Nalloy, LLC

REVISED TEST REPORT TO 104760-44

YRP0R7

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247 (FHSS 902-928MHz)

Report No.: 104760-44A

Date of issue: June 23, 2021



written consent of CKC Laboratories, Inc.

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:

Nalloy, LLC 2301 5th Avenue Seattle, WA 98108 **REPORT PREPARED BY:**

Terri Rayle CKC Laboratories, Inc. 5046 Sierra Pines Drive Mariposa, CA 95338

Representative: Naga Suryadevara Customer Reference Number: 2D-04568090

DATE OF EQUIPMENT RECEIPT: DATE(S) OF TESTING: Project Number: 104760

May 14, 2021 May 14 and 21, 2021

Revision History

Original: Testing of the YRPOR7 to FCC Part 15 Subpart C Section(s) 15.207 & 15.247 (FHSS 902-928MHz). **Revision A:** To replace the test setup photos to clarify the EUT from peripheral equipment.

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 -7 Belo

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., Canyon Park, Bothell, WA 98021

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19

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	Pass

NA = Not Applicable

NA1 = Not applicable because the EUT does not have a conducted port.

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.	YRPOR7	NA
Support Equipment: Device	Manufacturer	Model #	S/N
Laptop	Lenovo	T430	PBPXKGW
Laptop PSU	Lenovo	92P1156	11S92P1156Z1ZDXN0AVB44
Power Supply	ZKTeco Co LTD	ZK-MSS-PS	Power Supply

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Radio Module
Type of Wideband System:	FHSS
Operating Frequency Range:	902.4-927.6 MHz
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:	Tested at 100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	PCB Antenna / -2 dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	5-30 VDC
Firmware / Software used for Test:	Railtest_v2.2.0 Realterm 2.0.0.70



Block Diagram of Test Setup(s)

Test Setup Block Diagram





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):	5/21/2021	
Configuration:	1			
Test Setup: Test Mode: Continuously Modulated				
The spectrum analyzer is connected to a near field probe located near EUT antenna.				

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

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
2871 Spectrum Analyzer Agilent E4440A 3/12/2020 3/12					3/12/2022

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	246.3	≤500	Pass
914.8	1	GFSK-2	244.4	≤500	Pass
927.6	1	GFSK-2	243.7	≤500	Pass



Plot(s)



Low Channel



Middle Channel





High Channel



15.247(a)(1) Carrier Separation

Test Data Summary					
Limit applied: 2	Limit applied: 20dB bandwidth of the hopping channel.				
Antenna Port	Operational Mode	Measured (kHz)	Limit (kHz)	Results	
1	Transmitting	400	≥ 246.3	Pass	

Plot(s)





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

Test Data Summary					
$Limit = \begin{cases} 50 & 0\\ 25 & 0 \end{cases}$	$Limit = \begin{cases} 50 \ Channels \ 20 \ dB \ BW < 250 kHz \\ 25 \ Channels \ 20 \ dB \ BW \ge 250 kHz \end{cases}$				
Antenna Port	Operational Mode	Measured (Channels)	Limit (Channels)	Results	
1	Transmitting	64	≥ 50	Pass	

Plot(s)





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

	Test Data S	ummary		
Observation Pe P _{Obs} =	$= \begin{cases} 20 \ Seconds \ 20 \ dB \ BW < 250 \ kHz \\ 10 \ Seconds \ 20 \ dB \ BW \ge 250 \ kHz \end{cases}$			
Antenna Port	Operational Mode	Measured (ms)	Limit (ms/P _{obs})	Results
1	Hopping	2.87	≤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 (Pobs):	20s
Number of RF Bursts / Pobs::	1
On time of RF Burst:	2.87ms
Number of Control or other signals / Pobs:	0
On time of Control or other Signals:	0
Total Measured On Time:	2.87



Plot(s)



TOO 20 Seconds



TOO Pulse



Test Setup Photo(s)





15.247(b)(2) Output Power

	Test Setup,	Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison		
Test Method:	ANSI C63.10 (2013)	Test Date(s):	5/14/2021		
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.				
	In order not to mask emissions from the EUT, the power supply was placed at distance of 30cm from the EUT.				
	installation.				

Environmental Conditions				
Temperature (^o C)	20	Relative Humidity (%):	33	

Test Equipment						
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due	
2871	Spectrum Analyzer	Agilent	E4440A	3/12/2020	3/12/2022	
1995	Biconilog Antenna	Chase	CBL6111C	4/14/2020	4/14/2022	
02307	Preamp	HP	8447D	1/10/2020	1/10/2022	
P05275	Attenuator	Weinschel	1W	3/26/2020	3/26/2022	
D06122	Power Supply	Lambda	GEN 125-80	1/18/2021	1/18/2023	

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 / 1	16.3	16.5	16.4	0.2
914.8	GFSK-2 / 1	17.3	17.4	17.3	0.1
927.6	GFSK-2 / 1	15.9	16.1	16	0.2

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} :	5-30 VDC
V _{Minimum} :	4. 5 VDC (EUT Shut off below 4.5VDC)
V _{Maximum} :	34.5 VDC



	Test Data Summary - Radiated Measurement					
$Limit = \begin{cases} 30\\ 24 \end{cases}$	$Limit = \begin{cases} 30dBm \ Conducted/36dBm \ EIRP \mid \ge 50 \ Channels \\ 24dBm \ Conducted/30dBm \ EIRP \mid < 50 \ Channels \ (\min 25) \end{cases}$					
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Field Strength (dBuV/m @3m)	Calculated (dBm)	Limit (dBm)	Results
902.4	GFSK-2	PCB Antenna / -2 dBi	111.7	18.5	≤ 30	Pass
914.8	GFSK-2	PCB Antenna / -2 dBi	112.6	19.4	≤ 30	Pass
927.6	GFSK-2	PCB Antenna / -2 dBi	111.3	18.2	≤ 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





Low Channel





Middle Channel



High Channel



Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. •	22116 23rd Drive SE, Suite A • Bot	thell, WA 98021 • 1-800-500-4EMC
Customer:	Nalloy, LLC		
Specification:	15.247(b) Power Output	(902-928 MHz FHSS >50 Chan	nels)
Work Order #:	104760	Date:	5/14/2021
Test Type:	Maximized Emissions	Time:	12:46:41
Tested By:	M. Harrison	Sequence#:	7
Software:	EMITest 5.03.19		

Equipment Tested:

<u> </u>				
Device	Manufacturer	Model #	S/N	
Configuration 1				
Support Equipment:				
Device	Monufacturor	Model #	S/N	

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Environment Conditions:
Temperature: 20°C
Humidity: 33%
Pressure: 102.1kPa
Test Method: ANSI C63.10: 2013
Frequency range: 902.4-927.6 MHz
Setup: AOS V2 Powered Via Delta PSU (24VDC/100W PSU MSS) Low Channel (0) 902.4 MHz, Mid (31) 914.8MHz, High (63) 927.6MHz GFSK-2 100% Duty Cycle PWR Level Setting: 150 PWR Output: 15dBm
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.
In order not to mask emissions from the EUT, the power supply was placed at distance of 30cm from the EUT.
The peripheral equipment was placed away from each other in order to simulate typical installation.



Nalloy, LLC WO#: 104760 Sequence#: 7 Date: 5/14/2021 15.247(b) Power Output (902-928 MHz FHSS >50 Channels) Test Distance: 3 Meters Vert



── Readings
○ Peak Readings
× QP Readings
★ Average Readings
▼ Ambient

- Software Version: 5.03.19
- 1 15.247(b) Power Output (902-928 MHz FHSS >50 Channels)

Test Equipment:								
ID	Asset #	Description	Model	Calibration Date	Cal Due Date			
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022			
T1	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021			
T2	ANP05360	Cable	RG214	2/3/2020	2/3/2022			
Т3	ANP06540	Cable	Heliax	8/23/2019	8/23/2021			
T4	AN01995	Biconilog Antenna	CBL6111C	4/14/2020	4/14/2022			
T5	ANP05275	Attenuator	1W	3/26/2020	3/26/2022			

<i>Measurement Data:</i> Reading listed by margin.		Test Distance: 3 Meters									
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5								
	MHz	dBµV	dB	dB	dB	dB	Table	$dB\mu V/m$	$dB\mu V/m$	dB	Ant
1	914.842M	78.9	+1.5	+2.1	+0.4	+23.6	+0.0	112.6	131.2	-18.6	Vert
			+6.1								
2	902.434M	78.4	+1.4	+2.1	+0.3	+23.4	+0.0	111.7	131.2	-19.5	Vert
			+6.1								
3	927.536M	77.3	+1.5	+2.2	+0.4	+23.8	+0.0	111.3	131.2	-19.9	Vert
			+6.1								



Test Setup Photo(s)



Below 1GHz



Below 1GHz





X Axis



Y Axis





Z Axis



15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22	116 23rd Drive SE, Suite A • Bot	hell, WA 98021 • 1-800-500-4EMC
Customer:	Nalloy, LLC		
Specification:	15.247(d) / 15.209 Radiated	Spurious Emissions	
Work Order #:	104760	Date:	5/14/2021
Test Type:	Maximized Emissions	Time:	10:02:00
Tested By:	M. Harrison	Sequence#:	3
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:				
Device	Manufacturer	Model #	S/N	
Configuration 1				
Test Conditions / Notes:				
Test Environment Condition	ne			

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

Test Method: ANSI C63.10: 2013

Frequency range: 9k-10GHz (Highest Frequency Generated = 927.6MHz)

Setup: AOS V2 Powered Via Delta PSU (24VDC/100W PSU MSS) Low Channel (0) 902.4 MHz, Mid (31) 914.8MHz, High (63) 927.6MHz GFSK-2 100% Duty Cycle PWR Level Setting: 150 PWR Output: 15dBm

In order not to mask emissions from the EUT, the power supply was placed at distance of 30cm from the EUT.

The peripheral equipment was placed away from each other in order to simulate typical installation.



Nalloy, LLC WO#: 104760 Sequence#: 3 Date: 5/14/2021 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Perp/Para



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T2	AN03540	Preamp	83017A	5/13/2019	5/13/2021
Т3	AN01467	Horn Antenna-ANSI	3115	7/5/2019	7/5/2021
		C63.5 Calibration			
T4	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
T5	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
Т6	ANP07505	Cable	CLU40-KMKM-	1/26/2021	1/26/2023
			02.00F		
T7	AN03170	High Pass Filter	HM1155-11SS	10/23/2019	10/23/2021
Т8	AN02307	Preamp	8447D	1/10/2020	1/10/2022
Т9	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T10	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T11	AN01995	Biconilog Antenna	CBL6111C	4/14/2020	4/14/2022
T12	ANP05275	Attenuator	1W	3/26/2020	3/26/2022
T13	AN00052	Loop Antenna	6502	5/4/2020	5/4/2022



Measu	rement Data:	Re	eading lis	ted by ma	argin.		Τe	est Distance	e: 3 Meters		
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10	T11	T12					
			T13								
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	978.700M	30.8	+0.0	+0.0	+0.0	+0.0	+0.0	38.6	54.0	-15.4	Vert/
			+0.4	+0.0	+0.0	-27.1					
			+1.5	+2.3	+24.6	+6.1					
			+0.0								
2	979.600M	28.8	+0.0	+0.0	+0.0	+0.0	+0.0	36.6	54.0	-17.4	Vert/
			+0.4	+0.0	+0.0	-27.1					
			+1.5	+2.3	+24.6	+6.1					
			+0.0								
3	1805.046M	50.8	+0.0	-34.8	+26.1	+2.3	+0.0	45.7	91.7	-46.0	Vert/
			+0.5	+0.3	+0.5	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
4	1855.170M	49.5	+0.0	-34.7	+26.5	+2.4	+0.0	44.9	91.7	-46.8	Vert/
			+0.5	+0.3	+0.4	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0								
5	1829.475M	47.5	+0.0	-34.8	+26.3	+2.4	+0.0	42.6	91.7	-49.1	Vert/
			+0.5	+0.3	+0.4	+0.0					
			+0.0	+0.0	+0.0	+0.0					
	005 (00) (21.0	+0.0	0.0	0.0		0.0	265	<u></u>		X X /
6	825.400M	31.9	+0.0	+0.0	+0.0	+0.0	+0.0	36.7	91.7	-55.0	Vert/
			+0.3	+0.0	+0.0	-27.6					
			+1.4	+1.9	+22.7	+6.1					
7	964 20014	20.0	+0.0	.0.0	.0.0	.0.0	.0.0	24.2	01.7	E7 4	VI. at /
/	804.200M	28.9	+0.0	+0.0	+0.0	+0.0	+0.0	54.5	91.7	-57.4	vert/
			+0.5	+0.0	+0.0	-27.3					
			+1.4	+2.0	+23.1	± 0.1					
Q	11 2071	16.8	+0.0	+0.0			40.0	21.0	01.7	60.8	Dorn/
0	11.37/K	40.8	+0.0	+0.0	+0.0	+0.0	-40.0	21.9	91.7	-09.8	reip
			+0.0	+0.0	+0.0	+0.0					
			±15.0	10.0	10.0	10.0					
9	86 300M	33.0	+10.0	+0.0	+0.0	+0.0	+0.0	20.4	91.7	-71.3	Vert/
	00.500101	55.0	+0.0	+0.0	+0.0	-27.8	10.0	20.4)1./	-71.5	V CIU
			+0.1	+0.0	+8.2	± 6.0					
			+0.0	10.5	10.2	10.0					
10	79.218k	38.5	+0.0	+0.0	+0.0	+0.0	-40.0	8.1	91 7	-83.6	Pern/
10	79.210K	50.5	+0.0	+0.0	+0.0	+0.0	10.0	0.1	<i>J</i> 1.7	05.0	I eip/
			+0.0	+0.0	+0.0	+0.0					
			+9.6	. 0.0	. 0.0	. 0.0					
11	18.209M	11 5	+0.0	+0.0	+0.0	+0.2	-20.0	-0.2	91.7	-91 9	Pern/
	10.207111	11.0	+0.0	+0.0	+0.0	+0.0	20.0	5.2	> 1.1	, 1.,	•••P'
			+0.0	+0.0	+0.0	+0.0					
			+8.0								
J											



Band Edge

	Band Edge Summary										
Operating Mo	de: Single Channel	(Low and High)									
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results						
614	GFSK-2	PCB Antenna	42	< 46	Pass						
902	GFSK-2	PCB Antenna	58.4	< 91.7	Pass						
928	GFSK-2	PCB Antenna	55.5	< 91.7	Pass						
960	GFSK-2	PCB Antenna	44.2	<54	Pass						

	Band Edge Summary										
Operating Mo	ode: Hopping										
Frequency (MHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit (dBuV/m @3m)	Results						
614	GFSK-2	PCB Antenna	41.8	<46	Pass						
902	GFSK-2	PCB Antenna	57.5	< 91.7	Pass						
928	GFSK-2	PCB Antenna	57.6	< 91.7	Pass						
960	GFSK-2	PCB Antenna	47.8	<54	Pass						



Band Edge Plots

























Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE	, Suite A • Bot	thell, WA 98021 • 1-800-500-4EMC
Customer:	Nalloy, LLC		
Specification:	15.247(d) / 15.209 Radiated Spurious Emiss	sions	
Work Order #:	104760	Date:	5/14/2021
Test Type:	Maximized Emissions	Time:	08:40:47
Tested By:	M. Harrison	Sequence#:	6
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N	
Configuration 1				
Support Equipment:				

$\sim -FF \sim -1 - T$			
Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Conditions / Totles.
Test Environment Conditions:
Temperature: 20°C
Humidity: 33%
Pressure: 102.1kPa
Test Method: ANSI C63.10: 2013
Frequency range: 600-970MHz (Highest Frequency Generated = 927.6MHz)
Setup:
AOS V2 Powered Via Delta PSU (24VDC/100W PSU MSS)
Low Channel (0) 902.4 MHz, Mid (31) 914.8MHz, High (63) 927.6MHz
GFSK-2
100% Duty Cycle
PWR Level Setting: 150
PWR Output: 15dBm
In order not to mask emissions from the EUT, the power supply was placed at distance of 30cm from the EUT.

The peripheral equipment was placed away from each other in order to simulate typical installation.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T2	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T3	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T4	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T5	AN01995	Biconilog Antenna	CBL6111C	4/14/2020	4/14/2022
T6	ANP05275	Attenuator	1W	3/26/2020	3/26/2022



Measu	rement Data:	Re	eading lis	ted by ma	argin.	Test Distance: 3 Meters					
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6							
	MHz	dBµV	dB	dB	dB	dB	Table	$dB\mu V/m$	$dB\mu V/m$	dB	Ant
1	902.345M	78.4	+0.0	+1.4	+2.1	+0.3	+0.0	111.7	111.7	+0.0	Vert
			+23.4	+6.1					SC		
2	614.000M	12.7	+0.0	+1.2	+1.7	+0.3	+0.0	42.0	46.0	-4.0	Vert
			+20.0	+6.1					SC		
3	614.000M	12.5	+0.0	+1.2	+1.7	+0.3	+0.0	41.8	46.0	-4.2	Vert
			+20.0	+6.1					Нор		
4	960.000M	13.3	+0.0	+1.5	+2.2	+0.4	+0.0	47.8	54.0	-6.2	Vert
			+24.3	+6.1					Нор		
5	960.000M	9.7	+0.0	+1.5	+2.2	+0.4	+0.0	44.2	54.0	-9.8	Vert
			+24.3	+6.1					SC		
6	902.000M	25.1	+0.0	+1.4	+2.1	+0.3	+0.0	58.4	91.7	-33.3	Vert
			+23.4	+6.1					SC		
7	928.000M	23.6	+0.0	+1.5	+2.2	+0.4	+0.0	57.6	91.7	-34.1	Vert
			+23.8	+6.1					Нор		
8	902.000M	24.2	+0.0	+1.4	+2.1	+0.3	+0.0	57.5	91.7	-34.2	Vert
			+23.4	+6.1					Нор		
9	928.000M	21.5	+0.0	+1.5	+2.2	+0.4	+0.0	55.5	91.7	-36.2	Vert
			+23.8	+6.1					SC		



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. • 2	2116 23rd Drive SE, Suite A • Bot	thell, WA 98021 • 1-800-500-4EMC
Customer:	Nalloy, LLC		
Specification:	15.207 AC Mains - Avera	ge	
Work Order #:	104760	Date:	5/14/2021
Test Type:	Conducted Emissions	Time:	13:58:29
Tested By:	M. Harrison	Sequence#:	8
Software:	EMITest 5.03.19		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipmen	<i>t:</i>			
Device	Manufacturer	Model #	S/N	
Configuration 1				
Test Conditions / N	otes:			
Test Environment C	onditions:			
Temperature: 20°C				
Humidity: 33%				
Pressure: 102.1kPa				
Test Method: ANSI Frequency range: 15	C63.10: 2013 0k-30MHz			
Setup:				
AOS V2 Powered V	ia Delta PSU (24VDC/100W F	PSU MSS)		
Low Channel (0) 902	2.4 MHz, Mid (31) 914.8MHz,	High (63) 927.6MHz		
GFSK-2		-		
100% Duty Cycle				
PWR Level Setting:	150			
PWR Output: 15dBr	n			



Nalloy, LLC WO#: 104760 Sequence#: 8 Date: 5/14/2021 15.207 AC Mains - Average Test Lead: 120V 60Hz Line



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP06219	Attenuator	768-10	4/7/2020	4/7/2022
T2	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
Т3	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
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T5	AN02611	High Pass Filter	HE9615-150K-	1/10/2020	1/10/2022
			50-720B		



Meası	irement Data:	Re	eading list	ted by ma	argin.			Test Lead	d: 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	512.876k	2.8	+9.1	+0.0	+0.0	-0.4	+0.0	11.7	46.0	-34.3	Line
	Ave		+0.2								
^	512.875k	16.8	+9.1 +0.2	+0.0	+0.0	-0.4	+0.0	25.7	46.0	-20.3	Line
3	211.085k	7.4	+9.1	+0.0	+0.0	-1.1	+0.0	15.7	53.2	-37.5	Line
	Ave		+0.3								
^	211.085k	41.1	+9.1 +0.3	+0.0	+0.0	-1.1	+0.0	49.4	53.2	-3.8	Line
5	316.530k	3.4	+9.1	+0.0	+0.0	-0.7	+0.0	11.9	49.8	-37.9	Line
	Ave		+0.1								
۸	316.530k	23.5	+9.1	+0.0	+0.0	-0.7	+0.0	32.0	49.8	-17.8	Line
			+0.1								
7	189.269k	7.6	+9.1	+0.0	+0.0	-1.3	+0.0	15.7	54.1	-38.4	Line
•	Ave	41.1	+0.3	.0.0	.0.0	1.2	.0.0	40.0	541	1.0	T ·
	189.269k	41.1	+9.1 +0.3	+0.0	+0.0	-1.3	+0.0	49.2	54.1	-4.9	Line
9	279 443k	3.9	+0.3	+0.0	+0.0	-0.8	+0.0	12.3	50.8	-38 5	Line
	Ave	5.7	+0.1	10.0	10.0	0.0	10.0	12.5	50.0	50.5	Line
^	279.442k	24.3	+9.1 +0.1	+0.0	+0.0	-0.8	+0.0	32.7	50.8	-18.1	Line
11	266.353k	4.2	+9.1	+0.0	+0.0	-0.8	+0.0	12.7	51.2	-38.5	Line
	Ave		+0.2								
^	266.352k	24.3	+9.1 +0.2	+0.0	+0.0	-0.8	+0.0	32.8	51.2	-18.4	Line
13	247.446k	4.5	+9.1	+0.0	+0.0	-0.9	+0.0	12.9	51.8	-38.9	Line
	Ave		+0.2								
^	247.445k	30.9	+9.1 +0.2	+0.0	+0.0	-0.9	+0.0	39.3	51.8	-12.5	Line
15	176.907k	7.0	+9.1	+0.0	+0.0	-1.4	+0.0	15.1	54.6	-39.5	Line
	Ave		+0.4								
^	176.906k	41.0	+9.1 +0.4	+0.0	+0.0	-1.4	+0.0	49.1	54.6	-5.5	Line
17	171.816k	7.2	+9.1	+0.0	+0.0	-1.5	+0.0	15.2	54.9	-39.7	Line
	Ave		+0.4								
^	171.816k	40.8	+9.1	+0.0	+0.0	-1.5	+0.0	48.8	54.9	-6.1	Line
L			+0.4								
19	164.544k	6.9	+9.1	+0.0	+0.0	-1.6	+0.0	14.9	55.2	-40.3	Line
-	Ave	40.0	+0.5		. 0. 0	1 /	.0.0	40.0		~ 1	T ·
^	164.544k	40.8	+9.1	+0.0	+0.0	-1.6	+0.0	48.8	55.2	-6.4	Line
			+0.5								



Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive	SE, Suite A • Bot	thell, WA 98021 • 1-800-500-4EMC
Customer:	Nalloy, LLC		
Specification:	15.207 AC Mains - Average		
Work Order #:	104760	Date:	5/14/2021
Test Type:	Conducted Emissions	Time:	14:10:26
Tested By:	M. Harrison	Sequence#:	9
Software:	EMITest 5.03.19		120V 60Hz

Equipment Tested:

Configuration 1 Support Equipment: Device Manufacturer Model # S/N	
Support Equipment: Device Manufacturer Model # S/N	
Device Manufacturer Model # S/N	
Configuration 1	
Test Conditions / Notes:	
Test Environment Conditions:	
Temperature: 20°C	
Humidity: 33%	
Pressure: 102.1kPa	
Test Method: ANSI C63.10: 2013 Frequency range: 150k-30MHz	
Setup:	
AOS V2 Powered Via Delta PSU (24VDC/100W PSU MSS)	
Low Channel (0) 902.4 MHz, Mid (31) 914.8MHz, High (63) 927.6MHz	
GFSK-2	
100% Duty Cycle	
PWR Level Setting: 150	
PWR Output: 15dBm	



Nalloy, LLC WO#: 104760 Sequence#: 9 Date: 5/14/2021 15.207 AC Mains - Average Test Lead: 120V 60Hz Neutral



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP06219	Attenuator	768-10	4/7/2020	4/7/2022
T2	ANP06515	Cable	Heliax	7/1/2020	7/1/2022
Т3	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
	AN02871	Spectrum Analyzer	E4440A	3/12/2020	3/12/2022
T5	AN02611	High Pass Filter	HE9615-150K-	1/10/2020	1/10/2022
			50-720B		



Meası	rement Data:	Re	eading lis	ted by ma	rgin.			Test Lead	1: 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	473.607k	3.0	+9.1	+0.0	+0.0	-0.4	+0.0	11.9	46.5	-34.6	Neutr
	Ave		+0.2								
^	473.606k	19.5	+9.1	+0.0	+0.0	-0.4	+0.0	28.4	46.5	-18.1	Neutr
3	448.882k	3.1	+0.2	+0.0	+0.0	-0.5	+0.0	11.9	46.9	-35.0	Neutr
	Ave		+0.2								
^	448.881k	20.9	$^{+9.1}_{+0.2}$	+0.0	+0.0	-0.5	+0.0	29.7	46.9	-17.2	Neutr
5	379.070k	3.2	+9.1	+0.0	+0.0	-0.5	+0.0	12.0	48.3	-36.3	Neutr
	Ave		+0.2								
^	379.069k	20.4	+9.1	+0.0	+0.0	-0.5	+0.0	29.2	48.3	-19.1	Neutr
			+0.2								
7	210.358k	7.7	+9.1	+0.0	+0.0	-1.1	+0.0	16.0	53.2	-37.2	Neutr
	Ave		+0.3								
^	210.358k	43.2	+9.1	+0.0	+0.0	-1.1	+0.0	51.5	53.2	-1.7	Neutr
	201 (22)		+0.3		0.0			1.5.0			
9	201.632k	7.9	+9.1	+0.0	+0.0	-1.2	+0.0	16.0	53.5	-37.5	Neutr
	Ave	4.4.1	+0.2	.0.0	.0.0	1.0	.0.0	52.2	52.5	1.2	NT. A.
	201.631K	44.1	+9.1 +0.2	+0.0	+0.0	-1.2	+0.0	52.2	55.5	-1.3	Neutr
11	218.357k	7.0	+9.1	+0.0	+0.0	-1.1	+0.0	15.3	52.9	-37.6	Neutr
	Ave		+0.3								
^	218.357k	40.1	+9.1 +0.3	+0.0	+0.0	-1.1	+0.0	48.4	52.9	-4.5	Neutr
13	321.621k	3.3	+9.1	+0.0	+0.0	-0.6	+0.0	11.9	49.7	-37.8	Neutr
	Ave		+0.1								
^	321.620k	22.1	+9.1	+0.0	+0.0	-0.6	+0.0	30.7	49.7	-19.0	Neutr
15	201 2501	2.6	+0.1	+0.0	+0.0	0.7		12.1	50.2	29.1	Noutr
15	301.237K Δνε	5.0	+9.1	± 0.0	± 0.0	-0.7	+0.0	12.1	50.2	-36.1	INCULI
٨	301 258k	24.7	+9.1	+0.0	+0.0	-0.7	+0.0	33.2	50.2	-17.0	Neutr
	501.250K	27.7	+0.1	10.0	10.0	0.7	10.0	55.2	50.2	17.0	iteuu
17	290.351k	3.7	+9.1	+0.0	+0.0	-0.7	+0.0	12.2	50.5	-38.3	Neutr
	Ave		+0.1								
^	290.350k	23.1	+9.1	+0.0	+0.0	-0.7	+0.0	31.6	50.5	-18.9	Neutr
			+0.1								
19	188.542k	7.5	+9.1	+0.0	+0.0	-1.3	+0.0	15.6	54.1	-38.5	Neutr
	Ave		+0.3								
^	188.541k	42.8	+9.1	+0.0	+0.0	-1.3	+0.0	50.9	54.1	-3.2	Neutr
			+0.3								



Test Setup Photo(s)





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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 dB μ V/m, the spectrum analyzer reading in dB μ 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	(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.