.0	+2.4			+0.0	54.1	89.9	-35.8	None
15	5185.720M	42.9	+10.0	+1.1			+0.0	54.0	89.9	-35.9	None
16	22369.760 M	41.5	+10.1	+2.4			+0.0	54.0	89.9	-35.9	None
17	22610.778 M	41.6	+10.0	+2.4			+0.0	54.0	89.9	-35.9	None

18	24926.647 M	41.2	+10.1	+2.6		+0.0	53.9	89.9	-36.0	None
19	21017.963 M	41.2	+10.0	+2.4		+0.0	53.6	89.9	-36.3	None
20	6.666M	43.8	+9.7	+0.0		+0.0	53.5	89.9	-36.4	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**105488**	Date:	12/7/2021
Test Type:	**Conducted Scan**	Time:	10:01:15 AM
Tested By:	Hoang Cao	Sequence#:	3
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 9			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 9			

Test Conditions / Notes:

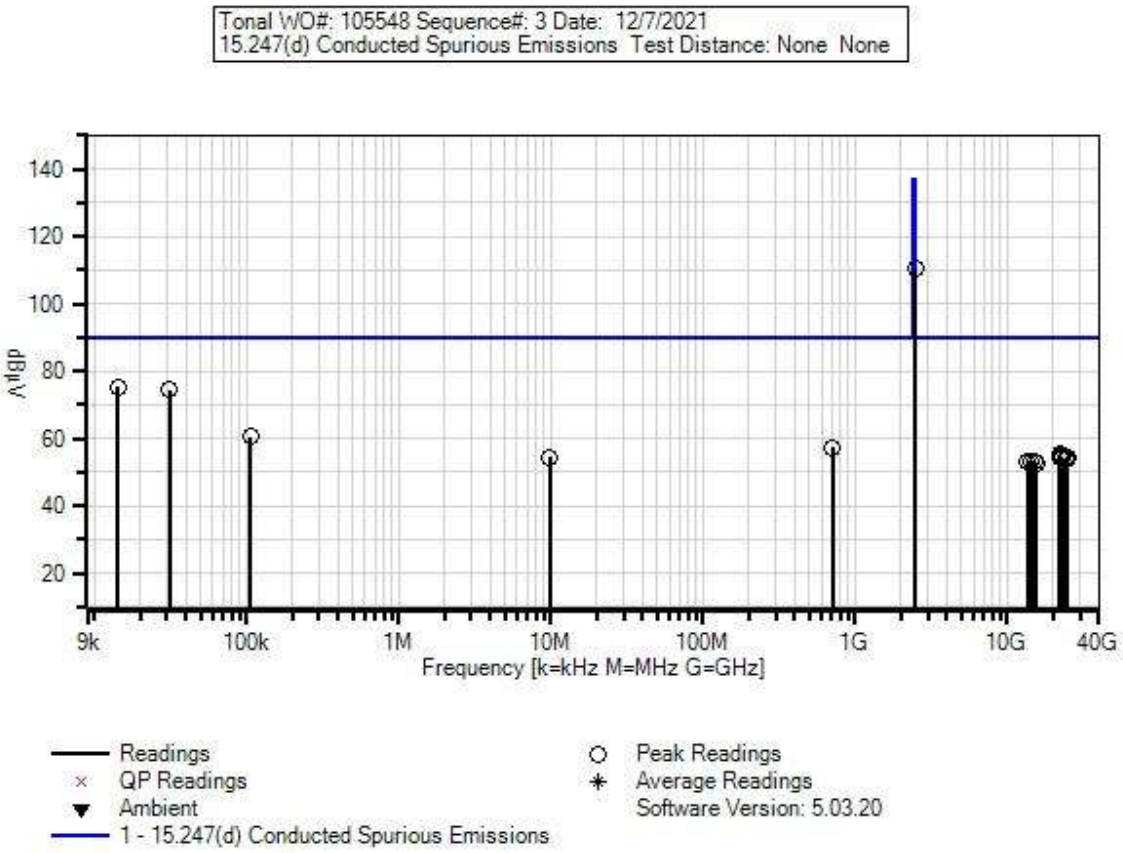
Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

Environmental Conditions:
Temperature: 21.8ºC
Humidity: 47%
Atmospheric Pressure: 101.5kPa
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

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

RF output level: PL8 (+4dBm)

Note:
High Channel



Test Equipment:

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T1	ANP07365	Attenuator	54A-10	5/26/2021	5/26/2023
T2	ANP06904	Cable	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

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

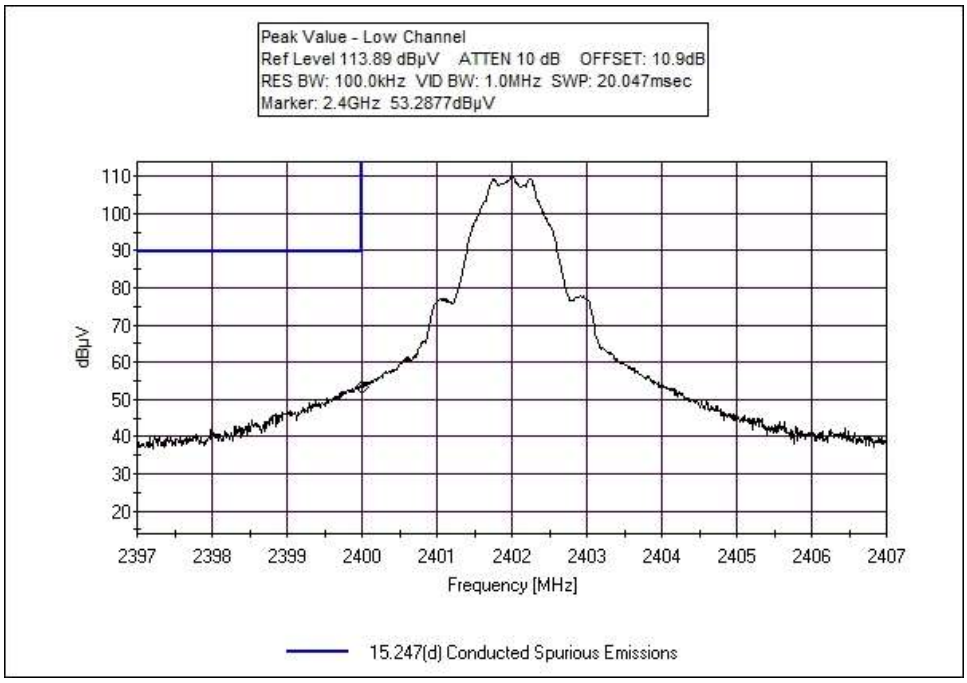
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	14.255k	65.5	+9.7	+0.0			+0.0	75.2	89.9	-14.7	None
2	31.368k	64.8	+9.7	+0.0			+0.0	74.5	89.9	-15.4	None
3	2478.568M	99.6	+9.9	+0.8			+0.0	110.3	137.0	-26.7	None
4	106.967k	50.8	+9.7	+0.0			+0.0	60.5	89.9	-29.4	None
5	712.002M	47.2	+9.8	+0.4			+0.0	57.4	89.9	-32.5	None
6	21940.119 M	42.8	+10.1	+2.4			+0.0	55.3	89.9	-34.6	None
7	22034.431 M	42.4	+10.1	+2.4			+0.0	54.9	89.9	-35.0	None
8	22264.970 M	42.0	+10.1	+2.4			+0.0	54.5	89.9	-35.4	None
9	22233.532 M	41.9	+10.1	+2.4			+0.0	54.4	89.9	-35.5	None
10	24738.024 M	41.7	+10.1	+2.6			+0.0	54.4	89.9	-35.5	None
11	9.774M	44.7	+9.7	+0.0			+0.0	54.4	89.9	-35.5	None
12	24392.215 M	41.6	+10.1	+2.5			+0.0	54.2	89.9	-35.7	None
13	22705.089 M	41.7	+10.0	+2.4			+0.0	54.1	89.9	-35.8	None
14	24779.940 M	41.4	+10.1	+2.6			+0.0	54.1	89.9	-35.8	None
15	24098.802 M	41.3	+10.1	+2.5			+0.0	53.9	89.9	-36.0	None
16	24297.904 M	41.3	+10.1	+2.5			+0.0	53.9	89.9	-36.0	None
17	13614.222 M	41.3	+10.0	+1.9			+0.0	53.2	89.9	-36.7	None
18	14438.526 M	41.3	+10.0	+1.9			+0.0	53.2	89.9	-36.7	None

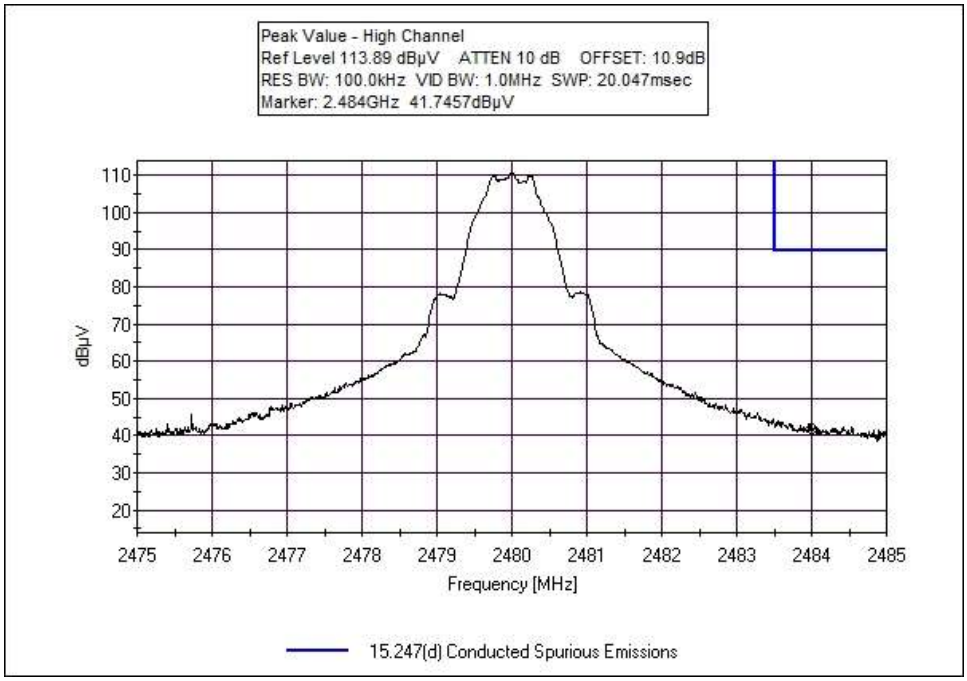
19	15076.345 M	41.0	+10.0	+1.9		+0.0	52.9	89.9	-37.0	None
20	15453.591 M	40.7	+10.0	+2.0		+0.0	52.7	89.9	-37.2	None

Band Edge

Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB.				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400.0	GFSK	53.2877	<90	Pass
2483.5	GFSK	41.7457	<90	Pass

Band Edge Plots




Peak Value - High Channel
Ref Level 113.89 dBµV ATTEN 10 dB OFFSET: 10.9dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 20.047msec
Marker: 2.484GHz 41.7457dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
2475
2476
2477
2478
2479
2480
2481
2482
2483
2484
2485
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

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:	**15.209 Radiated Emissions**		
Work Order #:	**105488**	Date:	12/19/2021
Test Type:	**Radiated Scan**	Time:	11:32:05 AM
Tested By:	Randy Clark	Sequence#:	73
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 Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 18.7ºC
Humidity: 36%
Atmospheric Pressure: 101.9kPa

Method: ANSI C63.10 2013

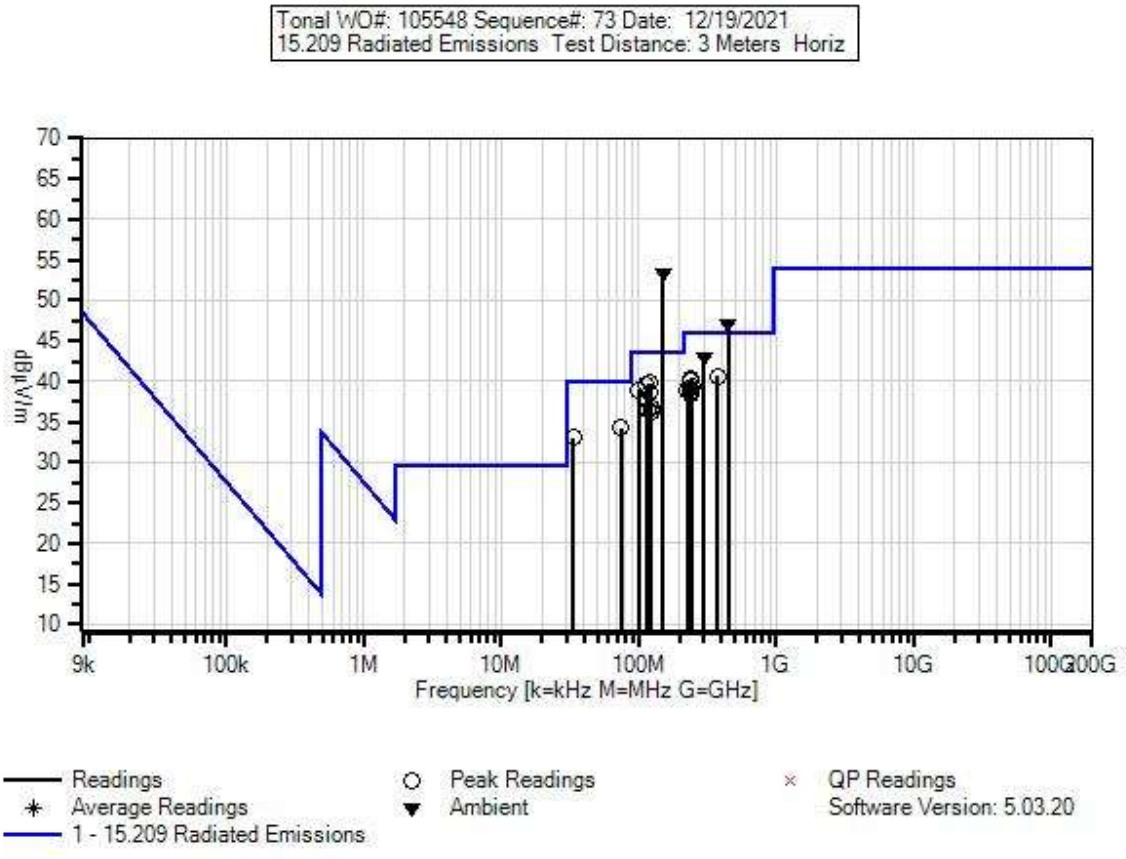
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT is set to 2442 MHz with GFSK modulation type, LE1Mbps with pattern length 1 at power level 9 (+9dBm) at 100% duty cycle.
Operational mode is representative of worst case.

Measurements marked as Unintentional have been evaluated with radios turned off and determined not to be radio emissions. Indicated emissions are ignored for the purposes of this report.

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

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

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.
No emissions from EUT has been found in 20dB tolerance in the frequency range 9kHz to 30MHz.



Test Equipment:

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

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

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6							
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	149.762M	66.3	-32.0	+11.5	+5.9	+0.2	+0.0	53.4	43.5	+9.9	Horiz
	Ambient		+0.4	+1.1					Unintentional Emissions		
2	449.221M	52.8	-31.9	+17.0	+5.9	+0.5	+0.0	47.2	46.0	+1.2	Horiz
	Ambient		+0.8	+2.1					Unintentional Emissions		
3	299.432M	53.1	-31.9	+13.2	+6.0	+0.4	+0.0	43.0	46.0	-3.0	Horiz
	Ambient		+0.6	+1.6					Unintentional Emissions		
4	122.375M	52.6	-32.0	+11.9	+5.9	+0.1	+0.0	39.8	43.5	-3.7	Horiz
			+0.3	+1.0							
5	113.486M	52.9	-32.0	+11.4	+5.9	+0.1	+0.0	39.5	43.5	-4.0	Horiz
			+0.3	+0.9							
6	100.032M	53.3	-32.0	+10.4	+5.9	+0.1	+0.0	38.9	43.5	-4.6	Horiz
			+0.3	+0.9							
7	120.092M	51.5	-32.0	+11.9	+5.9	+0.1	+0.0	38.7	43.5	-4.8	Horiz
			+0.3	+1.0							
8	374.386M	48.4	-31.9	+15.1	+6.0	+0.4	+0.0	40.6	46.0	-5.4	Horiz
			+0.7	+1.9							
9	241.294M	51.9	-31.9	+12.1	+6.0	+0.3	+0.0	40.4	46.0	-5.6	Horiz
			+0.6	+1.4							
10	74.854M	52.4	-32.0	+6.9	+5.9	+0.1	+0.0	34.3	40.0	-5.7	Horiz
			+0.3	+0.7							
11	242.134M	51.5	-31.9	+12.1	+6.0	+0.3	+0.0	40.0	46.0	-6.0	Horiz
			+0.6	+1.4							
12	244.297M	50.8	-31.9	+12.2	+6.0	+0.3	+0.0	39.4	46.0	-6.6	Horiz
			+0.6	+1.4							
13	122.735M	49.5	-32.0	+11.9	+5.9	+0.1	+0.0	36.7	43.5	-6.8	Horiz
			+0.3	+1.0							
14	239.972M	50.8	-31.9	+12.0	+6.0	+0.3	+0.0	39.2	46.0	-6.8	Horiz
			+0.6	+1.4							
15	33.660M	41.5	-32.1	+17.1	+5.9	+0.0	+0.0	33.0	40.0	-7.0	Horiz
			+0.2	+0.4							
16	224.597M	51.8	-31.9	+11.0	+5.9	+0.3	+0.0	39.0	46.0	-7.0	Horiz
			+0.5	+1.4							
17	117.810M	49.4	-32.0	+11.7	+5.9	+0.1	+0.0	36.4	43.5	-7.1	Horiz
			+0.3	+1.0							
18	123.696M	49.0	-32.0	+11.9	+5.9	+0.1	+0.0	36.2	43.5	-7.3	Horiz
			+0.3	+1.0							
19	242.855M	50.0	-31.9	+12.2	+6.0	+0.3	+0.0	38.6	46.0	-7.4	Horiz
			+0.6	+1.4							
20	240.693M	50.1	-31.9	+12.0	+6.0	+0.3	+0.0	38.5	46.0	-7.5	Horiz
			+0.6	+1.4							

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.209 Radiated Emissions**		
Work Order #:	**105488**	Date:	12/19/2021
Test Type:	**Radiated Scan**	Time:	11:12:15 AM
Tested By:	Randy Clark	Sequence#:	72
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 Emission
Frequency Range: 30MHz to 1GHz

Environmental Conditions:
Temperature: 18.7ºC
Humidity: 36%
Atmospheric Pressure: 101.9kPa

Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT is set to 2442 MHz with GFSK modulation type, LE1Mbps with pattern length 1 at power level 9 (+9dBm) at 100% duty cycle.
Operational mode is representative of worst case.

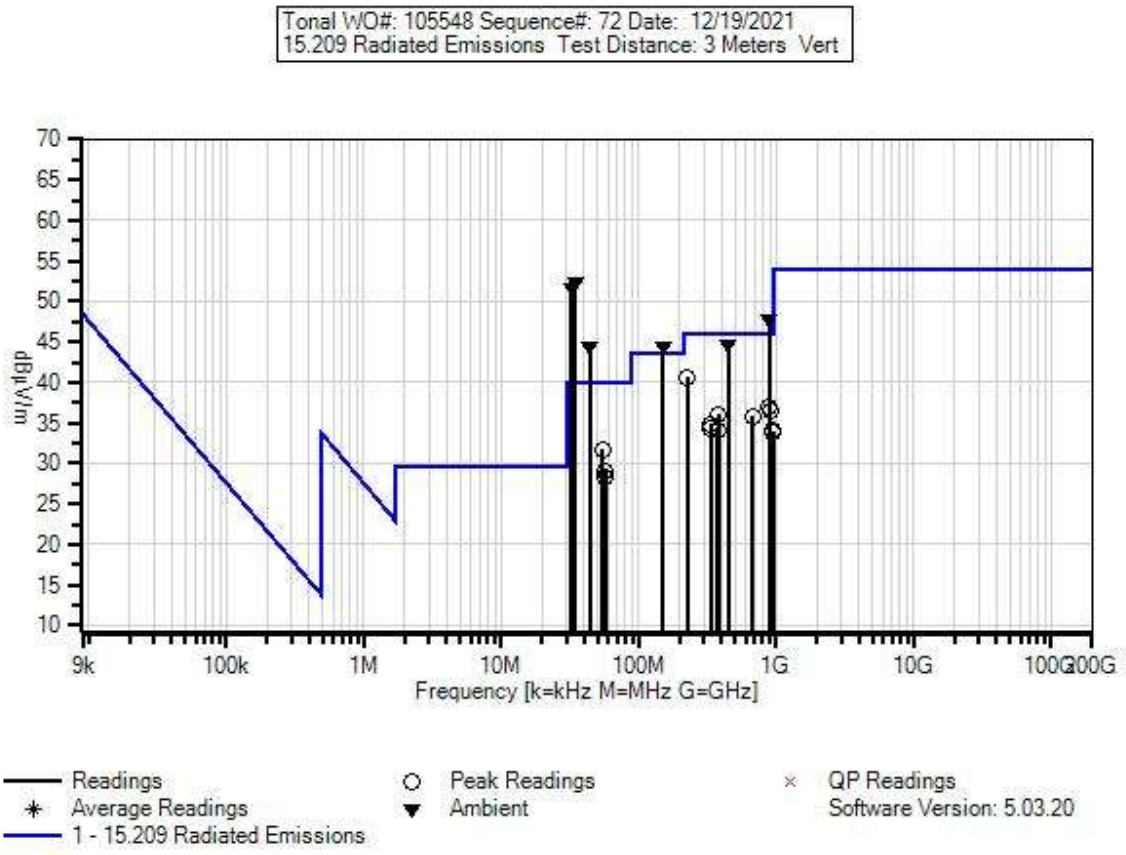
Measurements marked as Unintentional / Support equipment have been evaluated with radios turned off and determined not to be radio emissions. Indicated emissions are ignored for the purposes of this report.

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

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

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.

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



Test Equipment:

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

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	34.725M Ambient	61.1	-32.0 +0.2	+16.7 +0.4	+5.9	+0.0	+0.0	52.3	40.0 Support Laptop Related	+12.3	Vert
2	32.196M Ambient	59.6	-32.1 +0.2	+17.7 +0.4	+5.9	+0.0	+0.0	51.7	40.0 Support Laptop Related	+11.7	Vert
3	44.308M Ambient	58.6	-32.1 +0.2	+11.4 +0.5	+5.9	+0.0	+0.0	44.5	40.0 Support Laptop Related	+4.5	Vert
4	898.470M Ambient	45.0	-31.4 +1.2	+23.2 +3.2	+5.9	+0.7	+0.0	47.8	46.0 Unintentional Emissions	+1.8	Vert
5	149.762M Ambient	57.3	-32.0 +0.4	+11.5 +1.1	+5.9	+0.2	+0.0	44.4	43.5 Unintentional Emissions	+0.9	Vert
6	449.221M Ambient	50.3	-31.9 +0.8	+17.0 +2.1	+5.9	+0.5	+0.0	44.7	46.0 Unintentional Emissions	-1.3	Vert
7	224.597M	53.5	-31.9 +0.5	+11.0 +1.4	+5.9	+0.3	+0.0	40.7	46.0	-5.3	Vert
8	54.756M	49.2	-32.1 +0.2	+7.8 +0.6	+5.9	+0.1	+0.0	31.7	40.0	-8.3	Vert
9	897.389M	34.1	-31.4 +1.2	+23.2 +3.2	+5.9	+0.7	+0.0	36.9	46.0	-9.1	Vert
10	899.431M	33.6	-31.3 +1.2	+23.2 +3.2	+5.9	+0.7	+0.0	36.5	46.0	-9.5	Vert
11	382.675M	43.7	-31.9 +0.7	+15.3 +1.9	+6.0	+0.4	+0.0	36.1	46.0	-9.9	Vert
12	673.846M	36.9	-32.0 +1.0	+20.7 +2.7	+5.9	+0.6	+0.0	35.8	46.0	-10.2	Vert
13	57.085M	47.0	-32.0 +0.2	+7.3 +0.6	+5.9	+0.1	+0.0	29.1	40.0	-10.9	Vert
14	336.789M	43.6	-31.9 +0.7	+14.2 +1.8	+6.0	+0.4	+0.0	34.8	46.0	-11.2	Vert
15	336.429M	43.2	-31.9 +0.7	+14.2 +1.8	+6.0	+0.4	+0.0	34.4	46.0	-11.6	Vert
16	57.817M	46.2	-32.0 +0.2	+7.2 +0.6	+5.9	+0.1	+0.0	28.2	40.0	-11.8	Vert
17	374.386M	41.8	-31.9 +0.7	+15.1 +1.9	+6.0	+0.4	+0.0	34.0	46.0	-12.0	Vert
18	957.800M	29.8	-30.9 +1.3	+23.9 +3.3	+5.9	+0.7	+0.0	34.0	46.0	-12.0	Vert
19	959.365M	29.6	-30.8 +1.3	+23.9 +3.4	+5.9	+0.7	+0.0	34.0	46.0	-12.0	Vert
20	956.360M	29.7	-30.9 +1.3	+23.9 +3.3	+5.9	+0.7	+0.0	33.9	46.0	-12.1	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 #:	**105488**	Date:	1/25/2022
Test Type:	**Radiated Scan**	Time:	13:44:38
Tested By:	Hoang Cao	Sequence#:	351
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 3			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 3			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1 to 26GHz

Environmental Conditions:
Temperature: 22.5ºC
Humidity: 33%
Atmospheric Pressure: 101.7kPa

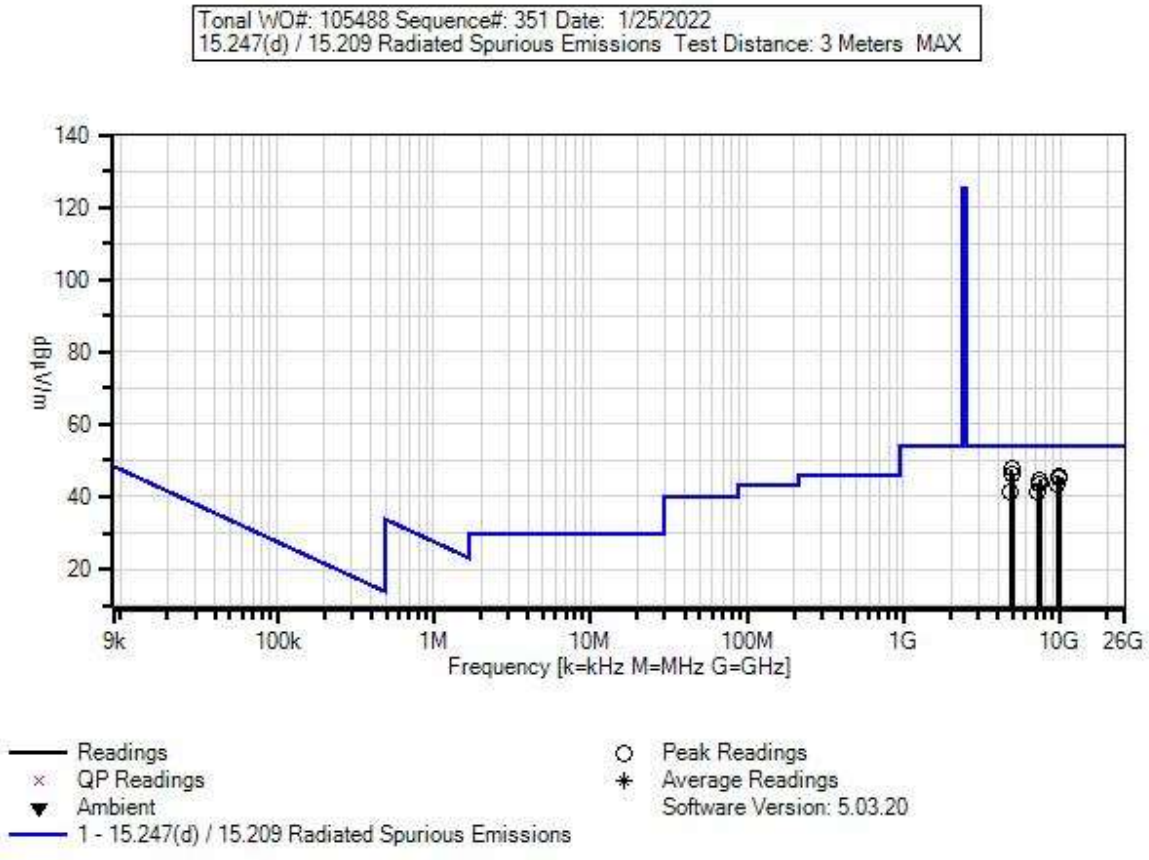
Method: ANSI C63.10 2013

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor.
BT transmitting continuously with GFSK modulation type, LE1Mbps with pattern of 0s and 1s at power level 8 (+4dBm).
Operational mode is representative of worst case.

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

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

Support laptop included in this setup to control Bluetooth operating mode; port is internal to the equipment for configuration only.
Unintentional emissions related to display and display controller increased due to external cable to laptop.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/10/2022	1/10/2024
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
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
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
	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
	ANP00928	Cable	various	1/12/2022	1/12/2024
	ANP06693	Cable	PE3062-360	9/28/2020	9/28/2022

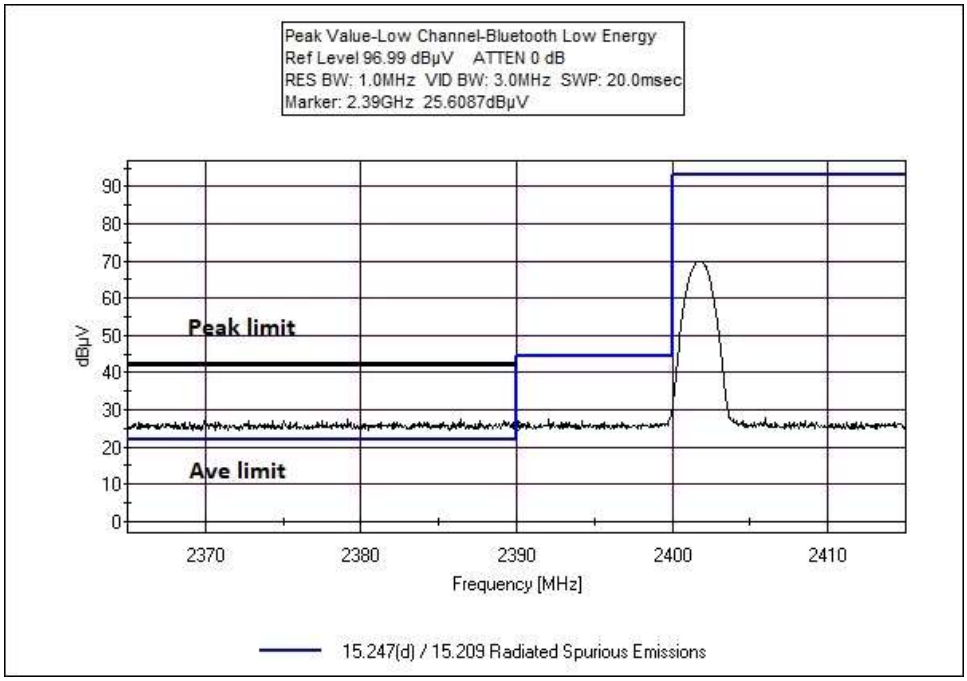
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

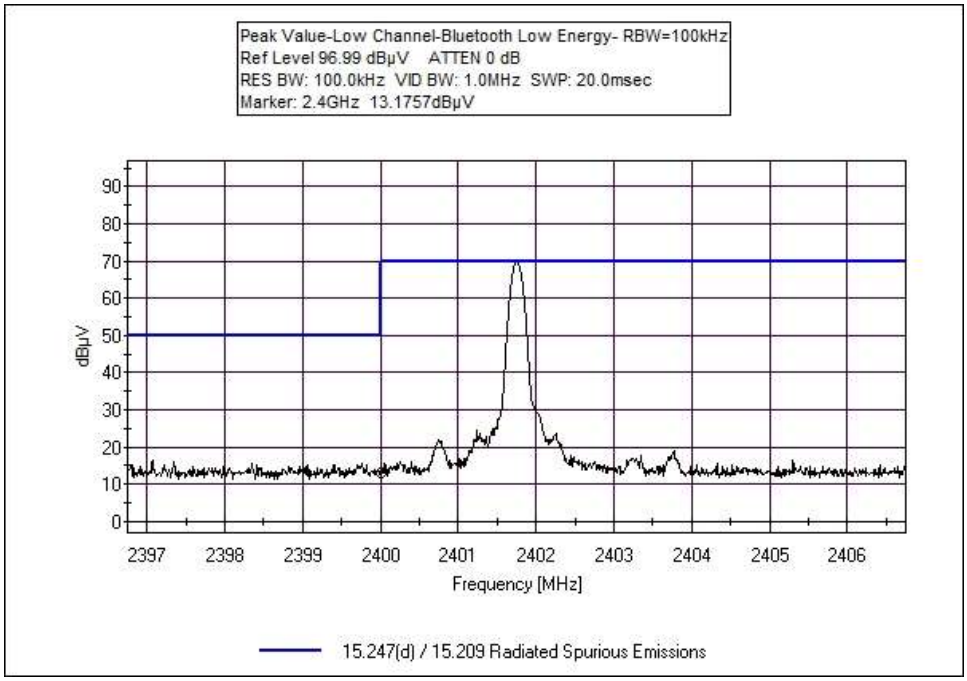
#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	4883.375M	64.1	+32.4 +0.4	+2.0 -56.1	+3.7	+1.2	+0.0	47.7	54.0 Middle Channel	-6.3	Vert
2	4959.500M	62.3	+32.6 +0.4	+2.0 -56.1	+3.8	+1.2	+0.0	46.2	54.0 High Channel	-7.8	Vert
3	9919.460M	55.0	+36.7 +0.5	+2.9 -56.7	+5.4	+1.7	+0.0	45.5	54.0 High Channel	-8.5	Vert
4	9771.360M	55.4	+36.6 +0.4	+2.9 -57.0	+5.3	+1.7	+0.0	45.3	54.0 Middle Channel	-8.7	Vert
5	7445.520M	57.5	+35.3 +0.5	+2.5 -57.3	+4.6	+1.5	+0.0	44.6	54.0 High Channel	-9.4	Vert
6	7324.580M	56.9	+35.0 +0.4	+2.5 -57.2	+4.6	+1.5	+0.0	43.7	54.0 Middle Channel	-10.3	Vert
7	9608.140M	53.7	+36.5 +0.4	+2.9 -57.0	+5.3	+1.7	+0.0	43.5	54.0 Low Channel	-10.5	Vert
8	4803.560M	57.8	+32.2 +0.4	+2.0 -56.1	+3.7	+1.2	+0.0	41.2	54.0 Low Channel	-12.8	Vert
9	7207.200M	54.8	+34.6 +0.4	+2.5 -57.1	+4.5	+1.5	+0.0	41.2	54.0 Low Channel	-12.8	Vert

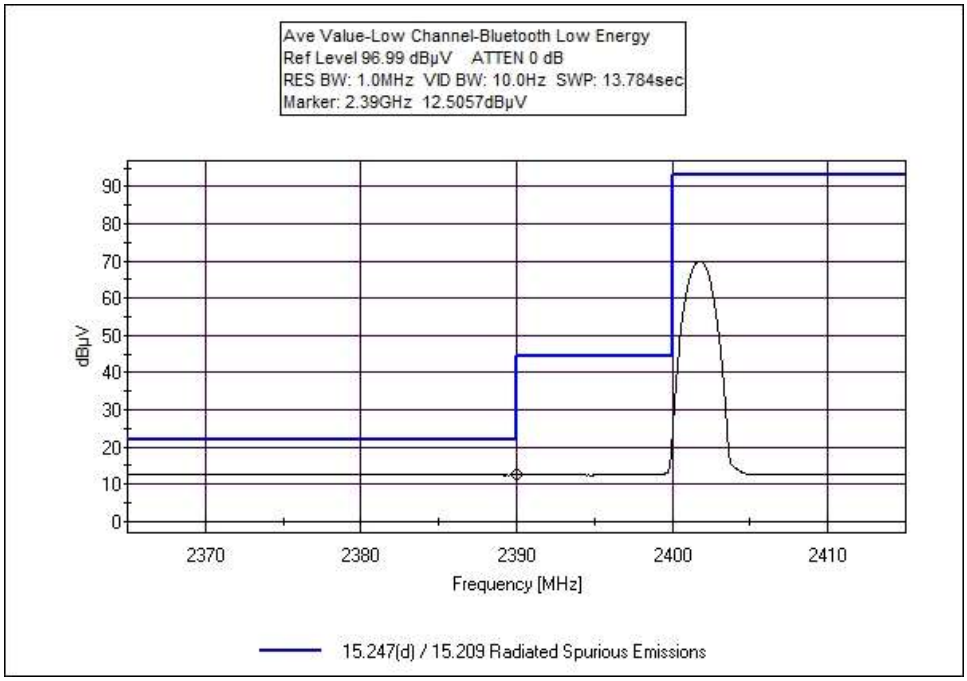
Band Edge

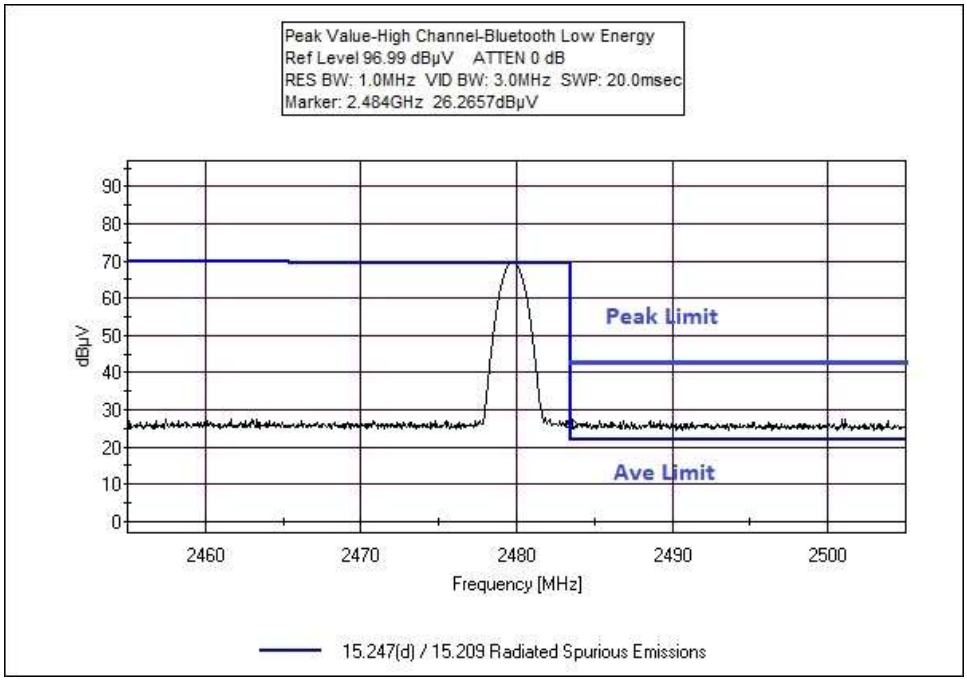
Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	GFSK	External Connector	44.4057	<54	Pass
2400.0	GFSK	External Connector	45.1757	<78	Pass
2483.5	GFSK	External Connector	44.8687	<54	Pass

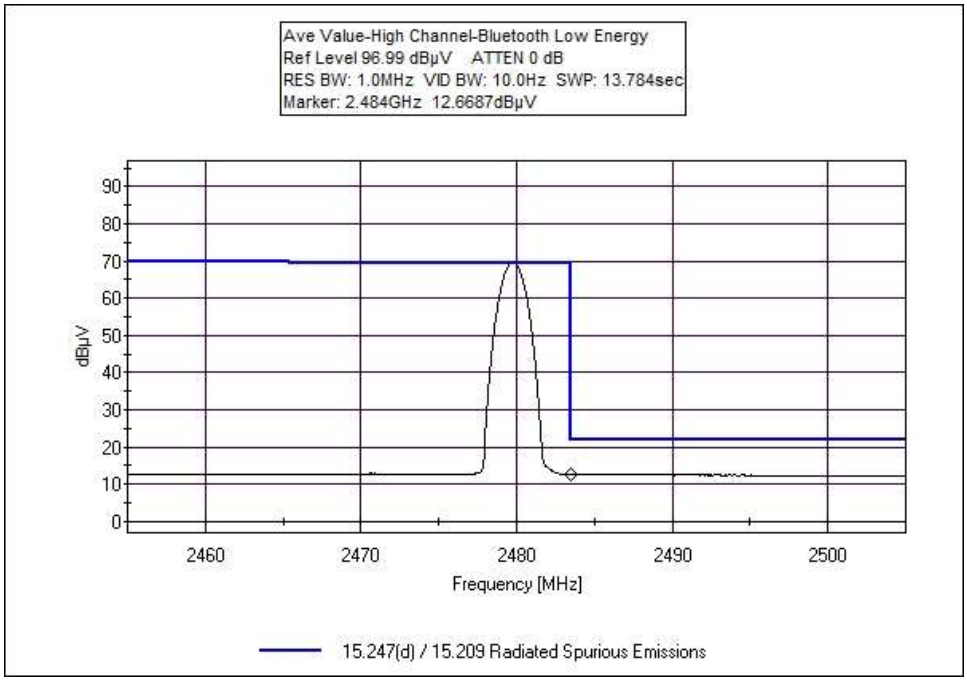
Band Edge Plots




Peak Value-Low Channel-Bluetooth Low Energy- RBW=100kHz
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 1.0MHz SWP: 20.0msec
Marker: 2.4GHz 13.1757dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-Low Channel-Bluetooth Low Energy
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 12.5057dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value-High Channel-Bluetooth Low Energy
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.484GHz 26.2657dBµV
Peak Limit
Ave Limit
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value-High Channel-Bluetooth Low Energy
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.484GHz 12.6687dBµV
dBµV
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 #:	**105488**	Date:	1/25/2022
Test Type:	**Radiated Scan**	Time:	
Tested By:	Hoang Cao	Sequence#:	
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 3			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 3			

Test Conditions / Notes:

Band edge

BT-DTS

Environmental Conditions:
Temperature: 22.9ºC
Humidity: 43%
Atmospheric Pressure: 101.3kPa
Software: Putty version 0.74
Highest Generated Frequency: 2.48GHz
Method: ANSI C63.10 2013

Test Equipment:

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
	AN03302	Cable	32026-29094K-29094K-72TC	1/10/2022	1/10/2024
	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022

15.247(e) Power Spectral Density

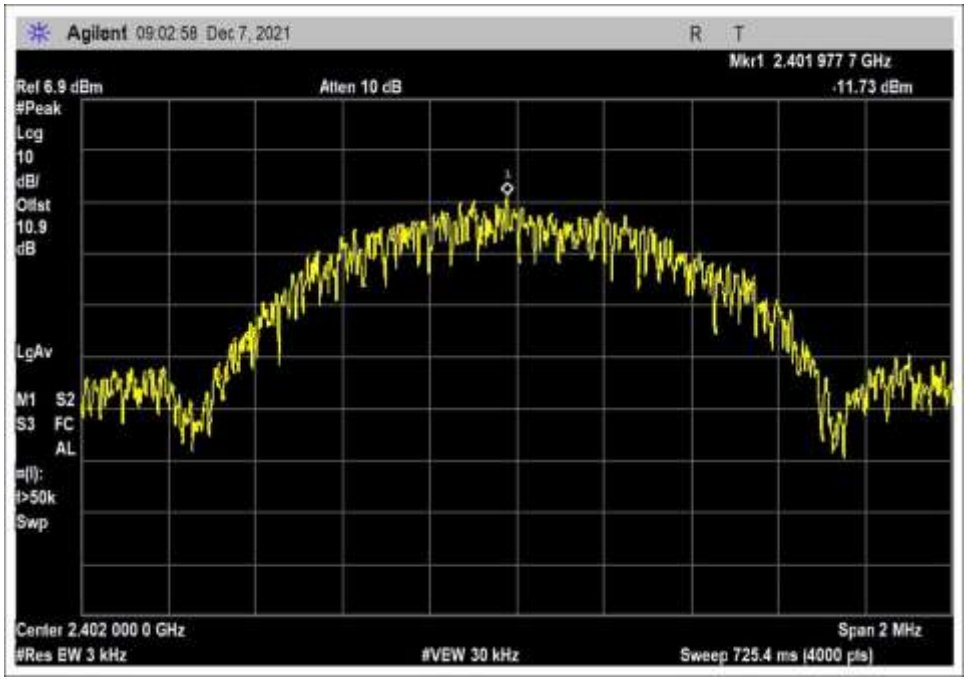
Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/7/2021
Configuration:	9		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

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

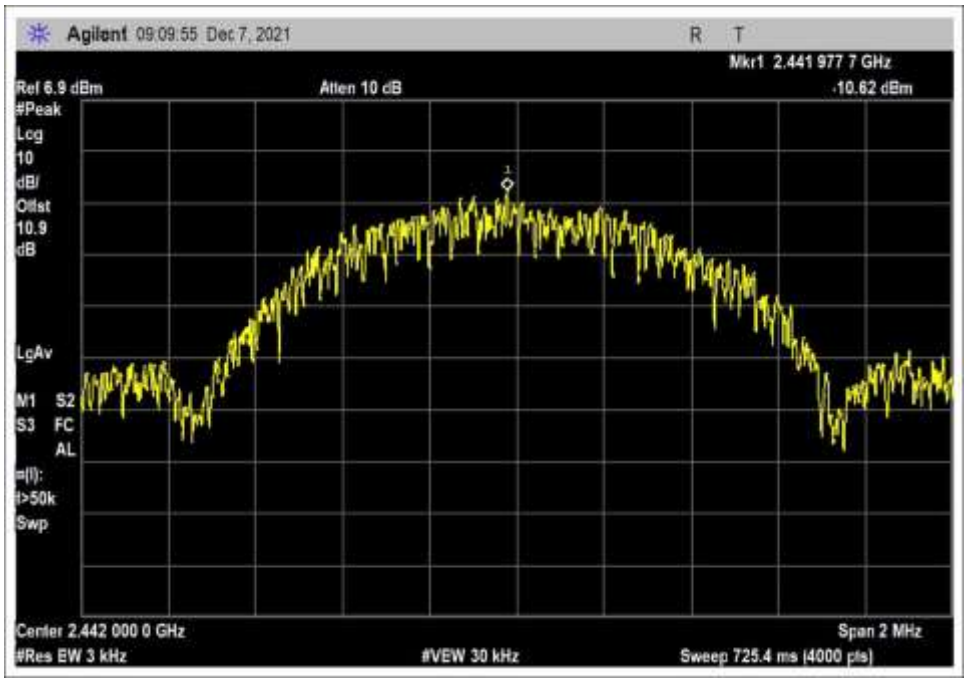
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022

Test Data Summary - RF Conducted Measurement				
Measurement Method: PKPSD				
Frequency (MHz)	**Modulation**	**Measured (dBm/3kHz)**	**Limit (dBm/3kHz)**	**Results**
2402	GFSK	-11.73	≤8	Pass
2442	GFSK	-10.62	≤8	Pass
2480	GFSK	-10.97	≤8	Pass

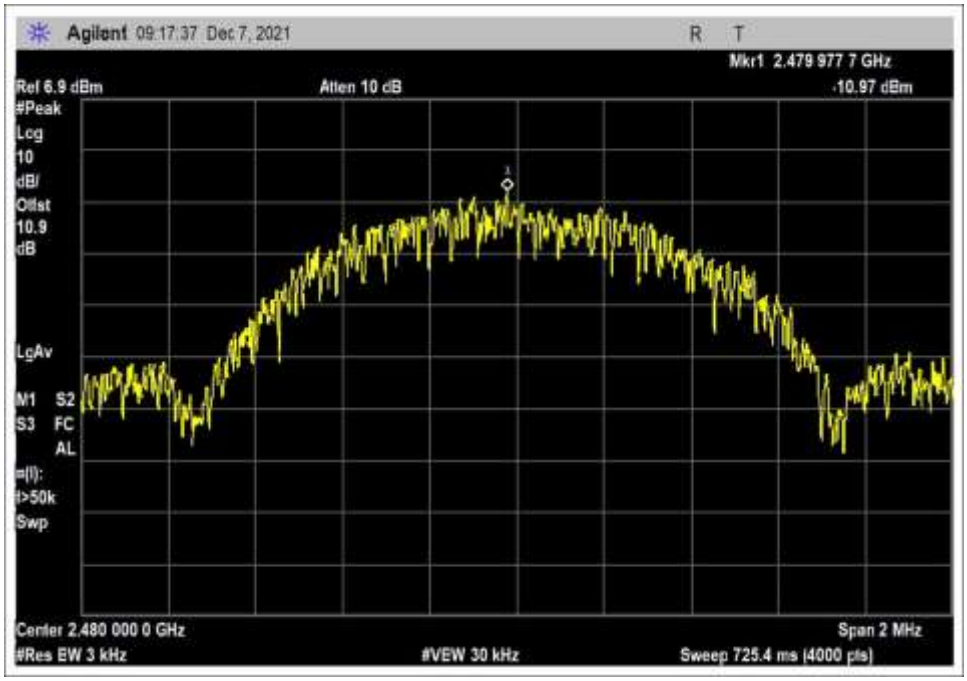
Plots



Low Channel



Middle Channel



High Channel

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

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

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

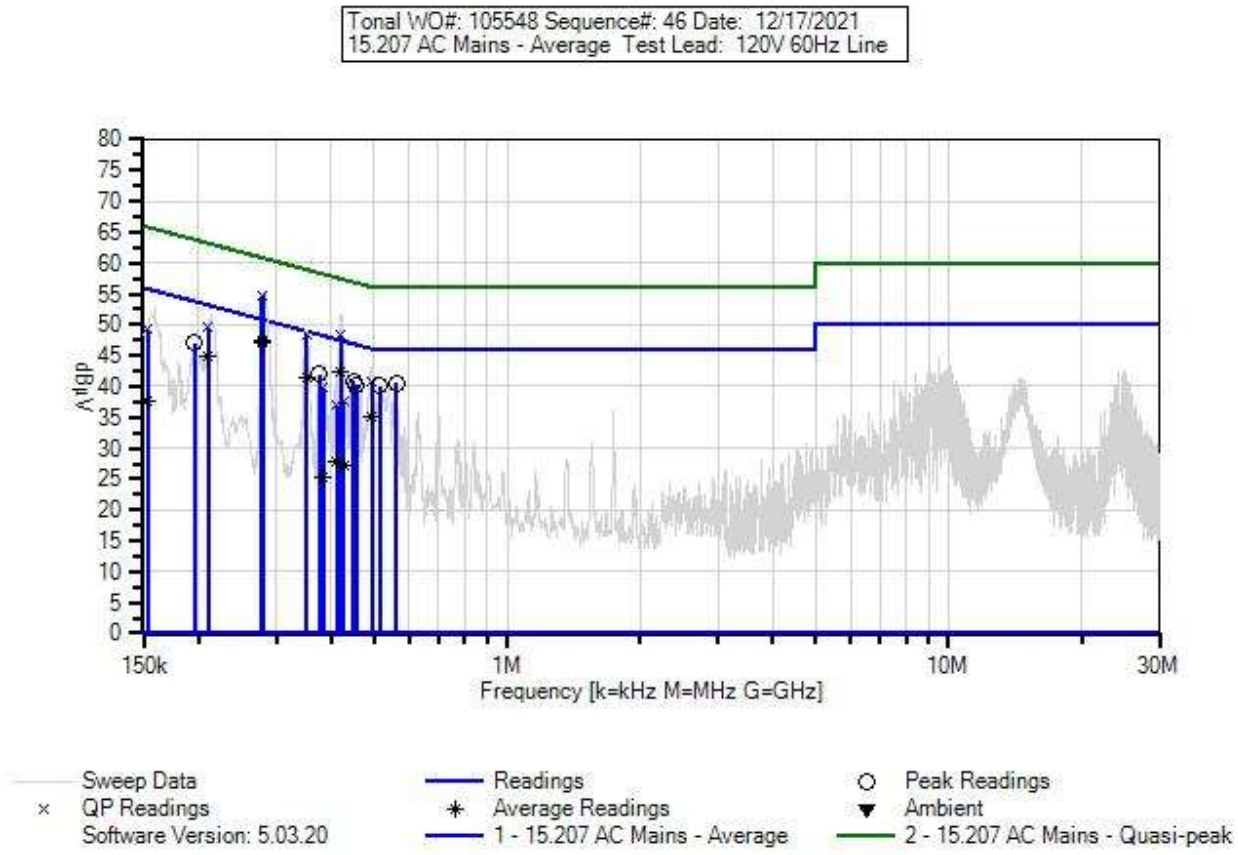
Conducted Emission
Frequency Range: 150kHz to 30MHz

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

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

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

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



Test Equipment:

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

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

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

^	493.040k	35.1	+9.9 +0.1	+0.0	+0.1	+0.1	+0.0	45.3	46.1	-0.8	Line
25	153.270k QP	37.7	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	49.3	65.8	-16.5	Line
26	153.270k Ave	25.9	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	37.5	55.8	-18.3	Line
^	153.270k	44.2	+9.9 +1.6	+0.0	+0.0	+0.1	+0.0	55.8	55.8	+0.0	Line
28	383.373k QP	29.6	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	39.7	58.2	-18.5	Line
29	427.092k QP	27.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	37.5	57.3	-19.8	Line
30	411.207k Ave	17.7	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	27.7	47.6	-19.9	Line
31	427.092k Ave	17.3	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	27.3	47.3	-20.0	Line
^	427.092k	37.0	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	47.0	47.3	-0.3	Line
33	411.207k QP	26.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	36.9	57.6	-20.7	Line
^	411.207k	35.2	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	45.2	47.6	-2.4	Line
^	409.611k	32.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	42.4	47.7	-5.3	Line
36	383.373k Ave	15.2	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	25.3	48.2	-22.9	Line
^	383.373k	35.4	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	45.5	48.2	-2.7	Line
^	385.613k	32.5	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	42.6	48.2	-5.6	Line

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

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

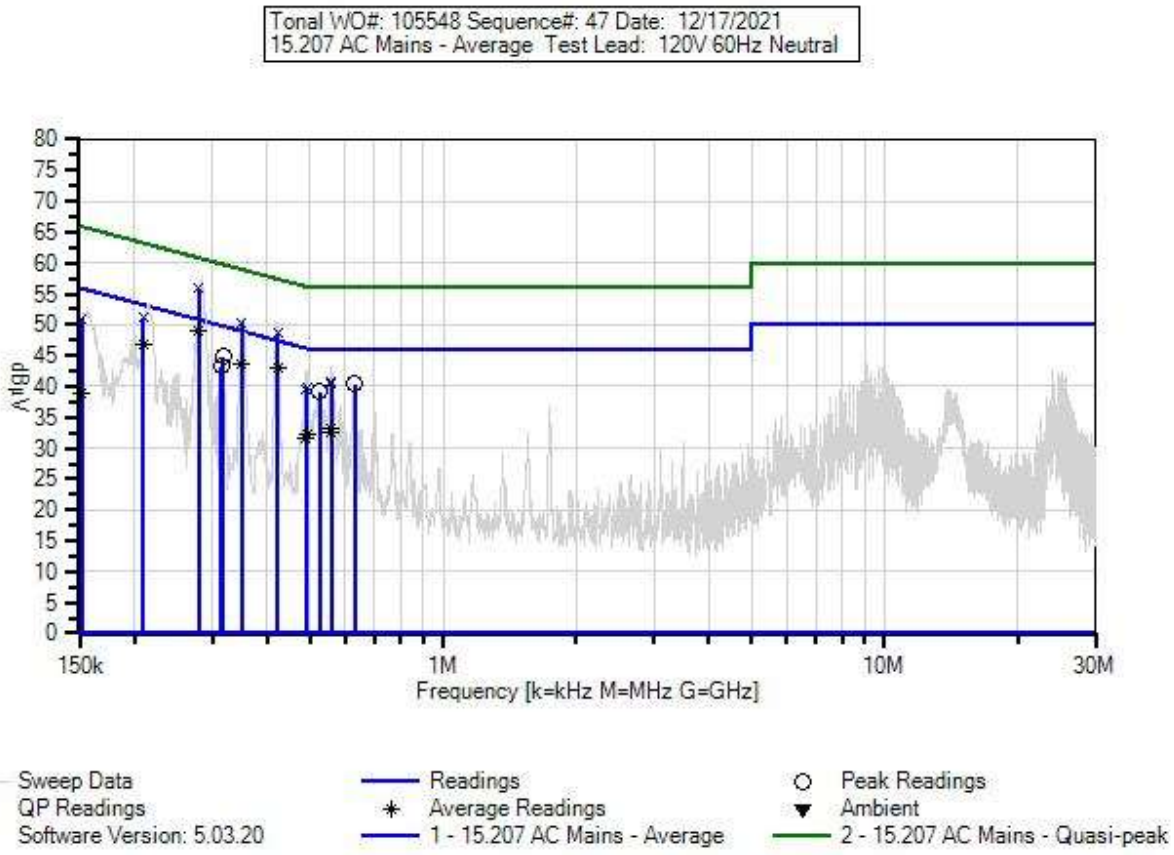
Conducted Emission
Frequency Range: 150kHz to 30MHz

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

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

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

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



Test Equipment:

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

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

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	280.264k	38.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.9	50.8	-1.9	Neutr
	Ave										
2	421.660k	33.0	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	43.0	47.4	-4.4	Neutr
	Ave										
3	280.264k	45.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	55.9	60.8	-4.9	Neutr
	QP										
^	280.264k	47.7	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	57.7	50.8	+6.9	Neutr
5	317.256k	34.8	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	44.8	49.8	-5.0	Neutr
6	350.035k	33.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	43.5	49.0	-5.5	Neutr
	Ave										
7	630.682k	30.2	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	40.4	46.0	-5.6	Neutr
8	209.412k	36.7	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	46.7	53.2	-6.5	Neutr
	Ave										
9	315.074k	33.3	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	43.3	49.8	-6.5	Neutr
10	525.237k	29.0	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	39.2	46.0	-6.8	Neutr
11	350.035k	40.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	50.4	59.0	-8.6	Neutr
	QP										
^	350.035k	43.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	53.5	49.0	+4.5	Neutr
13	421.660k	38.6	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.6	57.4	-8.8	Neutr
	QP										
^	421.660k	43.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	53.9	47.4	+6.5	Neutr
15	209.412k	41.1	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	51.1	63.2	-12.1	Neutr
	QP										
^	209.412k	44.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	54.4	53.2	+1.2	Neutr
17	558.862k	23.0	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	33.2	46.0	-12.8	Neutr
	Ave										
18	558.003k	22.4	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	32.6	46.0	-13.4	Neutr
	Ave										
19	492.486k	22.0	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	32.1	46.1	-14.0	Neutr
	Ave										
20	488.923k	21.6	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	31.7	46.2	-14.5	Neutr
	Ave										
21	152.236k	38.8	+9.9 +2.1	+0.0	+0.0	+0.1	+0.0	50.9	65.9	-15.0	Neutr
	QP										
22	558.862k	30.4	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	40.6	56.0	-15.4	Neutr
	QP										
23	558.003k	30.3	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	40.5	56.0	-15.5	Neutr
	QP										

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

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

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

Emissions Test Details

TESTING PARAMETERS

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

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

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

CORRECTION FACTORS

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

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

TEST INSTRUMENTATION AND ANALYZER SETTINGS

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

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

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

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

Peak

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

Quasi-Peak

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

Average

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