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 MCB Board for Arm lock/unlock

Report No.: 105488-38

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:

Darcy Thompson
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 105488

DATE OF EQUIPMENT RECEIPT: December 7, 2021
DATE(S) OF TESTING: December 7, 2021 – January 25, 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; Configuration: 1 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 105488-38_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
MCB Board	Tonal System	500-0105 Rev 003	02000169
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 10

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

Device Name	Manufacturer	Model #	S/N
MCB Board	Tonal System	500-0105 Rev 003	02000170

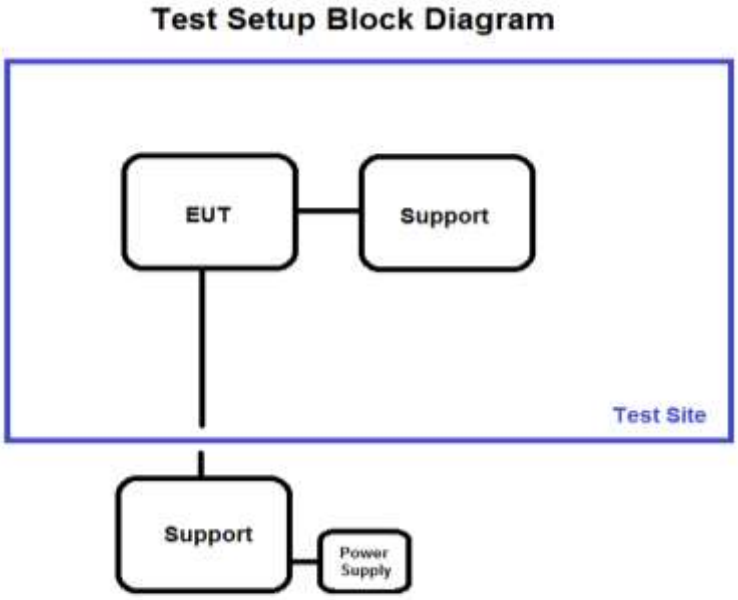
Support Equipment:

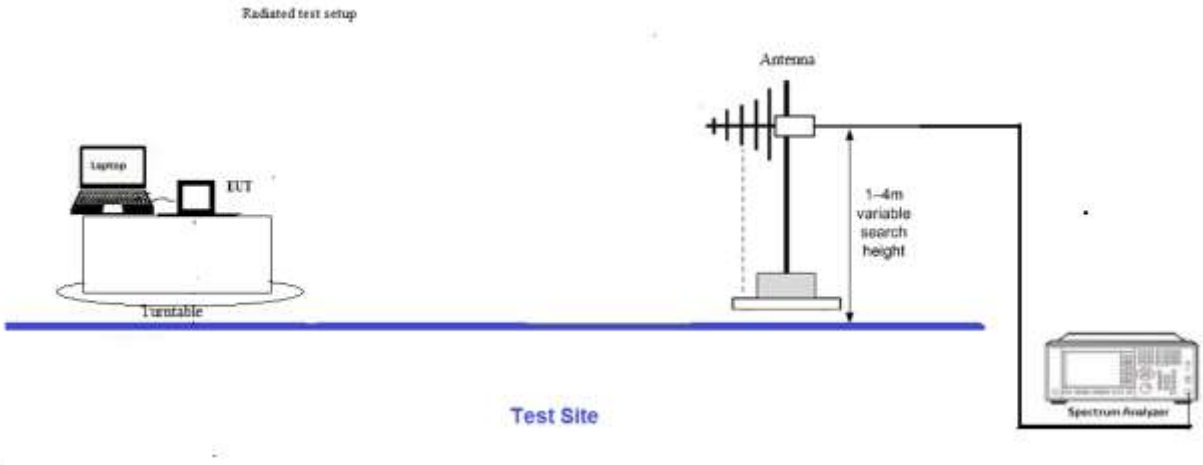
Device Name	Manufacturer	Model #	S/N
Laptop	Apple	MacBook Pro A1278	C1MMF2KDDV30
Laptop Power Supply	Apple	ADP-60AD T	E131881

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Bluetooth DTS for MCB Board for Arm lock/unlock
Operating Frequency Range:	2402-2480MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral 5.00dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	15VDC
Firmware / 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)





Rev. C

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

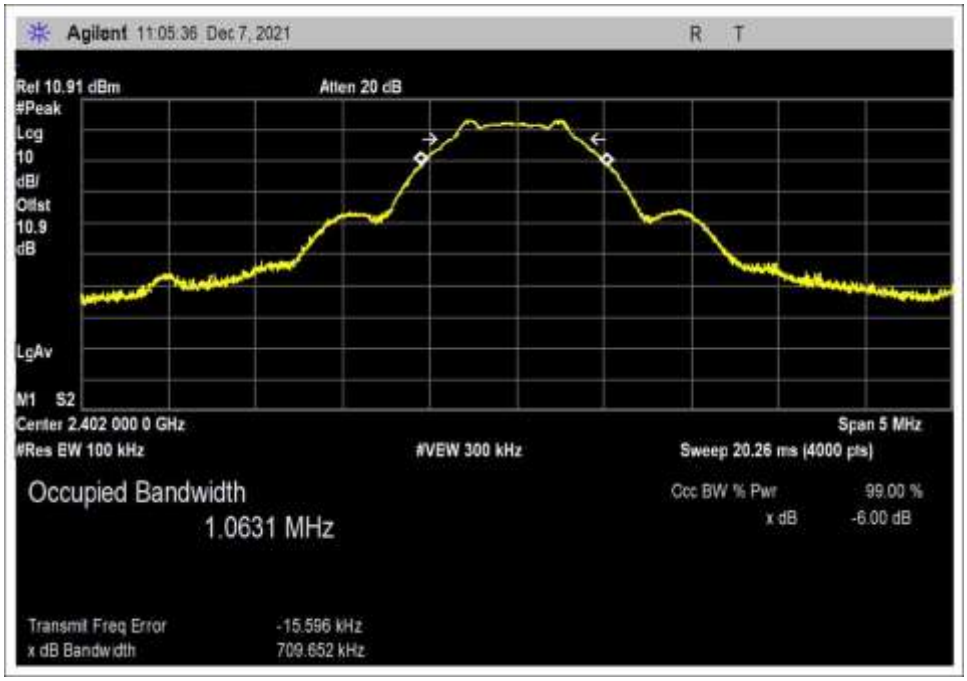
Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	12/7/2021
Configuration:	10		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight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

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

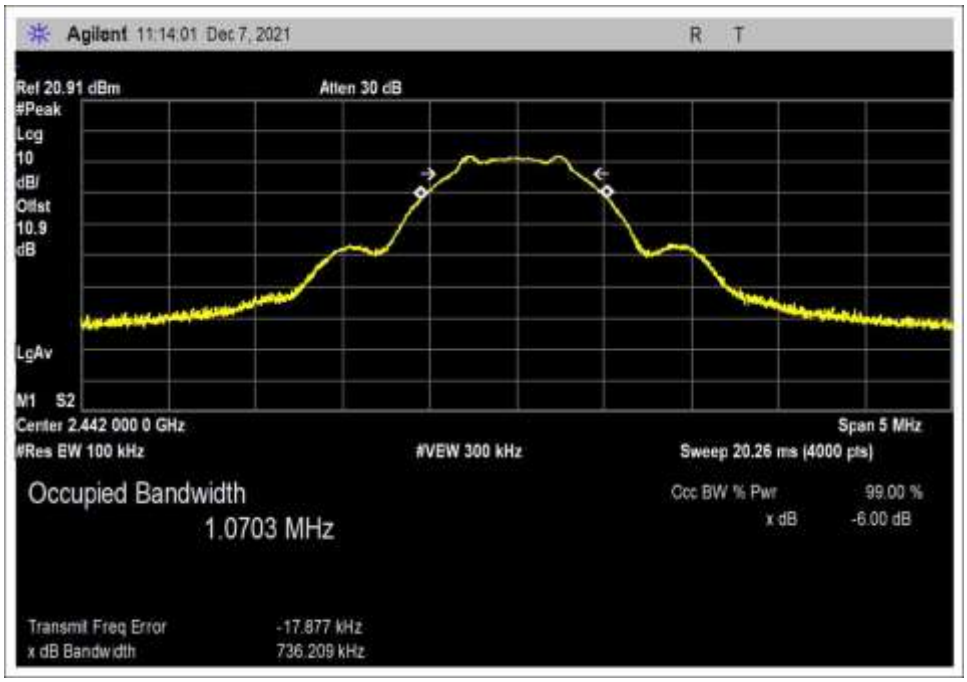
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	1	GFSK	709.652	≥500	Pass
2442	1	GFSK	736.209	≥500	Pass
2480	1	GFSK	728.354	≥500	Pass

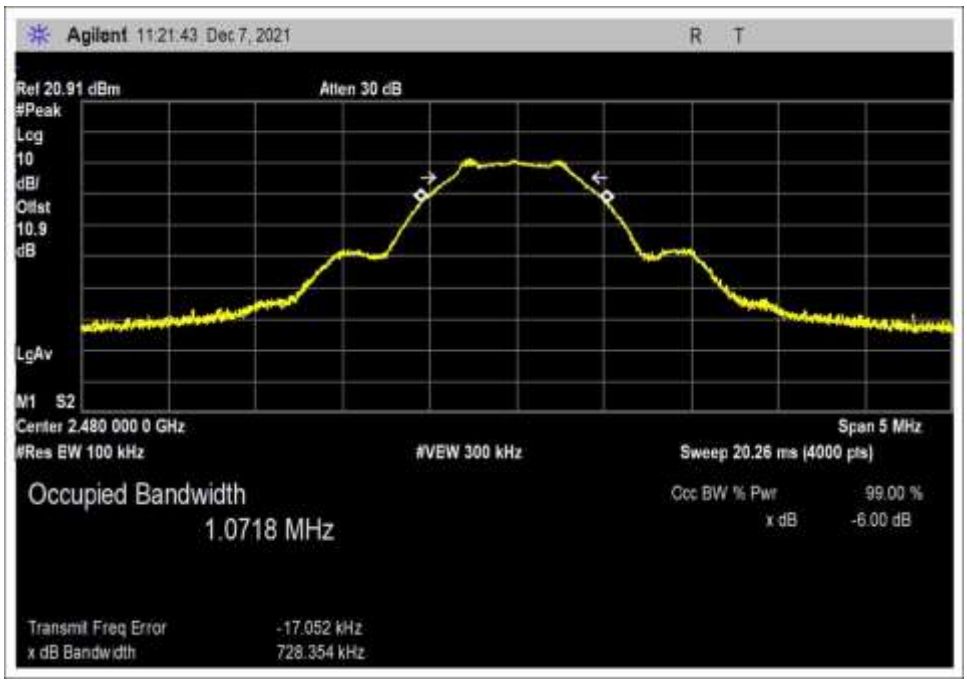
Plot(s)



Low Channel



Middle Channel



High Channel

15.247(b)(3) Output Power

Test Setup / Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	1/25/2022
Configuration:	10		
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	-1.40	-1.42	-1.47	0.07
2442	GFSK	-2.42	-2.43	-2.40	0.03
2480	GFSK	-3.69	-3.73	-3.74	0.05

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

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

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 /5.00	-1.40	≤30	Pass
2442	GFSK	Integral /5.00	-2.43	≤30	Pass
2480	GFSK	Integral /5.00	-3.73	≤30	Pass

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

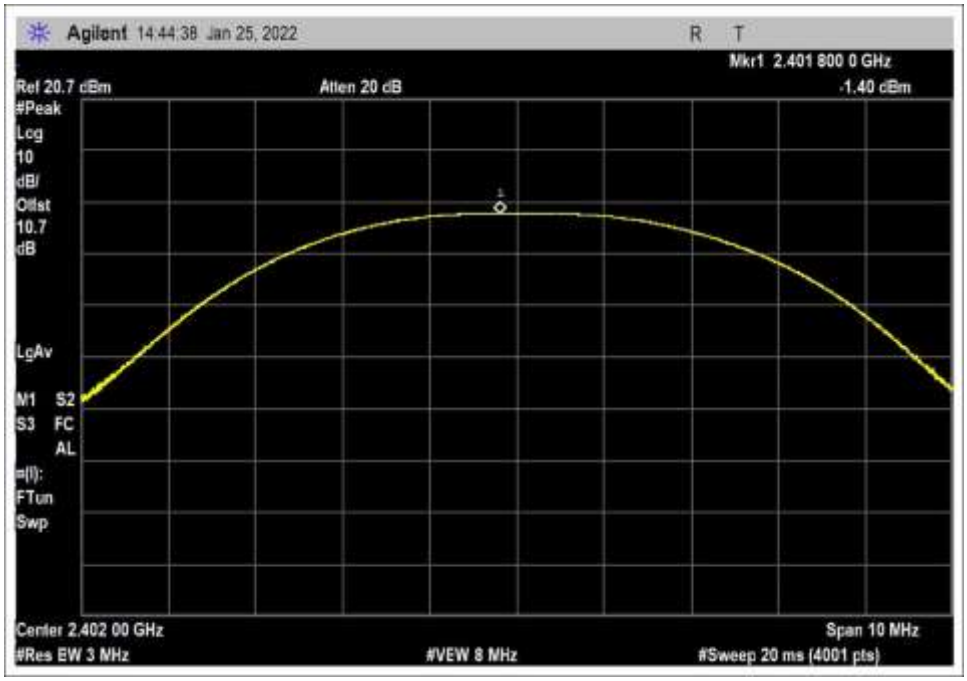
$$Limit = 30 - Roundup\left(\frac{G-6}{3}\right)$$

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

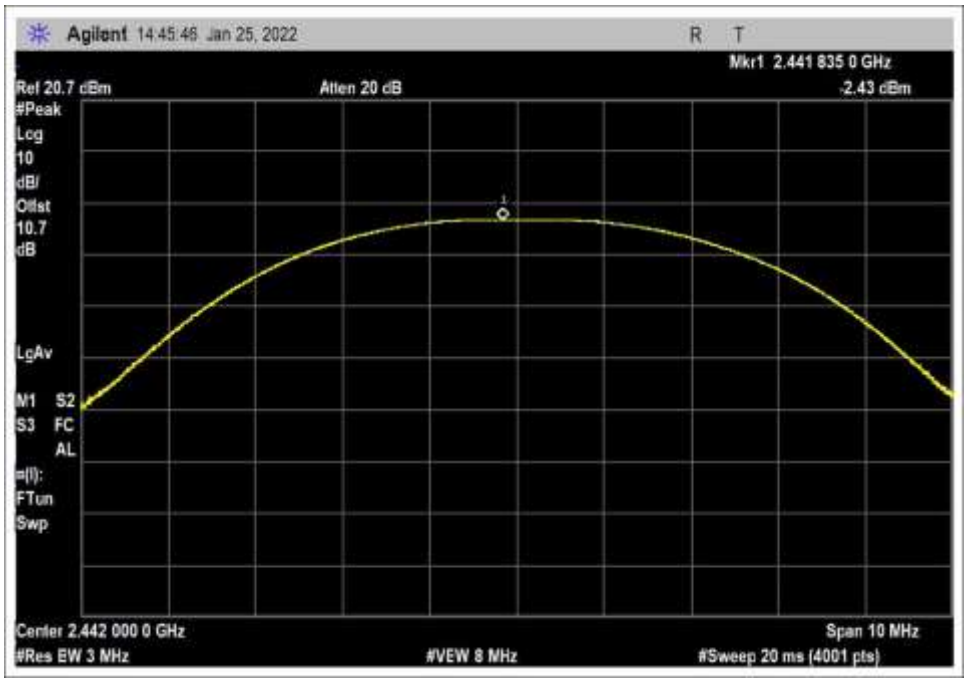
For all other antennas, the limit is calculated according to a maximum of 1W (30 dBm) conducted power with a maximum of 6dBi gain antenna in accordance with 15.247(b)

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

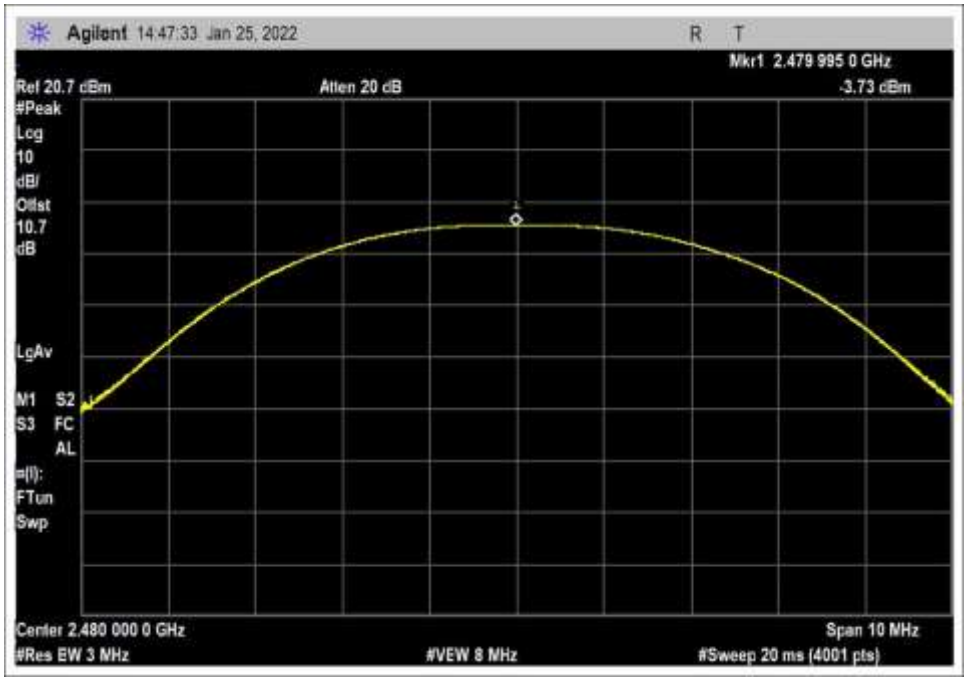
Plots



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 Place • 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:	11:34:55 AM
Tested By:	Hoang Cao	Sequence#:	4
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 10			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 10			

Test Conditions / Notes:

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

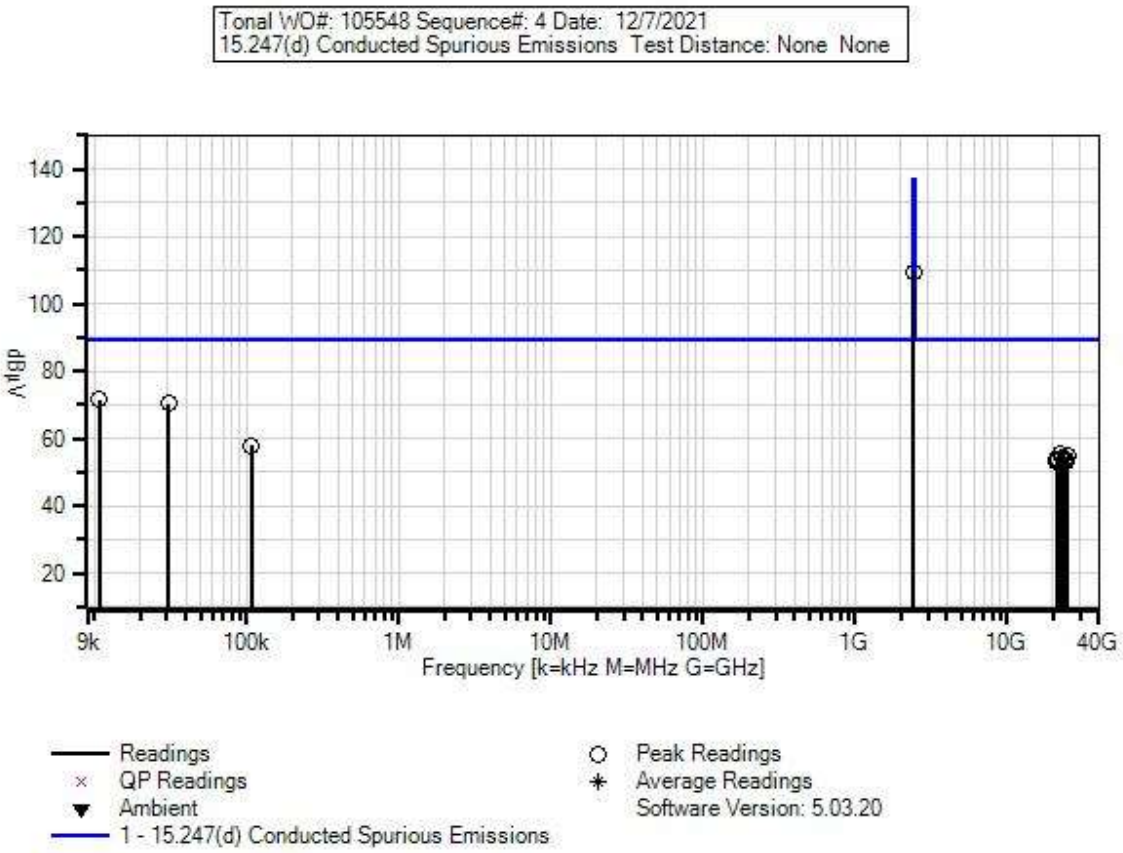
Highest Generated Frequency: 2.48GHz

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 power: 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	10.847k	61.9	+9.7	+0.0			+0.0	71.6	89.2	-17.6	None
2	30.990k	60.8	+9.7	+0.0			+0.0	70.5	89.2	-18.7	None
3	2400.765M	98.8	+9.9	+0.8			+0.0	109.5	137.0	-27.5	None
4	107.749k	48.3	+9.7	+0.0			+0.0	58.0	89.2	-31.2	None
5	22023.952 M	43.2	+10.1	+2.4			+0.0	55.7	89.2	-33.5	None
6	24926.647 M	42.0	+10.1	+2.6			+0.0	54.7	89.2	-34.5	None
7	22526.946 M	42.0	+10.0	+2.4			+0.0	54.4	89.2	-34.8	None
8	23124.251 M	41.5	+10.0	+2.5			+0.0	54.0	89.2	-35.2	None
9	21185.628 M	41.5	+10.0	+2.4			+0.0	53.9	89.2	-35.3	None
10	21646.706 M	41.3	+10.0	+2.4			+0.0	53.7	89.2	-35.5	None
11	21510.478 M	41.2	+10.0	+2.4			+0.0	53.6	89.2	-35.6	None
12	24193.114 M	40.9	+10.1	+2.5			+0.0	53.5	89.2	-35.7	None
13	21573.353 M	41.0	+10.0	+2.4			+0.0	53.4	89.2	-35.8	None
14	23501.497 M	40.8	+10.1	+2.5			+0.0	53.4	89.2	-35.8	None
15	23805.389 M	40.8	+10.1	+2.5			+0.0	53.4	89.2	-35.8	None
16	20976.047 M	40.9	+10.0	+2.4			+0.0	53.3	89.2	-35.9	None

17	24517.964 M	40.7	+10.1	+2.5		+0.0	53.3	89.2	-35.9	None
18	24077.844 M	40.6	+10.1	+2.5		+0.0	53.2	89.2	-36.0	None
19	24140.718 M	40.6	+10.1	+2.5		+0.0	53.2	89.2	-36.0	None
20	24538.922 M	40.6	+10.1	+2.5		+0.0	53.2	89.2	-36.0	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • 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:	11:42:28 AM
Tested By:	Hoang Cao	Sequence#:	5
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 10			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 10			

Test Conditions / Notes:

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

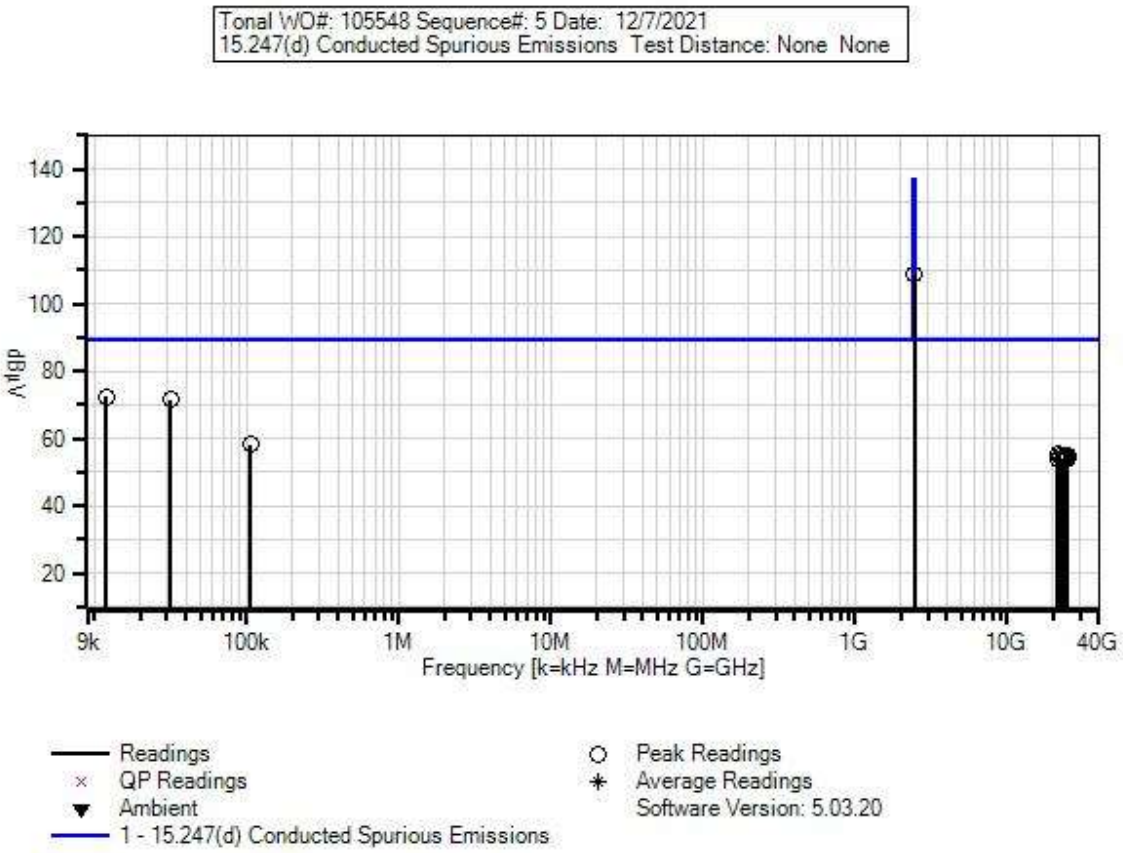
Highest Generated Frequency: 2.48GHz

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 power: 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	11.923k	62.7	+9.7	+0.0			+0.0	72.4	89.2	-16.8	None
2	31.595k	61.8	+9.7	+0.0			+0.0	71.5	89.2	-17.7	None
3	2442.659M	98.0	+9.9	+0.8			+0.0	108.7	137.0	-28.3	None
4	106.707k	48.6	+9.7	+0.0			+0.0	58.3	89.2	-30.9	None
5	21782.934 M	43.2	+10.0	+2.4			+0.0	55.6	89.2	-33.6	None
6	21971.556 M	42.5	+10.1	+2.4			+0.0	55.0	89.2	-34.2	None
7	24832.335 M	42.3	+10.1	+2.6			+0.0	55.0	89.2	-34.2	None
8	22128.742 M	42.4	+10.1	+2.4			+0.0	54.9	89.2	-34.3	None
9	24455.090 M	42.3	+10.1	+2.5			+0.0	54.9	89.2	-34.3	None
10	21866.766 M	42.2	+10.1	+2.4			+0.0	54.7	89.2	-34.5	None
11	24193.114 M	41.7	+10.1	+2.5			+0.0	54.3	89.2	-34.9	None
12	24727.545 M	41.4	+10.1	+2.6			+0.0	54.1	89.2	-35.1	None
13	24360.778 M	41.3	+10.1	+2.5			+0.0	53.9	89.2	-35.3	None
14	22799.401 M	41.4	+10.0	+2.4			+0.0	53.8	89.2	-35.4	None
15	21342.814 M	41.3	+10.0	+2.4			+0.0	53.7	89.2	-35.5	None
16	22642.215 M	41.2	+10.0	+2.4			+0.0	53.6	89.2	-35.6	None

17	23344.311 M	40.9	+10.1	+2.5		+0.0	53.5	89.2	-35.7	None
18	23260.479 M	40.9	+10.1	+2.5		+0.0	53.5	89.2	-35.7	None
19	23752.994 M	40.9	+10.1	+2.5		+0.0	53.5	89.2	-35.7	None
20	23459.581 M	40.9	+10.1	+2.5		+0.0	53.5	89.2	-35.7	None

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • 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:	11:49:36 AM
Tested By:	Hoang Cao	Sequence#:	6
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 10			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 10			

Test Conditions / Notes:

Conducted Spurious Emission
Frequency Range: 9kHz to 25GHz

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

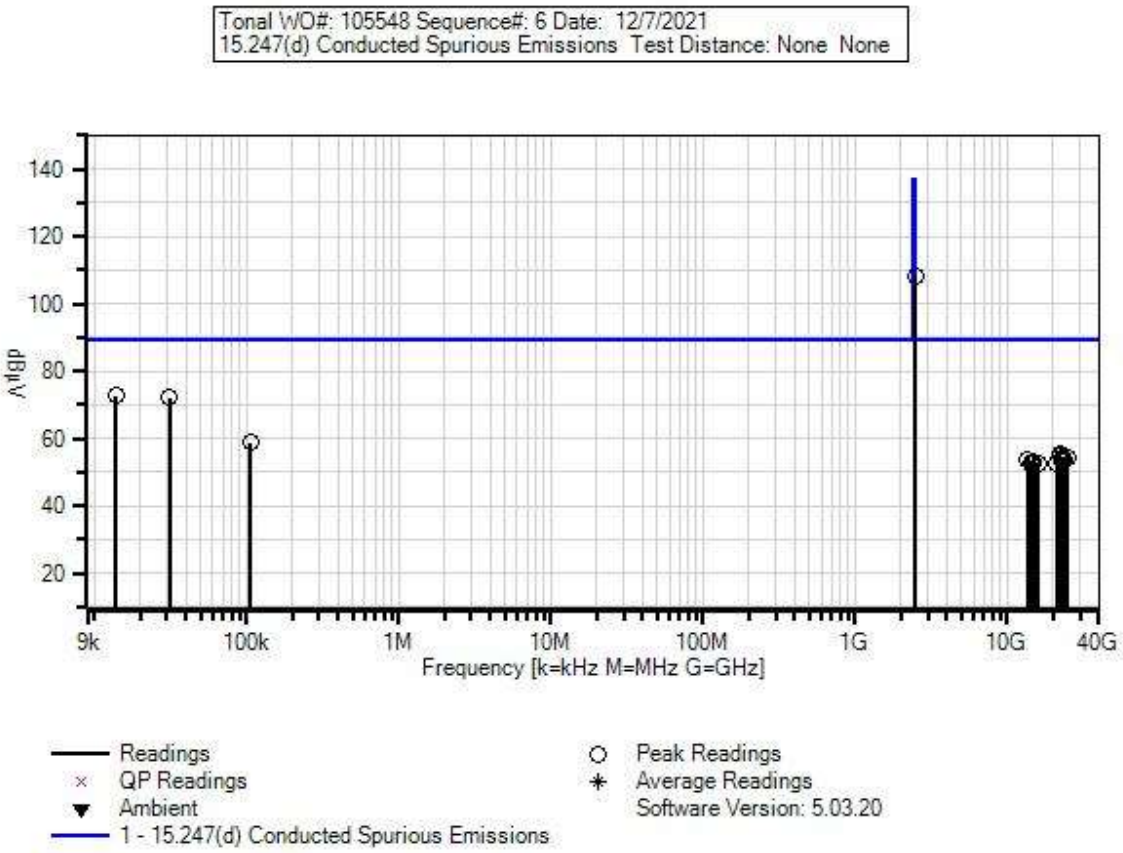
Highest Generated Frequency: 2.48GHz

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 power: 4dBm

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
	AN03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022

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

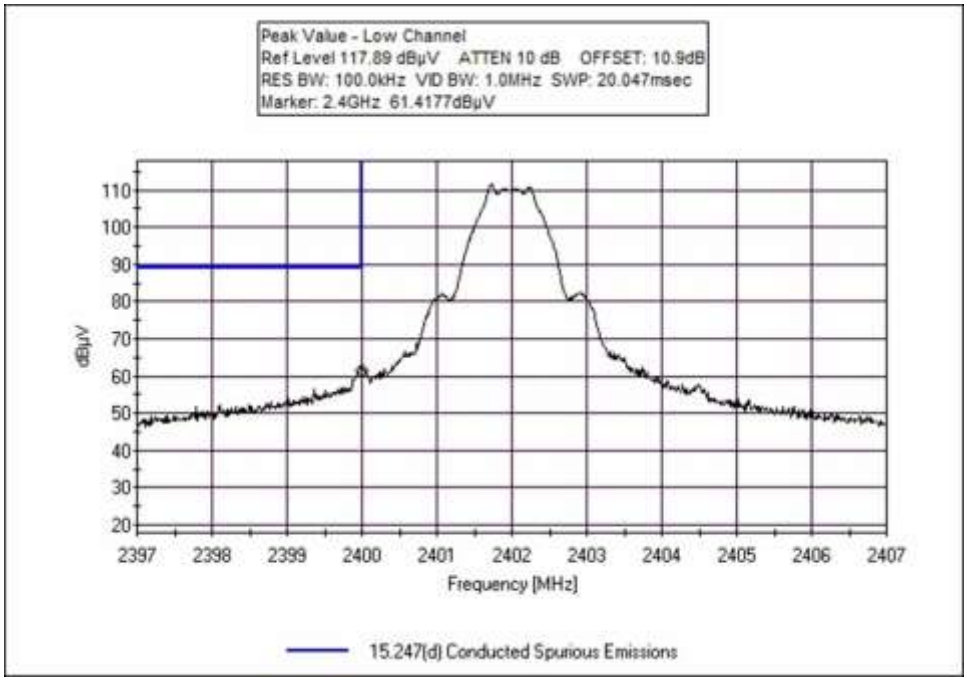
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	13.837k	63.0	+9.7	+0.0			+0.0	72.7	89.2	-16.5	None
2	31.292k	62.4	+9.7	+0.0			+0.0	72.1	89.2	-17.1	None
3	2478.568M	97.5	+9.9	+0.8			+0.0	108.2	137.0	-28.8	None
4	106.707k	49.0	+9.7	+0.0			+0.0	58.7	89.2	-30.5	None
5	22002.993 M	42.7	+10.1	+2.4			+0.0	55.2	89.2	-34.0	None
6	21856.287 M	42.7	+10.0	+2.4			+0.0	55.1	89.2	-34.1	None
7	22076.347 M	42.5	+10.1	+2.4			+0.0	55.0	89.2	-34.2	None
8	22883.233 M	41.8	+10.0	+2.5			+0.0	54.3	89.2	-34.9	None
9	24790.419 M	41.5	+10.1	+2.6			+0.0	54.2	89.2	-35.0	None
10	24717.066 M	41.4	+10.1	+2.6			+0.0	54.1	89.2	-35.1	None
11	13603.919 M	42.0	+10.0	+1.9			+0.0	53.9	89.2	-35.3	None
12	23187.125 M	41.3	+10.1	+2.5			+0.0	53.9	89.2	-35.3	None
13	23553.892 M	41.2	+10.1	+2.5			+0.0	53.8	89.2	-35.4	None
14	23008.982 M	41.0	+10.0	+2.5			+0.0	53.5	89.2	-35.7	None
15	14500.349 M	41.4	+10.0	+1.9			+0.0	53.3	89.2	-35.9	None
16	23061.377 M	40.6	+10.0	+2.5			+0.0	53.1	89.2	-36.1	None

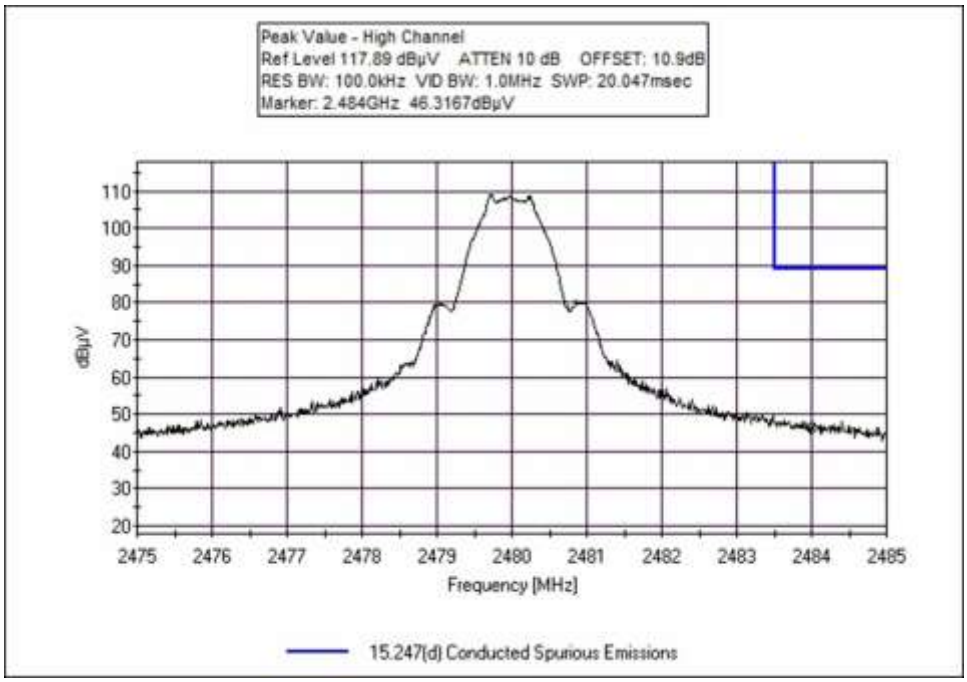
17	14211.842 M	40.9	+10.0	+1.9		+0.0	52.8	89.2	-36.4	None
18	14866.765 M	40.8	+10.0	+1.9		+0.0	52.7	89.2	-36.5	None
19	15820.358 M	40.7	+10.0	+2.0		+0.0	52.7	89.2	-36.5	None
20	20913.173 M	40.2	+10.0	+2.4		+0.0	52.6	89.2	-36.6	None

Band Edge

Band Edge Summary				
Limit applied: Max Power/100kHz - 20dB.				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400.0	GFSK	61.4177	<89.16	Pass
2483.5	GFSK	46.3167	<89.16	Pass

Band Edge Plots





15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	16:32:25
Tested By:	Hoang Cao	Sequence#:	296
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

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 at power level 0.

Operational mode is representative of worst case.

Low Channel

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.

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	149.432M	50.5	-32.0	+11.5	+5.9	+0.2	+0.0	37.6	43.5	-5.9	Horiz
	QP		+0.4	+1.1							
^	149.432M	53.4	-32.0	+11.5	+5.9	+0.2	+0.0	40.5	43.5	-3.0	Horiz
			+0.4	+1.1							
3	296.282M	49.8	-31.9	+13.2	+6.0	+0.4	+0.0	39.7	46.0	-6.3	Horiz
	QP		+0.6	+1.6							
^	296.282M	57.3	-31.9	+13.2	+6.0	+0.4	+0.0	47.2	46.0	+1.2	Horiz
			+0.6	+1.6							
5	147.567M	50.0	-32.0	+11.5	+5.9	+0.2	+0.0	37.1	43.5	-6.4	Horiz
	QP		+0.4	+1.1							
^	147.567M	52.7	-32.0	+11.5	+5.9	+0.2	+0.0	39.8	43.5	-3.7	Horiz
			+0.4	+1.1							
7	444.404M	44.6	-31.9	+16.9	+5.9	+0.5	+0.0	38.9	46.0	-7.1	Horiz
	QP		+0.8	+2.1							
^	444.404M	47.8	-31.9	+16.9	+5.9	+0.5	+0.0	42.1	46.0	-3.9	Horiz
			+0.8	+2.1							
9	446.615M	44.0	-31.9	+16.9	+5.9	+0.5	+0.0	38.3	46.0	-7.7	Horiz
	QP		+0.8	+2.1							
^	446.615M	47.1	-31.9	+16.9	+5.9	+0.5	+0.0	41.4	46.0	-4.6	Horiz
			+0.8	+2.1							
11	383.035M	45.7	-31.9	+15.3	+6.0	+0.4	+0.0	38.1	46.0	-7.9	Vert
			+0.7	+1.9							
12	884.626M	34.5	-31.4	+23.1	+5.9	+0.7	+0.0	37.2	46.0	-8.8	Horiz
	QP		+1.2	+3.2							
^	884.626M	38.5	-31.4	+23.1	+5.9	+0.7	+0.0	41.2	46.0	-4.8	Horiz
			+1.2	+3.2							

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	17:06:18
Tested By:	Hoang Cao	Sequence#:	299
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

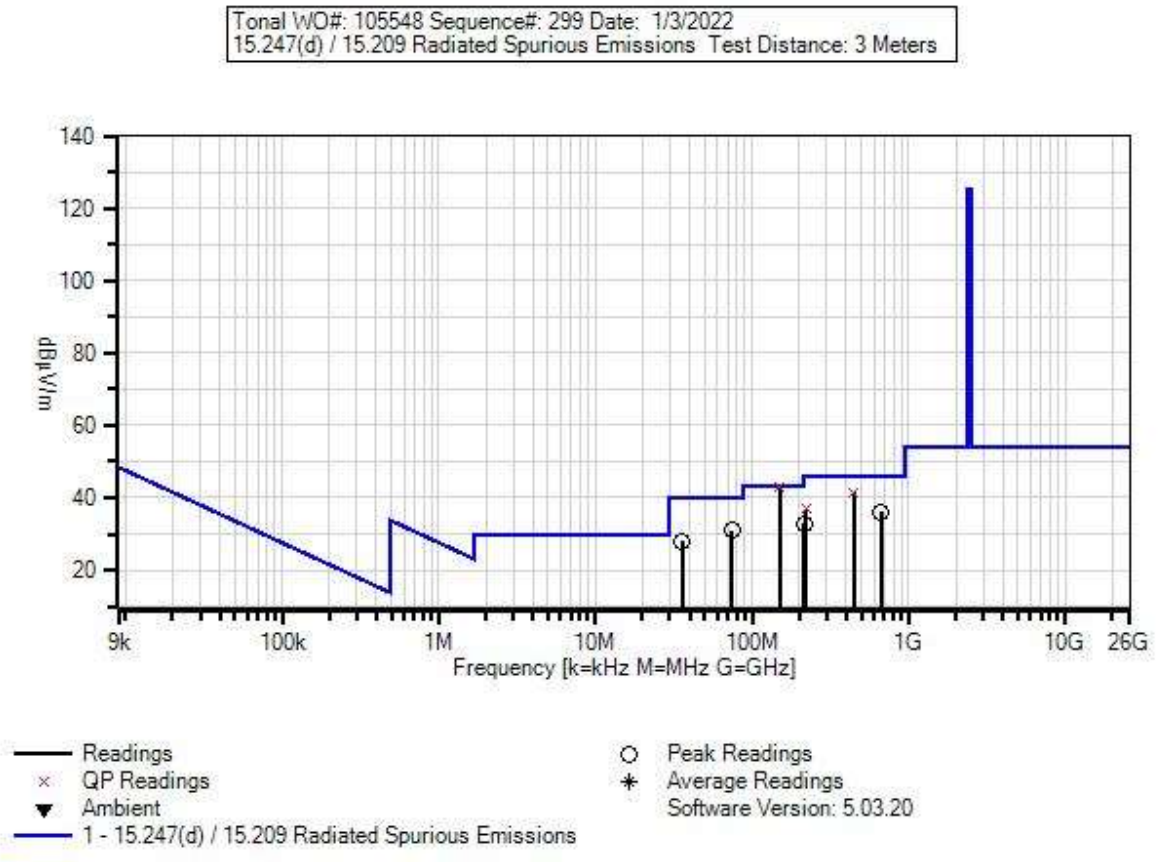
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

Middle Channel

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.



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	149.385M	55.9	-32.0	+11.5	+5.9	+0.2	+0.0	43.0	43.5	-0.5	Horiz
	QP		+0.4	+1.1							
^	149.385M	63.6	-32.0	+11.5	+5.9	+0.2	+0.0	50.7	43.5	+7.2	Horiz
			+0.4	+1.1							
3	446.603M	47.3	-31.9	+16.9	+5.9	+0.5	+0.0	41.6	46.0	-4.4	Horiz
	QP		+0.8	+2.1							
^	446.603M	50.5	-31.9	+16.9	+5.9	+0.5	+0.0	44.8	46.0	-1.2	Horiz
			+0.8	+2.1							
5	74.473M	49.2	-32.0	+6.8	+5.9	+0.1	+0.0	31.0	40.0	-9.0	Horiz
			+0.3	+0.7							
6	221.314M	50.0	-31.9	+10.7	+5.9	+0.3	+0.0	36.9	46.0	-9.1	Horiz
	QP		+0.5	+1.4							
^	221.314M	53.6	-31.9	+10.7	+5.9	+0.3	+0.0	40.5	46.0	-5.5	Horiz
			+0.5	+1.4							
8	672.407M	37.4	-32.0	+20.6	+5.9	+0.6	+0.0	36.2	46.0	-9.8	Horiz
			+1.0	+2.7							
9	215.969M	46.4	-31.9	+10.4	+5.9	+0.3	+0.0	32.9	43.5	-10.6	Vert
			+0.5	+1.3							
10	35.976M	37.5	-32.0	+16.0	+5.9	+0.0	+0.0	28.0	40.0	-12.0	Vert
			+0.2	+0.4							

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	17:25:06
Tested By:	Hoang Cao	Sequence#:	302
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

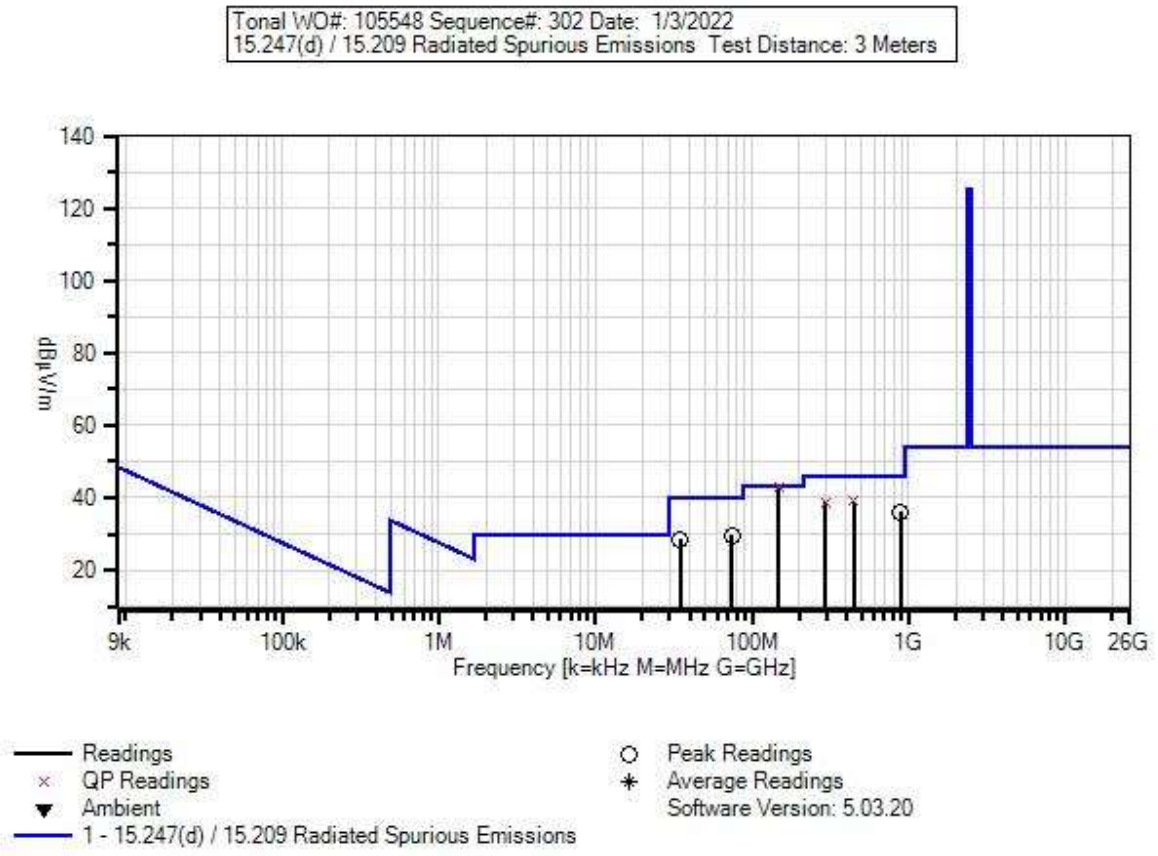
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

High Channel

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.



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	148.127M	55.8	-32.0	+11.5	+5.9	+0.2	+0.0	42.9	43.5	-0.6	Horiz
	QP		+0.4	+1.1							
^	148.127M	62.5	-32.0	+11.5	+5.9	+0.2	+0.0	49.6	43.5	+6.1	Horiz
			+0.4	+1.1							
3	444.373M	44.8	-31.9	+16.9	+5.9	+0.5	+0.0	39.1	46.0	-6.9	Horiz
	QP		+0.8	+2.1							
^	444.373M	48.7	-31.9	+16.9	+5.9	+0.5	+0.0	43.0	46.0	-3.0	Horiz
			+0.8	+2.1							
5	295.700M	48.8	-31.9	+13.2	+6.0	+0.4	+0.0	38.7	46.0	-7.3	Horiz
	QP		+0.6	+1.6							
^	295.700M	54.9	-31.9	+13.2	+6.0	+0.4	+0.0	44.8	46.0	-1.2	Horiz
			+0.6	+1.6							
7	885.571M	33.4	-31.4	+23.1	+5.9	+0.7	+0.0	36.1	46.0	-9.9	Vert
			+1.2	+3.2							
8	74.511M	47.7	-32.0	+6.8	+5.9	+0.1	+0.0	29.5	40.0	-10.5	Horiz
			+0.3	+0.7							
9	35.050M	37.4	-32.0	+16.6	+5.9	+0.0	+0.0	28.5	40.0	-11.5	Vert
			+0.2	+0.4							

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	13:47:45
Tested By:	Hoang Cao	Sequence#:	287
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

Method: ANSI C63.10 2013

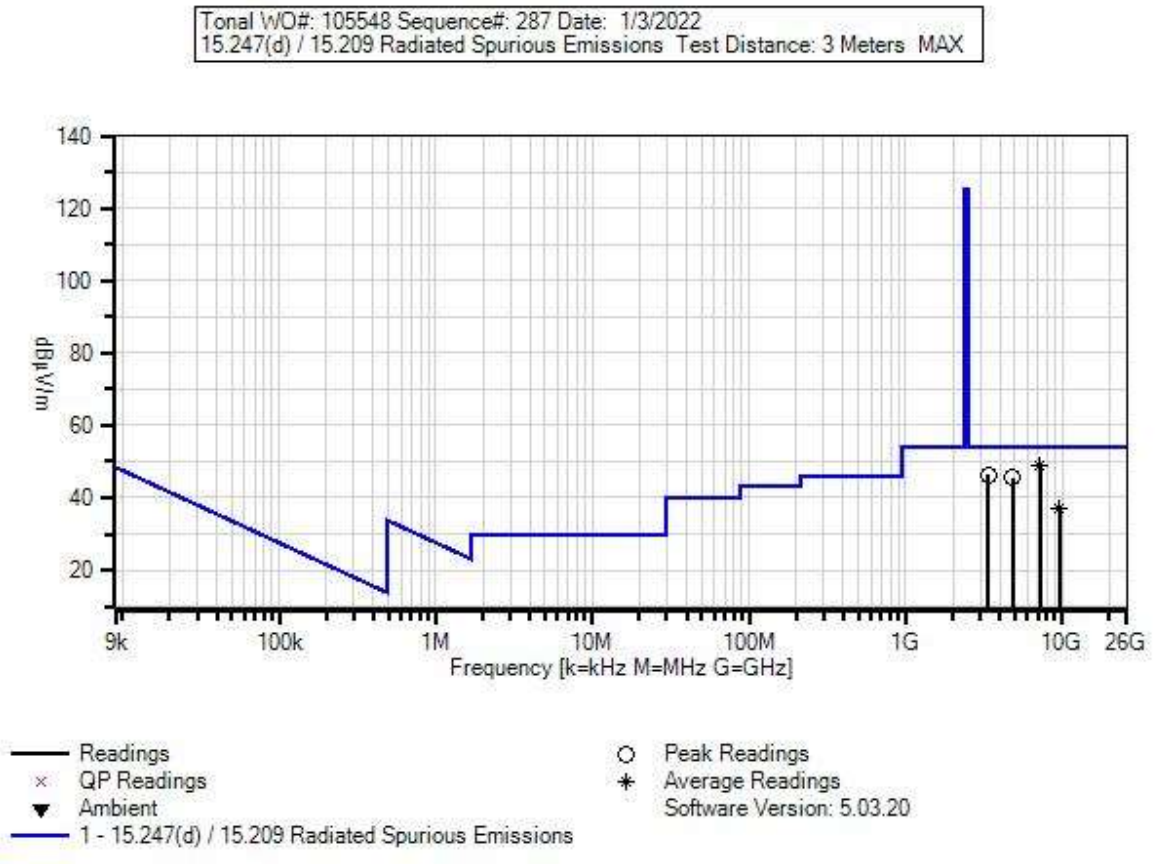
The unit is mounted to a floor standing rack as to simulate typical wall mounted setup.
One weight line is extended to the floor.
BT transmitting continuously at power level 0.

Operational mode is representative of worst case.

Low Channel

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.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T2	AN02812	Preamp	83017-69004	9/22/2020	9/22/2022
T3	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T4	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T5	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
	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

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

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	7206.689M Ave	37.6	+34.6 +1.5	-31.4	+2.3	+4.5	+0.0	49.1	54.0	-4.9	Vert
^	7206.689M	46.4	+34.6 +1.5	-31.4	+2.3	+4.5	+0.0	57.9	54.0	+3.9	Vert
3	3387.385M	39.5	+30.9 +1.0	-29.6	+1.5	+3.1	+0.0	46.4	54.0	-7.6	Horiz
4	4804.496M	36.5	+32.2 +1.2	-30.0	+1.8	+3.7	+0.0	45.4	54.0	-8.6	Vert
5	9607.782M Ave	23.6	+36.5 +1.7	-32.4	+2.6	+5.3	+0.0	37.3	54.0	-16.7	Vert
^	9607.782M	36.7	+36.5 +1.7	-32.4	+2.6	+5.3	+0.0	50.4	54.0	-3.6	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	14:15:38
Tested By:	Hoang Cao	Sequence#:	290
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

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 at power level 0.

Operational mode is representative of worst case.

Middle Channel

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.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T2	AN02812	Preamp	83017-69004	9/22/2020	9/22/2022
T3	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T4	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T5	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
	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

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

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1637.295M	47.6	+26.1 +0.7	-31.6	+1.0	+2.1	+0.0	45.9	54.0	-8.1	Vert
2	4884.000M	36.3	+32.4 +1.2	-29.9	+1.8	+3.7	+0.0	45.5	54.0	-8.5	Vert
3	7325.247M Ave	33.1	+35.0 +1.5	-31.5	+2.3	+4.6	+0.0	45.0	54.0	-9.0	Vert
^	7325.247M	42.3	+35.0 +1.5	-31.5	+2.3	+4.6	+0.0	54.2	54.0	+0.2	Vert
5	9767.761M Ave	23.1	+36.6 +1.7	-32.2	+2.6	+5.3	+0.0	37.1	54.0	-16.9	Vert
^	9767.761M	35.4	+36.6 +1.7	-32.2	+2.6	+5.3	+0.0	49.4	54.0	-4.6	Vert
7	2093.039M Ave	30.2	+27.6 +0.8	-30.9	+1.2	+2.4	+0.0	31.3	54.0	-22.7	Horiz
^	2093.039M	52.7	+27.6 +0.8	-30.9	+1.2	+2.4	+0.0	53.8	54.0	-0.2	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	14:39:20
Tested By:	Hoang Cao	Sequence#:	293
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 26GHz

Environmental Conditions:
Temperature: 23.4°C
Humidity: 50%
Atmospheric Pressure: 100.6kPa

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 at power level 0.

Operational mode is representative of worst case.

High Channel

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.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02660	Spectrum Analyzer	E4446A	12/4/2020	12/4/2022
T1	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T2	AN02812	Preamp	83017-69004	9/22/2020	9/22/2022
T3	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
T4	ANP01210	Cable	FSJ1P-50A-4A	11/2/2020	11/2/2022
T5	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022
	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

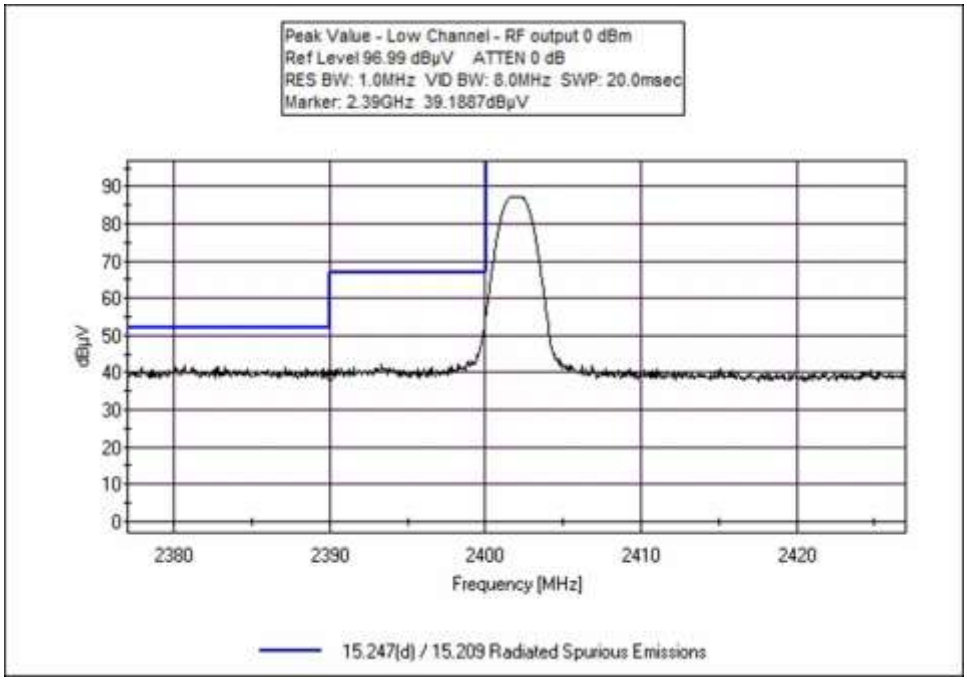
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

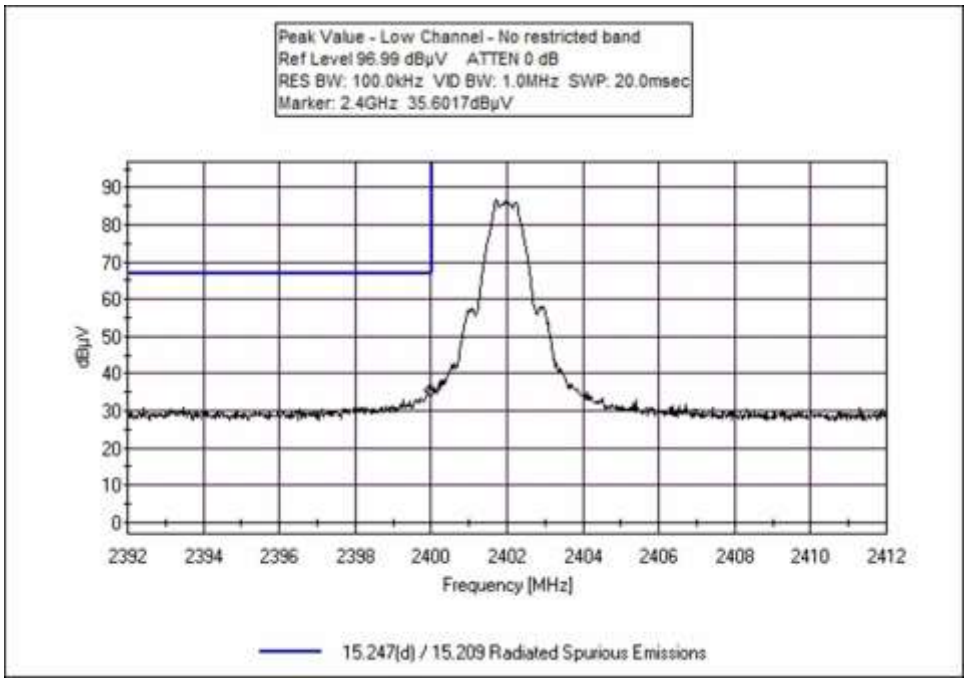
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	7439.131M Ave	36.0	+35.2 +1.5	-31.7	+2.3	+4.6	+0.0	47.9	54.0	-6.1	Vert
^	7439.131M	44.9	+35.2 +1.5	-31.7	+2.3	+4.6	+0.0	56.8	54.0	+2.8	Vert
3	1631.267M	48.0	+26.1 +0.7	-31.6	+1.0	+2.1	+0.0	46.3	54.0	-7.7	Vert
4	4960.292M	36.8	+32.6 +1.2	-29.9	+1.8	+3.8	+0.0	46.3	54.0	-7.7	Vert
5	9919.654M Ave	23.3	+36.7 +1.7	-32.1	+2.7	+5.4	+0.0	37.7	54.0	-16.3	Vert
^	9919.654M	36.0	+36.7 +1.7	-32.1	+2.7	+5.4	+0.0	50.4	54.0	-3.6	Vert
7	2074.316M Ave	30.6	+27.5 +0.8	-30.9	+1.2	+2.3	+0.0	31.5	54.0	-22.5	Horiz
^	2074.316M	51.0	+27.5 +0.8	-30.9	+1.2	+2.3	+0.0	51.9	54.0	-2.1	Horiz

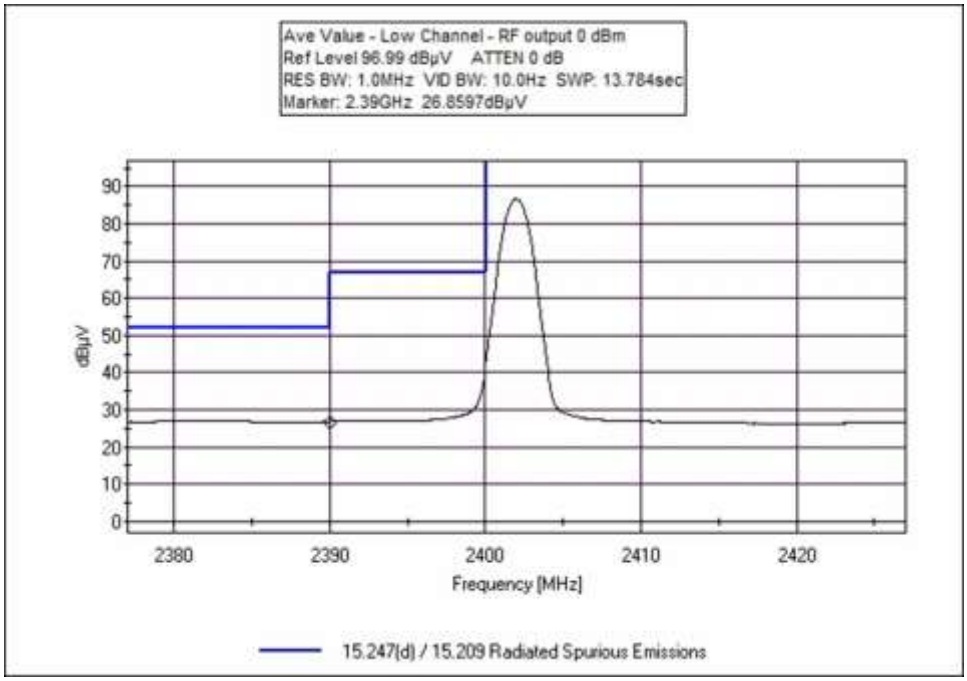
Band Edge

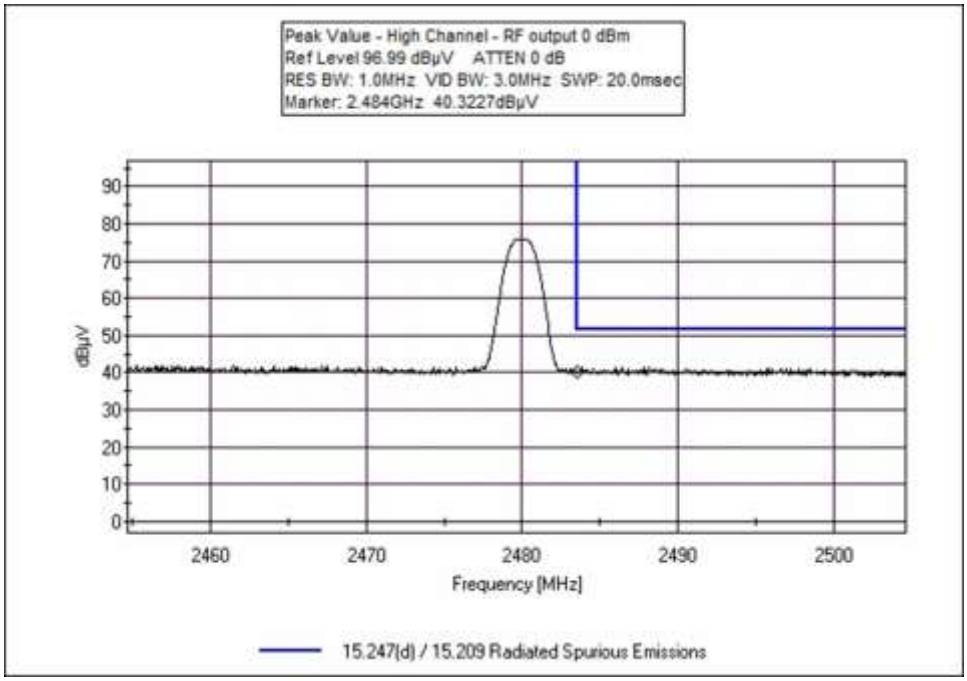
Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	GFSK	Integral	29.2597	<54	Pass
2400.0	GFSK	Integral	38.0017	<79	Pass
2483.5	GFSK	Integral	29.4517	<54	Pass

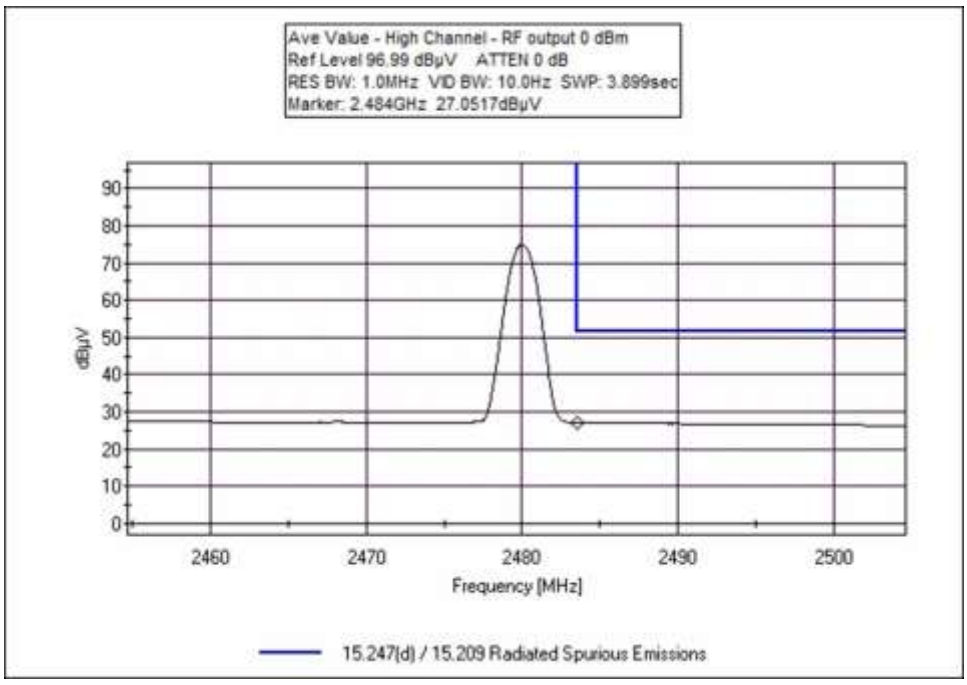
Band Edge Plots






Ave Value - Low Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 13.784sec
Marker: 2.39GHz 26.8597dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2380
2390
2400
2410
2420
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Peak Value - High Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.484GHz 40.3227dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Ave Value - High Channel - RF output 0 dBm
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 3.899sec
Marker: 2.484GHz 27.0517dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2460
2470
2480
2490
2500
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510-249-1170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**105488**	Date:	1/3/2022
Test Type:	**Radiated Scan**	Time:	
Tested By:	Hoang Cao	Sequence#:	
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Band edge

Environmental Conditions:
Temperature: 20.4°C
Humidity: 42%
Atmospheric Pressure: 101.5kPa

Software: Putty version 0.74

Highest Generated Frequency: 2.48GHz

Method: ANSI C63.10 2013

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	AN02113	Horn Antenna-ANSI C63.5	3115	3/11/2021	3/11/2023
T4	AN02812	Preamp	83017-69004	9/22/2020	9/22/2022
T5	ANP06902	Cable	32022-29094K-29094K-36TC	8/13/2020	8/13/2022

15.247(e) Power Spectral Density

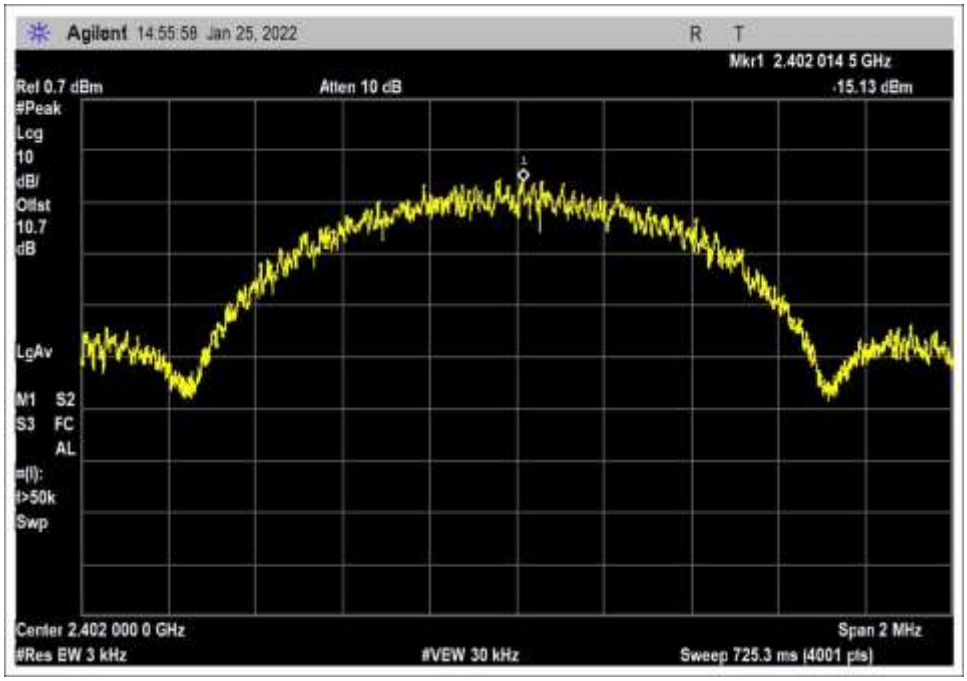
Test Setup / Conditions / Data			
Test Location:	Fremont Lab C3	Test Engineer:	Hoang Cao
Test Method:	ANSI C63.10 (2013), KDB 558074 D01 15.247 Meas Guidance v05r02	Test Date(s):	1/25/2022
Configuration:	10		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

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

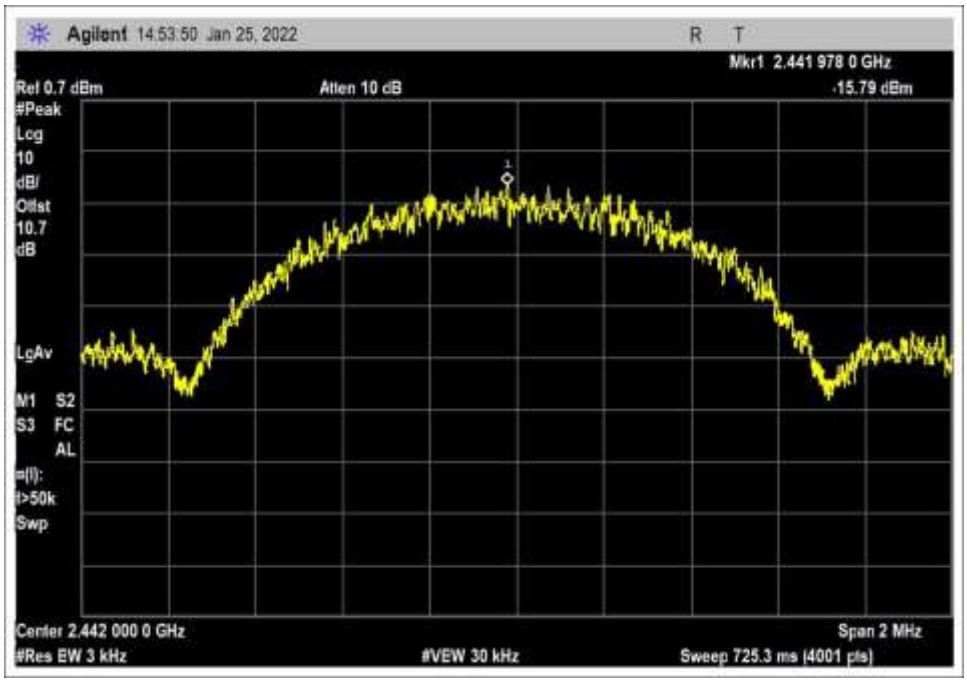
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P06239	Attenuator	Weinschel	54A-10	6/17/2020	6/17/2022
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022

PSD Test Data Summary - RF Conducted Measurement				
Measurement Method: PKPSD				
Frequency (MHz)	**Modulation**	**Measured (dBm/3kHz)**	**Limit (dBm/3kHz)**	**Results**
2402	GFSK	-15.13	≤8	Pass
2442	GFSK	-15.79	≤8	Pass
2480	GFSK	-17.88	≤8	Pass

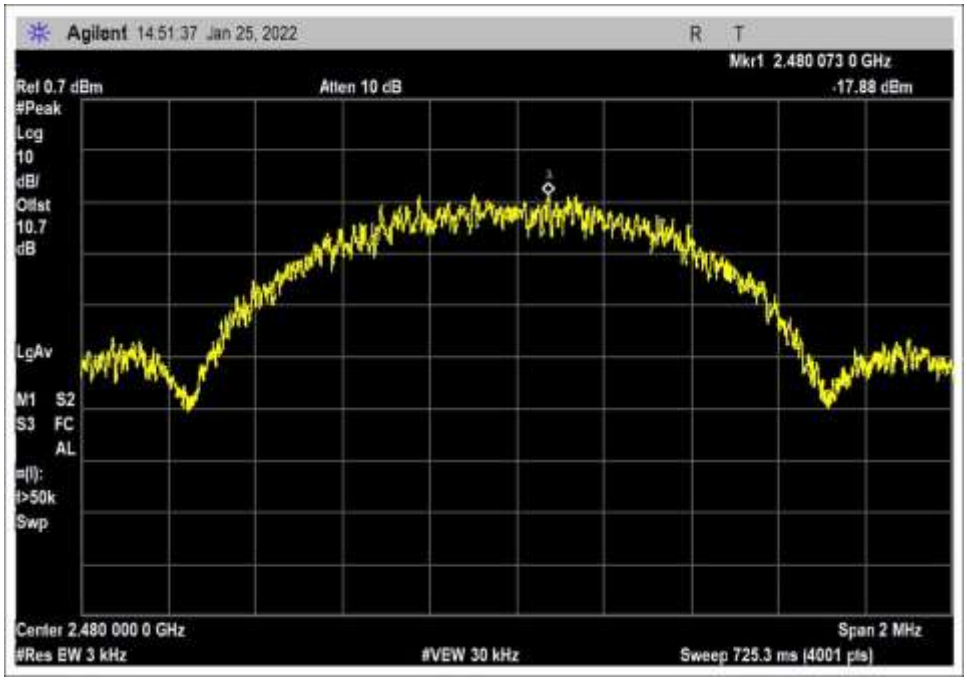
Plots



Low Channel



Middle Channel



High Channel

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • 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:

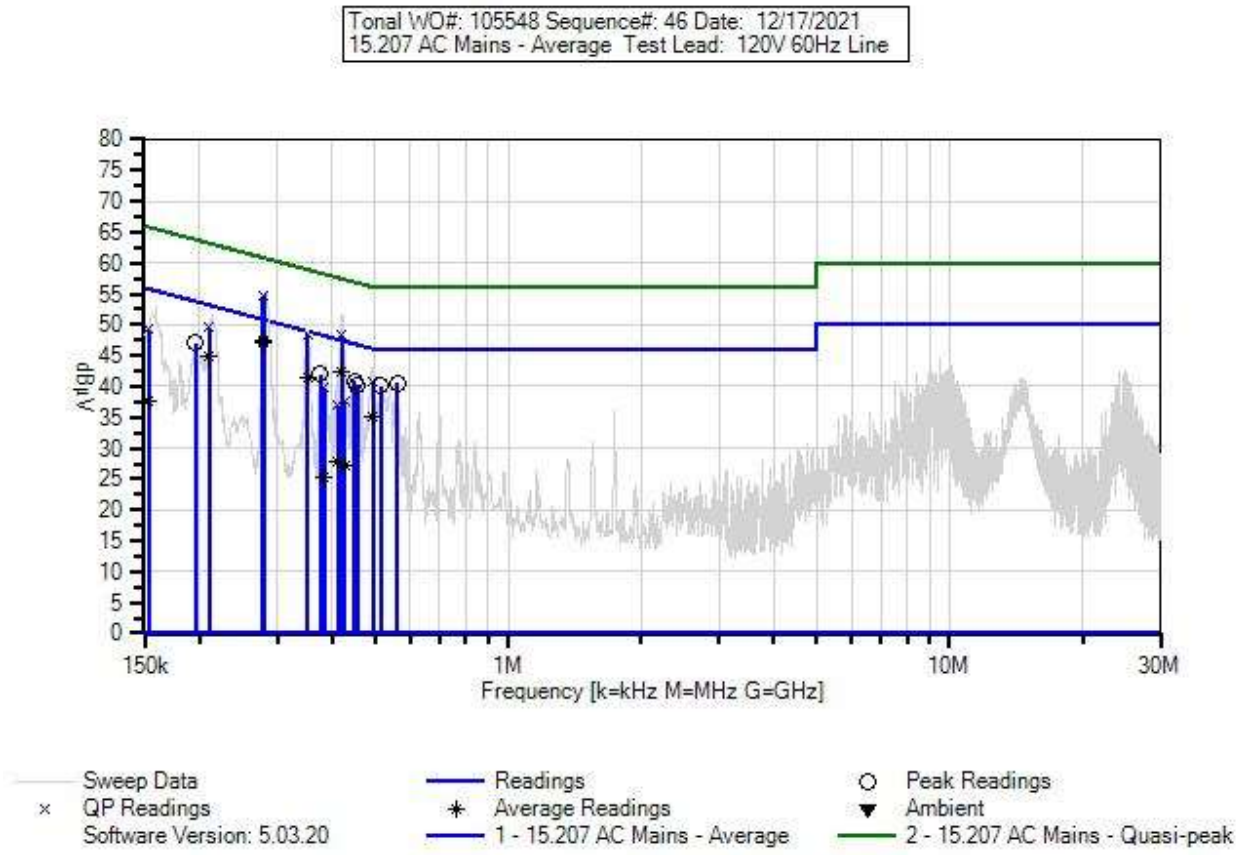
Conducted Emission
Frequency Range: 150kHz to 30MHz

Environmental Conditions:
Temperature: 21.8°C
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 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	280.316k Ave	37.3	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	47.4	50.8	-3.4	Line
2	278.856k Ave	37.1	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	47.2	50.8	-3.6	Line
3	420.747k Ave	32.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	42.4	47.4	-5.0	Line
4	562.324k	30.3	+9.9 +0.2	+0.0	+0.1	+0.1	+0.0	40.6	46.0	-5.4	Line
5	515.783k	29.7	+9.9 +0.2	+0.0	+0.1	+0.1	+0.0	40.0	46.0	-6.0	Line
6	280.316k QP	44.6	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	54.7	60.8	-6.1	Line
7	448.880k	30.7	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	40.8	46.9	-6.1	Line
8	278.856k QP	44.5	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	54.6	60.8	-6.2	Line
^	280.316k	46.6	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	56.7	50.8	+5.9	Line
^	278.856k	46.5	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	56.6	50.8	+5.8	Line
11	375.432k	31.8	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	41.9	48.4	-6.5	Line
12	454.698k	30.1	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	40.2	46.8	-6.6	Line
13	195.812k	36.8	+9.9 +0.2	+0.0	+0.0	+0.1	+0.0	47.0	53.8	-6.8	Line
14	351.428k Ave	31.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	41.4	48.9	-7.5	Line
15	209.905k Ave	34.9	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	45.0	53.2	-8.2	Line
16	420.747k QP	38.3	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.3	57.4	-9.1	Line
^	420.747k	43.2	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	53.2	47.4	+5.8	Line
18	351.428k QP	38.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.5	58.9	-10.4	Line
^	351.428k	42.2	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	52.2	48.9	+3.3	Line
20	493.040k Ave	24.9	+9.9 +0.1	+0.0	+0.1	+0.1	+0.0	35.1	46.1	-11.0	Line
21	209.905k QP	39.5	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	49.6	63.2	-13.6	Line
^	209.905k	43.1	+9.9 +0.1	+0.0	+0.0	+0.1	+0.0	53.2	53.2	+0.0	Line
23	493.040k QP	30.7	+9.9 +0.1	+0.0	+0.1	+0.1	+0.0	40.9	56.1	-15.2	Line
^	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 Place • 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

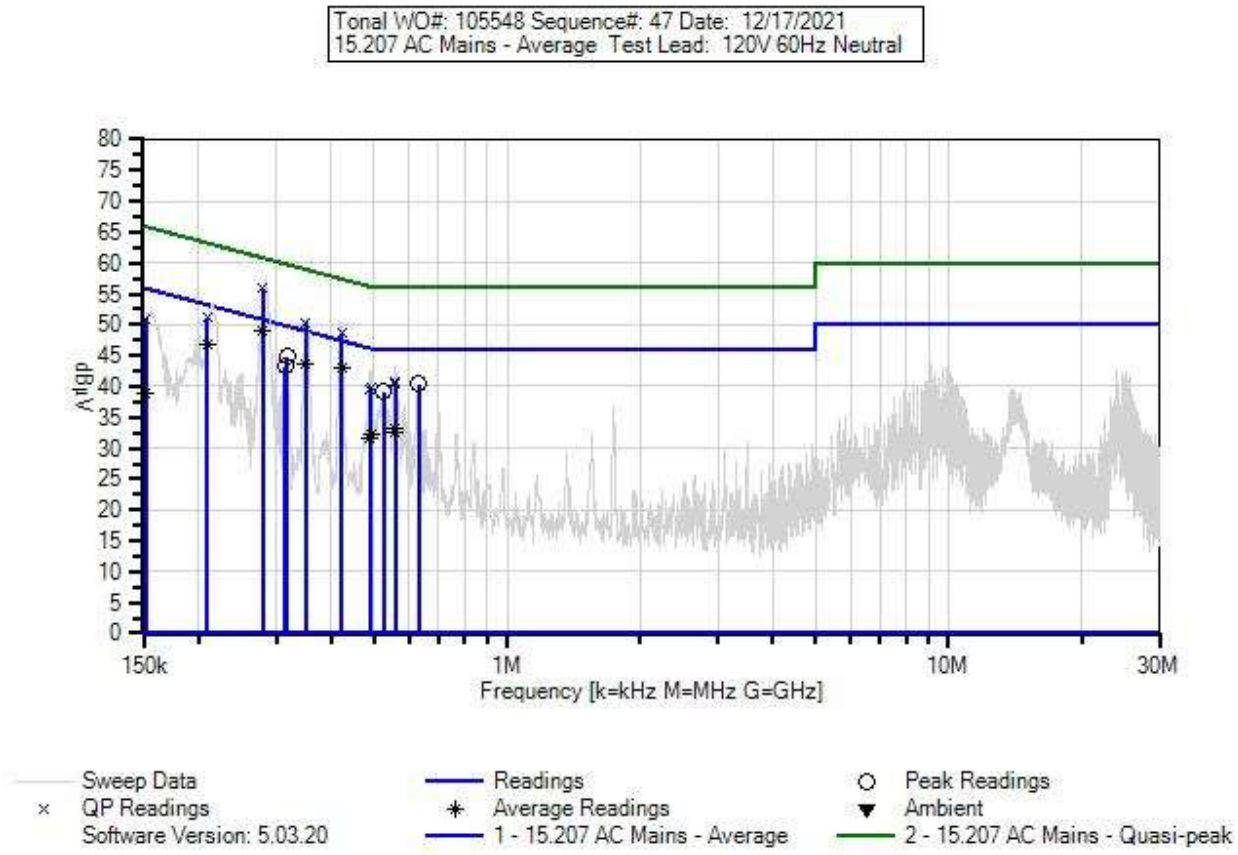
Environmental Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

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 Ave	38.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.9	50.8	-1.9	Neutr
2	421.660k Ave	33.0	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	43.0	47.4	-4.4	Neutr
3	280.264k QP	45.9	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	55.9	60.8	-4.9	Neutr
^	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 Ave	33.5	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	43.5	49.0	-5.5	Neutr
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 Ave	36.7	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	46.7	53.2	-6.5	Neutr
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 QP	40.4	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	50.4	59.0	-8.6	Neutr
^	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 QP	38.6	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	48.6	57.4	-8.8	Neutr
^	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 QP	41.1	+9.9 +0.1	+0.0	+0.0	+0.0	+0.0	51.1	63.2	-12.1	Neutr
^	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 Ave	23.0	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	33.2	46.0	-12.8	Neutr
18	558.003k Ave	22.4	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	32.6	46.0	-13.4	Neutr
19	492.486k Ave	22.0	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	32.1	46.1	-14.0	Neutr
20	488.923k Ave	21.6	+9.9 +0.1	+0.0	+0.1	+0.0	+0.0	31.7	46.2	-14.5	Neutr
21	152.236k QP	38.8	+9.9 +2.1	+0.0	+0.0	+0.1	+0.0	50.9	65.9	-15.0	Neutr
22	558.862k QP	30.4	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	40.6	56.0	-15.4	Neutr

23	558.003k QP	30.3	+9.9 +0.2	+0.0	+0.1	+0.0	+0.0	40.5	56.0	-15.5	Neutr
^	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.