Nalloy, LLC

TEST REPORT FOR

Model: 142HL8

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(DTS 2400-2483.5 MHz)

Report No.: 102803-2

Date of issue: June 16, 2020

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

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

Test Certificate # 803.01

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Nalloy, LLC
2301 5th Avenue
Seattle, WA 98108

Representative: Naga Suryadevara
Customer Reference Number: 2D-03187704

REPORT PREPARED BY:

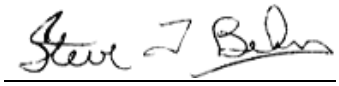
Darcy Thompson
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 102803

DATE OF EQUIPMENT RECEIPT: March 30, 2020
DATE(S) OF TESTING: March 30, April 7 and May 28, 2020

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	Pass

NA = Not Applicable
NA1 = The manufacturer declares the EUT does not have direct antenna port connection.

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
None

EQUIPMENT UNDER TEST (EUT)

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

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
NA	Nalloy, LLC	142HL8	P3A1R70393630081

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Lenovo	ADL45WCC	NA
AC Adapter	Amazon	PS39WR	NA

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
NA	Nalloy, LLC	142HL8	P3A1R70393630100

Support Equipment:

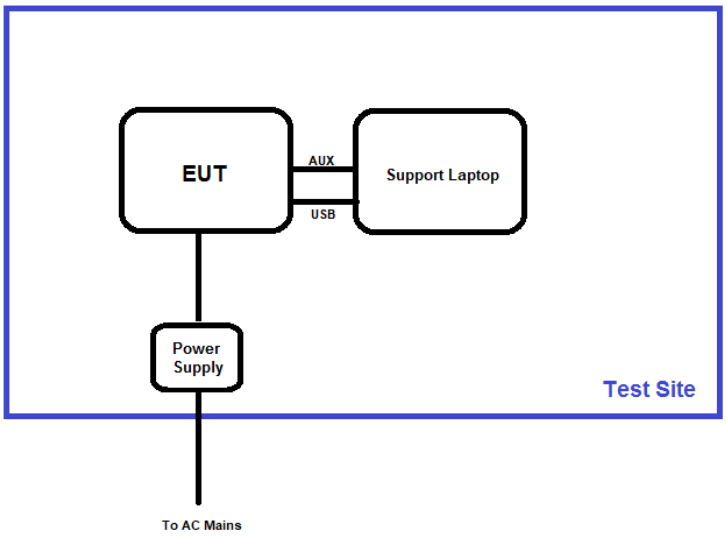
Device	Manufacturer	Model #	S/N
AC Adapter	Amazon	PS57CP	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	DTS (BLE)
Operating Frequency Range:	2402-2480 MHz
Modulation Type(s):	GFSK
Maximum Duty Cycle:	100% Modulated (Tested Worst-Case)
Number of TX Chains:	1
Antenna Type(s) and Gain:	Chip / 3.77dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	120VAC
Firmware / Software used for Test:	Realterm 3.0.1.4 / FW 1.4.364.0

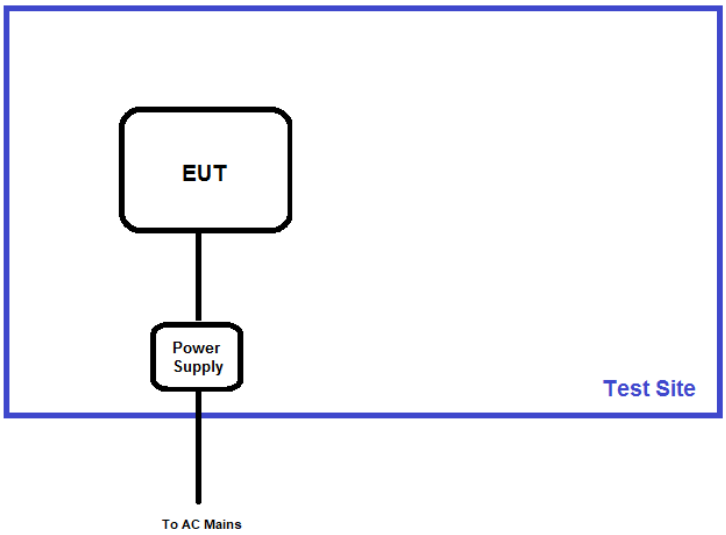
Block Diagram of Test Setup(s)

Test Setup Block Diagram



Configuration 1

Test Setup Block Diagram



Configuration 2

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

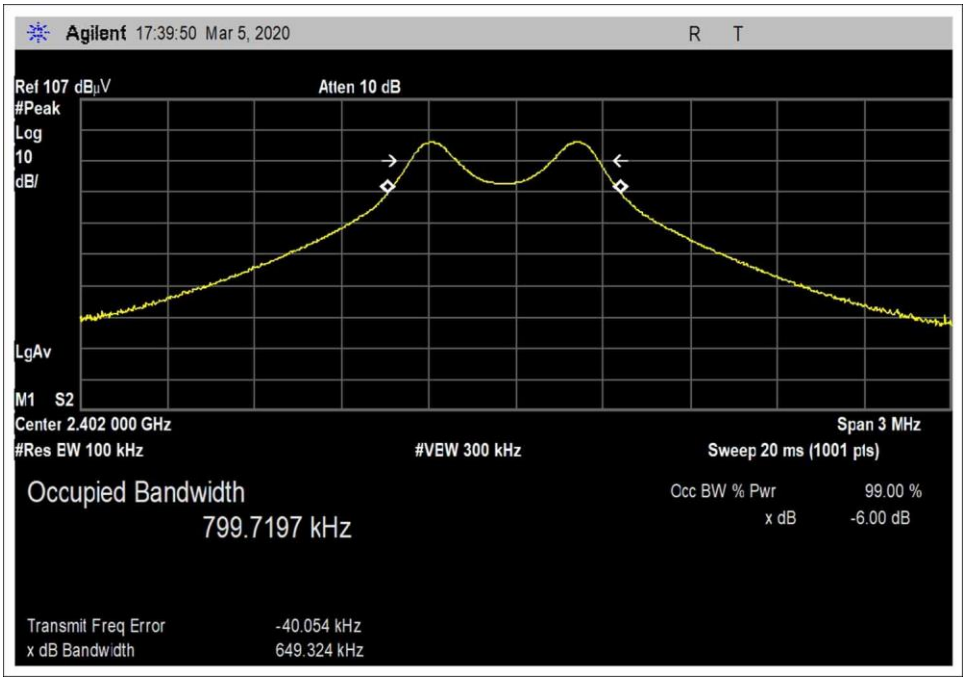
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison
Test Method:	ANSI C63.10 (2013), KDB 558074 (April 2, 2019)	Test Date(s):	3/30/2020
Configuration:	1		
Test Setup:	Test Mode: Continuously Modulated The EUT is set 1.5 meters high on a Styrofoam table. X, Y and Z axis are investigated with the worst case reported.		

Environmental Conditions			
Temperature (ºC)	23	Relative Humidity (%):	31

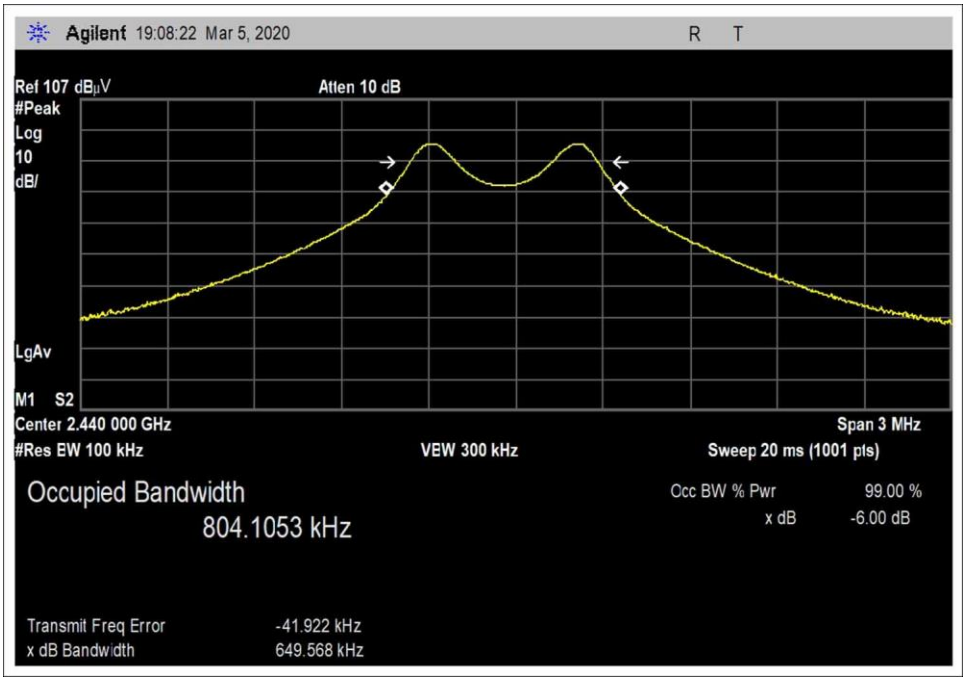
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02872	Spectrum Analyzer	Agilent	E4440A	11/18/2019	11/18/2021
01467	Horn Antenna	EMCO	3115	7/5/2019	7/5/2021
03540	Preamp	HP	83017A	5/13/2019	5/13/2021

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
2402	Radiated	GFSK	649.3	≥500	Pass
2440	Radiated	GFSK	649.6	≥500	Pass
2480	Radiated	GFSK	649.9	≥500	Pass

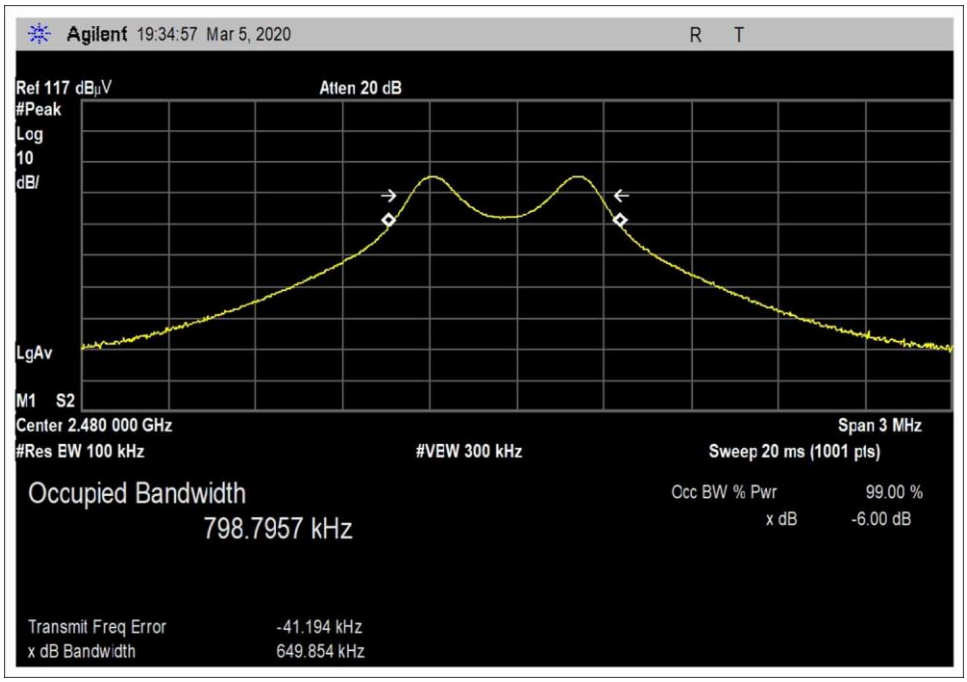
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)


03.30.2020 10:13

15.247(b)(3) Output Power

Test Data Summary - Voltage Variations					
Frequency (MHz)	Modulation / Ant Port	$V_{Minimum}$ (dBm)	$V_{Nominal}$ (dBm)	$V_{Maximum}$ (dBm)	Max Deviation from $V_{Nominal}$ (dB)
2402	GFSK	-7.3	-7.3	-7.3	0
2440	GFSK	-9.6	-9.6	-9.6	0
2480	GFSK	-9.4	-9.4	-9.4	0

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

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	120
$V_{Minimum}$:	102
$V_{Maximum}$:	138

Power Output Test Data Summary - Radiated Measurement						
Measurement Option: RBW > DTS Bandwidth						
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Field Strength (dBuV/m @3m)	Calculated (dBm)	Limit (dBm)	Results
2402	GFSK	Chip / 3.77	91.7	-7.3	≤30	Pass
2440	GFSK	Chip / 3.77	89.4	-9.6	≤30	Pass
2480	GFSK	Chip / 3.77	89.6	-9.4	≤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.

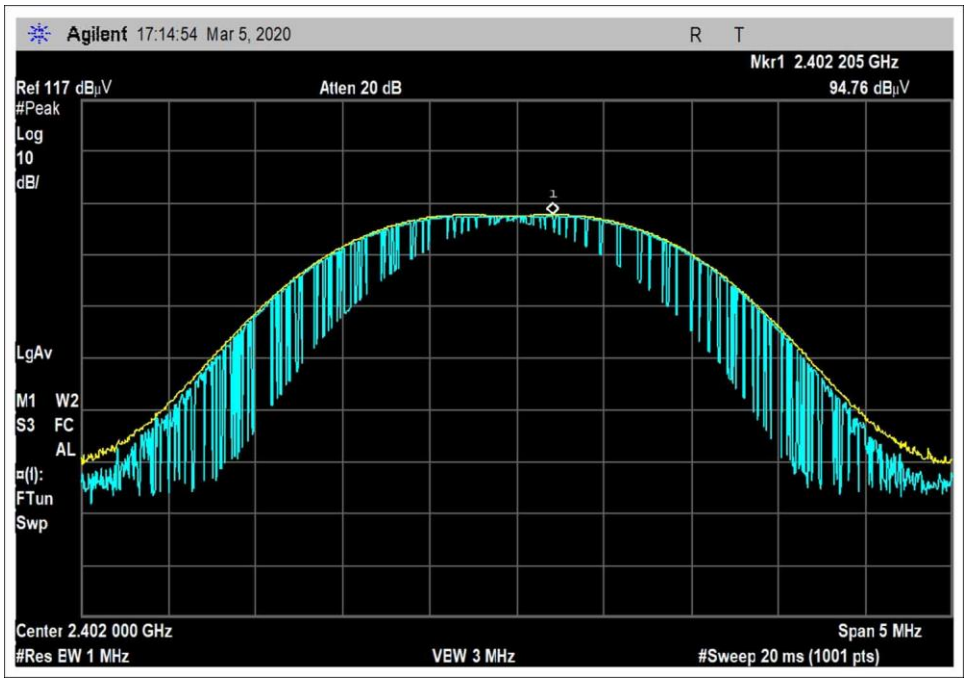
Conducted RF output power calculated in accordance with ANSI C63.10.

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

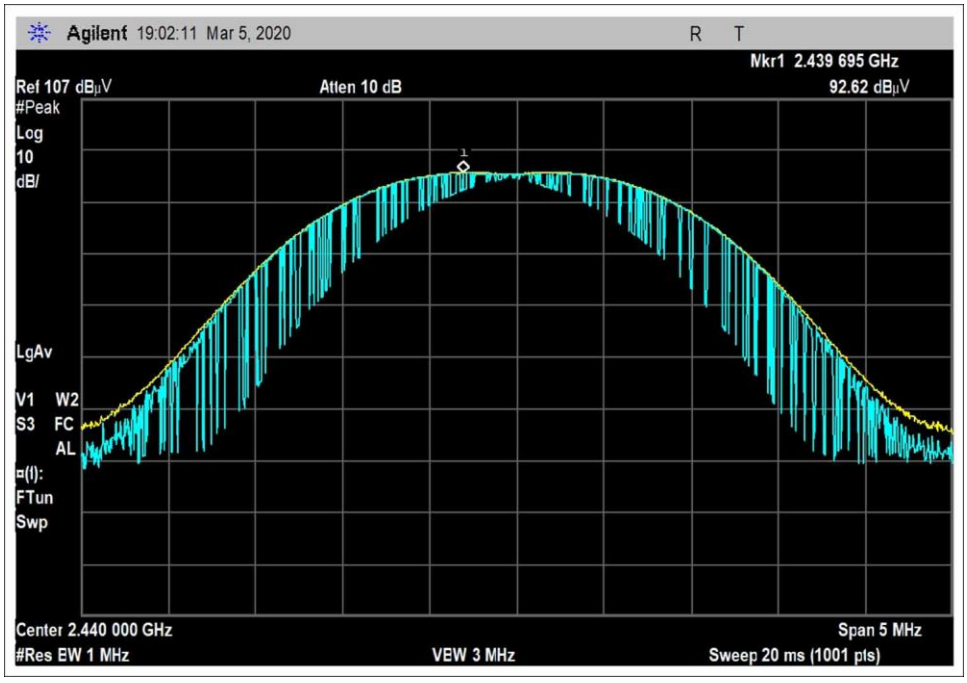
Or equivalently, in logarithmic form:

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

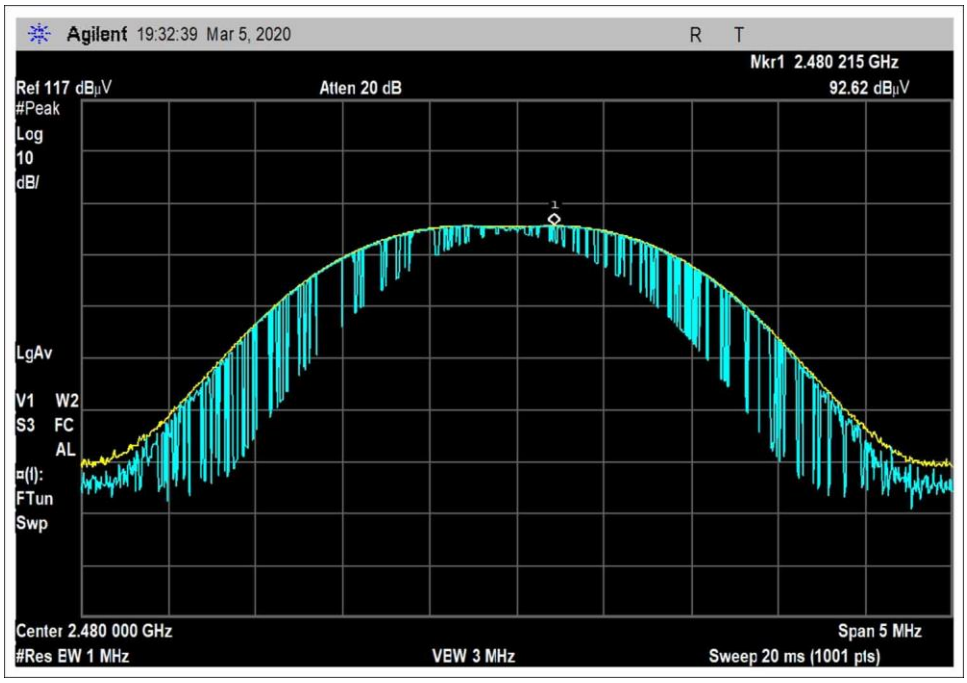
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.247(b) Power Output (2400-2483.5 MHz DTS)**		
Work Order #:	**102802**	Date:	3/30/2020
Test Type:	**Maximized Emissions**	Time:	13:22:30
Tested By:	Steven Pittsford	Sequence#:	34
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: 22°C
Humidity: 28%
Pressure: 101.3 kPa

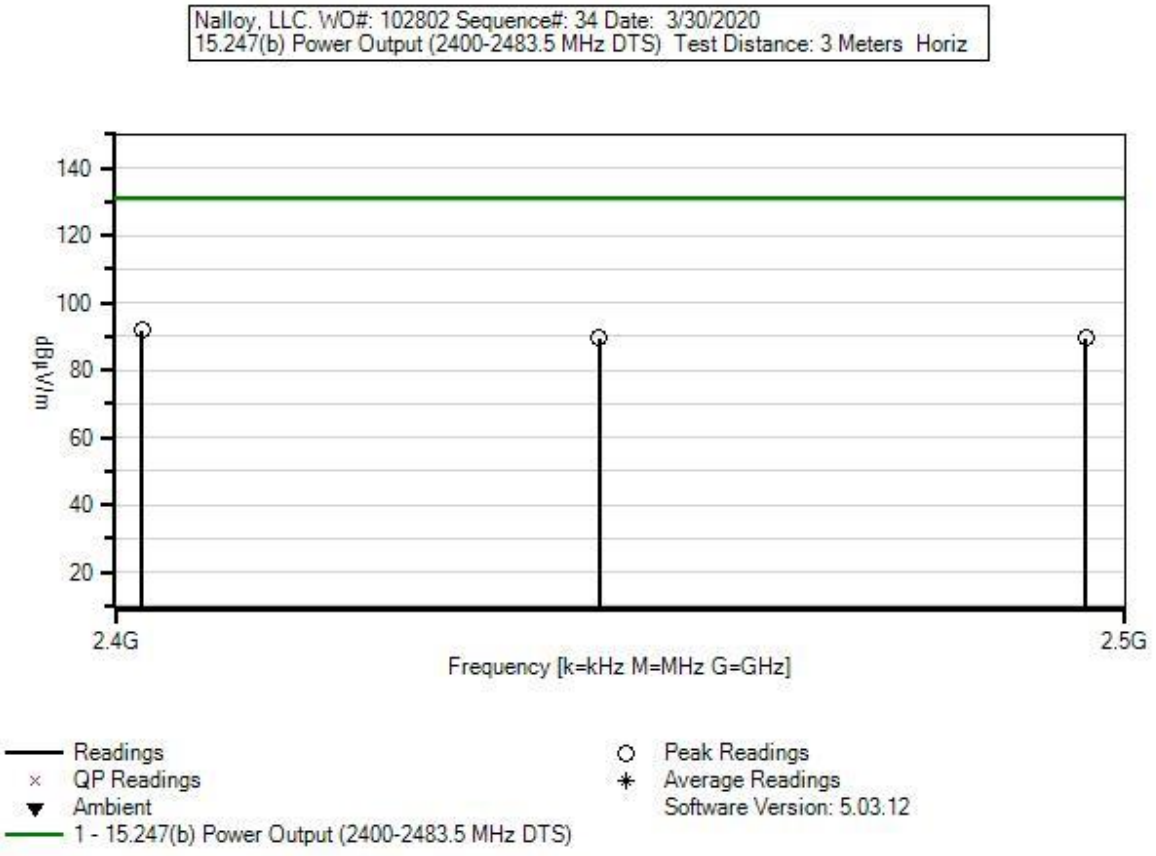
Frequency Range: 2.402-2.48GHz
Frequency tested: 2402, 2440, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013 KDB 558074 (April 2, 2019)
Test Mode: Transmitting
Test Setup: EUT is setup 1.5m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Low, Mid, and High channels, x, y, and z axis, and all data rates investigated, worst-case provided.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T4	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T5	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T6	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021

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	2402.205M	94.8	+27.7 -34.3	+2.6 +0.3	+0.6	+0.0	+0.0 27	91.7	131.2 Y-Axis	-39.5	Horiz 100
2	2480.215M	92.6	+27.6 -34.2	+2.7 +0.3	+0.6	+0.0	+0.0 40	89.6	131.2 Y-Axis	-41.6	Horiz 109
3	2439.695M	92.6	+27.6 -34.3	+2.6 +0.3	+0.6	+0.0	+0.0 30	89.4	131.2 Y-Axis	-41.8	Horiz 110

15.247(e) Power Spectral Density

PSD Test Data Summary - Radiated Measurement						
Measurement Method: PKPSD						
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Field Strength (dBuV/m @3m)**	**Calculated (dBµV/100kHz)**	**Limit (dBµV /3kHz)**	**Results**
2402	GFSK	Chip / 3.77	89.9	-9.09	≤8	Pass
2440	GFSK	Chip / 3.77	89.3	-9.69	≤8	Pass
2480	GFSK	Chip / 3.77	89.4	-9.59	≤8	Pass

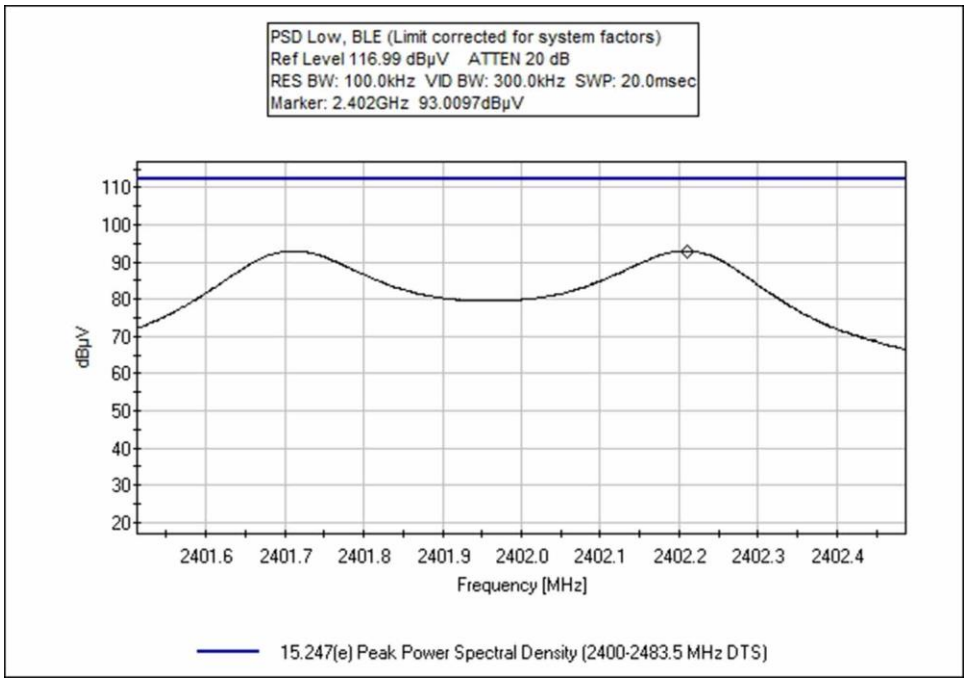
Conducted RF output power calculated in accordance with ANSI C63.10.

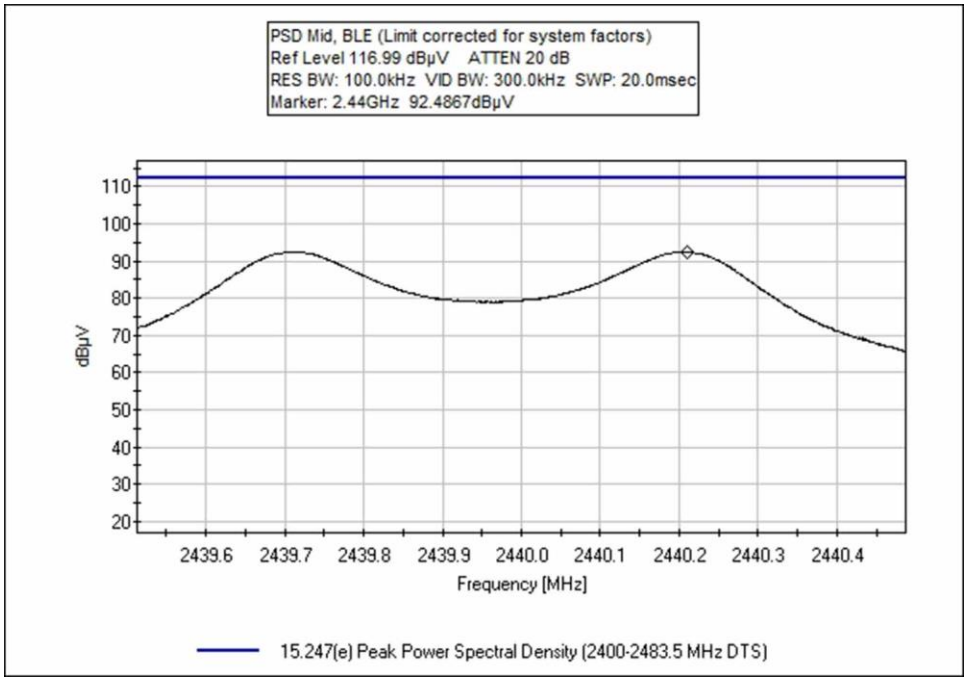
$$P(W) = \frac{(E \cdot d)^2}{30\ G}$$

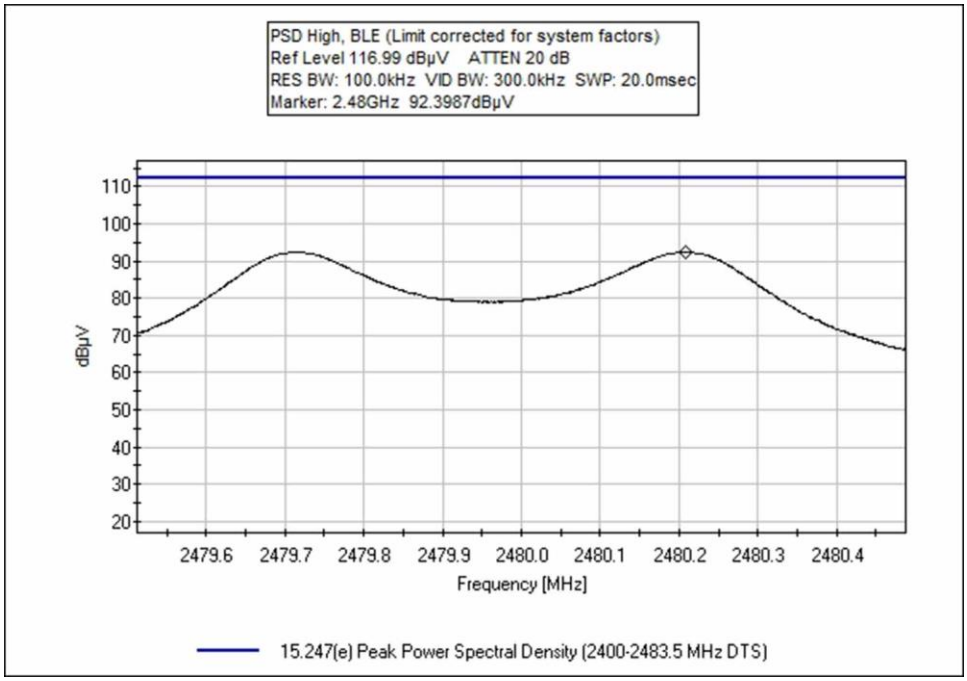
Or equivalently, in logarithmic form:

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

Plots




PSD Mid, BLE (Limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.44GHz 92.4867dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
2439.6
2439.7
2439.8
2439.9
2440.0
2440.1
2440.2
2440.3
2440.4
Frequency [MHz]
15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)


PSD High, BLE (Limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 2.48GHz 92.3987dBµV
dBµV
110
100
90
80
70
60
50
40
30
20
2479.6
2479.7
2479.8
2479.9
2480.0
2480.1
2480.2
2480.3
2480.4
Frequency [MHz]
15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)**		
Work Order #:	**102803**	Date:	3/30/2020
Test Type:	**Maximized Emissions**	Time:	13:29:55
Tested By:	Matthew Harrison	Sequence#:	2
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: 22°C
Humidity: 28%
Pressure: 101.3 kPa

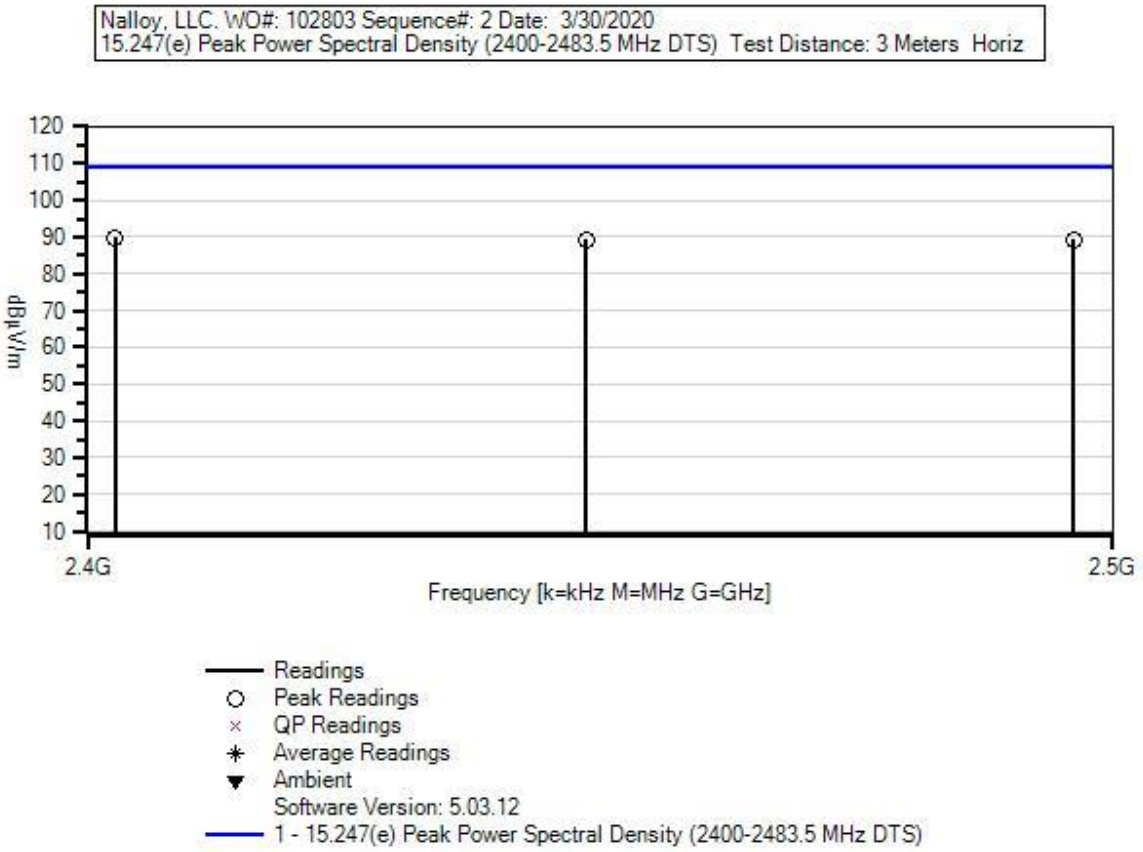
Frequency Range: 2.402-2.48GHz
Frequency tested: 2402, 2440, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013 KDB 558074 (April 2, 2019)
Test Mode: Transmitting
Test Setup: EUT is setup 1.5m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Low, Mid, and High channels, x, y, and z axis, and all data rates investigated, worst-case provided.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T4	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T5	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021

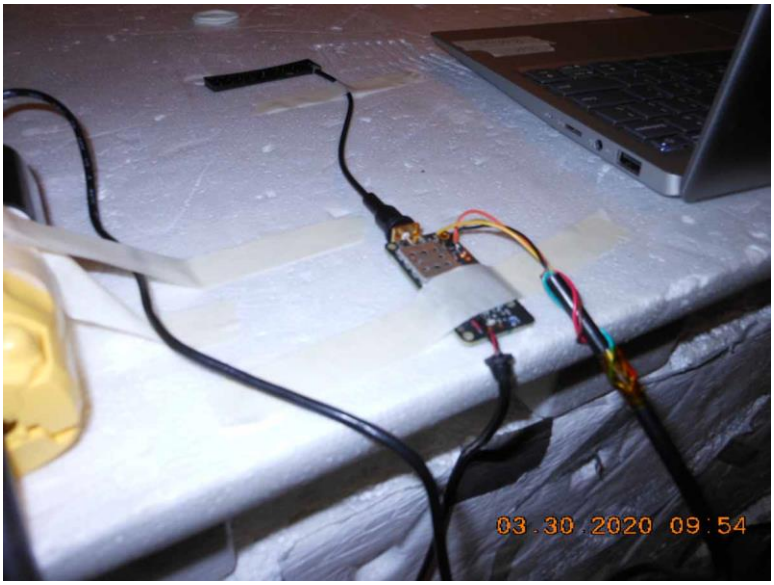
Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	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	2402.210M	93.0	+27.7 +0.3	+2.6	+0.6	-34.3	+0.0	89.9	109.2	-19.3	Horiz
2	2480.209M	92.4	+27.6 +0.3	+2.7	+0.6	-34.2	+0.0	89.4	109.2	-19.8	Horiz
3	2440.210M	92.5	+27.6 +0.3	+2.6	+0.6	-34.3	+0.0	89.3	109.2	-19.9	Horiz

Test Setup Photo(s)

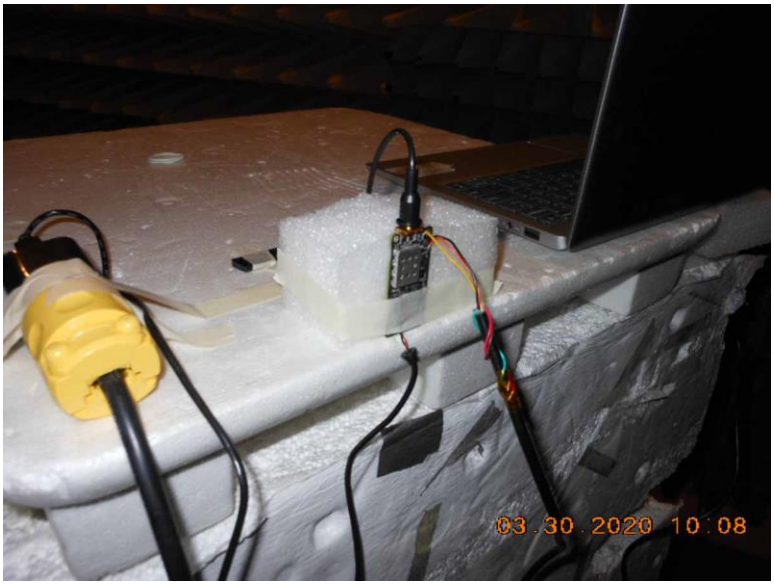
Above 1GHz

Above 1GHz



X-Axis

Y-Axis



Z-Axis

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102803**	Date:	4/7/2020
Test Type:	**Maximized Emissions**	Time:	11:45:03
Tested By:	Matthew Harrison	Sequence#:	4
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: 22°C
Humidity: 28%
Pressure: 101.3 kPa

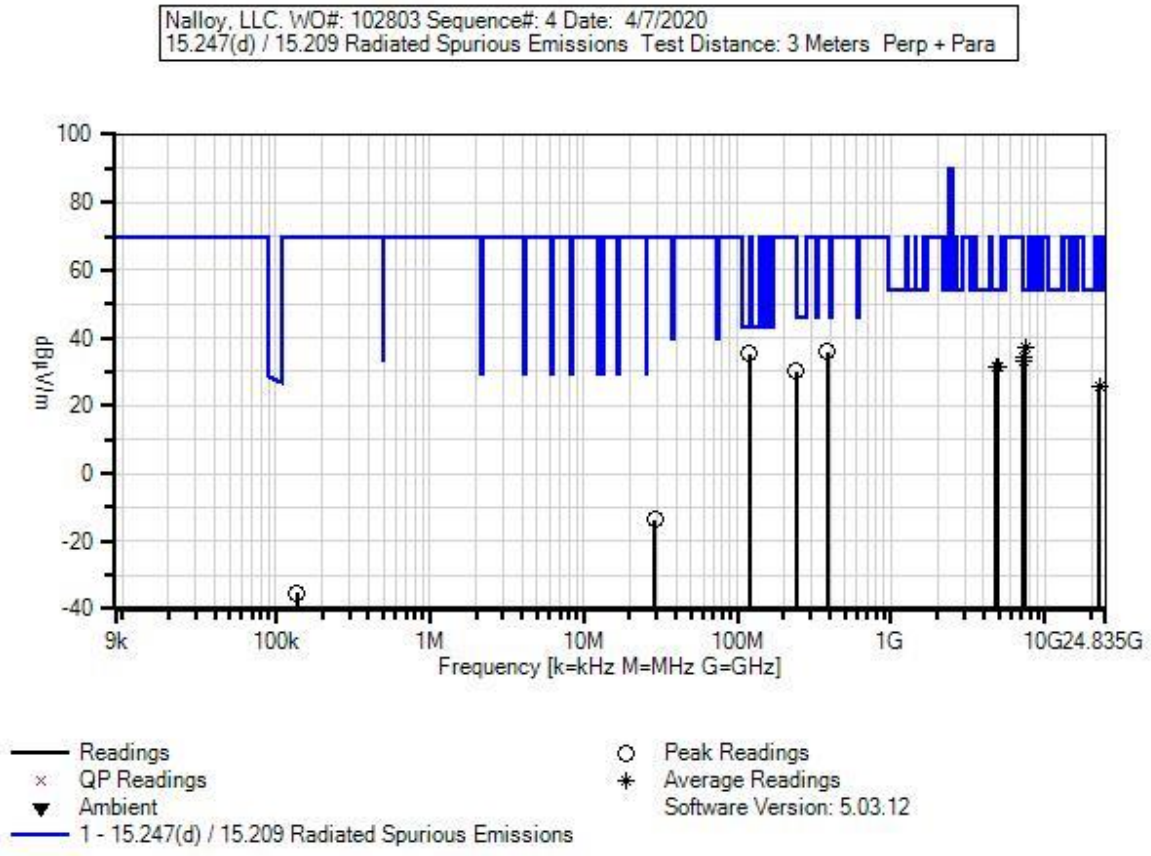
Frequency Range: 9kHz-25GHz
Frequency tested: 2402, 2440, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013 KDB 558074 (April 2, 2019)
Test Mode: Transmitting
Test Setup: EUT is setup 1.5m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Low, Mid, and High channels, x, y, and z axis, and all data rates investigated, worst-case provided.



Test Equipment:

ID	Asset #	Description	Model	Cal Date	Cal Due Date
T1	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T4	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T5	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T6	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021
T7	AN02742	Active Horn Antenna	AMFW-5F-18002650-20-10P	10/16/2018	10/16/2020
T8	AN02763-69	Waveguide	Multiple	4/23/2018	4/23/2020
T9	ANP06678	Cable	32026-29801-29801-144	2/20/2020	2/20/2022
T10	ANP07211	Cable	32026-29801-29801-18	8/7/2019	8/7/2021
T11	ANP07212	Cable	32026-29801-29801-18	8/7/2019	8/7/2021
T12	AN02307	Preamp	8447D	1/10/2020	1/10/2022
T13	AN03628	Biconilog Antenna	3142E	6/11/2019	6/11/2021
T14	ANP06123	Attenuator	18N-6	4/5/2019	4/5/2021
T15	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T16	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T17	AN00052	Loop Antenna	6502	5/7/2018	5/7/2020

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

#	Freq	Rdng	T1 T5 T9 T13 T17	T2 T6 T10 T14	T3 T7 T11 T15	T4 T8 T12 T16	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	120.200M	47.9	+0.0 +0.0 +0.0 +8.0 +0.0	+0.0 +0.0 +0.0 +5.8	+0.1 +0.0 +0.0 +0.5	+0.0 +0.0 -27.6 +0.6	+0.0	35.3	43.5	-8.2	Vert
2	240.500M	37.8	+0.0 +0.0 +0.0 +11.8 +0.0	+0.0 +0.0 +0.0 +5.8	+0.2 +0.0 +0.0 +0.8	+0.0 +0.0 -27.1 +0.9	+0.0	30.2	46.0	-15.8	Vert
3	7440.675M Ave	27.2	+37.1 -34.7 +0.0 +0.0 +0.0	+5.5 +0.3 +0.0 +0.0	+1.6 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	37.0	54.0	-17.0	Vert
^	7440.675M	41.9	+37.1 -34.7 +0.0 +0.0 +0.0	+5.5 +0.3 +0.0 +0.0	+1.6 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	51.7	54.0	-2.3	Vert
5	7319.085M Ave	25.3	+36.8 -34.6 +0.0 +0.0 +0.0	+5.4 +0.4 +0.0 +0.0	+1.3 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	34.6	54.0	-19.4	Vert
^	7319.085M	38.5	+36.8 -34.6 +0.0 +0.0 +0.0	+5.4 +0.4 +0.0 +0.0	+1.3 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	47.8	54.0	-6.2	Vert
7	4879.560M Ave	27.1	+32.5 -33.6 +0.0 +0.0 +0.0	+4.2 +0.5 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	31.6	54.0	-22.4	Vert
^	4879.560M	39.9	+32.5 -33.6 +0.0 +0.0 +0.0	+4.2 +0.5 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	44.4	54.0	-9.6	Vert

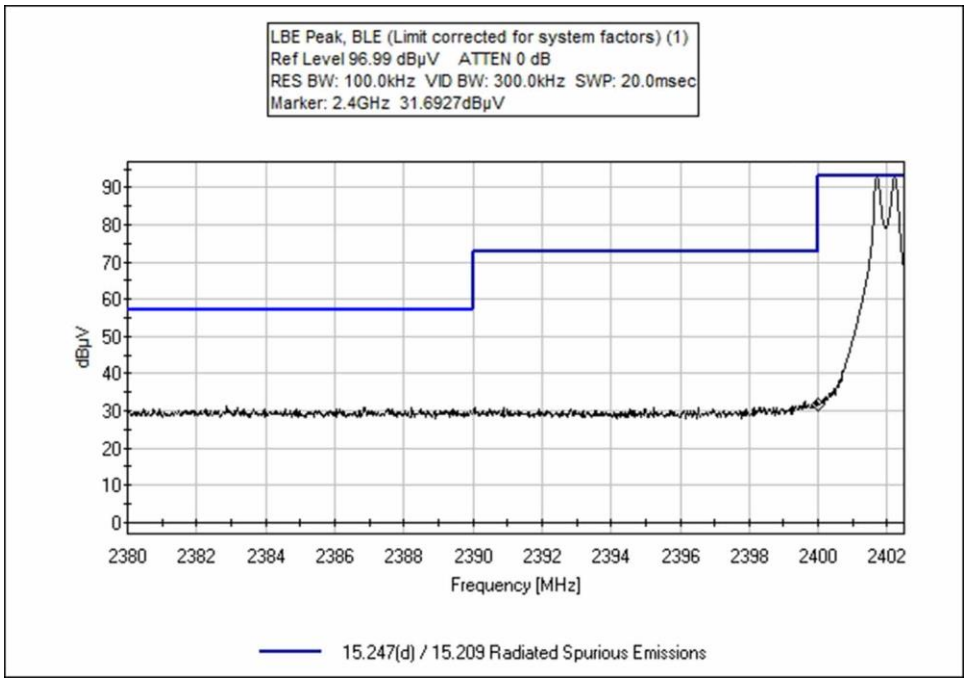
9	4803.575M Ave	27.2	+32.4 -33.6 +0.0 +0.0 +0.0	+4.1 +0.6 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	31.6	54.0	-22.4	Vert
^	4803.575M	38.9	+32.4 -33.6 +0.0 +0.0 +0.0	+4.1 +0.6 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	43.3	54.0	-10.7	Vert
11	4960.105M Ave	26.8	+32.6 -33.6 +0.0 +0.0 +0.0	+4.2 +0.4 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	31.3	54.0	-22.7	Vert
^	4960.105M	41.5	+32.6 -33.6 +0.0 +0.0 +0.0	+4.2 +0.4 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	46.0	54.0	-8.0	Vert
13	22641.000 M Ave	28.4	+0.0 +0.0 +9.4 +0.0 +0.0	+0.0 +0.0 +0.9 +0.0	+0.0 -16.1 +1.2 +0.0	+0.0 +1.8 +0.0 +0.0	+0.0	25.6	54.0	-28.4	Vert
^	22641.000 M	43.1	+0.0 +0.0 +9.4 +0.0 +0.0	+0.0 +0.0 +0.9 +0.0	+0.0 -16.1 +1.2 +0.0	+0.0 +1.8 +0.0 +0.0	+0.0	40.3	54.0	-13.7	Vert
15	383.100M	38.3	+0.0 +0.0 +0.0 +16.8 +0.0	+0.0 +0.0 +0.0 +5.8	+0.2 +0.0 +0.0 +1.0	+0.0 +0.0 -27.5 +1.3	+0.0	35.9	69.9	-34.0	Vert
16	7204.800M Ave	24.0	+36.5 -34.5 +0.0 +0.0 +0.0	+5.3 +0.5 +0.0 +0.0	+1.1 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	32.9	69.9	-37.0	Vert
^	7204.800M	38.8	+36.5 -34.5 +0.0 +0.0 +0.0	+5.3 +0.5 +0.0 +0.0	+1.1 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0	47.7	69.9	-22.2	Vert

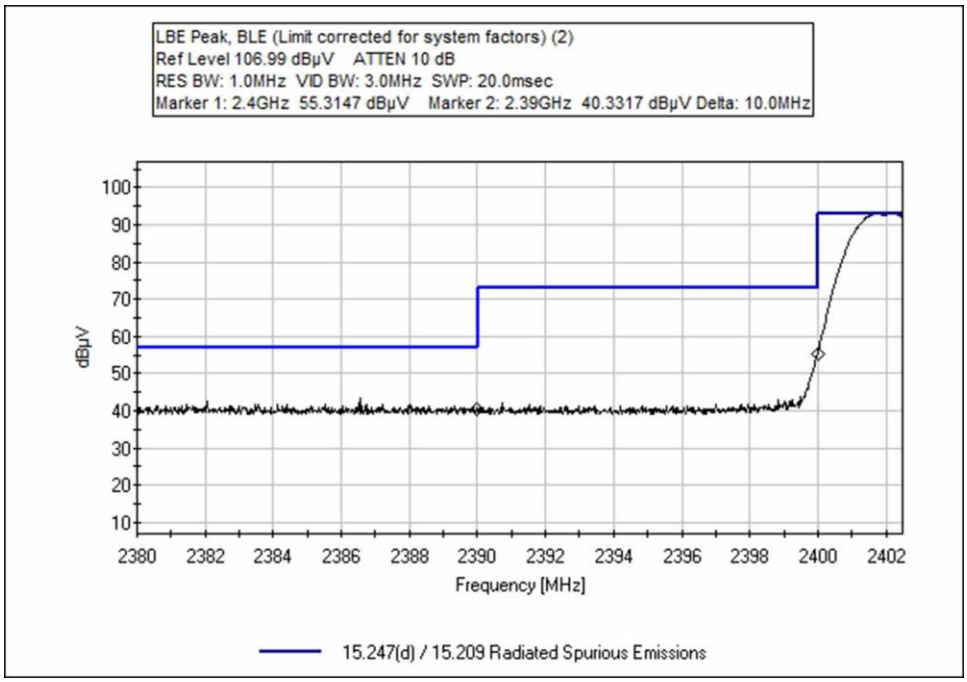
18	28.925M	20.1	+0.0 +0.0 +0.0 +0.0 +5.9	+0.3 +0.0 +0.0 +0.0	+0.1 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	-40.0	-13.6	69.9	-83.5	Perp
19	137.592k	35.2	+0.0 +0.0 +0.0 +0.0 +9.6	+0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	-80.0	-35.2	69.9	-105.1	Perp

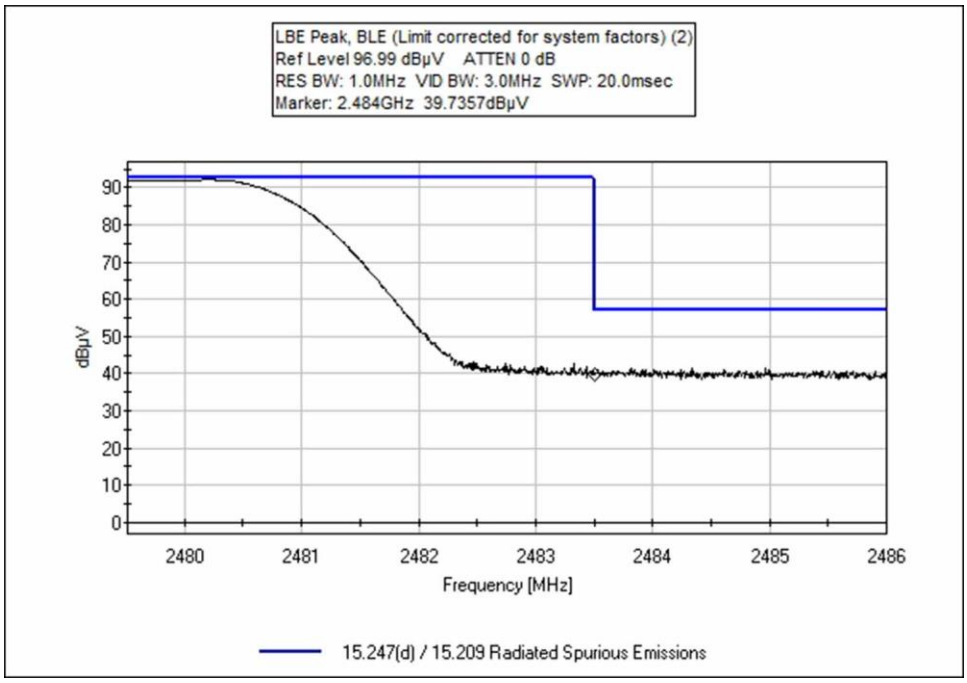
Band Edge

Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0	GFSK	Chip	37.2	<54	Pass
2400.0	GFSK	Chip	52.2	<69.9	Pass
2483.5	GFSK	Chip	36.7	<54	Pass

Band Edge Plots






LBE Peak, BLE (Limit corrected for system factors) (2)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 3.0MHz SWP: 20.0msec
Marker: 2.484GHz 39.7357dBµV
dBµV
90
80
70
60
50
40
30
20
10
0
2480
2481
2482
2483
2484
2485
2486
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**102803**	Date:	3/30/2020
Test Type:	**Maximized Emissions**	Time:	13:40:50
Tested By:	Matthew Harrison	Sequence#:	3
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: 22°C
Humidity: 28%
Pressure: 101.3 kPa

Frequency Range: 2.38-2.486GHz
Frequency tested: 2402, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013 KDB 558074 (April 2, 2019)
Test Mode: Transmitting
Test Setup: EUT is setup 1.5m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Low, Mid, and High channels, x, y, and z axis, and all data rates investigated, worst-case provided.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T4	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T5	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T6	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021

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	2390.000M	40.3	+27.7 -34.3	+2.6 +0.3	+0.6	+0.0	+0.0	37.2	54.0	-16.8	Horiz
2	2483.500M	39.7	+27.6 -34.2	+2.7 +0.3	+0.6	+0.0	+0.0	36.7	54.0	-17.3	Horiz
3	2400.000M	55.3	+27.7 -34.3	+2.6 +0.3	+0.6	+0.0	+0.0	52.2	69.9	-17.7	Horiz
5	2400.000M	31.7	+27.7 -34.3	+2.6 +0.3	+0.6	+0.0	+0.0	28.6	69.9 100kHz RBW	-41.3	Horiz

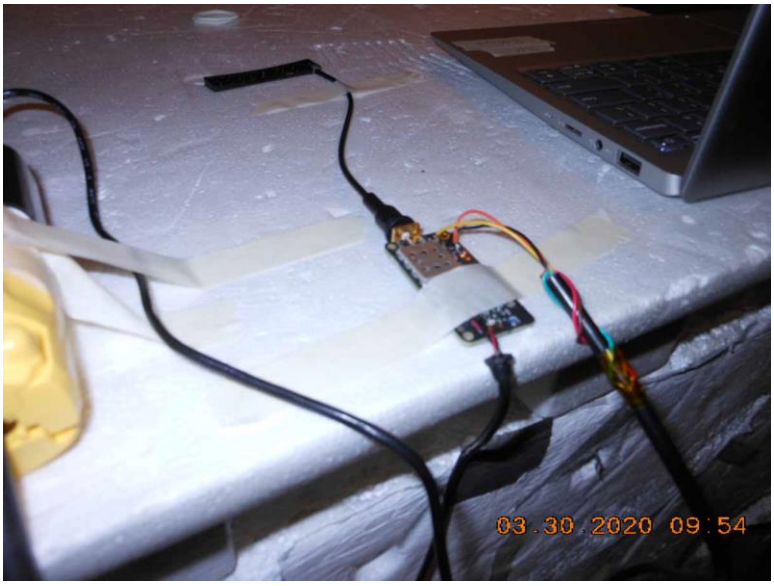
Test Setup Photo(s)

Below 1GHz

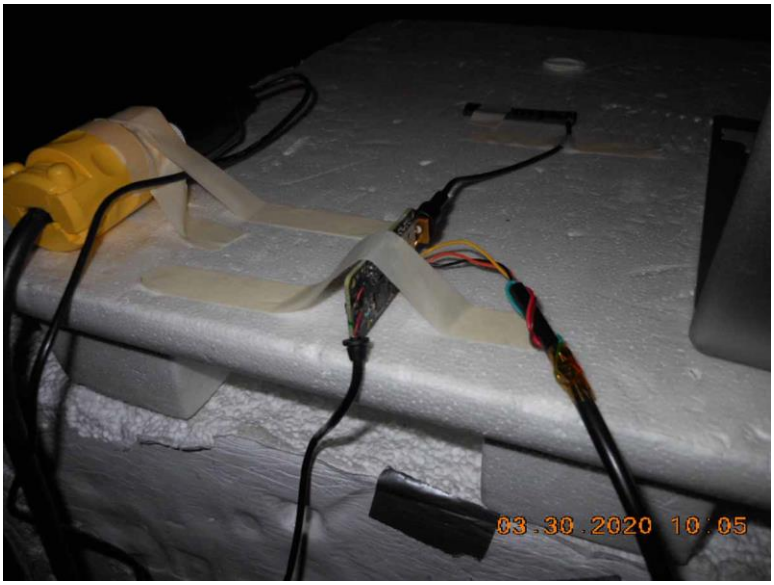
Below 1GHz

Above 1GHz

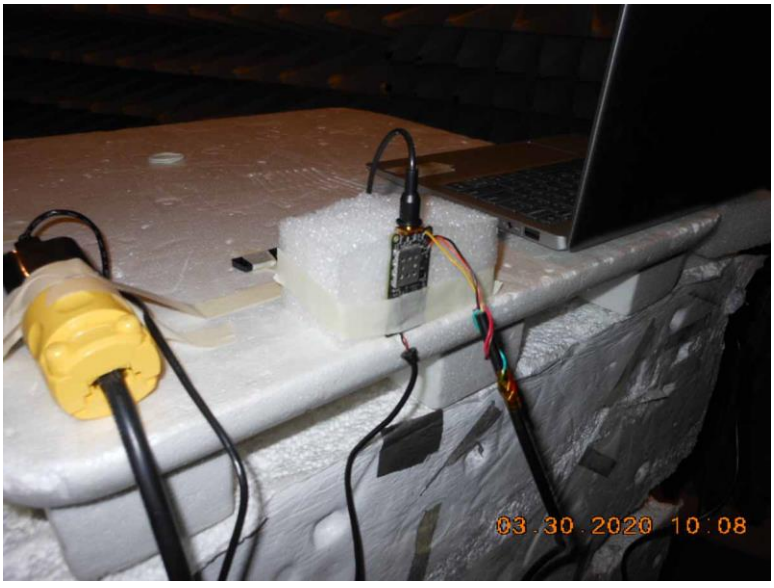
Above 1GHz



X-Axis



Y-Axis



Z-Axis

15.207 AC Conducted Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**102802**	Date:	4/7/2020
Test Type:	**Conducted Emissions**	Time:	12:06:20
Tested By:	Matthew Harrison	Sequence#:	14
Software:	EMITest 5.03.12		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Temperature: 22°C
Humidity: 28%
Pressure: 101.3 kPa

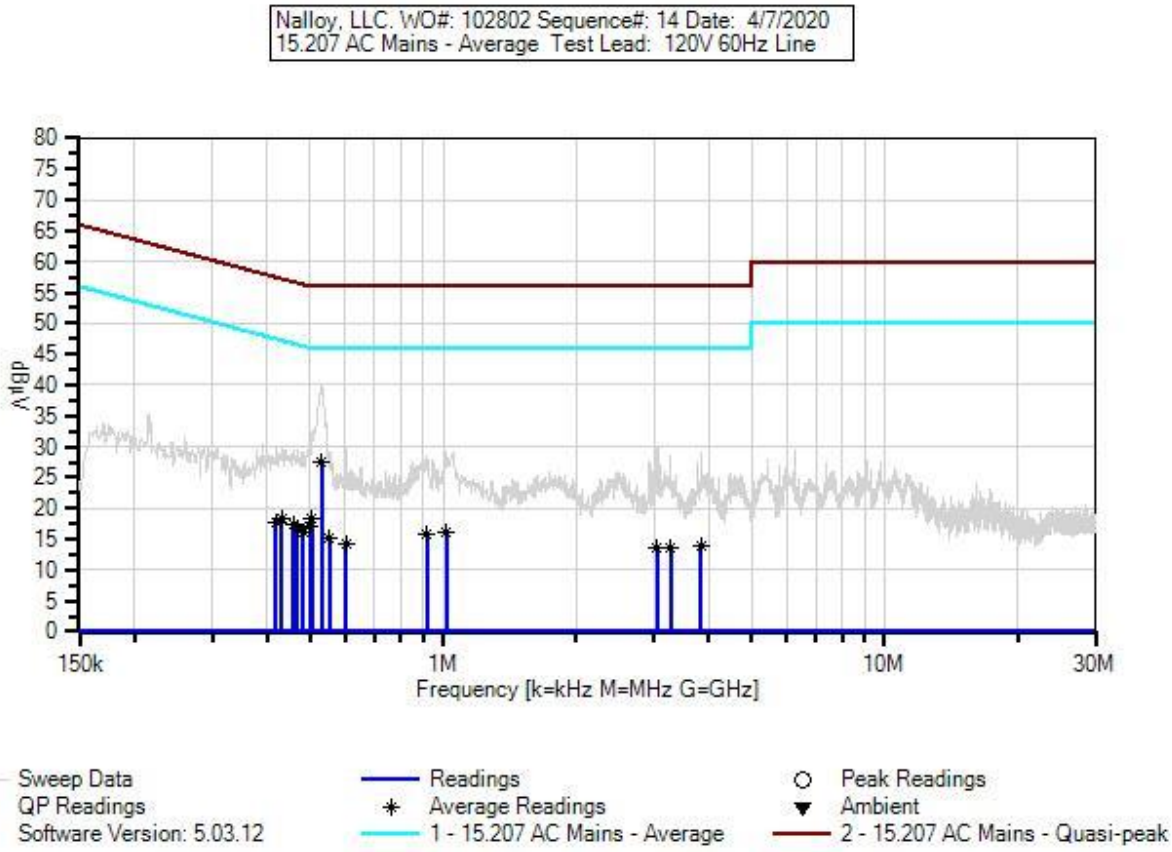
Frequency Range: 150k-30MHz
Frequency tested: 2402, 2440, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013
Test Mode: Transmitting
Test Setup: EUT is setup 0.8m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Setup: EUT is connected to a Laptop via USB and Audio cable. EUT is in NFC A Mode, BT On, Poll Test, NFC I2C Enabled, EEPROM Exercised.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T1	ANP06219	Attenuator	768-10	4/13/2018	4/13/2020
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T4	AN01311	50uH LISN-Line1 (L)	3816/2	2/24/2020	2/24/2022
	AN01311	50uH LISN-Line2 (N)	3816/2	2/24/2020	2/24/2022
T5	AN02611	High Pass Filter	HE9615-150K-50-720B	1/10/2020	1/10/2022

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	531.056k	18.6	+9.1	+0.0	+0.0	-0.4	+0.0	27.6	46.0	-18.4	Line
Ave			+0.3								
^	531.055k	31.2	+9.1	+0.0	+0.0	-0.4	+0.0	40.2	46.0	-5.8	Line
			+0.3								
3	504.149k	9.4	+9.1	+0.0	+0.0	-0.4	+0.0	18.3	46.0	-27.7	Line
Ave			+0.2								
^	504.149k	23.4	+9.1	+0.0	+0.0	-0.4	+0.0	32.3	46.0	-13.7	Line
			+0.2								
5	498.332k	8.3	+9.1	+0.0	+0.0	-0.4	+0.0	17.2	46.0	-28.8	Line
Ave			+0.2								
^	498.331k	22.6	+9.1	+0.0	+0.0	-0.4	+0.0	31.5	46.0	-14.5	Line
			+0.2								
7	431.429k	9.4	+9.1	+0.1	+0.0	-0.5	+0.0	18.3	47.2	-28.9	Line
Ave			+0.2								
^	431.428k	21.2	+9.1	+0.1	+0.0	-0.5	+0.0	30.1	47.2	-17.1	Line
			+0.2								
9	458.335k	8.4	+9.1	+0.1	+0.0	-0.5	+0.0	17.3	46.7	-29.4	Line
Ave			+0.2								
^	458.335k	20.7	+9.1	+0.1	+0.0	-0.5	+0.0	29.6	46.7	-17.1	Line
			+0.2								
11	468.516k	8.0	+9.1	+0.1	+0.0	-0.5	+0.0	16.9	46.5	-29.6	Line
Ave			+0.2								
^	468.516k	20.5	+9.1	+0.1	+0.0	-0.5	+0.0	29.4	46.5	-17.1	Line
			+0.2								
13	417.612k	8.8	+9.1	+0.0	+0.0	-0.5	+0.0	17.6	47.5	-29.9	Line
Ave			+0.2								
^	417.611k	21.2	+9.1	+0.0	+0.0	-0.5	+0.0	30.0	47.5	-17.5	Line
			+0.2								
15	1.018M	7.0	+9.1	+0.0	+0.0	-0.3	+0.0	16.0	46.0	-30.0	Line
Ave			+0.2								
^	1.018M	20.2	+9.1	+0.0	+0.0	-0.3	+0.0	29.2	46.0	-16.8	Line
			+0.2								
17	482.333k	7.4	+9.1	+0.0	+0.0	-0.5	+0.0	16.2	46.3	-30.1	Line
Ave			+0.2								
^	482.333k	20.5	+9.1	+0.0	+0.0	-0.5	+0.0	29.3	46.3	-17.0	Line
			+0.2								
19	919.732k	6.8	+9.1	+0.0	+0.0	-0.3	+0.0	15.8	46.0	-30.2	Line
Ave			+0.2								
^	919.732k	19.5	+9.1	+0.0	+0.0	-0.3	+0.0	28.5	46.0	-17.5	Line
			+0.2								
21	553.599k	6.3	+9.1	+0.0	+0.0	-0.4	+0.0	15.3	46.0	-30.7	Line
Ave			+0.3								
^	553.599k	20.1	+9.1	+0.0	+0.0	-0.4	+0.0	29.1	46.0	-16.9	Line
			+0.3								
23	603.049k	5.3	+9.1	+0.0	+0.0	-0.4	+0.0	14.3	46.0	-31.7	Line
Ave			+0.3								
^	603.049k	20.9	+9.1	+0.0	+0.0	-0.4	+0.0	29.9	46.0	-16.1	Line
			+0.3								

25 Ave	3.833M	4.8	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	13.8	46.0	-32.2	Line
^	3.833M	20.3	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	29.3	46.0	-16.7	Line
27 Ave	3.276M	4.6	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	13.6	46.0	-32.4	Line
^	3.276M	19.5	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	28.5	46.0	-17.5	Line
29 Ave	3.059M	4.6	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	13.6	46.0	-32.4	Line
^	3.059M	21.1	+9.1 +0.1	+0.1	+0.0	-0.3	+0.0	30.1	46.0	-15.9	Line

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**102803**	Date:	4/7/2020
Test Type:	**Conducted Emissions**	Time:	12:16:42
Tested By:	Matthew Harrison	Sequence#:	15
Software:	EMITest 5.03.12		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Temperature: 22°C
Humidity: 28%
Pressure: 101.3 kPa

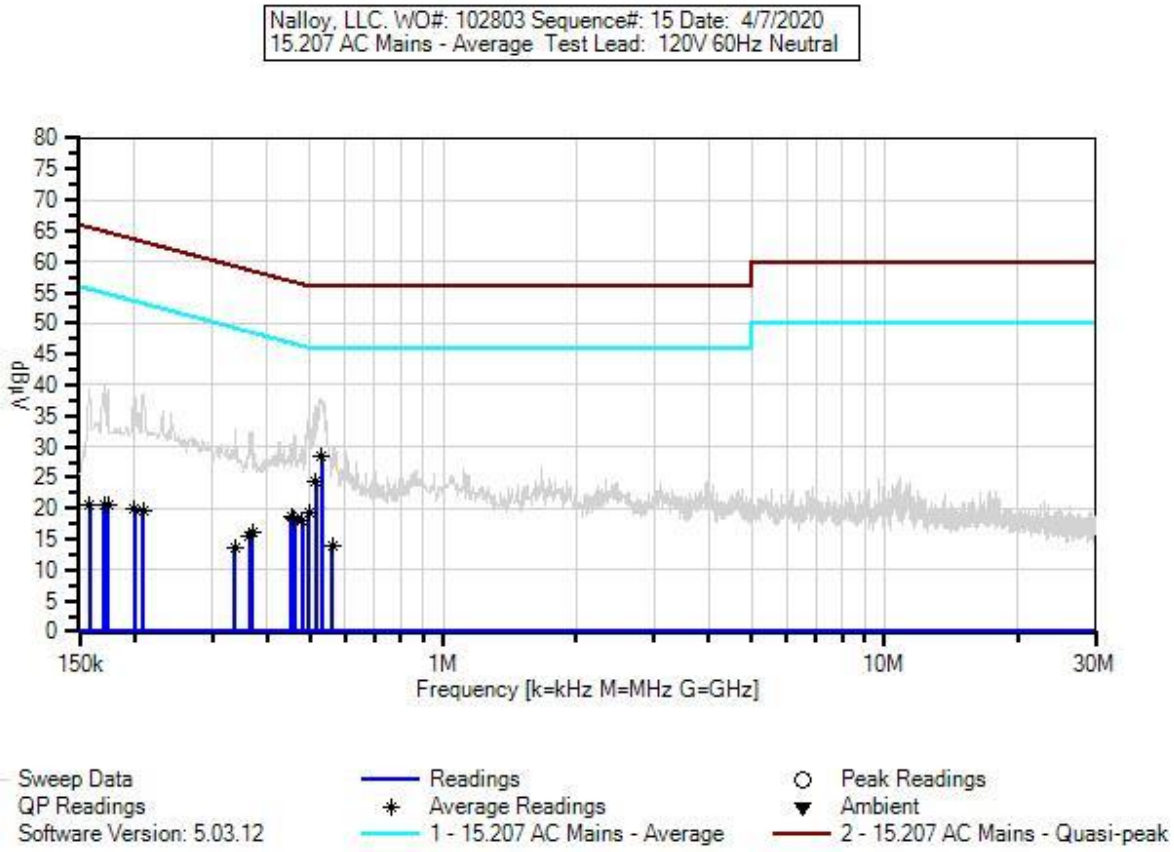
Frequency Range: 150k-30MHz
Frequency tested: 2402, 2440, 2480
Firmware power setting: Default
EUT Firmware:
Protocol /MCS/Modulation: BLE, 1Mbps

Antenna type: Chip
Antenna Gain: 3.77 dBi.

Duty Cycle: 100% Modulated

Test Method: ANSI C63.10: 2013
Test Mode: Transmitting
Test Setup: EUT is setup 0.8m high on a Styrofoam table.
Modifications Added: None
Setup: EUT is connected to a Laptop via USB and Audio cable.

Setup: EUT is connected to a Laptop via USB and Audio cable. EUT is in NFC A Mode, BT On, Poll Test, NFC I2C Enabled, EEPROM Exercised.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T1	ANP06219	Attenuator	768-10	4/13/2018	4/13/2020
T2	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
	AN01311	50uH LISN-Line1 (L)	3816/2	2/24/2020	2/24/2022
T4	AN01311	50uH LISN-Line2 (N)	3816/2	2/24/2020	2/24/2022
T5	AN02611	High Pass Filter	HE9615-150K-50-720B	1/10/2020	1/10/2022

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	531.055k	19.6	+9.1	+0.0	+0.0	-0.4	+0.0	28.6	46.0	-17.4	Neutr
	Ave		+0.3								
^	531.054k	28.8	+9.1	+0.0	+0.0	-0.4	+0.0	37.8	46.0	-8.2	Neutr
			+0.3								
3	515.784k	15.5	+9.1	+0.0	+0.0	-0.4	+0.0	24.4	46.0	-21.6	Neutr
	Ave		+0.2								
^	515.783k	27.8	+9.1	+0.0	+0.0	-0.4	+0.0	36.7	46.0	-9.3	Neutr
			+0.2								
5	497.603k	10.5	+9.1	+0.0	+0.0	-0.4	+0.0	19.4	46.0	-26.6	Neutr
	Ave		+0.2								
^	497.603k	26.3	+9.1	+0.0	+0.0	-0.4	+0.0	35.2	46.0	-10.8	Neutr
			+0.2								
7	452.517k	9.9	+9.1	+0.1	+0.0	-0.5	+0.0	18.8	46.8	-28.0	Neutr
	Ave		+0.2								
^	452.516k	21.7	+9.1	+0.1	+0.0	-0.5	+0.0	30.6	46.8	-16.2	Neutr
			+0.2								
9	461.243k	9.5	+9.1	+0.1	+0.0	-0.5	+0.0	18.4	46.7	-28.3	Neutr
	Ave		+0.2								
^	461.243k	23.1	+9.1	+0.1	+0.0	-0.5	+0.0	32.0	46.7	-14.7	Neutr
			+0.2								
11	479.423k	9.0	+9.1	+0.0	+0.0	-0.4	+0.0	17.9	46.3	-28.4	Neutr
	Ave		+0.2								
^	479.423k	21.3	+9.1	+0.0	+0.0	-0.4	+0.0	30.2	46.3	-16.1	Neutr
			+0.2								
13	560.870k	5.0	+9.1	+0.0	+0.0	-0.4	+0.0	14.0	46.0	-32.0	Neutr
	Ave		+0.3								
^	560.870k	21.3	+9.1	+0.0	+0.0	-0.4	+0.0	30.3	46.0	-15.7	Neutr
			+0.3								
15	369.615k	7.4	+9.1	+0.0	+0.0	-0.6	+0.0	16.0	48.5	-32.5	Neutr
	Ave		+0.1								
^	369.615k	23.9	+9.1	+0.0	+0.0	-0.6	+0.0	32.5	48.5	-16.0	Neutr
			+0.1								
17	364.525k	7.0	+9.1	+0.0	+0.0	-0.6	+0.0	15.6	48.6	-33.0	Neutr
	Ave		+0.1								
^	364.524k	23.9	+9.1	+0.0	+0.0	-0.6	+0.0	32.5	48.6	-16.1	Neutr
			+0.1								
19	208.903k	11.5	+9.1	+0.0	+0.0	-1.1	+0.0	19.7	53.2	-33.5	Neutr
	Ave		+0.2								
^	208.902k	30.5	+9.1	+0.0	+0.0	-1.1	+0.0	38.7	53.2	-14.5	Neutr
			+0.2								
21	199.449k	11.9	+9.1	+0.0	+0.0	-1.2	+0.0	20.0	53.6	-33.6	Neutr
	Ave		+0.2								
^	199.449k	30.2	+9.1	+0.0	+0.0	-1.2	+0.0	38.3	53.6	-15.3	Neutr
			+0.2								
23	173.997k	12.4	+9.1	+0.0	+0.0	-1.4	+0.0	20.5	54.8	-34.3	Neutr
	Ave		+0.4								

24 Ave	171.088k	12.5	+9.1 +0.4	+0.0	+0.0	-1.5	+0.0	20.5	54.9	-34.4	Neutr
^	171.087k	32.0	+9.1 +0.4	+0.0	+0.0	-1.5	+0.0	40.0	54.9	-14.9	Neutr
^	173.996k	31.3	+9.1 +0.4	+0.0	+0.0	-1.4	+0.0	39.4	54.8	-15.4	Neutr
27 Ave	157.998k	12.3	+9.1 +0.7	+0.0	+0.0	-1.6	+0.0	20.5	55.6	-35.1	Neutr
^	157.998k	31.0	+9.1 +0.7	+0.0	+0.0	-1.6	+0.0	39.2	55.6	-16.4	Neutr
29 Ave	337.618k	5.1	+9.1 +0.1	+0.0	+0.0	-0.6	+0.0	13.7	49.3	-35.6	Neutr
^	337.618k	24.3	+9.1 +0.1	+0.0	+0.0	-0.6	+0.0	32.9	49.3	-16.4	Neutr

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**102803**	Date:	5/28/2020
Test Type:	**Conducted Emissions**	Time:	08:41:06
Tested By:	Michael Atkinson	Sequence#:	3
Software:	EMITest 5.03.12		115VAC 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

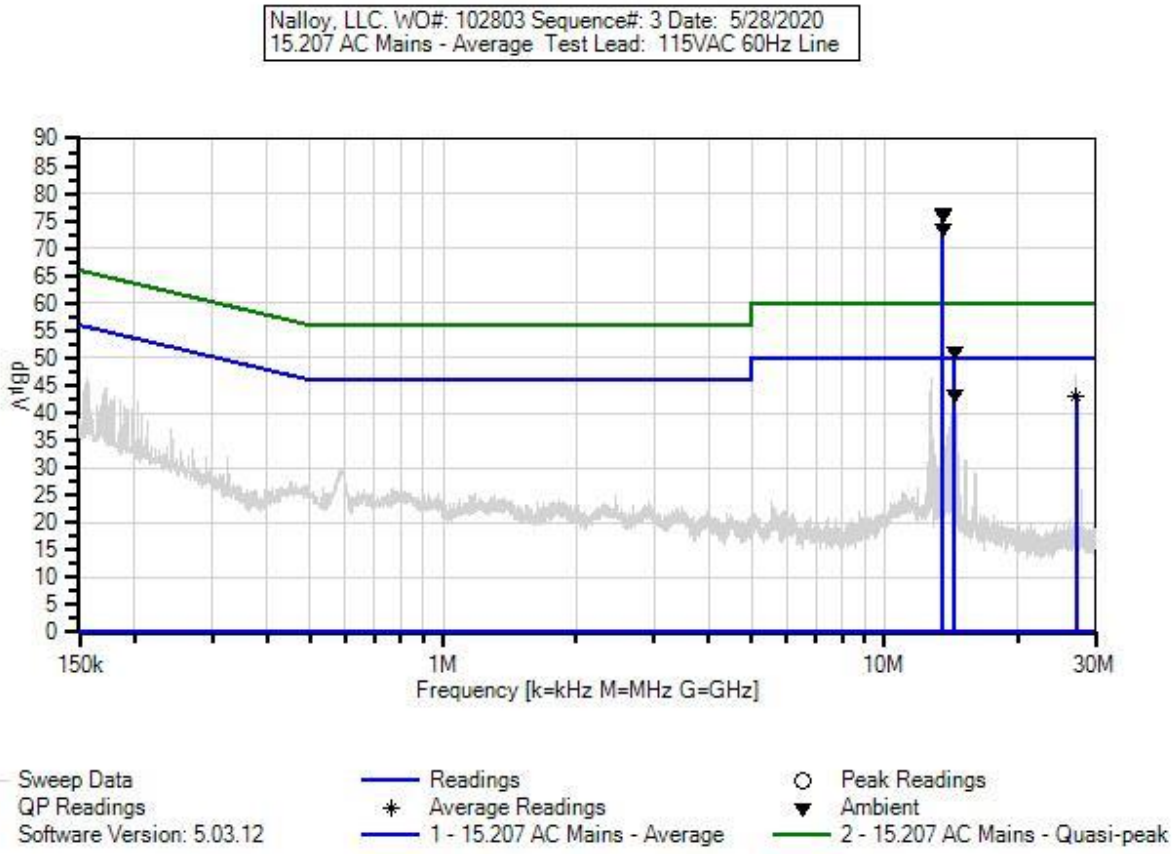
Temperature: 23°C
Humidity: 37%
Pressure: 101.6 kPa

Frequency Range: 0.15-30MHz

Test Method: ANSI C63.10 (2013)

Test Setup: EUT is setup 0.8 meters high on Styrofoam table.

Setup: NFC On. NFC I2C on. EEPROM on. Force test on. CPU Stress Test. Bluetooth poll test on. Fundamental of NFC transmitter marked as ambient and is to be ignored against this limit.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02611	High Pass Filter	HE9615-150K-50-720B	1/10/2020	1/10/2022
T2	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T3	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T4	ANP06219	Attenuator	768-10	4/7/2020	4/7/2022
	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
T5	AN01311	50uH LISN-Line1 (L)	3816/2	2/24/2020	2/24/2022
	AN01311	50uH LISN-Line2 (N)	3816/2	2/24/2020	2/24/2022

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	13.561M	67.4	+0.2	+0.0	+0.2	+9.1	+0.0	76.3	50.0	+26.3	Line
	Ambient		-0.6								
2	13.557M	67.1	+0.2	+0.0	+0.2	+9.1	+0.0	76.0	50.0	+26.0	Line
	Ambient		-0.6								
3	13.561M	64.7	+0.2	+0.0	+0.2	+9.1	+0.0	73.6	50.0	+23.6	Line
	Ambient		-0.6								
4	14.407M	42.4	+0.2	+0.0	+0.2	+9.1	+0.0	51.3	50.0	+1.3	Line
	Ambient		-0.6								
5	14.408M	34.3	+0.2	+0.0	+0.2	+9.1	+0.0	43.2	50.0	-6.8	Line
	Ambient		-0.6								
6	27.121M	34.2	+0.2	+0.1	+0.3	+9.1	+0.0	43.0	50.0	-7.0	Line
	Ave		-0.9								
^	27.120M	38.4	+0.2	+0.1	+0.3	+9.1	+0.0	47.2	50.0	-2.8	Line
			-0.9								

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE • Bothell, WA 98021 • 800-500-4362		
Customer:	**Nalloy, LLC.**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**102803**	Date:	5/28/2020
Test Type:	**Conducted Emissions**	Time:	08:45:30
Tested By:	Michael Atkinson	Sequence#:	4
Software:	EMITest 5.03.12		115VAC 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

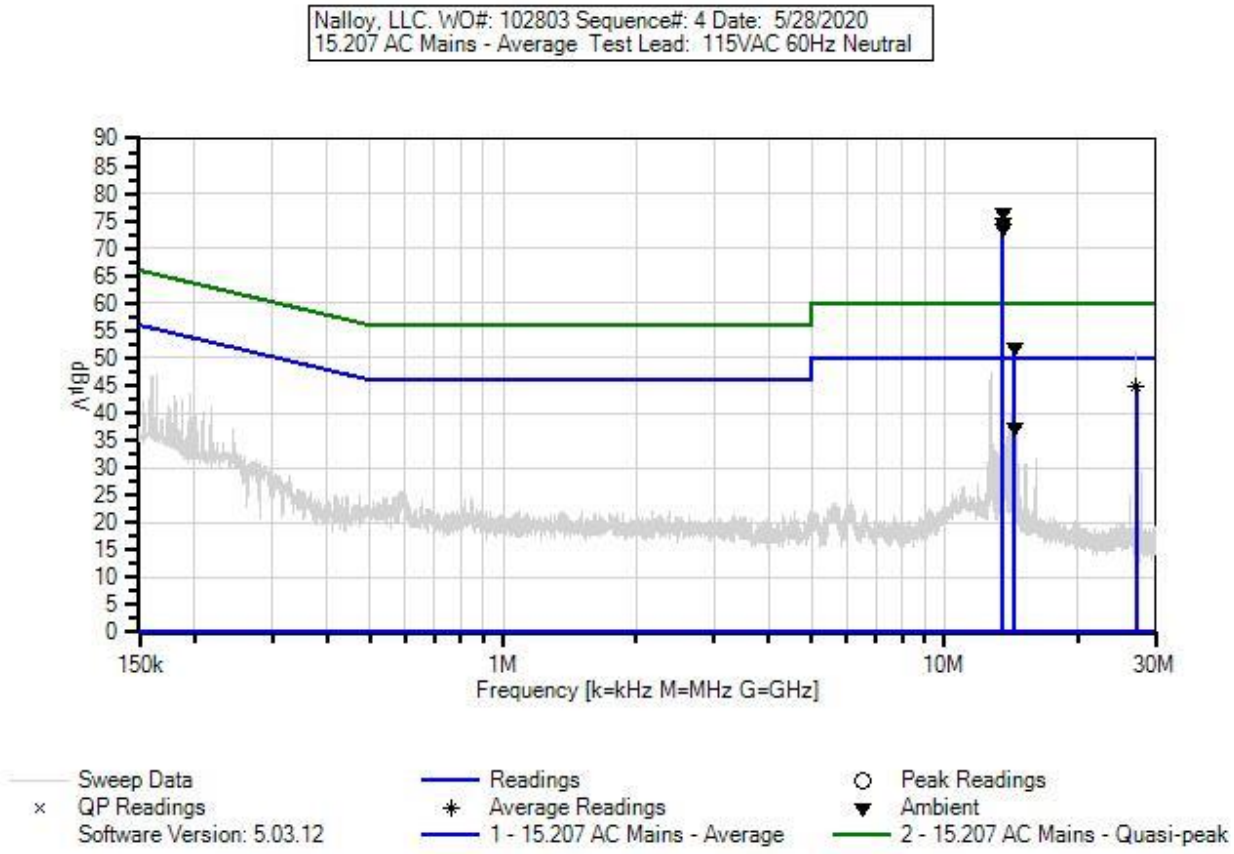
Temperature: 23°C
Humidity: 37%
Pressure: 101.6 kPa

Frequency Range: 0.15-30MHz

Test Method: ANSI C63.10 (2013)

Test Setup: EUT is setup 0.8 meters high on Styrofoam table.

Setup: NFC On. NFC I2C on. EEPROM on. Force test on. CPU Stress Test. Bluetooth poll test on. Fundamental of NFC transmitter marked as ambient and is to be ignored against this limit.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02611	High Pass Filter	HE9615-150K-50-720B	1/10/2020	1/10/2022
T2	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T3	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T4	ANP06219	Attenuator	768-10	4/7/2020	4/7/2022
	AN02872	Spectrum Analyzer	E4440A	11/18/2019	11/18/2021
	AN01311	50uH LISN-Line1 (L)	3816/2	2/24/2020	2/24/2022
T5	AN01311	50uH LISN-Line2 (N)	3816/2	2/24/2020	2/24/2022

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	13.561M	67.7	+0.2	+0.0	+0.2	+9.1	+0.0	76.6	50.0	+26.6	Neutr
	Ambient		-0.6								
2	13.557M	65.8	+0.2	+0.0	+0.2	+9.1	+0.0	74.7	50.0	+24.7	Neutr
	Ambient		-0.6								
3	13.561M	64.9	+0.2	+0.0	+0.2	+9.1	+0.0	73.8	50.0	+23.8	Neutr
	Ambient		-0.6								
4	14.356M	43.0	+0.2	+0.0	+0.2	+9.1	+0.0	51.9	50.0	+1.9	Neutr
	Ambient		-0.6								
5	27.121M	35.9	+0.2	+0.1	+0.3	+9.1	+0.0	44.7	50.0	-5.3	Neutr
	Ave		-0.9								
^	27.120M	42.6	+0.2	+0.1	+0.3	+9.1	+0.0	51.4	50.0	+1.4	Neutr
			-0.9								
7	14.354M	28.6	+0.2	+0.0	+0.2	+9.1	+0.0	37.5	50.0	-12.5	Neutr
	Ambient		-0.6								

Test Setup Photo(s)

Configuration 1

Configuration 1

Configuration 2

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.