Nalloy, LLC

TEST REPORT FOR

Model: VG8HYF

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(FHSS 902-928MHz)

Report No.: 106571-54

Date of issue: June 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

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-07565727

REPORT PREPARED BY:

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

Project Number: 106571

DATE OF EQUIPMENT RECEIPT: April 8, 2022
DATE(S) OF TESTING: April 8 - May 19, 2022 and June 14, 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.
Canyon Park
22116 23rd Drive S.E., Suite A
Bothell, WA 98021

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 (FHSS 902-928MHz)

Test Procedure	Description	Modifications	Results
15.247(a)(1)(i)	Occupied Bandwidth	NA	Pass
15.247(a)(1)	Carrier Separation	NA	Pass
15.247(a)(1)(i)	Number of Hopping Channels	NA	Pass
15.247(a)(1)(i)	Average Time of Occupancy	NA	Pass
15.247(b)(2)	Output Power	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 = The manufacturer declares the EUT does not have an external antenna port.
NA2 = The manufacturer declares the EUT is battery powered only.

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 Under Test:

Device	Manufacturer	Model #	S/N
NA	Nalloy, LLC.	VG8HYF	NA

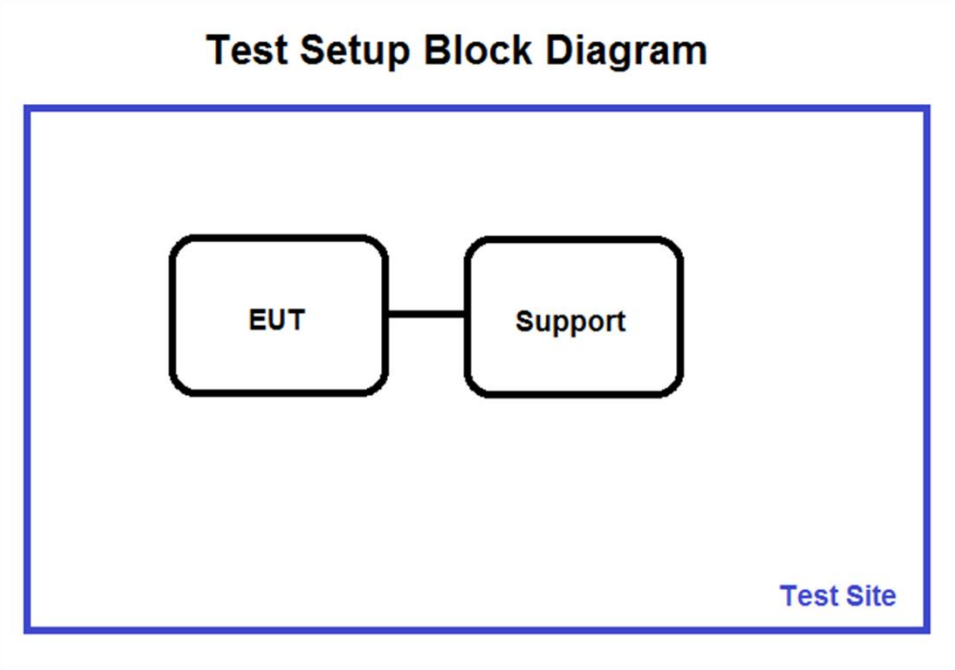
Support Equipment:

Device	Manufacturer	Model #	S/N
Battery	Luxshare	AWF28#*8C	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Type of Wideband System:	Proprietary FHSS
Operating Frequency Range:	902.4-927.6MHz
Number of Hopping Channels:	64
Receiver Bandwidth and Synchronization:	The manufacturer declares the receiver input bandwidth matches the transmit channel bandwidth and shifts frequencies in synchronization with the transmitter.
Modulation Type(s):	GFSK-2
Maximum Duty Cycle:	Assume 100% as worst case
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCBA / 5.6dBi Gain
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	Battery Powered, 5-24VDC Nominal
Firmware / Software used for Test:	Realterm 2.0.0.70 Rail test_v2.2.0
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)



FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison
Test Method:	ANSI C63.10 (2013)	Test Date(s):	4/8/2022 to 5/19/2022
Configuration:	1		
Test Setup:	EUT is continuously transmitting in the test chamber on a foam table 80cm high.		

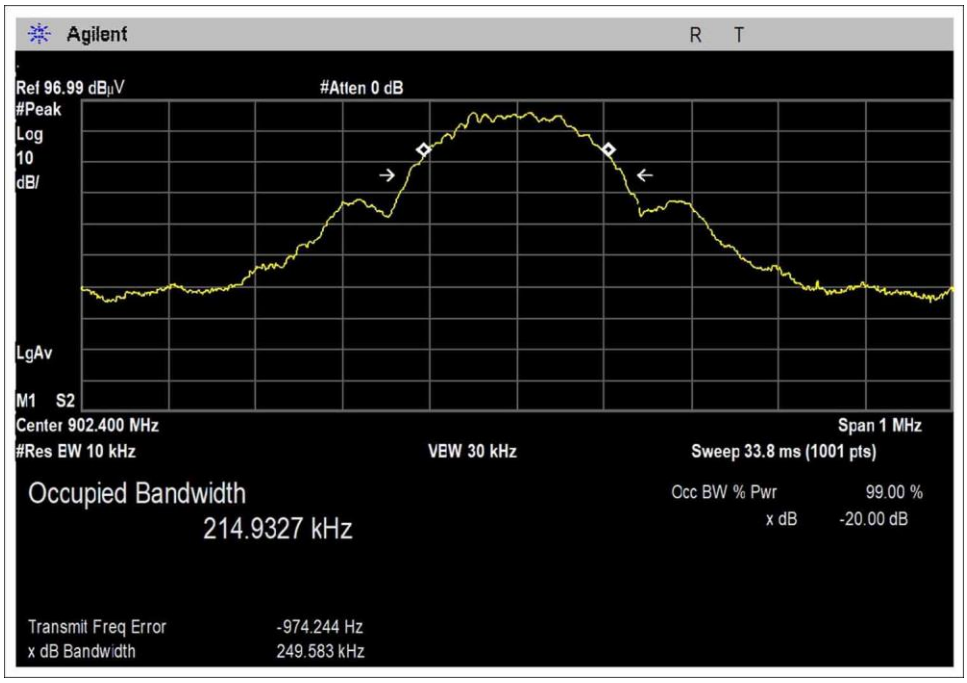
Environmental Conditions			
Temperature (ºC)	20-32	Relative Humidity (%):	35-45

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2021	2/3/2023
P06540	Cable	Andrews	Heliax	1/17/2022	1/17/2024
P06515	Cable	Andrews	Heliax	7/1/2020	7/1/2022
P05360	Cable	Belden	RG214	2/4/2022	2/4/2024
03628	Biconilog Antenna (Cal includes 6dB pad)	ETS	3142E	6/3/2021	6/3/2023

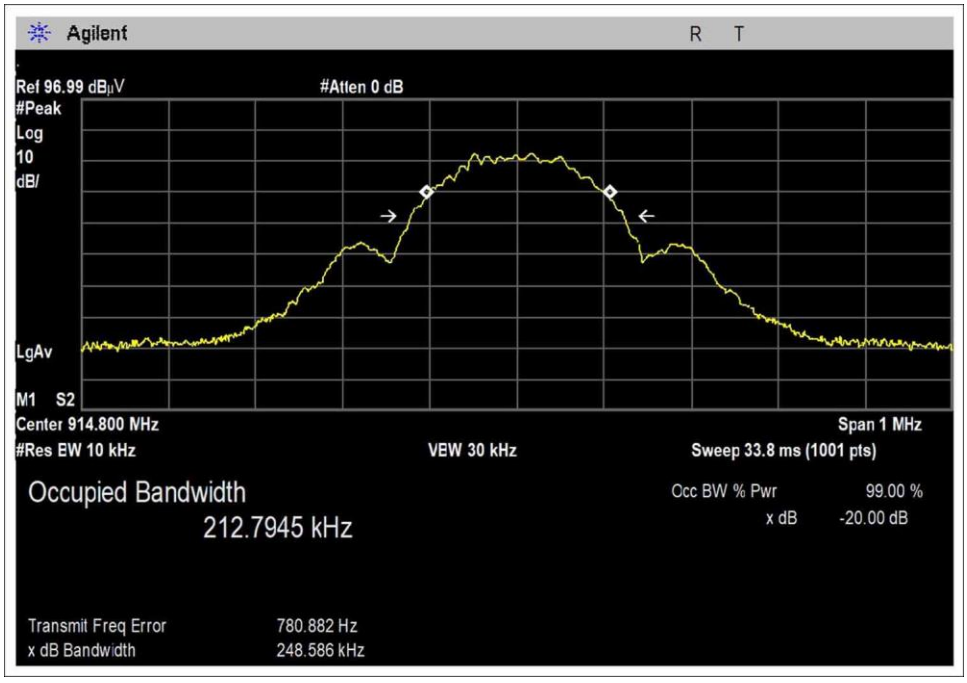
15.247(a)(1) 20 dB Bandwidth

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
902.4	1	GFSK-2	249.583	≤500	Pass
914.8	1	GFSK-2	248.586		
927.6	1	GFSK-2	248.918		

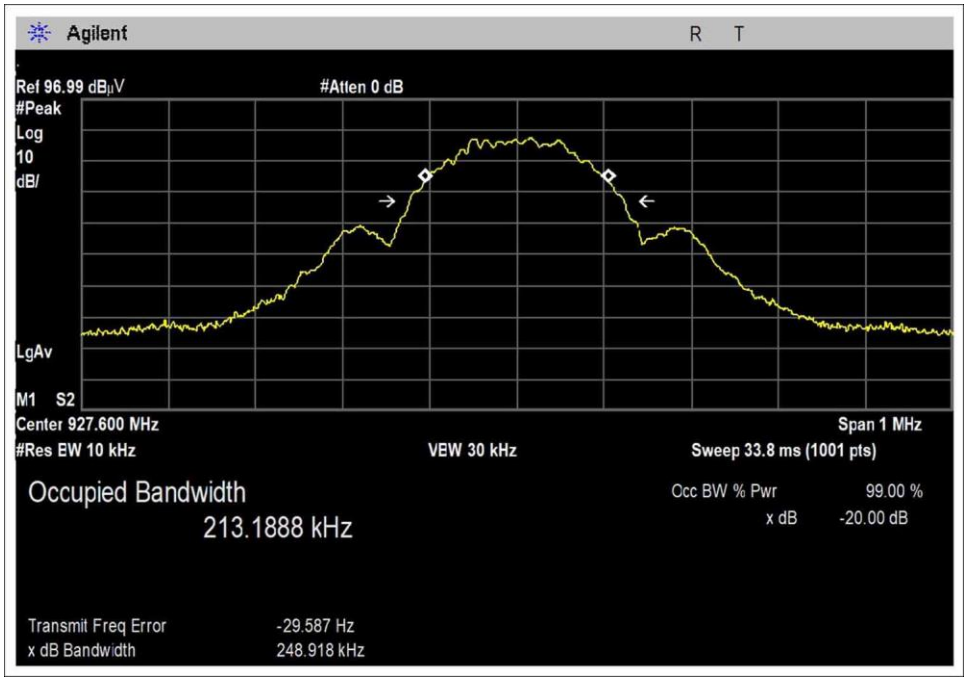
Plot(s)



Low Channel



Middle Channel

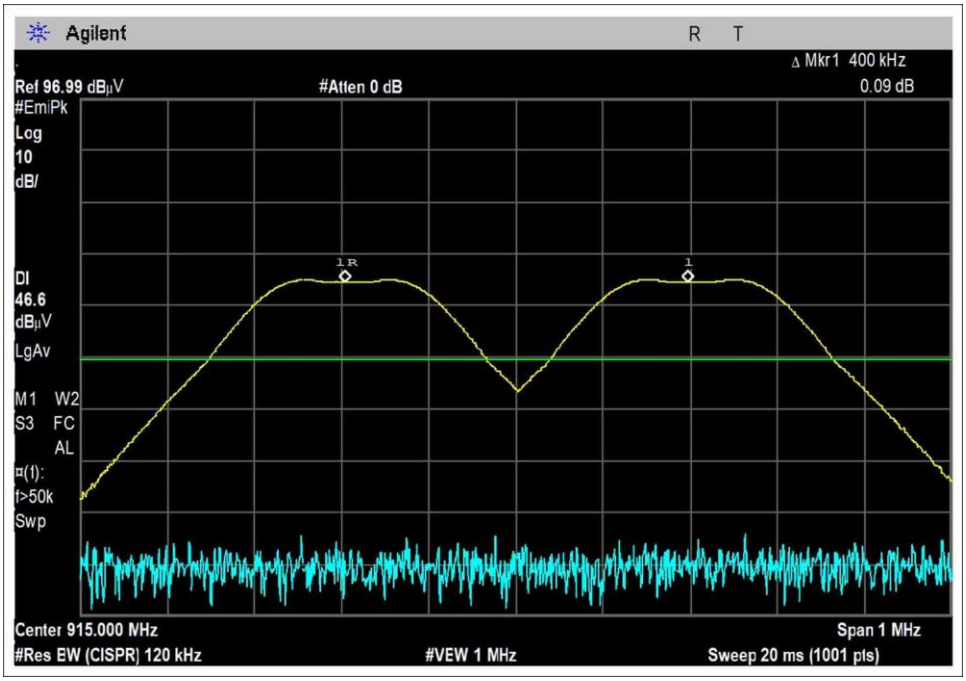


High Channel

15.247(a)(1) Carrier Separation

Test Data Summary				
Limit applied: 20dB bandwidth of the hopping channel.				
Antenna Port	**Operational Mode**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	Transmitting GFSK-2	400.0	>249.583	Pass

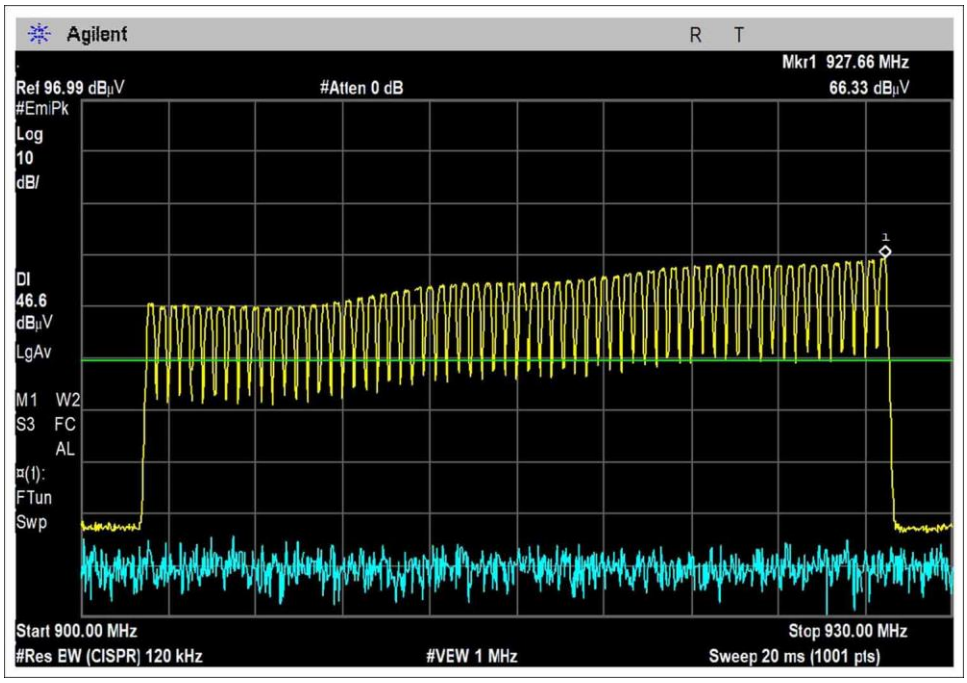
Plot(s)



15.247(a)(1)(iii) Number of Hopping Channels

Test Data Summary				
$Limit = \begin{cases} 50\ Channels \mid 20\ dB\ BW < 250kHz \\ 25\ Channels \mid 20\ dB\ BW \geq 250kHz \end{cases}$				
Antenna Port	**Operational Mode**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	Transmitting GFSK-2	64	≥50	Pass

Plot(s)



15.247(a)(1)(iii) Time of Occupancy

Test Data Summary				
Observation Period, P_{obs} is derived from the following: $P_{Obs} = \begin{cases} 20\ Seconds & 20\ dB\ BW < 250kHz \\ 10\ Seconds & 20\ dB\ BW \geq 250kHz \end{cases}$				
Antenna Port	**Operational Mode**	**Measured (ms)**	**Limit (ms/P_{obs})**	**Results**
1	Transmitting	87.6	≤400	Pass

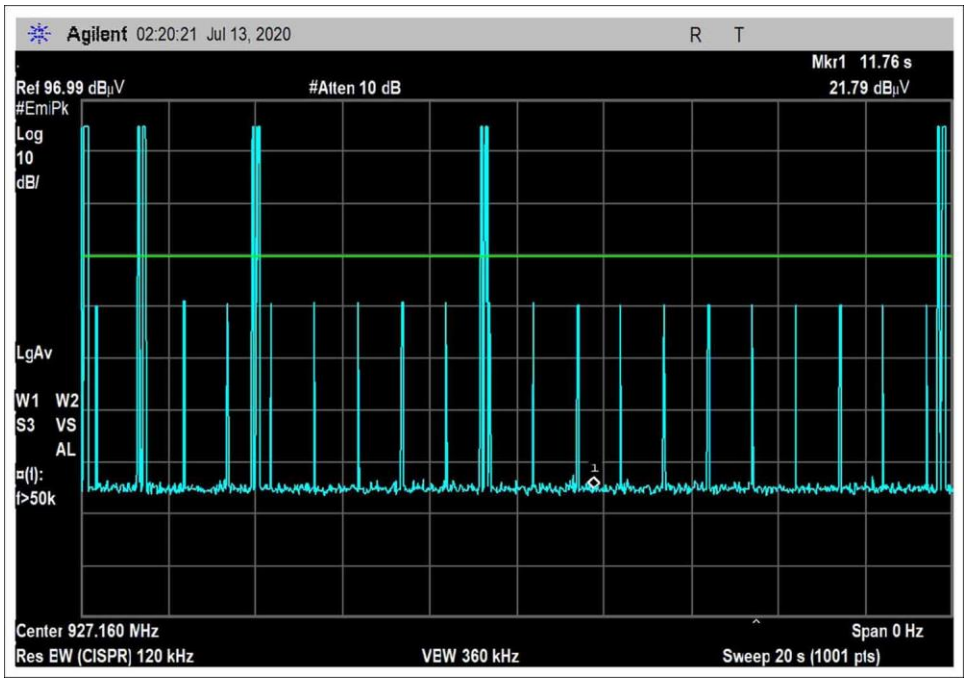
Measured results are calculated as follows:

$$Dwell\ time = \left(\sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right)\Big|_{P_{obs}}$$

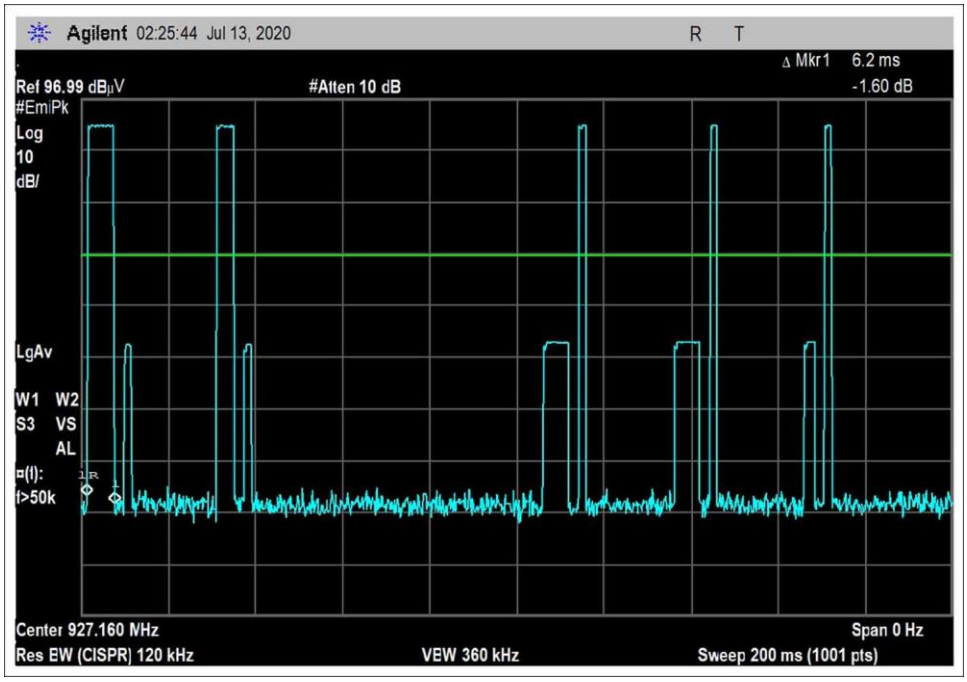
Actual Calculated Values:

Parameter	Value
Observation Period (P_{obs}):	20s
Number of RF Bursts / P_{obs}:	5
On time of RF Burst:	17.52
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	87.6

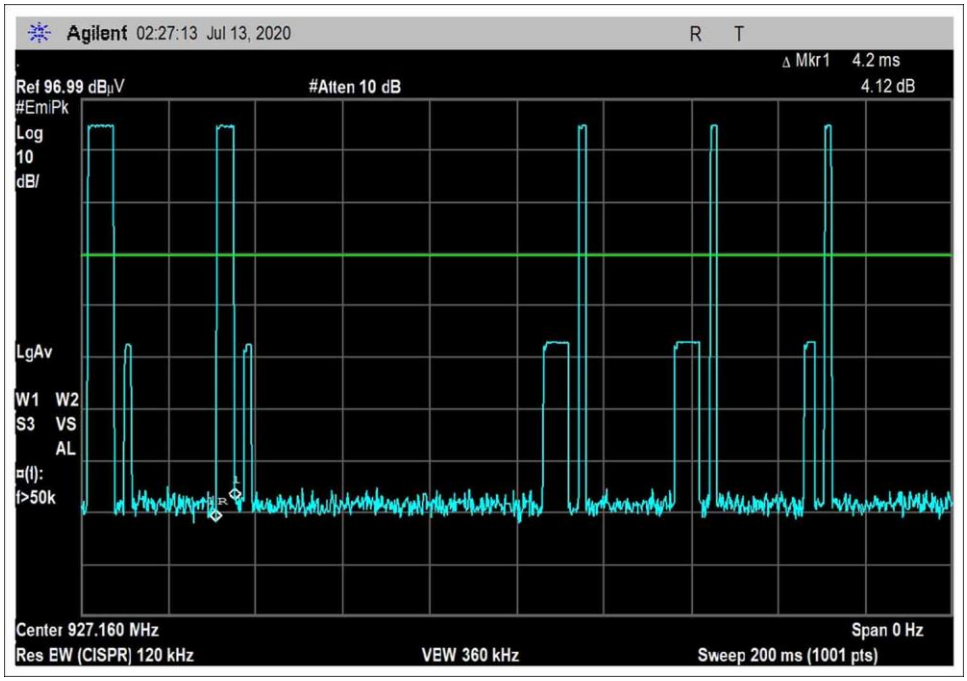
Plot(s)



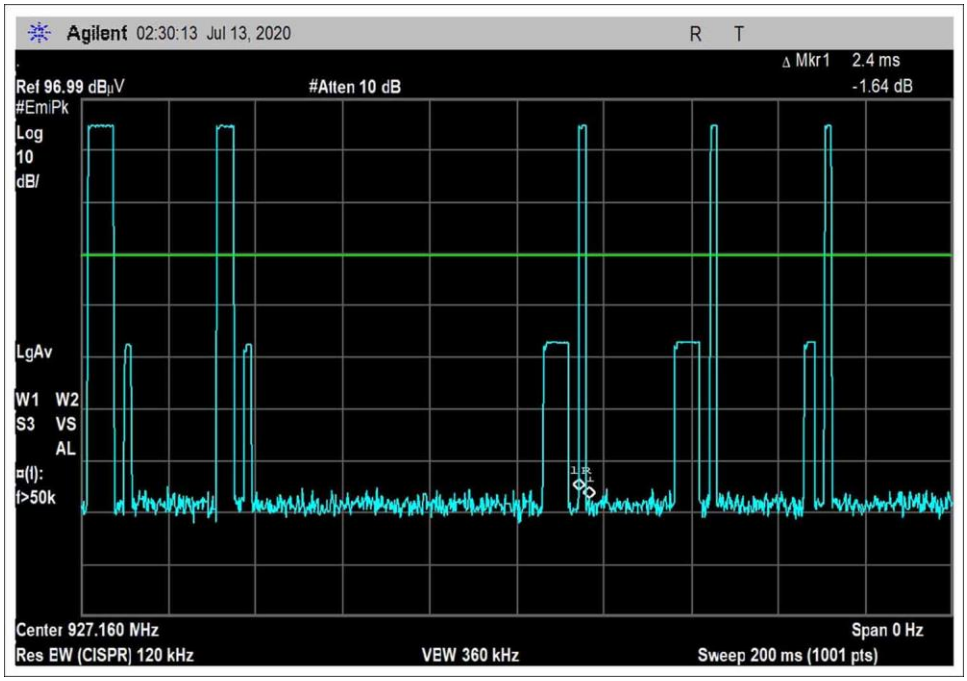
20s



Pulse 1



Pulse 2



Pulse 3

15.247(b)(2) Output Power

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03515	Multimeter	Fluke	87	12/3/2020	12/3/2022
AN02673	Spectrum Analyzer	Agilent	E4446A	2/3/2021	2/3/2023
AN03628	Biconilog Antenna	ETS	3142E	6/3/2021	6/3/2023
ANP05360	Cable	Belden	RG214	2/4/2022	2/4/2024
ANP06515	Cable	Andrews	Heliax	7/1/2020	7/1/2022
ANP06540	Cable	Andrews	Heliax	1/17/2022	1/17/2024

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)**
902.4	GFSK-2	14.0	14.0	14.0	0.0
914.8	GFSK-2	13.3	13.3	13.3	0.0
927.6	GFSK-2	13.1	13.1	13.1	0.0

The fundamental was evaluated with a fresh battery installed and for voltage variation testing, where an external power supply was used to vary the voltage ±15% from the manufacture's supported range of 5 to 24VDC for the externally powered configuration.

Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
$V_{Nominal}$:	Fresh Battery (3.3VDC)
$V_{Minimum}$:	4.25VDC
$V_{Maximum}$:	27.6VDC

Test Data Summary - Voltage Variations

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

Test Data Summary - Radiated Measurement						
$Limit = \begin{cases} 30dBm\ Conducted/36dBm\ EIRP \mid \geq 50\ Channels \\ 24dBm\ Conducted/30dBm\ EIRP \mid < 50\ Channels\ (\min 25) \end{cases}$						
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Field Strength (dBuV/m @3m)**	**Calculated (dBm)**	**Limit (dBm)**	**Results**
902.4	GFSK-2	PCBA / 5.6dBi Gain	114.8	14.0	≤30	Pass
914.8	GFSK-2	PCBA / 5.6dBi Gain	114.1	13.3	≤30	Pass
927.6	GFSK-2	PCBA / 5.6dBi Gain	113.9	13.1	≤30	Pass

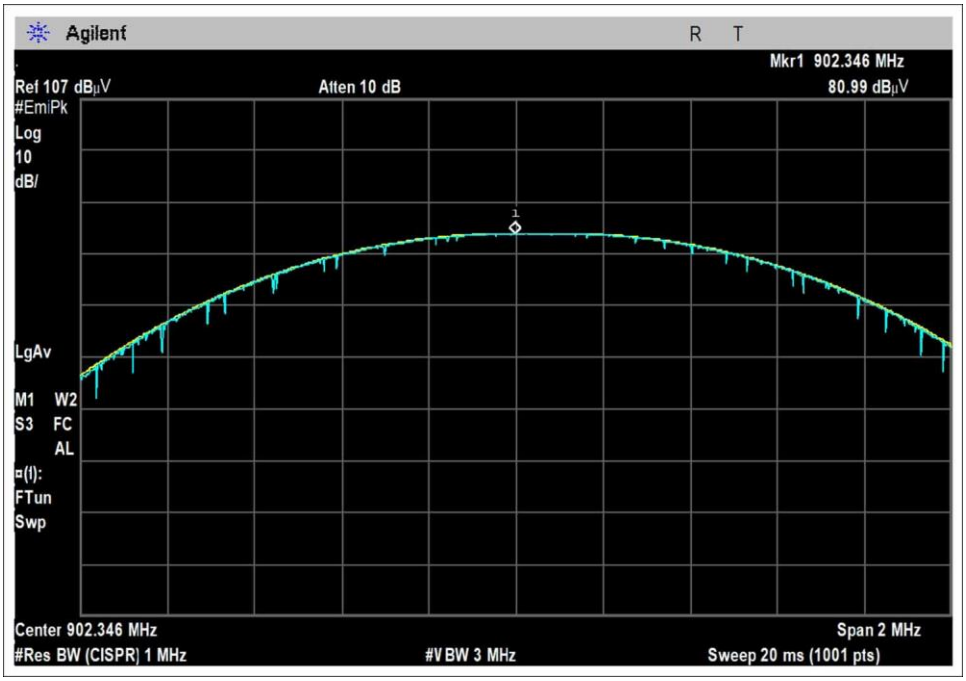
Conducted RF output power calculated in accordance with ANSI C63.10.

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

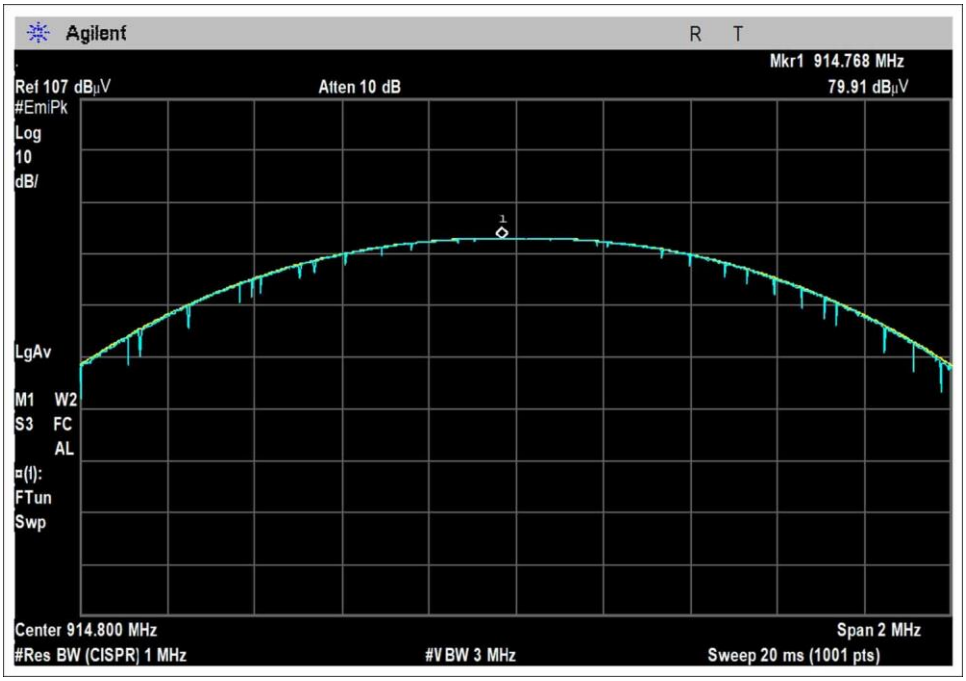
Or equivalently, in logarithmic form:

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

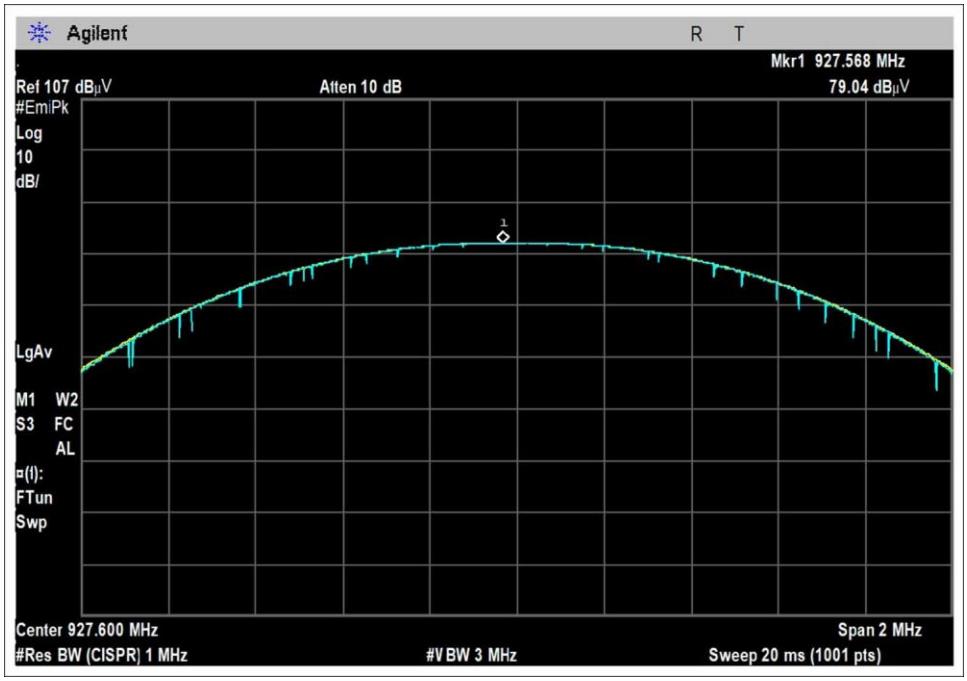
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717		
Customer:	**Nalloy, LLC**		
Specification:	**15.247(b) Power Output (902-928 MHz FHSS >50 Channels)**		
Work Order #:	**106571**	Date:	6/14/2022
Test Type:	**Radiated Scan**	Time:	16:45:33
Tested By:	Matt Harrison/Mike Atkinson	Sequence#:	4
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:

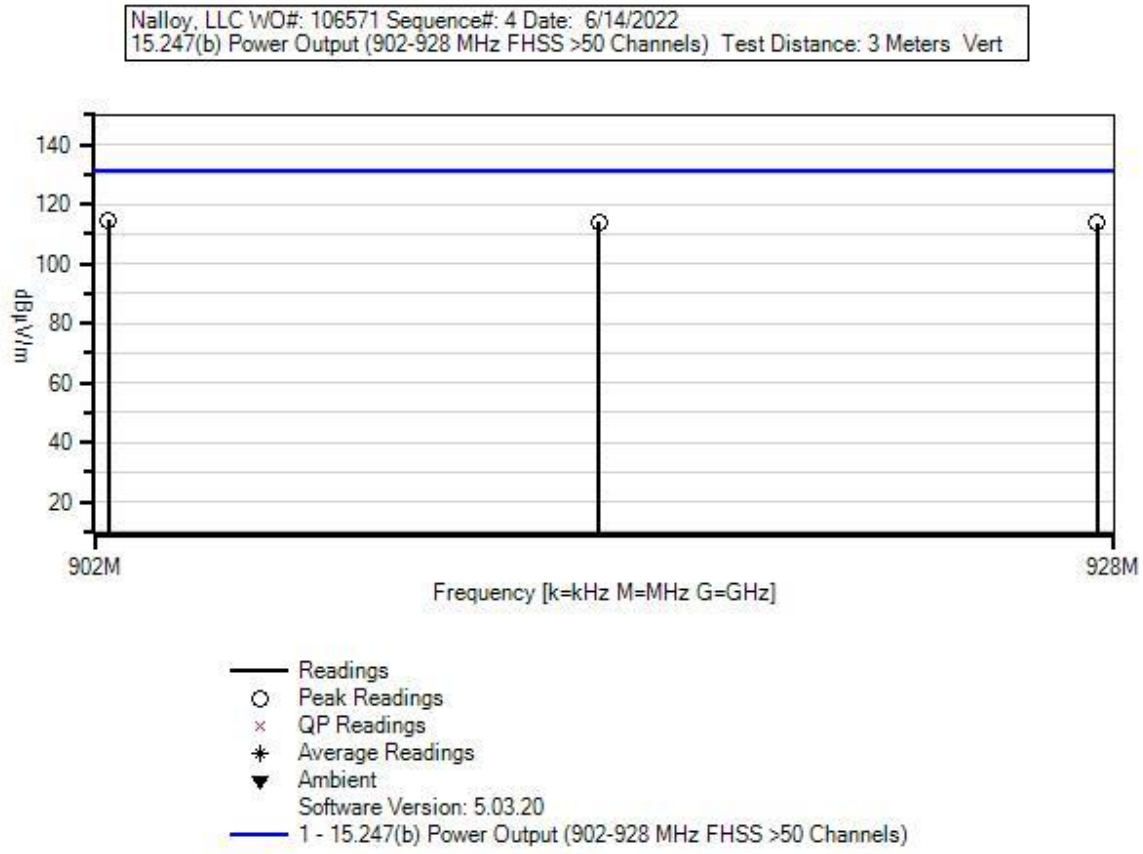
Environmental Conditions:
Temperature: 20°C to 23°C
Humidity: 33-45%
Pressure: 102.0-102.1kPa

Method: ANSI C63.10: 2013

Frequency range: Fundamental

Setup:
Continuously Transmitting
Antenna 1
Channels measured: (0) 902.4 MHz, (31) 914.8MHz High (63) 927.6MHz

The equipment was evaluated with a fresh battery installed, and voltage variations were performed with an external power supply.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02673	Spectrum Analyzer	E4446A	2/3/2021	2/3/2023
T1	AN03628	Biconilog Antenna	3142E	6/3/2021	6/3/2023
T2	ANP05360	Cable	RG214	2/4/2022	2/4/2024
T3	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
T4	ANP06540	Cable	Heliax	1/17/2022	1/17/2024

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

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	902.346M	81.0	+29.6	+2.3	+1.6	+0.3	+0.0	114.8	131.2	-16.4	Vert
2	914.768M	79.9	+29.9	+2.4	+1.6	+0.3	+0.0	114.1	131.2	-17.1	Vert
3	927.568M	79.0	+30.6	+2.4	+1.6	+0.3	+0.0	113.9	131.2	-17.3	Vert

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717		
Customer:	**Nalloy, LLC**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106571**	Date:	4/11/2022
Test Type:	**Maximized Emissions**	Time:	12:48:39
Tested By:	Michael Atkinson / Matt Harrison	Sequence#:	1
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

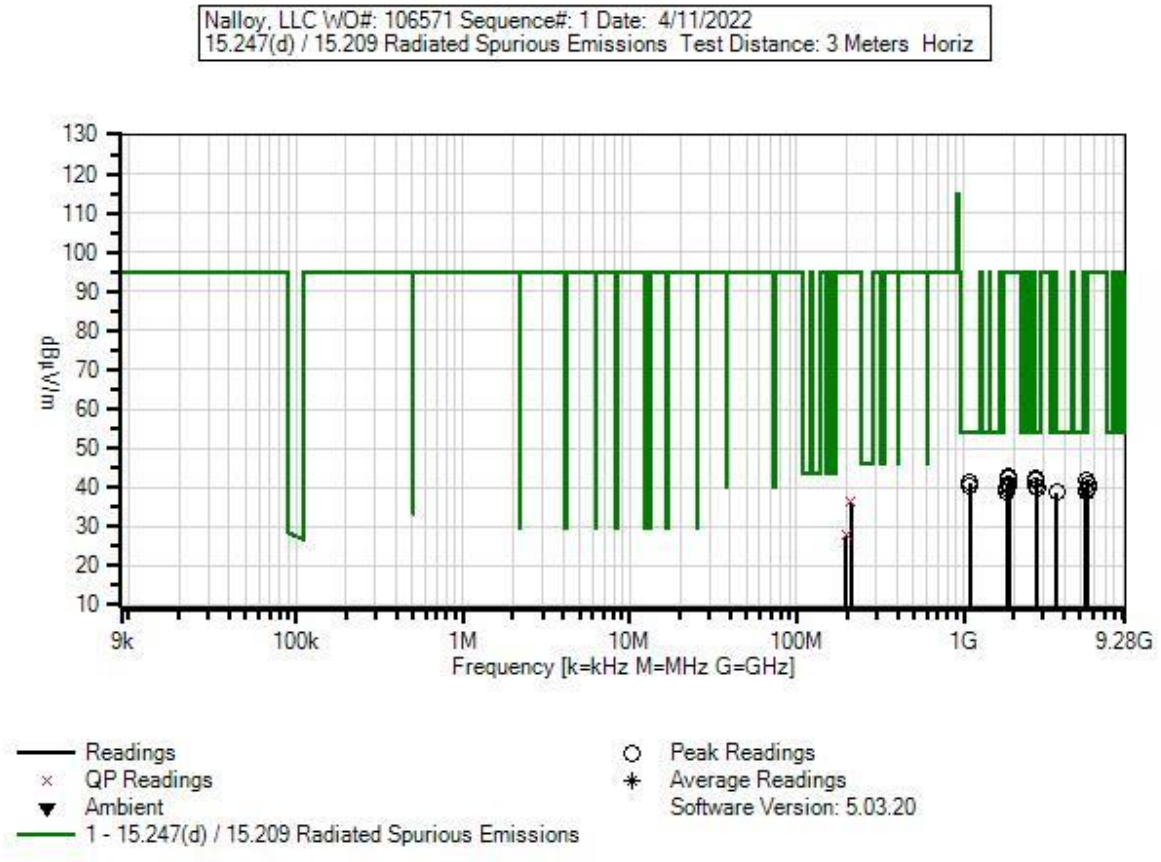
Environmental Conditions:
Temperature: 21°C
Humidity: 44%
Pressure: 102.1kPa

Method: ANSI C63.10: 2013

Frequency range: 9k-10GHz

Setup:
AoH
Tx Spurs

Notes:
No emissions found within 20dB of the limit below 30MHz.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02673	Spectrum Analyzer	E4446A	2/3/2021	2/3/2023
T2	ANP06540	Cable	Heliax	1/17/2022	1/17/2024
T3	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
T4	AN03540	Preamp	83017A	5/14/2021	5/14/2023
T5	ANP07504	Cable	CLU40-KMKM-02.00F	1/26/2021	1/26/2023
T6	AN02374ANSI	Horn Antenna	RGA-60	5/25/2021	5/25/2023
T7	AN03170	High Pass Filter	HM1155-11SS	9/16/2021	9/16/2023
T8	AN02307	Preamp	8447D	1/6/2022	1/6/2024
T9	AN03628	Biconilog Antenna	3142E	6/3/2021	6/3/2023
T10	ANP05360	Cable	RG214	2/4/2022	2/4/2024
	AN00052	Loop Antenna	6502	5/4/2020	5/4/2022

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

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2700.000M	42.8	+0.0 +0.5 +0.0	+0.5 +29.5 +0.0	+2.9 +0.2	-34.1 +0.0	+0.0	42.3	54.0 not a harmonic	-11.7	Vert
2	2700.060M	42.2	+0.0 +0.5 +0.0	+0.5 +29.5 +0.0	+2.9 +0.2	-34.1 +0.0	+0.0	41.7	54.0 not a harmonic	-12.3	Vert
3	1081.000M	43.6	+0.0 +0.2 +0.0	+0.3 +24.4 +0.0	+1.8 +7.6	-36.6 +0.0	+0.0	41.3	54.0	-12.7	Horiz
4	1090.000M	44.4	+0.0 +0.2 +0.0	+0.3 +24.5 +0.0	+1.8 +5.9	-36.6 +0.0	+0.0	40.5	54.0	-13.5	Vert
5	2707.250M	40.7	+0.0 +0.5 +0.0	+0.5 +29.5 +0.0	+2.9 +0.2	-34.1 +0.0	+0.0	40.2	54.0 Low	-13.8	Horiz
6	2744.450M	40.7	+0.0 +0.5 +0.0	+0.5 +29.3 +0.0	+2.9 +0.3	-34.1 +0.0	+0.0	40.1	54.0 Mid	-13.9	Horiz
7	5414.070M	32.2	+0.0 +0.6 +0.0	+0.8 +34.7 +0.0	+4.3 +0.4	-33.6 +0.0	+0.0	39.4	54.0 Low	-14.6	Horiz
8	5414.620M	31.6	+0.0 +0.6 +0.0	+0.8 +34.7 +0.0	+4.3 +0.4	-33.6 +0.0	+0.0	38.8	54.0 Low	-15.2	Vert
9	3609.650M	36.1	+0.0 +0.4 +0.0	+0.5 +31.7 +0.0	+3.4 +0.3	-33.8 +0.0	+0.0	38.6	54.0 Low	-15.4	Horiz
10	1855.350M	46.1	+0.0 +0.3 +0.0	+0.4 +27.7 +0.0	+2.4 +0.6	-34.7 +0.0	+0.0	42.8	94.7 High	-51.9	Horiz
11	1855.350M	45.7	+0.0 +0.3 +0.0	+0.4 +27.7 +0.0	+2.4 +0.6	-34.7 +0.0	+0.0	42.4	94.7 High	-52.3	Vert
12	5488.400M	34.5	+0.0 +0.5 +0.0	+0.8 +34.7 +0.0	+4.4 +0.4	-33.6 +0.0	+0.0	41.7	94.7 Mid	-53.0	Horiz
13	1829.500M	44.2	+0.0 +0.3 +0.0	+0.4 +27.5 +0.0	+2.4 +0.6	-34.7 +0.0	+0.0	40.7	94.7 Mid	-54.0	Vert
14	5563.350M	33.6	+0.0 +0.5 +0.0	+0.8 +34.5 +0.0	+4.4 +0.5	-33.6 +0.0	+0.0	40.7	94.7 High	-54.0	Vert
15	1829.650M	43.7	+0.0 +0.3 +0.0	+0.4 +27.5 +0.0	+2.4 +0.6	-34.7 +0.0	+0.0	40.2	94.7 Mid	-54.5	Horiz

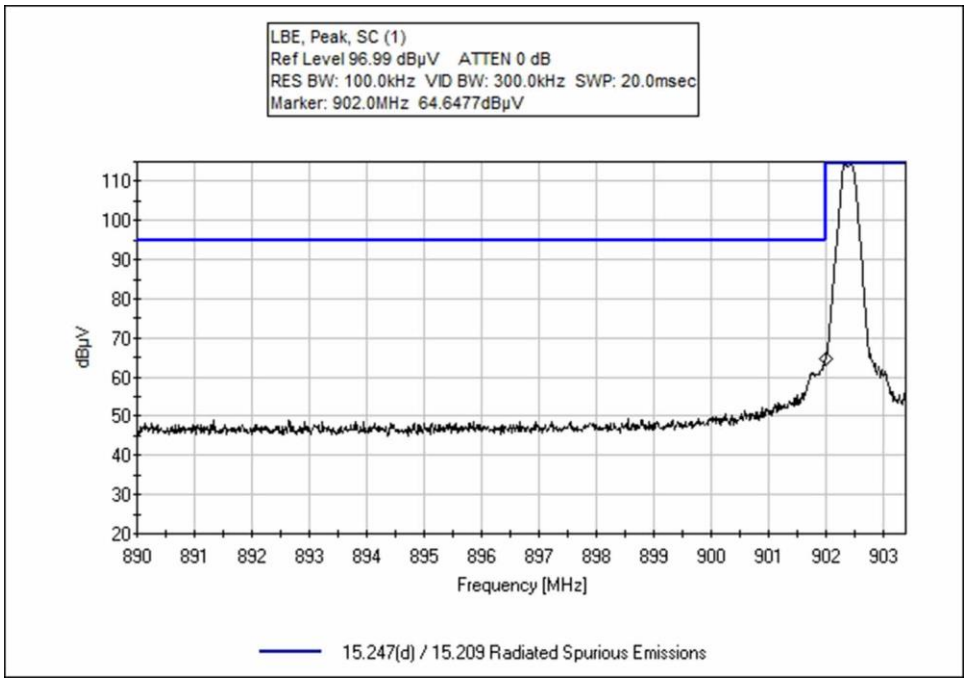
16	1804.690M	43.8	+0.0	+0.4	+2.3	-34.7	+0.0	40.0	94.7	-54.7	Vert
			+0.3	+27.3	+0.6	+0.0			Low		
			+0.0	+0.0							
17	5565.750M	32.7	+0.0	+0.8	+4.4	-33.6	+0.0	39.8	94.7	-54.9	Horiz
			+0.5	+34.5	+0.5	+0.0			High		
			+0.0	+0.0							
18	5488.700M	32.4	+0.0	+0.8	+4.4	-33.6	+0.0	39.6	94.7	-55.1	Vert
			+0.5	+34.7	+0.4	+0.0			Mid		
			+0.0	+0.0							
19	1804.894M	42.5	+0.0	+0.4	+2.3	-34.7	+0.0	38.7	94.7	-56.0	Horiz
			+0.3	+27.3	+0.6	+0.0			Low		
			+0.0	+0.0							
20	210.364M	45.1	+0.0	+0.1	+0.7	+0.0	+0.0	36.1	94.7	-58.6	Horiz
	QP		+0.0	+0.0	+0.0	-27.2					
			+16.5	+0.9							
^	210.364M	56.1	+0.0	+0.1	+0.7	+0.0	+0.0	47.1	94.7	-47.6	Horiz
			+0.0	+0.0	+0.0	-27.2					
			+16.5	+0.9							
22	196.878M	37.6	+0.0	+0.1	+0.7	+0.0	+0.0	27.7	94.7	-67.0	Horiz
	QP		+0.0	+0.0	+0.0	-27.3					
			+15.7	+0.9							
^	196.878M	51.3	+0.0	+0.1	+0.7	+0.0	+0.0	41.4	94.7	-53.3	Horiz
			+0.0	+0.0	+0.0	-27.3					
			+15.7	+0.9							

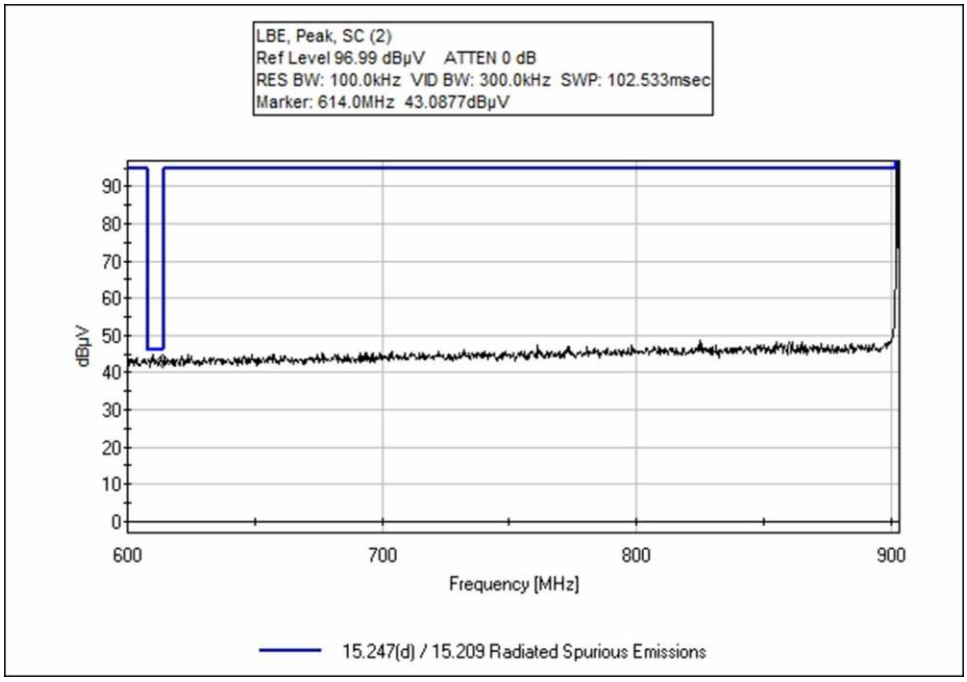
Band Edge

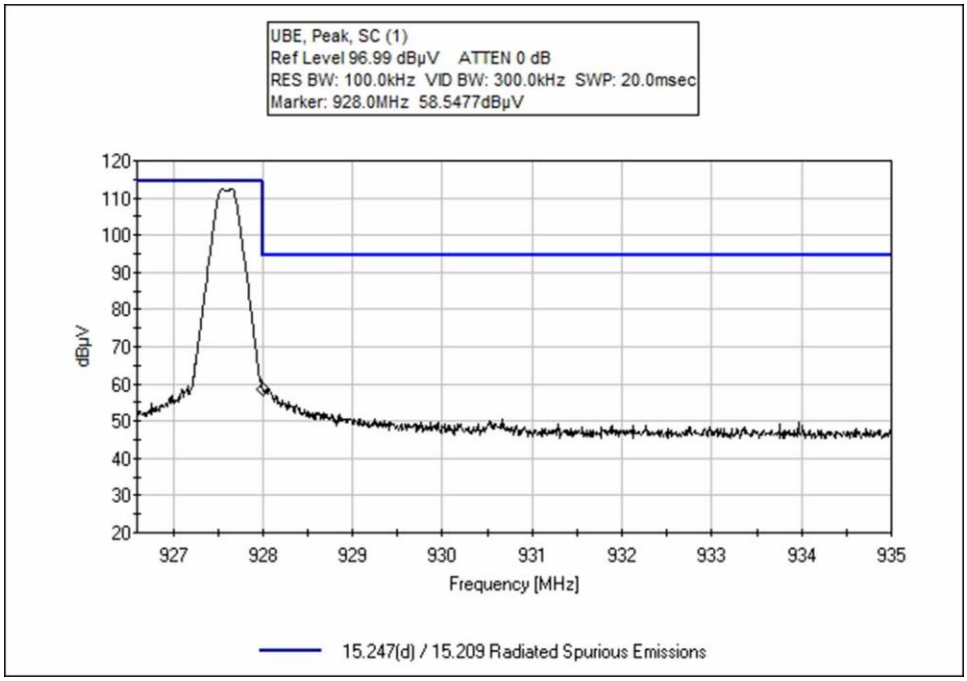
Band Edge Summary					
Operating Mode: Single Channel (Low and High)					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
614	GFSK-2	PCBA	39.5	< 46	Pass
902	GFSK-2	PCBA	64.6	< 94.7	Pass
928	GFSK-2	PCBA	58.5	< 94.7	Pass
960	GFSK-2	PCBA	45.7	< 54	Pass

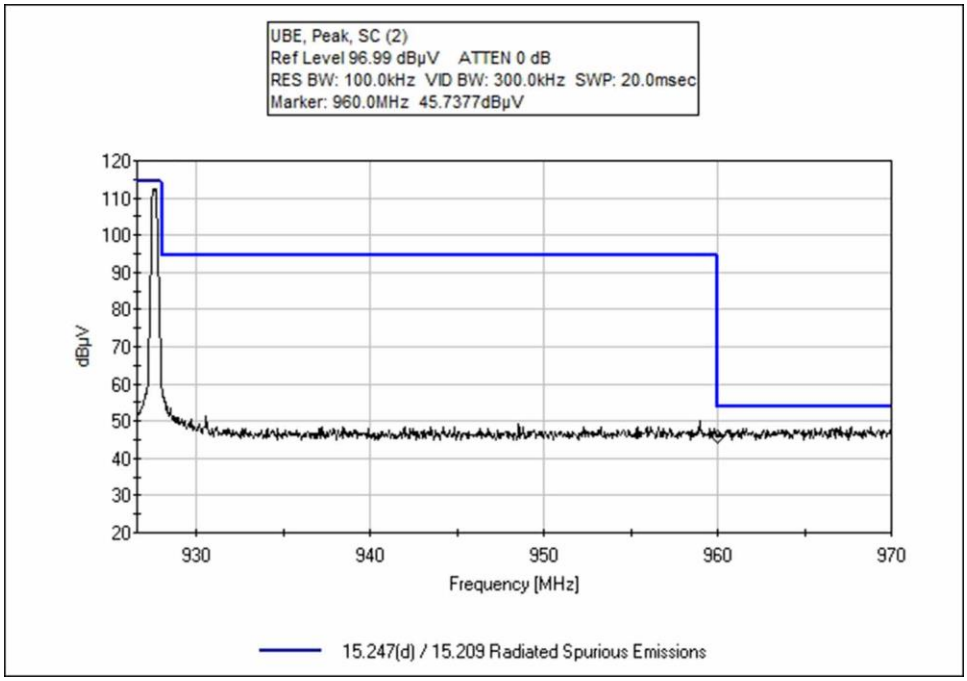
Band Edge Summary					
Operating Mode: Hopping					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
614	GFSK-2	PCBA	39.5	< 46	Pass
902	GFSK-2	PCBA	65.0	< 94.7	Pass
928	GFSK-2	PCBA	60.3	< 94.7	Pass
960	GFSK-2	PCBA	47.8	< 54	Pass

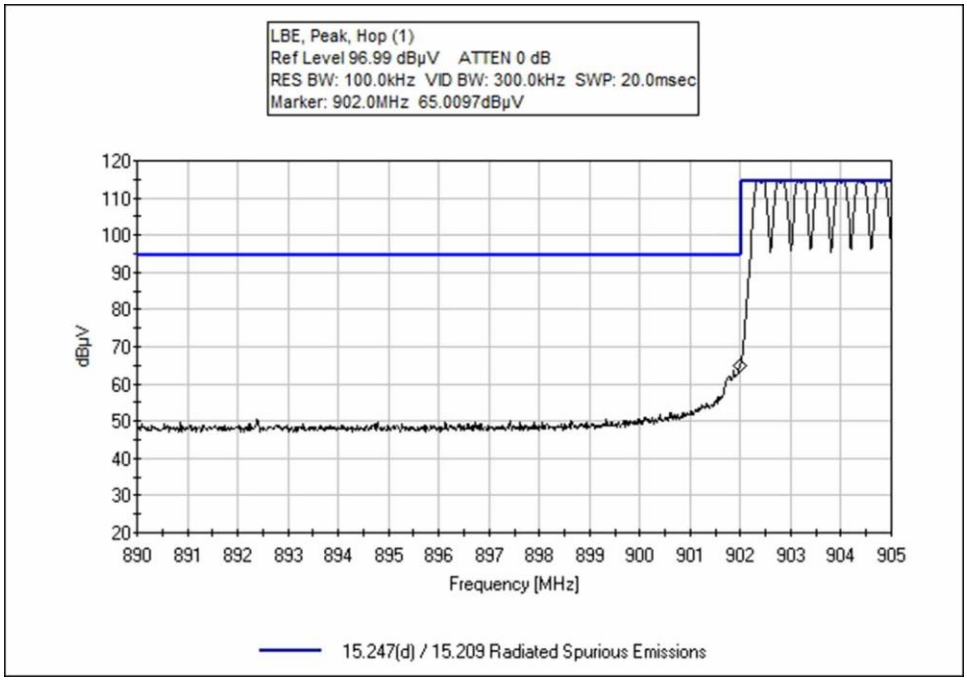
Band Edge Plots

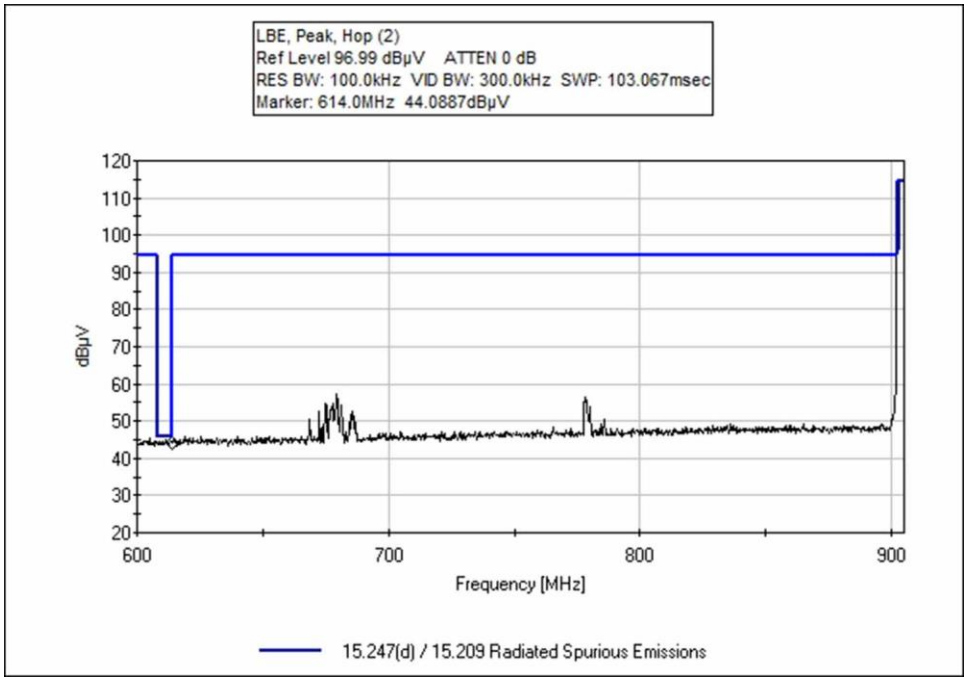


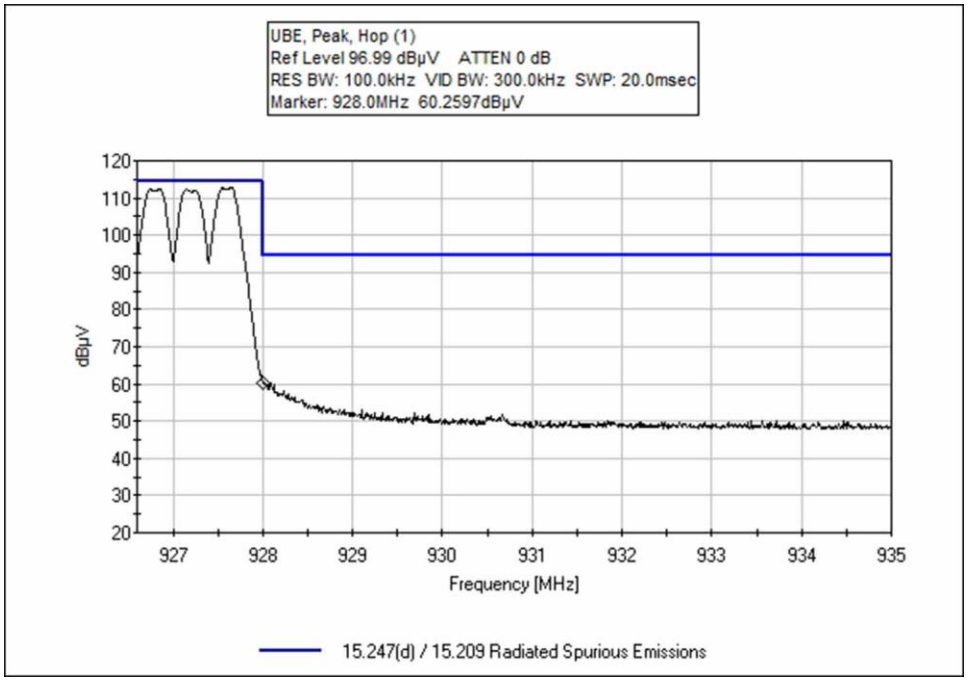


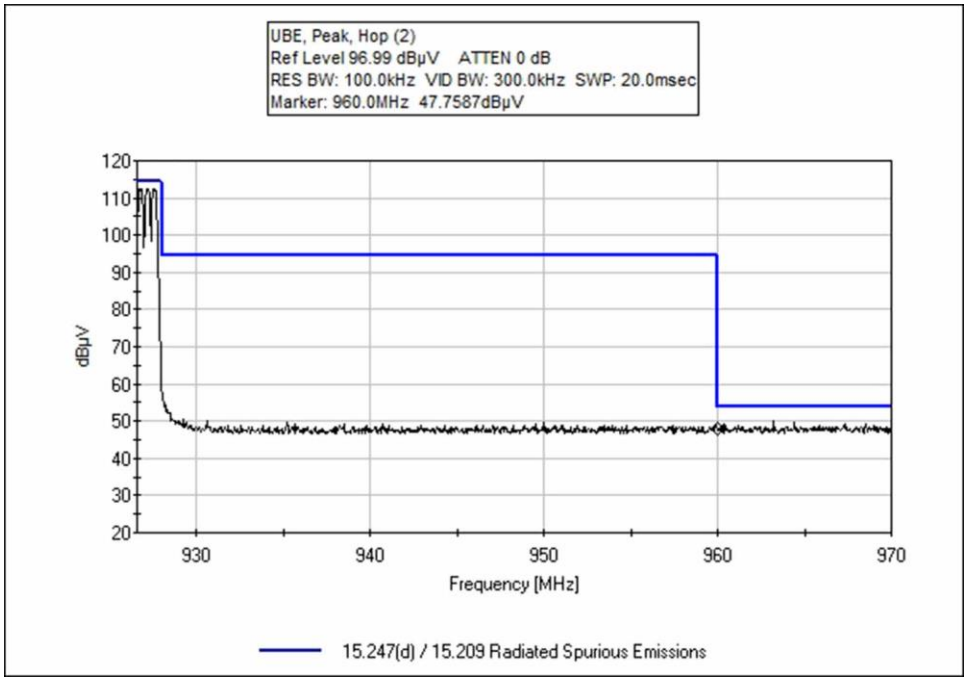

UBE, Peak, SC (1)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 928.0MHz 58.5477dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


UBE, Peak, SC (2)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 960.0MHz 45.7377dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


LBE, Peak, Hop (1)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 902.0MHz 65.0097dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


LBE, Peak, Hop (2)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 103.067msec
Marker: 614.0MHz 44.0887dBµV
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


UBE, Peak, Hop (1)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 928.0MHz 60.2597dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
20
927
928
929
930
931
932
933
934
935
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


UBE, Peak, Hop (2)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 20.0msec
Marker: 960.0MHz 47.7587dBµV
dBµV
120
110
100
90
80
70
60
50
40
30
20
930
940
950
960
970
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717		
Customer:	**Nalloy, LLC**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**106571**	Date:	4/11/2022
Test Type:	**Radiated Scan**	Time:	10:55:59
Tested By:	Matt Harrison	Sequence#:	3
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Environmental Conditions:
Temperature: 20°C
Humidity: 33%
Pressure: 102.1kPa

Method: ANSI C63.10: 2013

Frequency range: 600-970 MHz

Setup:
Continuously Transmitting
Antenna 1
Channels measured: (0) 902.4 MHz, High (63) 927.6MHz

Notes:
Correct factors loaded directly into PSA to display corrected plots.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02673	Spectrum Analyzer	E4446A	2/3/2021	2/3/2023
	AN03628	Biconilog Antenna	3142E	6/3/2021	6/3/2023
	ANP05360	Cable	RG214	2/4/2022	2/4/2024
	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
	ANP06540	Cable	Heliax	1/17/2022	1/17/2024

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

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	960.000M	47.8					+0.0	47.8	54.0 Hop	-6.2	Horiz
2	614.000M QP	39.5					+0.0	39.5	46.0 Hop	-6.5	Horiz
3	614.000M QP	39.5					+0.0	39.5	46.0 SC	-6.5	Horiz
^	614.000M	44.1					+0.0	44.1	46.0 Hop	-1.9	Horiz
^	614.000M	43.1					+0.0	43.1	46.0 SC	-2.9	Horiz
6	960.000M	45.7					+0.0	45.7	54.0 SC	-8.3	Horiz
7	902.000M	65.0					+0.0	65.0	94.7 Hop	-29.7	Horiz
8	902.000M	64.6					+0.0	64.6	94.7 SC	-30.1	Horiz
9	928.000M	60.3					+0.0	60.3	94.7 Hop	-34.4	Horiz
10	928.000M	58.5					+0.0	58.5	94.7 SC	-36.2	Horiz

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.