

Ossia, Inc.

REVISED TEST REPORT TO 102778-12

**Cota Forever Tracker Client
Model: Tracker Rx**

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

**15.247
(DTS 2400-2483.5 MHz)**

Report No.: 102778-12A

Date of issue: August 30, 2019



Test Certificate # 803.01

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.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Ossia, Inc.
1100 112th Ave NE Suite 301
Bellevue WA 98004

Representative: Bob McDonald
Customer Reference Number: 13076

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

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

Project Number: 102778

July 1, 2019

July 1-2, 2019

Revision History

Original: Testing of the Cota Forever Tracker Client, Model: Tracker Rx to FCC Part 15 Subpart C Section(s) 15.247 (DTS 2400-2483.5 MHz)

Revision A: Changed NA2 definition for Summary of Results table. Added Conditions During Testing description with block diagram. Changed 15.247(b)(3) Output Power Test Data Summary - Voltage Variations description. Replaced the 15.247(e) Power Spectral Density data table. Added statement to test conditions for 15.247(d) Radiated Emissions & Band Edge. Replaced the 15.247 Radiated Band Edge plots and data.

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.
22116 23rd Drive S.E., Suite A
Canyon Park, Bothell, WA 98021

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.12

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	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(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	NA1
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NA2

NA = Not Applicable

NA1 = Not applicable because the EUT has an integral antenna.

NA2 = Not applicable because the manufacturer declares the EUT cannot transmit with the IEE802.15.4 radio while charging via the USB interface (wired charging).

ISO/IEC 17025 Decision Rule

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

Modifications During Testing

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

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

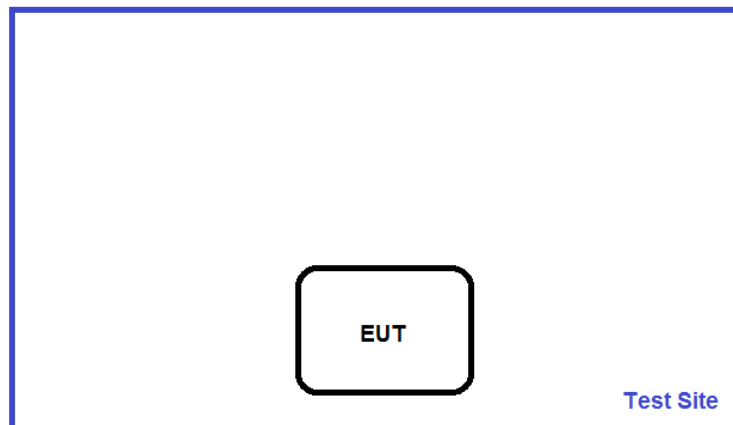
Conditions During Testing

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

Summary of Conditions

The manufacturer declares the EUT is a wireless power client with integrated battery that is capable of being charged wirelessly with a Part 18 device, or via USB charging. The EUT also consists of an IEEE802.15.4 radio and a beacon radio. The EUT cannot transmit while charging via USB interface (wired charging) so that configuration was not investigated for the radio emissions. The EUT was only tested as a standalone device (Configuration 1). The beacon radio emissions, unintentional emissions of the USB charging configuration, as well as the wireless charging functions are considered under the appropriate relevant standards separate reports. The manufacturer declares the radio under test was set to maximum output during testing.

Test Setup Block Diagram



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 Tested:

Device	Manufacturer	Model #	S/N
Cota Forever Tracker Client	Ossia, Inc.	Tracker Rx	728B

Support Equipment:

Device	Manufacturer	Model #	S/N
None			

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	Zigbee 802.15.4
Operating Frequency Range:	2405-2480MHz
Modulation Type(s):	OQPSK
Maximum Duty Cycle:	100% tested as worst case
Number of TX Chains:	1
Antenna Type(s) and Gain:	Patch, 6dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	Battery (3.7 VDC)
Firmware / Software used for Test:	0.17_TC8

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

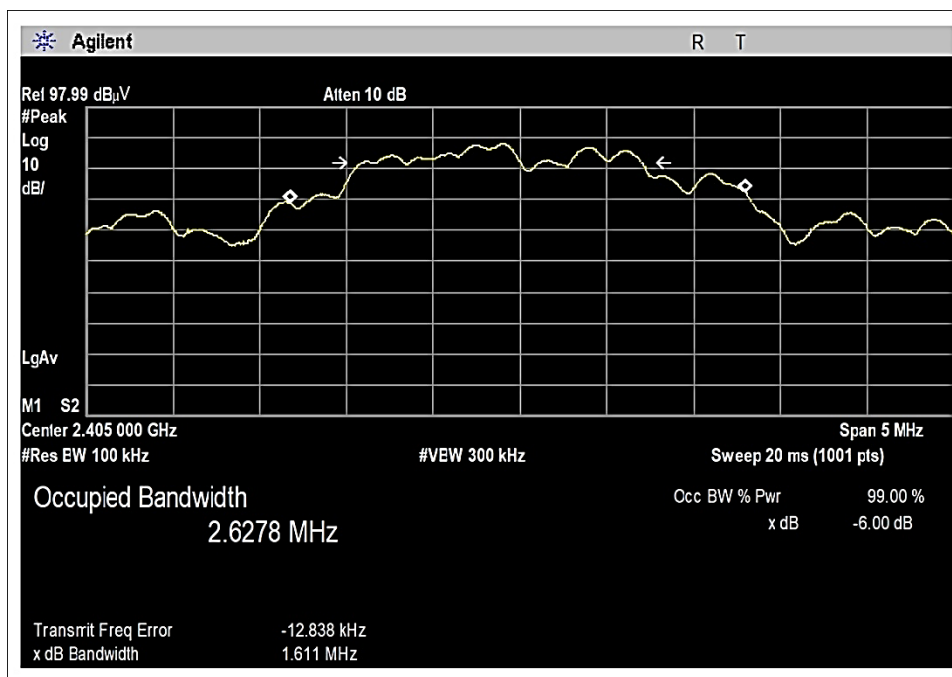
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Atkinson
Test Method:	ANSI C63.10 (2013), KDB 558074 v05r02 (April 2, 2019)	Test Date(s):	7/1/2019
Configuration:	1		
Test Setup:	Test mode: Continuously Modulated The EUT is operating with a fresh battery installed. The EUT is set 1.5 meters high on Styrofoam table.		

Environmental Conditions			
Temperature (°C)	21-23	Relative Humidity (%):	35-40

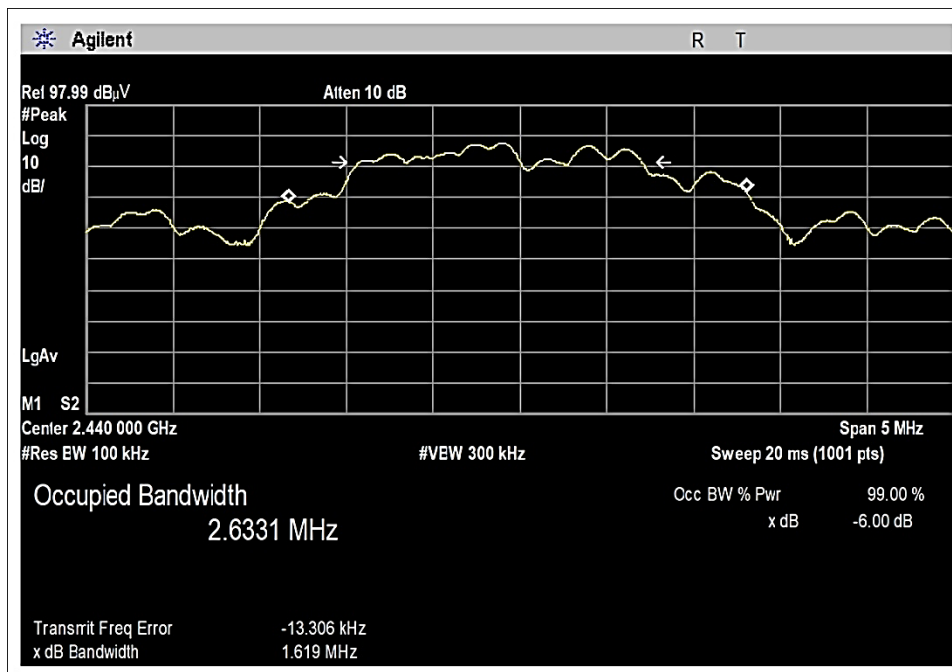
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02871	Spectrum Analyzer	Agilent	E4440A	1/9/2019	1/9/2021
P06540	Cable	Andrews	Heliast	10/30/2017	10/30/2019
P06515	Cable	Andrews	Heliast	6/29/2018	6/29/2020
03540	Preamplifier	HP	83017A	5/13/2019	5/13/2021
P06503	Cable	Astrolab	32026-29801-29801-36	3/13/2018	3/13/2020
01467	Horn Antenna	EMCO	3115	7/21/2017	7/21/2019
P07226	Attenuator	Pasternack	PE7004-6	12/1/2017	12/1/2019

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2405	1	OQPSK	1611	≥500	Pass
2440	1	OQPSK	1619	≥500	Pass
2480	1	OQPSK	1600	≥500	Pass

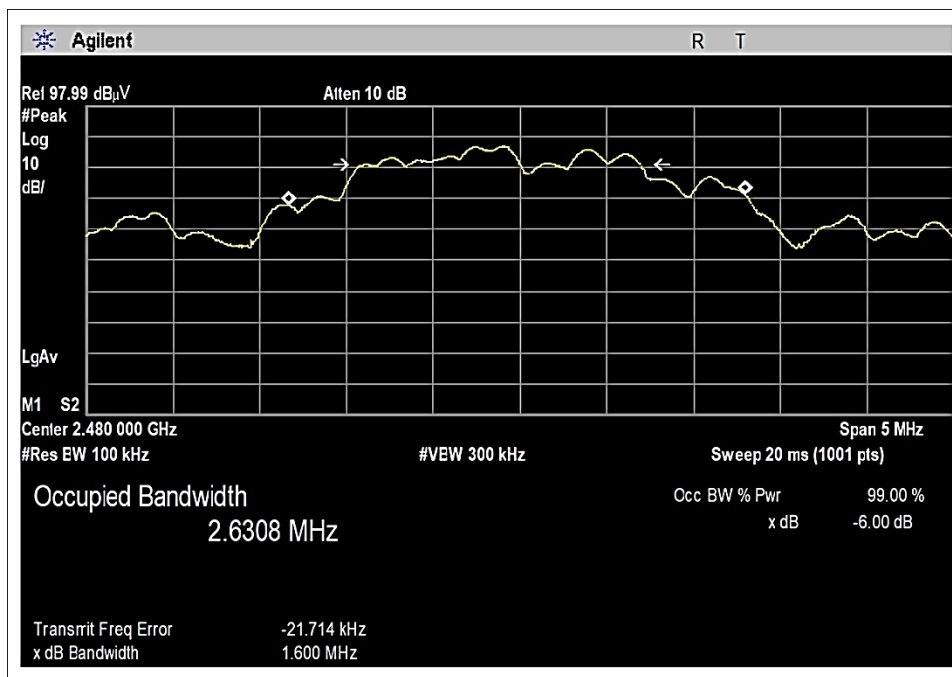
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



15.247(b)(3) Output Power

Test Data Summary - Voltage Variations

This equipment is battery powered and manufacturer declares the radio under test cannot operate while charging via USB. The manufacturer declares the voltage supplied to the radio circuitry from the battery is regulated. Power output tests were performed using a fresh battery.

Test Data Summary - Radiated Measurement

Measurement Option: RBW > DTS Bandwidth

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Field Strength (dBuV/m @3m)	Calculated EIRP (dBm)	Calculated Conducted Power (dBm)	Conducted Power Limit (dBm)	Results
2405	OQPSK	Integral / 6dBi	94.9	-0.33	-6.33	≤30	Pass
2440	OQPSK	Integral / 6dBi	95.1	-0.13	-6.13	≤30	Pass
2480	OQPSK	Integral / 6dBi	94.5	-0.73	-6.73	≤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.

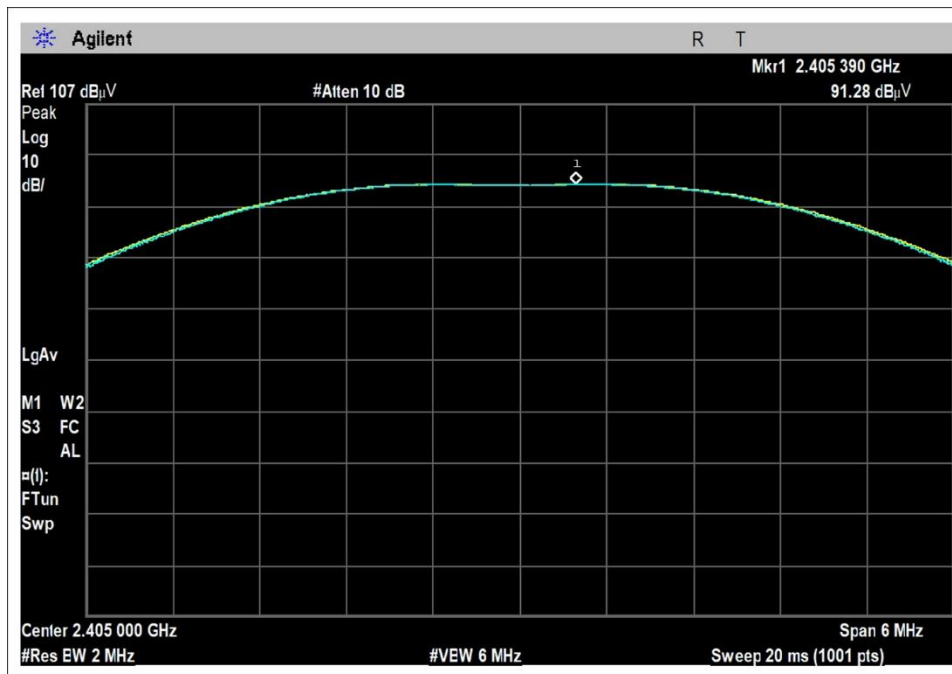
Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30 G}$$

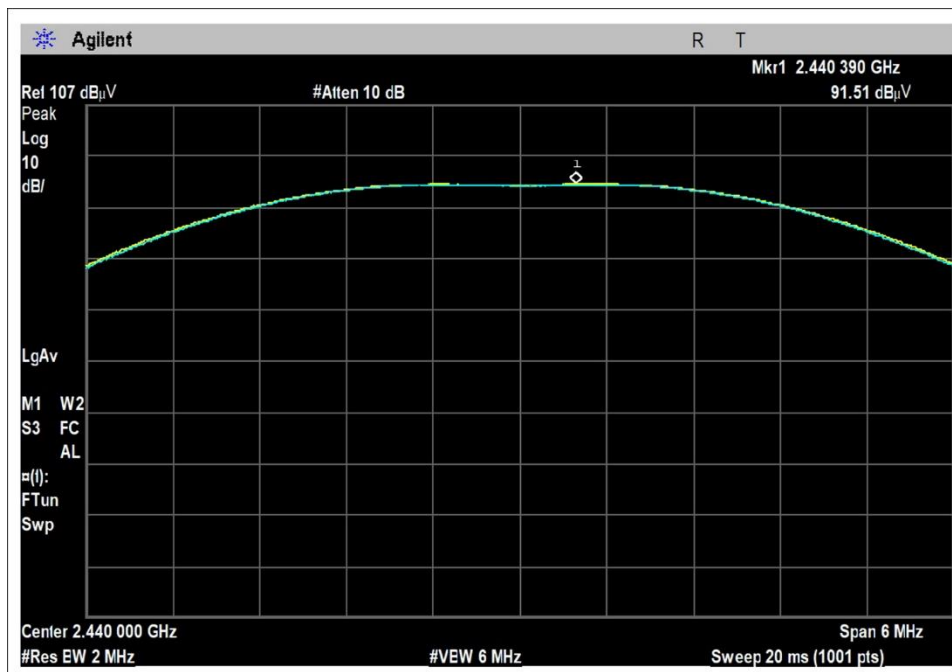
Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G - 104.77$$

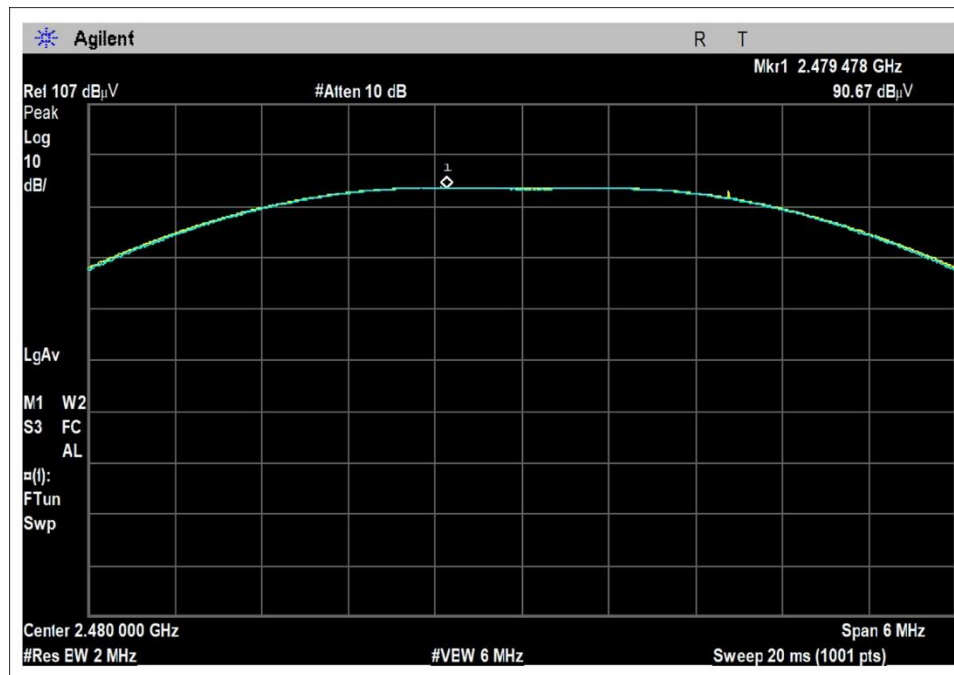
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Ossia, Inc.**
 Specification: **15.247(b) Power Output (2400-2483.5 MHz DTS)**
 Work Order #: **102778** Date: 7/1/2019
 Test Type: **Maximized Emissions** Time: 15:44:09
 Tested By: Michael Atkinson Sequence#: 13
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Temperature: 21-23°C
 Humidity: 35-40%
 Pressure: 101.5-103kPa

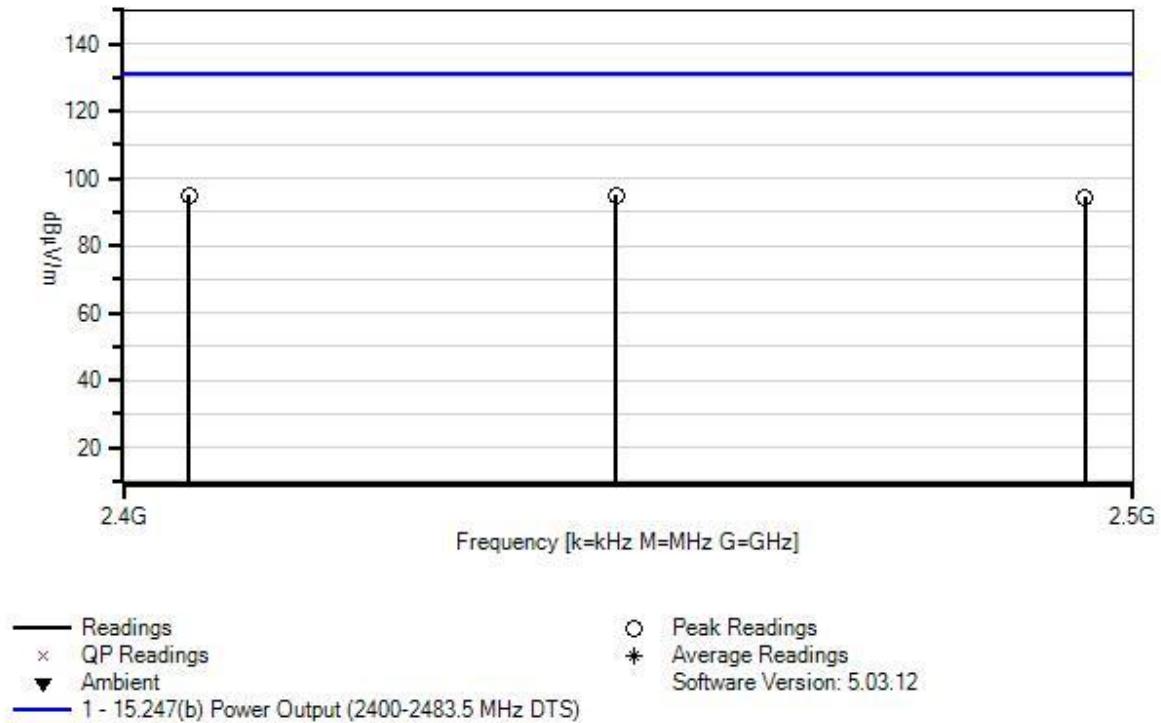
 Test Method: ANSI 63.10 (2013)
 KDB 558074 v05r02 (April 2, 2019)

 Test mode: Continuously Modulated

 The EUT is operating with a fresh battery installed.

 The EUT is set 1.5 meters high on Styrofoam table.
 X, Y, and Z axes investigated as well as horizontal and vertical antenna polarities investigated, worst case reported.
 Low, Mid, and High channels investigated.

Ossia, Inc. WO#: 102778 Sequence#: 13 Date: 7/1/2019
 15.247(b) Power Output (2400-2483.5 MHz DTS) Test Distance: 3 Meters Vert



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	1/9/2019	1/9/2021
T1	ANP06540	Cable	Heliac	10/30/2017	10/30/2019
T2	ANP07226	Attenuator	PE7004-6	12/1/2017	12/1/2019
T3	ANP06515	Cable	Heliac	6/29/2018	6/29/2020
T4	AN03540	Preamplifier	83017A	5/13/2019	5/13/2021
T5	ANP06503	Cable	32026-29801-29801-36	3/13/2018	3/13/2020
T6	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/21/2017	7/21/2019

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	2440.390M	91.5	+0.4 +1.0	+5.8 +28.1	+2.6	-34.3	+0.0	95.1	131.2	-36.1	Vert
									Battery Powered		
2	2405.390M	91.3	+0.4 +1.0	+5.8 +28.1	+2.6	-34.3	+0.0	94.9	131.2	-36.3	Vert
									Battery Powered		
3	2479.478M	90.7	+0.4 +1.0	+5.8 +28.1	+2.7	-34.2	+0.0	94.5	131.2	-36.7	Vert
									Battery Powered		

Test Setup Photo(s)



X Axis



Y Axis



Z Axis

15.247(e) Power Spectral Density

Test Data Summary - Radiated Measurement

Measurement Method: PKPSD

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Non-corrected Value from Analyzer (dBuV)	Correction Factors of measurement system (dB)	Corrected Field Strength (dBuV/m @3m)	Calculated (dBm/3kHz)	Limit (dBm/3kHz)	Results
2405	OQPSK	Integral / 6dBi	78.7	3.6	82.3	-18.9	≤8	Pass
2440	OQPSK	Integral / 6dBi	78.6	3.6	82.2	-19.0	≤8	Pass
2480	OQPSK	Integral / 6dBi	78.0	3.8	81.8	-19.4	≤8	Pass

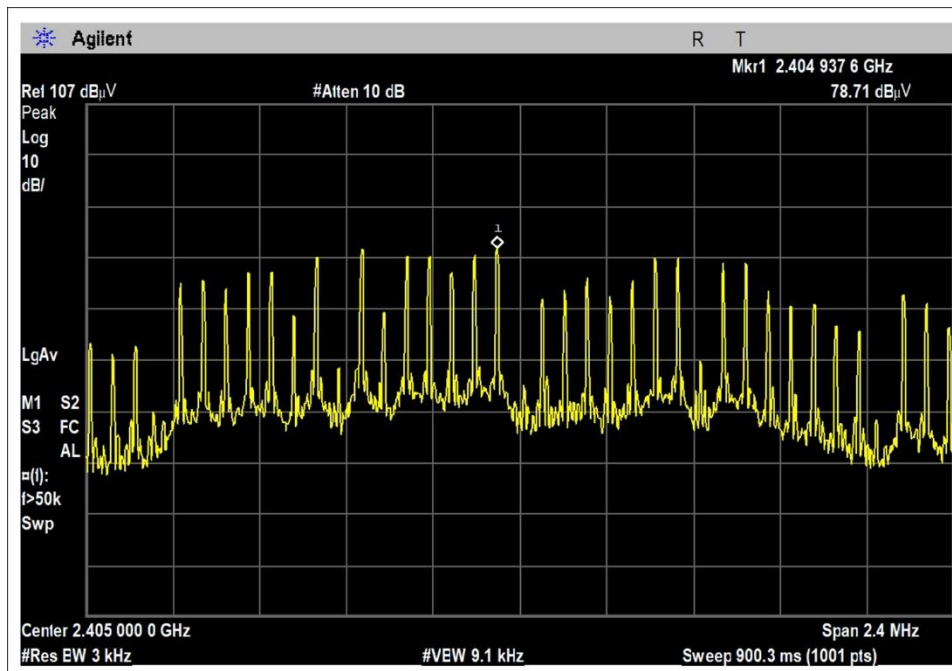
Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30 G}$$

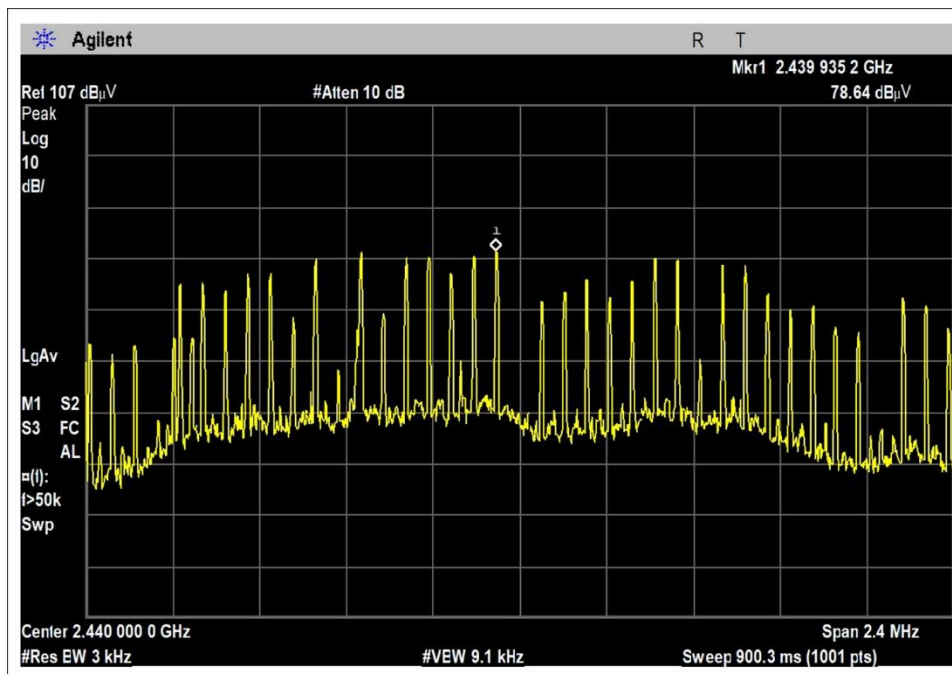
Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G - 104.77$$

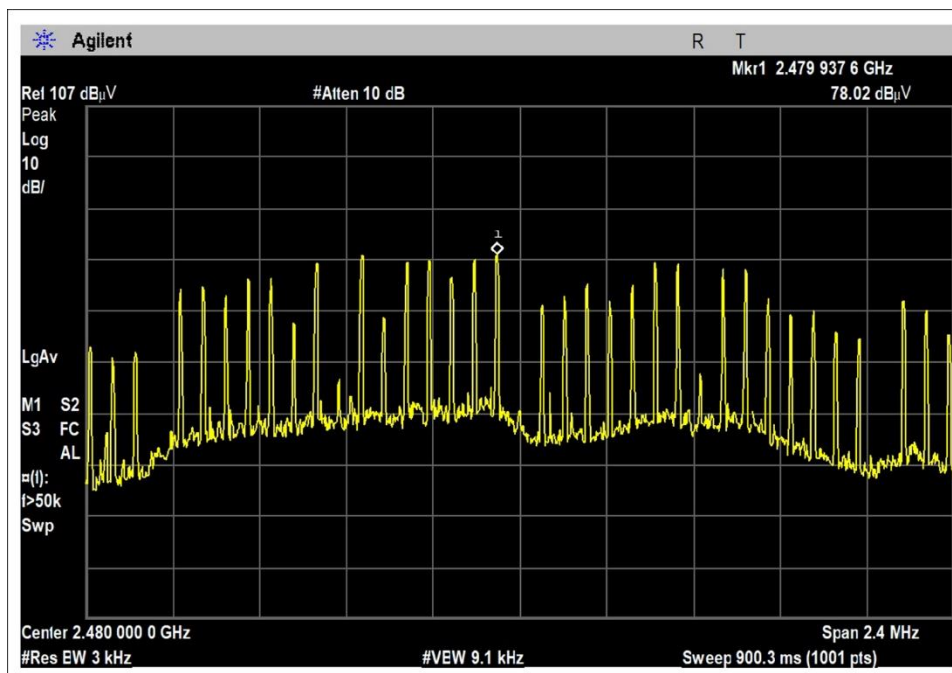
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Ossia, Inc.**
 Specification: **15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)**
 Work Order #: **102778** Date: 7/1/2019
 Test Type: **Maximized Emissions** Time: 15:55:31
 Tested By: Michael Atkinson Sequence#: 14
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Temperature: 21-23°C
 Humidity: 35-40%
 Pressure: 101.5-103kPa

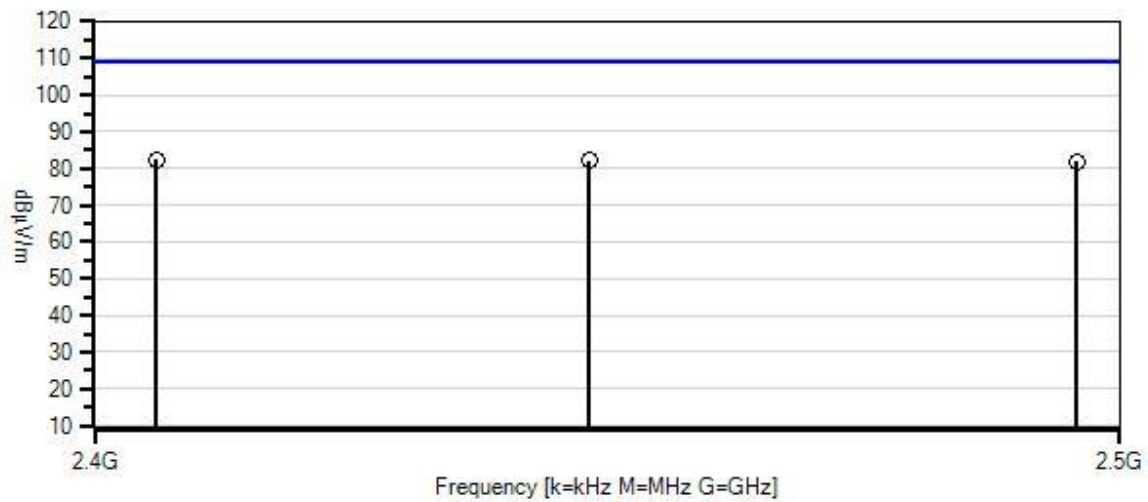
 Test Method: ANSI 63.10 (2013)
 KDB 558074 v05r02 (April 2, 2019)

 Test mode: Continuously Modulated

 The EUT is operating with a fresh battery installed.

 The EUT is set 1.5 meters high on Styrofoam table.
 X, Y, and Z axes investigated as well as horizontal and vertical antenna polarities investigated, worst case reported.
 Low, Mid, and High channels investigated.

Ossia, Inc. WO#: 102778 Sequence#: 14 Date: 7/1/2019
 15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS) Test Distance: 3 Meters Vert



- Readings
- Peak Readings
- × QP Readings
- * Average Readings
- ▼ Ambient
- Software Version: 5.03.12
- 1 - 15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	1/9/2019	1/9/2021
T1	ANP06540	Cable	Heliac	10/30/2017	10/30/2019
T2	ANP07226	Attenuator	PE7004-6	12/1/2017	12/1/2019
T3	ANP06515	Cable	Heliac	6/29/2018	6/29/2020
T4	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T5	ANP06503	Cable	32026-29801- 29801-36	3/13/2018	3/13/2020
T6	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/21/2017	7/21/2019

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	2404.938M	78.7	+0.4 +1.0	+5.8 +28.1	+2.6	-34.3	+0.0	82.3	109.2	-26.9	Vert
2	2439.935M	78.6	+0.4 +1.0	+5.8 +28.1	+2.6	-34.3	+0.0	82.2	109.2	-27.0	Vert
3	2479.938M	78.0	+0.4 +1.0	+5.8 +28.1	+2.7	-34.2	+0.0	81.8	109.2	-27.4	Vert

Test Setup Photo(s)



X Axis



Y Axis



Z Axis

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Ossia, Inc.**
 Specification: **15.209 Radiated Emissions**
 Work Order #: **102778** Date: 7/2/2019
 Test Type: **Maximized Emissions** Time: 11:08:01
 Tested By: Michael Atkinson Sequence#: 8
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

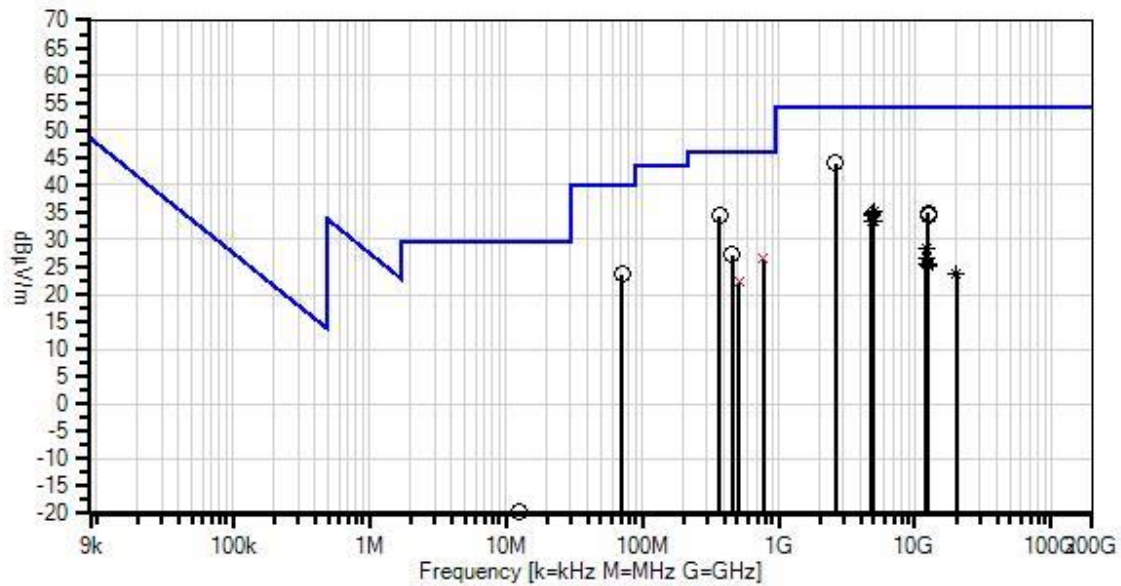
Temperature: 21-23°C
 Humidity: 35-40%
 Pressure: 101.5-103kPa

 Test Method: ANSI 63.10 (2013)
 KDB 558074 v05r02 (April 2, 2019)

 EUT is continuously transmitting.
 Investigated L, M, H channels, worst case reported.
 EUT is investigated in X, Y, & Z Axis with worst case reported.
 Investigated 3 x orthogonal axes below 30MHz, investigated horizontal and vertical polarities above 30MHz, worst case reported.

 For data collected below 30MHz an alternative test site (semi-anechoic chamber) was used instead of an open-field test site. The alternative test-site has been correlated to produce representative data compared to an open-field test site.

Ossia, Inc. WO#: 102778 Sequence#: 8 Date: 7/2/2019
15.209 Radiated Emissions Test Distance: 3 Meters Various



— Readings
* Average Readings
— 1 - 15.209 Radiated Emissions

○ Peak Readings
▼ Ambient

× QP Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	1/9/2019	1/9/2021
T2	ANP06540	Cable	Helix	10/30/2017	10/30/2019
T3	ANP05305	Cable	ETSI-50T	10/24/2017	10/24/2019
T4	AN02307	Preamplifier	8447D	1/15/2018	1/15/2020
T5	ANP05360	Cable	RG214	1/31/2018	1/31/2020
T6	ANP06123	Attenuator	18N-6	4/5/2019	4/5/2021
T7	AN00851	Biconilog Antenna	CBL6111C	5/1/2018	5/1/2020
T8	ANP07226	Attenuator	PE7004-6	12/1/2017	12/1/2019
T9	ANP06515	Cable	Helix	6/29/2018	6/29/2020
T10	AN03540	Preamplifier	83017A	5/13/2019	5/13/2021
T11	ANP06503	Cable	32026-29801-29801-36	3/13/2018	3/13/2020
T12	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/21/2017	7/21/2019
T13	AN02741	Active Horn Antenna	AMFW-5F-12001800-20-10P	4/26/2019	4/26/2021
T14	AN03122	Cable	32026-2-29801-36	3/13/2018	3/13/2020
T15	AN02742	Active Horn Antenna	AMFW-5F-18002650-20-10P	10/16/2018	10/16/2020
T16	ANP06678	Cable	32026-29801-29801-144	3/13/2018	3/13/2020
T17	AN02763-69	Waveguide	Multiple	4/23/2018	4/23/2020
T18	AN00052	Loop Antenna	6502	5/7/2018	5/7/2020

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10	T11	T12					
			T13	T14	T15	T16					
			T17	T18							
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	2630.000M	39.6	+0.0	+0.5	+0.0	+0.0	+0.0	43.9	54.0	-10.1	Horiz
			+0.0	+0.0	+0.0	+5.8					
			+2.6	-34.2	+1.1	+28.5					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
2	368.500M	38.2	+0.0	+0.2	+1.0	-27.4	+0.0	34.3	46.0	-11.7	Horiz
			+1.1	+5.8	+15.4	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							

3	71.700M	38.4	+0.0	+0.1	+0.4	-27.9	+0.0	23.6	40.0	-16.4	Horiz
			+0.5	+5.8	+6.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
4	457.800M	29.4	+0.0	+0.2	+1.1	-27.9	+0.0	27.2	46.0	-18.8	Vert
			+1.3	+5.8	+17.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
5	4959.040M Ave	24.1	+0.0	+0.5	+0.0	+0.0	+0.0	35.1	54.0	-18.9	Horiz
			+0.0	+0.0	+0.0	+5.8			High		
			+4.2	-33.6	+1.6	+32.5					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
^	4959.040M	34.9	+0.0	+0.5	+0.0	+0.0	+0.0	45.9	54.0	-8.1	Horiz
			+0.0	+0.0	+0.0	+5.8			High		
			+4.2	-33.6	+1.6	+32.5					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
7	12397.420 M	39.8	+0.0	+1.1	+0.0	+0.0	+0.0	34.9	54.0	-19.1	Horiz
			+0.0	+0.0	+0.0	+0.0					
			+7.0	+0.0	+0.0	+0.0			High		
			-13.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
8	4881.108M Ave	23.9	+0.0	+0.5	+0.0	+0.0	+0.0	34.8	54.0	-19.2	Vert
			+0.0	+0.0	+0.0	+5.8			Mid		
			+4.2	-33.6	+1.6	+32.4					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
9	4808.960M Ave	24.0	+0.0	+0.5	+0.0	+0.0	+0.0	34.7	54.0	-19.3	Vert
			+0.0	+0.0	+0.0	+5.9			Low		
			+4.1	-33.6	+1.5	+32.3					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							
^	4808.960M	34.9	+0.0	+0.5	+0.0	+0.0	+0.0	45.6	54.0	-8.4	Vert
			+0.0	+0.0	+0.0	+5.9			Low		
			+4.1	-33.6	+1.5	+32.3					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0							

11	12397.380 M	39.5	+0.0 +0.0 +7.0 -13.0 +0.0	+1.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	34.6	54.0	-19.4	Vert
									High		
12	780.800M QP	22.9	+0.0 +1.8 +0.0 +0.0 +0.0	+0.3 +5.8 +0.0 +0.0 +0.0	+1.5 +22.1 +0.0 +0.0 +0.0	-27.8 +0.0 +0.0 +0.0 +0.0	+0.0	26.6	46.0	-19.4	Vert
^	780.800M	28.9	+0.0 +1.8 +0.0 +0.0 +0.0	+0.3 +5.8 +0.0 +0.0 +0.0	+1.5 +22.1 +0.0 +0.0 +0.0	-27.8 +0.0 +0.0 +0.0 +0.0	+0.0	32.6	46.0	-13.4	Vert
14	4881.040M Ave	23.5	+0.0 +0.0 +4.2 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.6 +0.0 +0.0	+0.0 +5.8 +32.4 +0.0 +0.0	+0.0	34.4	54.0	-19.6	Horiz
									Mid		
^	4881.040M	34.6	+0.0 +0.0 +4.2 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.6 +0.0 +0.0	+0.0 +5.8 +32.4 +0.0 +0.0	+0.0	45.5	54.0	-8.5	Horiz
									Mid		
16	4959.220M Ave	22.5	+0.0 +0.0 +4.2 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.6 +0.0 +0.0	+0.0 +5.8 +32.5 +0.0 +0.0	+0.0	33.5	54.0	-20.5	Vert
									High		
^	4959.220M	34.7	+0.0 +0.0 +4.2 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.6 +0.0 +0.0	+0.0 +5.8 +32.5 +0.0 +0.0	+0.0	45.7	54.0	-8.3	Vert
									High		
18	4810.877M Ave	22.5	+0.0 +0.0 +4.1 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.5 +0.0 +0.0	+0.0 +5.9 +32.3 +0.0 +0.0	+0.0	33.2	54.0	-20.8	Horiz
									Low		
^	4810.900M	34.8	+0.0 +0.0 +4.1 +0.0 +0.0	+0.5 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +1.5 +0.0 +0.0	+0.0 +5.9 +32.3 +0.0 +0.0	+0.0	45.5	54.0	-8.5	Horiz
									Low		

20	516.000M QP	23.3	+0.0 +1.4 +0.0 +0.0 +0.0	+0.3 +5.8 +0.0 +0.0 +0.0	+1.2 +18.4 +0.0 +0.0 +0.0	-28.2 +0.0 +0.0 +0.0 +0.0	+0.0	22.2	46.0	-23.8	Horiz
^	516.000M	38.3	+0.0 +1.4 +0.0 +0.0 +0.0	+0.3 +5.8 +0.0 +0.0 +0.0	+1.2 +18.4 +0.0 +0.0 +0.0	-28.2 +0.0 +0.0 +0.0 +0.0	+0.0	37.2	46.0	-8.8	Horiz
22	12022.533 M Ave	33.7	+0.0 +0.0 +6.8 -13.0 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	28.5	54.0 Low	-25.5	Horiz
^	12022.533 M	44.4	+0.0 +0.0 +6.8 -13.0 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	39.2	54.0 Low	-14.8	Horiz
24	12197.450 M Ave	31.5	+0.0 +0.0 +6.9 -12.8 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	26.6	54.0 Mid	-27.4	Horiz
25	12197.530 M Ave	30.4	+0.0 +0.0 +0.0 -12.8 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+7.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	25.7	54.0 Mid, while charging	-28.3	Horiz
^	12197.450 M	41.7	+0.0 +0.0 +6.9 -12.8 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	36.8	54.0 Mid	-17.2	Horiz
^	12197.530 M	40.1	+0.0 +0.0 +0.0 -12.8 +0.0	+1.0 +0.0 +0.0 +0.0 +0.0	+7.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	35.4	54.0 Mid, while charging	-18.6	Horiz
28	12397.550 M Ave	30.5	+0.0 +0.0 +7.0 -13.0 +0.0	+1.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	25.6	54.0 High	-28.4	Horiz
29	12397.510 M Ave	30.0	+0.0 +0.0 +7.0 -13.0 +0.0	+1.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	25.1	54.0 High	-28.9	Vert

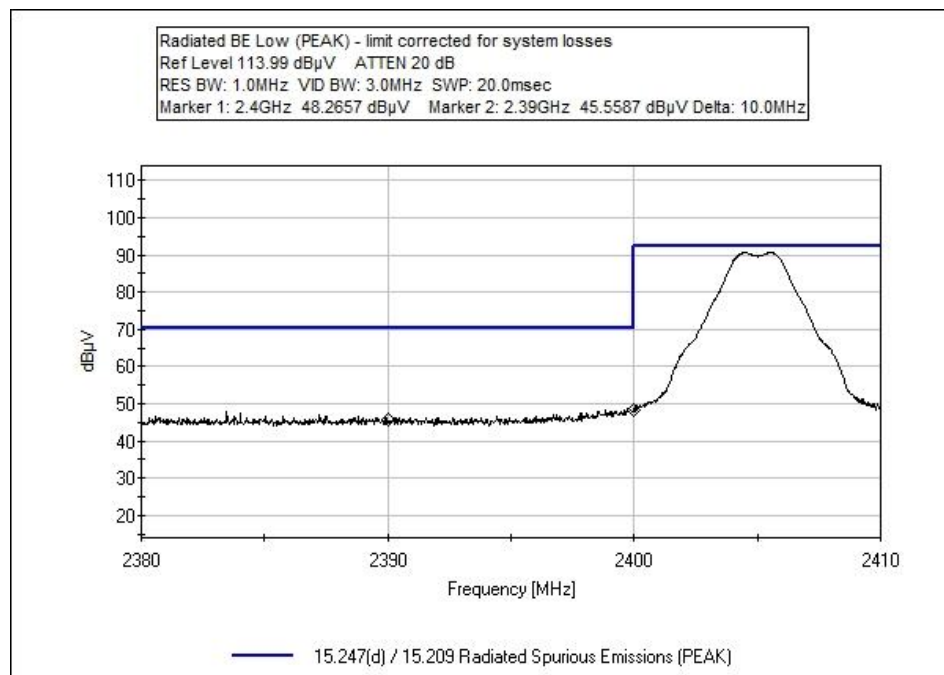
30	20016.000 M Ave	23.7	+0.0 +0.0 +0.0 +0.0 +2.2	+0.0 +0.0 +0.0 +2.3 +0.0	+0.0 +0.0 +0.0 -13.1 +8.6	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	23.7	54.0	-30.3	Vert
^	20016.000 M	36.7	+0.0 +0.0 +0.0 +0.0 +2.2	+0.0 +0.0 +0.0 +2.3 +0.0	+0.0 +0.0 +0.0 -13.1 +8.6	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0	36.7	54.0	-17.3	Vert
32	12.380M	10.9	+0.0 +0.0 +0.2 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +9.1	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	-40.0	-19.8	29.5	-49.3	Perp
33	10.200M	10.2	+0.0 +0.0 +0.2 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +9.2	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	-40.0	-20.4	29.5	-49.9	Groun
34	6.418M QP	9.6	+0.0 +0.0 +0.1 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +9.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	-40.0	-20.8	29.5	-50.3	Para
^	6.418M	15.3	+0.0 +0.0 +0.1 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +9.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	-40.0	-15.1	29.5	-44.6	Para
36	24.400M	10.1	+0.0 +0.0 +0.3 +0.0 +0.0	+0.1 +0.0 +0.0 +0.0 +7.1	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	-40.0	-22.4	29.5	-51.9	Groun

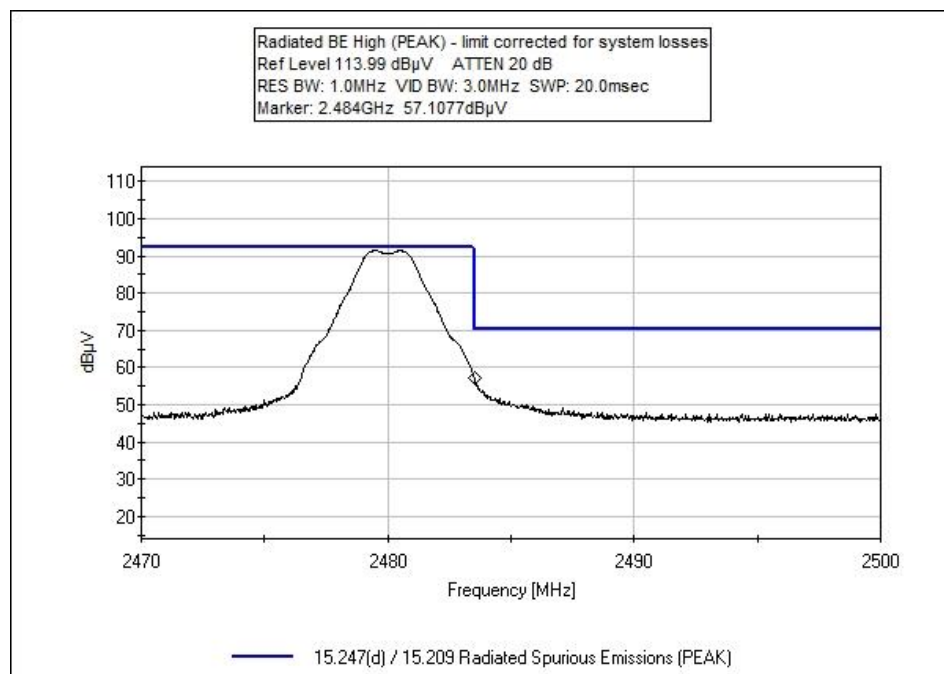
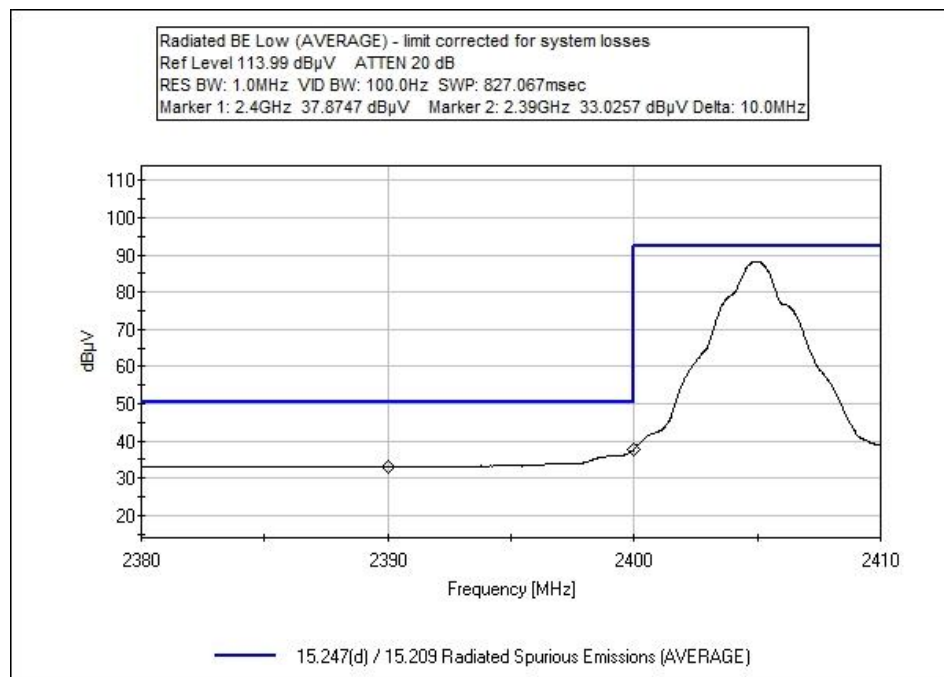
Band Edge

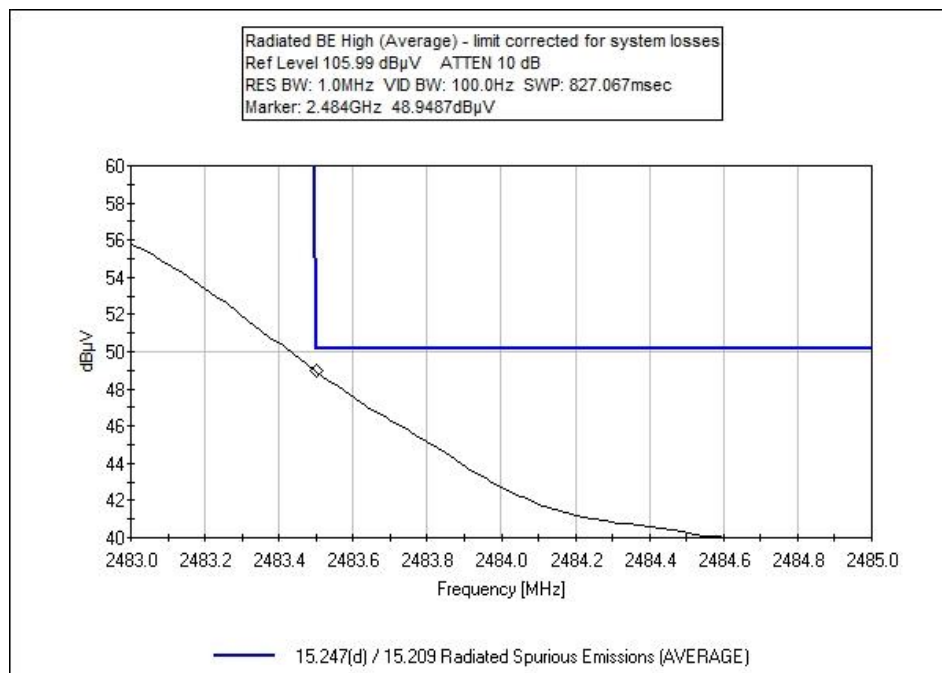
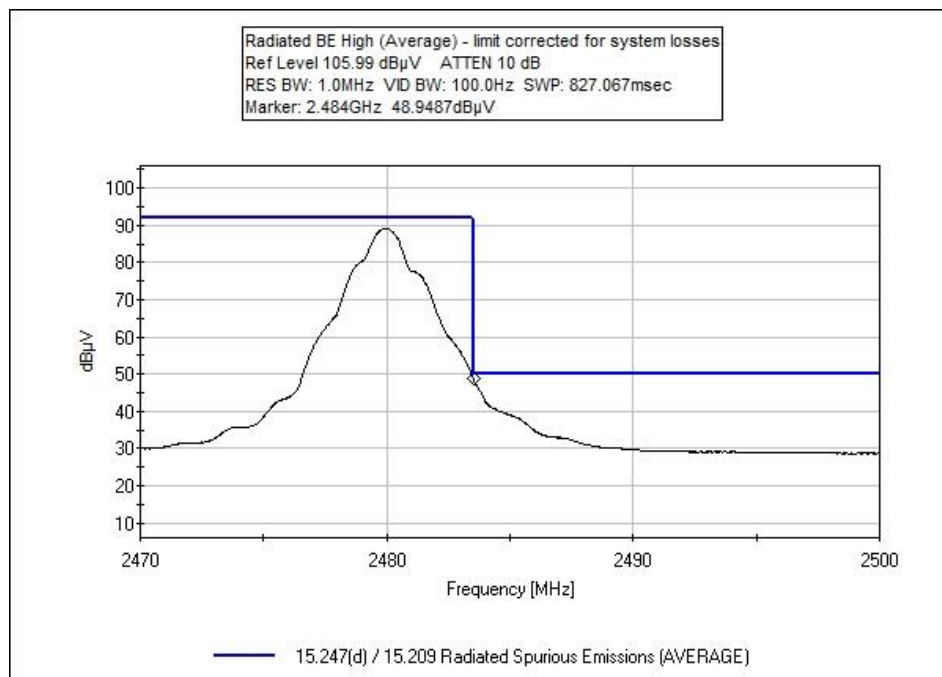
Band Edge Summary

Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results
2390.0 (Peak)	OQPSK	Patch/6dBi	49.2	<74	Pass
2390.0 (Average)	OQPSK	Patch/6dBi	36.7	<54	Pass
2400.0 (Peak)	OQPSK	Patch/6dBi	51.9	<96	Pass
2400.0 (Average)	OQPSK	Patch/6dBi	41.5	<76	Pass
2483.5 (Peak)	OQPSK	Patch/6dBi	60.8	<74	Pass
2483.5 (Average)	OQPSK	Patch/6dBi	52.7	<54	Pass

Band Edge Plots







Test Setup / Conditions / Data

Test Location: CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)
 Customer: **Ossia, Inc.**
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions (AVERAGE)**
 Work Order #: **102778** Date: 7/1/2019
 Test Type: **Maximized Emissions** Time: 08:47:51
 Tested By: Michael Atkinson Sequence#: 12
 Software: EMITest 5.03.12

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

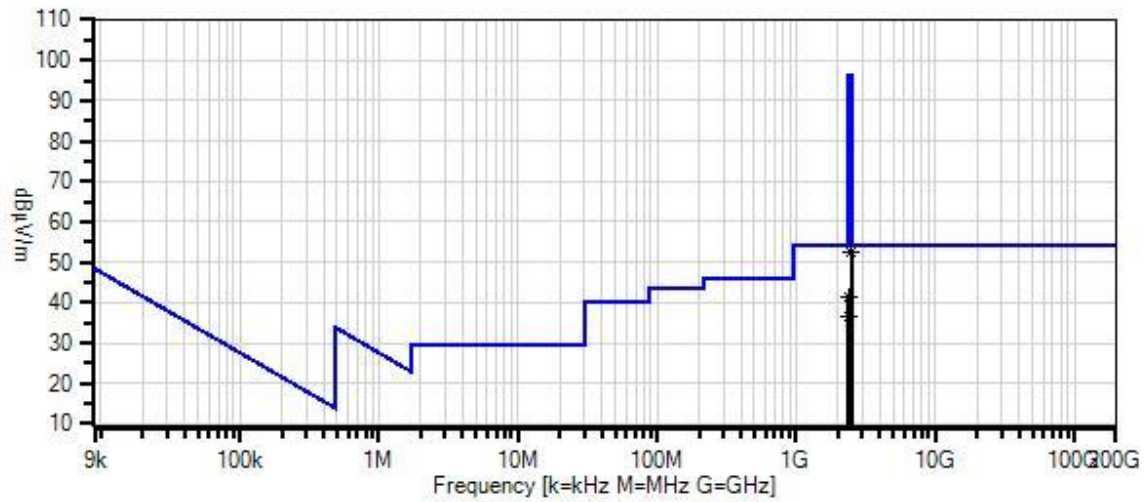
Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Temperature: 21-23°C Humidity: 35-40% Pressure: 101.5-103kPa Test Method: ANSI 63.10 (2013) EUT is continuously transmitting with fresh battery installed. Investigated L and H channels, EUT is investigated in X, Y, & Z Axis, horizontal and vertical polarities investigated with worst case reported.
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Ossia, Inc. WD#: 102778 Sequence#: 12 Date: 7/1/2019
15.247(d) / 15.209 Radiated Spurious Emissions (AVERAGE) Test Distance: 3 Meters Vert



— Readings
○ Peak Readings
× QP Readings
* Average Readings
▼ Ambient
Software Version: 5.03.12
— 1 - 15.247(d) / 15.209 Radiated Spurious Emissions (AVERAGE)

Test Equipment:

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	1/9/2019	1/9/2021
T2	ANP06540	Cable	Heliac	10/30/2017	10/30/2019
	ANP05305	Cable	ETSI-50T	10/24/2017	10/24/2019
	AN02307	Preamp	8447D	1/15/2018	1/15/2020
	ANP05360	Cable	RG214	1/31/2018	1/31/2020
	ANP06123	Attenuator	18N-6	4/5/2019	4/5/2021
	AN00851	Biconilog Antenna	CBL6111C	5/1/2018	5/1/2020
T3	ANP07226	Attenuator	PE7004-6	12/1/2017	12/1/2019
T4	ANP06515	Cable	Heliac	6/29/2018	6/29/2020
T5	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T6	ANP06503	Cable	32026-29801-29801-36	3/13/2018	3/13/2020
T7	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/21/2017	7/21/2019

Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 T7 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	2483.500M	48.9	+0.0	+0.4	+5.8	+2.7	+0.0	52.7	54.0	-1.3	Vert
	Ave		-34.2	+1.0	+28.1						
^	2483.500M	57.0	+0.0	+0.4	+5.8	+2.7	+0.0	60.8	74.0	-13.2	Vert
			-34.2	+1.0	+28.1						
3	2400.000M	37.9	+0.0	+0.4	+5.8	+2.6	+0.0	41.5	54.0	-12.5	Vert
	Ave		-34.3	+1.0	+28.1						
^	2400.000M	48.3	+0.0	+0.4	+5.8	+2.6	+0.0	51.9	74.0	-22.1	Vert
			-34.3	+1.0	+28.1						
5	2390.000M	33.1	+0.0	+0.4	+5.8	+2.6	+0.0	36.7	54.0	-17.3	Vert
	Ave		-34.3	+1.0	+28.1						
^	2390.000M	45.6	+0.0	+0.4	+5.8	+2.6	+0.0	49.2	74.0	-24.8	Vert
			-34.3	+1.0	+28.1						

Test Setup Photo(s)



Below 1GHz



Above 1GHz



X Axis



Y Axis



Z Axis

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 $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ 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	($\text{dB}\mu\text{V}$)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

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.