

TEST REPORT

Report Number: 105434881MPK-002 Project Numbers: G105434881 July 14, 2023

> Testing performed on the Communication Unit Model Number: 31570025

> > То

FCC Part 15 Subpart C (15.247) ISED RSS-247 Issue 2

For

Ampt, LLC

Test Performed by: Intertek 1365 Adams Court Menlo Park, CA 94025 USA Test Authorized by: Ampt, LLC 4850 Innovation Drive Fort Collins, CO 80525 USA

Prepared by:

Kenneth Roque

Reviewed by:

Anderson Soungpanya

Kinnith Roque

Date: July 14, 2023

Date: July 14, 2023

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Report No. 105434881MPK-002				
Equipment Under Test: Communication Unit				
Model Number(s): 31570025				
Applicant:	Ampt, LLC			
Contact:	Robin Richardson			
Address:	Ampt, LLC 4850 Innovation Drive Fort Collins, CO 80525			
Country:	USA			
Tel. Number:	1 (970) 372-6960			
Email:	robin.richardson@ampt.com			
Applicable Regulation: FCC Part 15 Subpart C (15.247) ISED RSS-247 Issue 2				
Date of Test:	May 25 – June 29, 2023			

We attest to the accuracy of this report:

Kinneth Roque

Kenneth Roque EMC Project Engineer

Anderson Soungpanya EMC Team Leader



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1.0 Summary of Tests

TEST	Reference FCC	Reference ISED	RESULTS	
RF Output Power	15.247(b)	RSS-247, 5.4.b)	Complies	
20-dB Bandwidth	15.247(a)(1)	RSS-247, 5.1.a)	Complies	
Channel Separation	15.247(a)(1)	RSS-247, 5.1.b)	Complies	
Number of Hopping Channels	15.247(a)(1)	RSS-247, 5.1.d)	Complies	
Average Channel Occupancy Time	15.247(a)(1)	RSS-247, 5.1.d)	Complies	
Out-of-Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies	
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-GEN	Complies	
AC Line Conducted Emissions	15.207	RSS-GEN	Complies	
Antenna Requirement	15.203	RSS-GEN	Complies (Professionally Installed Equipment)	

EUT receive date: May 23, 2023

EUT receive condition:The pre-production version of the EUT was received in good condition
with no apparent damage. As declared by the Applicant, it is identical
to the production units.Test start date:May 25, 2023Test completion date:June 29, 2023

The test results in this report pertain only to the item tested.



2.0 General Description

2.1 Product Description

Ampt, LLC supplied the following description of the EUT:

The Communication Unit is an industrial, indoor/outdoor use, cord connected, wireless unit used to communicate with Ampt String Optimizers in PV systems.

For more information, see user's manual provided by the manufacturer.

This test report covers only the 2.4GHz FHSS radio.

Information about the 2.4 GHz radio is presented below:

Applicant	Ampt, LLC			
Model No.	31570025			
Type of Transmission	Frequency Hopping Spread Spectrum			
Rated RF Output	12.77 dBm			
Antenna(s) & Gain*	Internal Antenna, Gain: 2.3 dBi			
Frequency Range	2410 – 2474.5 MHz			
Number of Channel(s)	255 (only 25 used at any given time)			
Modulation Type	FSK			
Applicant Name &	Ampt, LLC			
Address	4850 Innovation Drive			
	Fort Collins, CO 80525 USA			

*as provided by the client. Intertek takes no responsibility for the accuracy of this information.



2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System devices Operating under §15.247" (KDB 558074 D01 15.247 Meas Guidance v05r02), RSS-247 Issue 2, ANSI C63.10: 2013 and RSS-GEN Issue 5.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

Following is the channel test plan:

Channels in 2.4 GHz band					
Test C	hannel	Frequency, MHz	Tested		
Low 0		2410	√		
Middle	127	2442	V		
High 255		255 2474.5			
Hopping Mode		2410 - 2474.5	٧		

2.4 Test Facility

The test site used to is located at 1365 Adams Court, Menlo Park, California, 94025. This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.



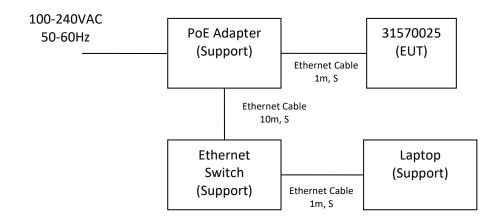
3.0 System Test Configuration

3.1 Support Equipment

Description	Manufacturer	Model Number
PoE Adapter	EnGenius	EPA5006GAT
Ethernet Switch	D-Link	DGS-2208
Laptop	Dell	Latitude 7490

3.2 Block Diagram of Test Setup

Equipment Under Test							
Description Manufacturer Model Number Serial Number							
Communication Unit	Ampt, LLC	31570025	31570025-00 C 4522T000011				



Antenna was removed and co-axial connector was installed for Conducted Measurements.

S = Shielded	F = With Ferrite
U = Unshielded	m = Length in Meters



3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table.

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on the low channel, middle channel, high channel and with hopping channels enabled.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.



4.0 Emissions Measurement Results

4.1 20dB Bandwidth, and 99% Occupied Bandwidth FCC Rule 15.247(a)(1)

4.1.1 Procedure

The Procedure described in the FCC Publication 558074 D01 Meas Guidance v05r02 & Section 7.8.7 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the 20dB bandwidth.

- Span = Approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the markerto-peak function to set the marker to the peak of the emission. Use the marker delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A Peak output reading was taken, a Display line was drawn for 20dB lower than Peak level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

Tested By	Test Date
Kenneth Roque	May 25, 2023



4.1.2 Test Result

Frequency MHz	20 dB FCC Bandwidth, kHz		
2410	97.530		1.1
2410		91.282	1.2
2442	96.430		1.3
2442		91.590	1.4
	97.250		1.5
2474.5		91.402	1.6

Results

Complies



MultiView	Sp	ectrum								-
Ref Level 20.	00 dBm	Offset	11.03	dB 🗢 RBW 1 kH	Iz					
Att	18 dB	S₩T	4.19 ms (~12 n	ns) 🗢 VBW 3 kH	Iz Mode Auto I	FFT				
1 Frequency S	weep									●1Pk View
									D2[1]	0.13 dB
							50			97.530 kHz
10 dBm				~			A		M1[1]	-11.79 dBm
					/				2.4	09885710 GHz
0 dBm				M1 0	mont	Lom				
-10 dBm	H1 -	11.530 dB	m		V.	~~~	10 ²			
-20 dBm				/						
00 db-1			m					Mar I	Annon	
-30 dBm	M	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Mar and a second					· · · · · ·	mm	a 🔿 .
man ~									· · · · ·	vy www.
-40 dBm										
-50 dBm										
-60 dBm										
-70 dBm										
CF 2.4099354				1001 pt	5	2	7.5 kHz/		S	ban 275.0 kHz
2 Marker Tab		_								
Type Re M1		2	X-Value 40988571 G		Y-Value L 1.79 dBm		Function		Function Re	sult
D2 M1	1	2.4	97.53 k		0.13 dB					
D3 M1			87.91 k		20.27 dB					
	~						~	Measuring		25.05.2023 23:26:45

Plot 1.1 – 20dB Bandwidth, 2410 MHz

23:26:46 25.05.2023



MultiView	- Spe	ectrum								
Ref Level 20	0.00 dBm	Offset	11.03	dB 🗢 RBW 1 kH	Ηz					
Att	18 dB	S₩T	4.19 ms (~12 r	ns) 🗢 VBW 3 kH	Hz Mode Auto I	FFT				
1 Occupied B	andwidt	h								o1Pk View
									M1[1]	8.47 dBm
10 dBm							M1		2.4	09973630 GHz
10 dbm				\wedge			LA			
0 dBm					mont	Mm	\wedge			
-10 dBm					₩ W	W V	72 13			
-20 dBm			, 	/			<u>ل</u> ـــــــــــ			
-30 dBm								m		
mm	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	<u> </u>						hum	mm
-40 dBm										
-50 dBm										
-60 dBm										
-70 dBm										
CF 2.409935	44 GHz		I	1001 pt	s	2	7.5 kHz/	1	S	pan 275.0 kHz
2 Marker Tal										
Type Re M1	ef Trc		X-Value 40997363	GH7	Y-Value 8.47 dBm	Occ Bw	Function		Function Re 91.2819488	
T1 T2	1 1 1	~	2.409889084 2.409980366	GHz	-8.15 dBm -10.92 dBm	Occ Bw Occ Bw Cer Occ Bw Fre			2.409934 -714.9043	725 GHz
	~						~	Measuring		25.05.2023 23:27:07

Plot 1.2 – 99% Bandwidth, 2410 MHz

23:27:08 25.05.2023





Plot 1.3 – 20dB Bandwidth, 2442 MHz

23:30:27 25.05.2023



MultiView	Spectrum	1							•
Ref Level 20.0	00 dBm Offset	: 11.03	dB 🖷 RBW 1 kH	Ηz					_
Att	18 dB SWT	4.19 ms (~12 r	ns) 🗢 VBW 3 kH	Iz Mode Auto I	FFT				
1 Occupied Ba	ndwidth								●1Pk View
								M1[1]	8.22 dBn
10 dBm			M1					2.4	41984620 GH:
			L Å			~			
10				/	Ν				
) dBm				0		N/N			
				mw yr	1 2 mm	Y T2			
10 dBm				VV.	Wγ .	12			
			1			Ι ζ			
-20 dBm		.(£			h			
-0		m					M		0
-30 dBm	Mary						- nh	······································	A
man	Winder .							·····	marine
40 dBm									
50 dBm									
60 dBm									
70 dBm									
F 2.4420261	GH7		1001 pt	e	2	 7.5 kHz/		St) 5an 275.0 kHz
Marker Tabl			1001 pt	3	Z				
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	sult
M1	1 2	.44198462 (8.22 dBm	Occ Bw		S	91.58975238	
T1 T2	1	2.441979007 2.442070597		-9.13 dBm -10.42 dBm	Occ Bw Ce Occ Bw Fre			2.442024 -1.298011	
12	1	2.442070597	0112	-10.42 dbm	OLC BW FIE				25.05.2023
							Measuring		23:30:44

Plot 1.4 – 99% Bandwidth, 2442 MHz

23:30:45 25.05.2023



MultiView	Spect	um							•
Ref Level 20.0	00 dBm Of	fset 1	1.03 dB 🗢 RBW 1 k	Hz					
Att	18 dB 🛛 SV	VT 4.19 ms (√12 ms) ● VBW 3 k	Hz Mode Auto	FFT				
1 Frequency Sv	weep			1					●1Pk View
								M3[1]	6.97 dBm
10 dBm						M3.			74409070 GHz
TO UBIII			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			X		M1[1]	-13.21 dBm
0.40.0			$ \uparrow$	/	N			2.4	74320880 GHz
0 dBm				mond	Im	N			
-10 dBm		80 dBm	MIN	× ₩		M _{Q2}			
-20 dBm	111 15.0.					4			
-20 d9m			\mathcal{A}				m.		
-30 dBm	www	mpmm	/*				. Ann	humm	man
-40 dBm									
-50 dBm									
-60 dBm									
00 00.00									
-70 dBm									
CF 2.47437006			1001 p	ts	2	7.5 kHz/		S	oan 275.0 kHz
2 Marker Table Type Ref		X-Valu	10	Y-Value		Function		Function Re	cult
M1 D2 M1	1	2.4743208		13.21 dBm -0.14 dB		rancuon		T UNCLOT RE	sur
M3	ī	2.4744090		6.97 dBm					
							Measuring		25.05.2023 23:42:01

Plot 1.5 – 20dB Bandwidth, 2474.5 MHz

23:42:02 25.05.2023



MultiView	= Spe	ectrum								-
Ref Level 20).00 dBm	Offset	11.03	dB 🗢 RBW 1 kH	Ηz					
Att	18 dB	SWT	4.19 ms (~12 n	ns) 👄 VBW 3 kH	Hz Mode Auto I	FFT				
1 Occupied B	andwidtl	h								●1Pk View
									M1[1]	6.97 dBm
10 dBm							M1		2.4	74409070 GHz
TO UBM				~			X			
				1	/	N				
0 dBm					mad	In	\bigwedge			
-10 dBm				- N	· • W	\mathbb{W}^{\vee}	<u> </u>			
							\			
-20 dBm				2			<u> </u>			
			ſ							
-30 dBm			· An e of					r Vh		
-30 dBm	m	vww	Mana.					w	mm	mm
io abiii										
-50 dBm										
-50 ubm										
-60 dBm										
-60 uBm										
-70 dBm										
CF 2.474370	Dó GHz			1001 pt	s	2	7.5 kHz/		Ś.	oan 275.0 kHz
2 Marker Tab										
Type Re	ef Trc		X-Value	CU-	Y-Value 6.97 dBm		Function		Function Re 91.4016422	
M1 T1	1	Ζ.	2.474323899		-8.76 dBm	Occ Bw Occ Bw Cei	ntroid	:		47 KHZ 3696 GHz
T2	1		2.474415301		-11.14 dBm	Occ Bw Fre			-460.1401	
	~						~	Measuring		25.05.2023 23:42:30

Plot 1.6 – 99% Bandwidth, 2474.5 MHz

23:42:31 25.05.2023



4.2 Conducted Output Power at Antenna Terminals FCC Rule 15.247(b)(1)

4.2.1 Requirement

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 nonoverlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

4.2.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.5 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the RF Output Power.

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot.

The antenna port of the EUT was connected to the input of a spectrum analyzer. Power was read directly from the spectrum analyzer and cable loss correction was added to the reading to obtain the power at the antenna terminals.

Tested By	Test Date				
Kenneth Roque	May 25, 2023				



4.2.3 Test Result

Refer to the following plots for the test result:

Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
2410	12.77	18.92	2.1
2442	12.06	16.07	2.2
2474.5	11.48	14.06	2.3

Results

Complies



MultiView	Spe	ectrum									· ·
Ref Level 20.0	00 dBm	Offset	11.03	dB 🖷 RBW	1 MHz						
Att			s (~6.6 n	ns) 🖷 VBW	3 MHz	Mode Auto	FFT				
1 Frequency S	weep										●1Pk View
						M1				M1[1]	12.77 dBm
						Y				2	.40990110 GHz
10 dBm											
0 dBm											
											\searrow
-10 dBm											
-20 dBm											
-30 dBm											
-40 dBm											
50 ID											
-50 dBm											
-60 dBm											
-70 dBm											
ro ubii											
CF 2.41 GHz				100	1 pts		30	0.0 kHz/		1	Span 3.0 MHz
	7							· · · · · · · · · · · · · · · · · · ·	Measuring		25.05.2023

Plot 2.1– Output Power, 2410 MHz

23:50:50 25.05.2023



MultiView	Spe	ectrum									· ·
Ref Level 20.0	00 dBm	Offset	11.03	dB • RBW :	1 MHz						
			s (~6.6 r	ns) 👄 VBW 3	3 MHz	Mode Auto	FFT				
1 Frequency Sv	weep										●1Pk View
										M1[1]	12.06 dBm
						M	1			2	.44199100 GHz
10 dBm											
				T							
0 dBm											
U UBM		-									
-10 dBm					_						
00.40.00											
-20 dBm											
-30 dBm					_						
-40 dBm											
-40 UBM											
-50 dBm					_						
-60 dBm											
-60 uBm											
-70 dBm											
CF 2.442 GHz				1001	pts		30	00.0 kHz/			Span 3.0 MHz
									Measuring		25.05.2023 23:50:20

Plot 2.2 – Output Power, 2442 MHz

23:50:21 25.05.2023



MultiView	Spe	ectrum										
Ref Level 20.	00 dBm	Offset		11.03	dB 🖷 RBV	V 1 MH:	Z					
		SWT	4.16 µs	s (~6.6 r	ms) 🗢 VBV	у з мн:	z Mode Auto) FFT				
1 Frequency S	weep		1		1					1		●1Pk View
							M1				M1[1]	11.48 dBm
											2	47433220 GHz
10 dBm												
			_									
0 dBm												
-10 dBm												<u> </u>
-20 dBm												
-20 UBIII-												
-30 dBm												
-40 dBm												
-50 dBm												
-60 dBm												
-70 dBm												
05.0.4745.004					10	01						
CF 2.4745 GH					10	01 pts		30	00.0 kHz/			Span 3.0 MHz
										Measuring		25.05.2023 23:51:51

Plot 2.3 – Output Power, 2474.5 MHz

23:51:51 25.05.2023



4.3 Carrier Frequency Separation FCC 15.247 (a)(1)

4.3.1 Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

4.3.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.2 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Carrier Frequency Separation.

- The EUT must have its hopping function enabled
- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) = 1% of the span
- Video (or Average) Bandwidth (VBW) = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

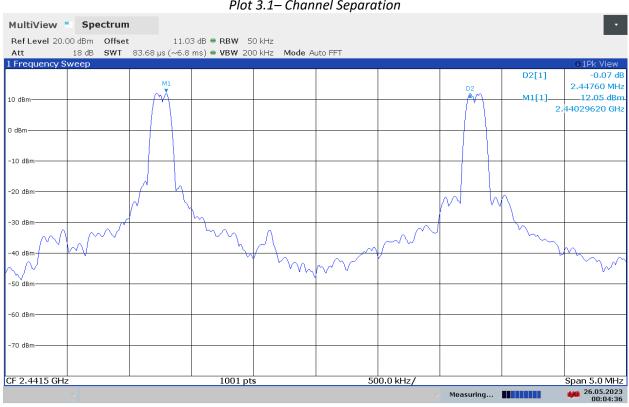
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Tested By	Test Date			
Kenneth Roque	May 26, 2023			



4.3.3 **Test Result**

The highest measured 20dB Bandwidth is 97.530 kHz, therefore the minimum Carrier Frequency Separation shall be greater than two thirds of the 20dB bandwidth; 65.020 kHz. The measured channel separation is 2.47760 MHz. Carrier Frequency Separation meets the minimum requirement. Please refer to spectrum analyzer Plot 3.1 below for the test result.



Plot 3.1- Channel Separation

00:04:37 26.05.2023

Results

Complies



4.4 Number of Channels FCC 15.247 (a)(1)(iii)

4.4.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequencies of occupancy on any frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

4.4.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.3 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Number of Channels.

- The EUT must have its hopping function enabled.
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

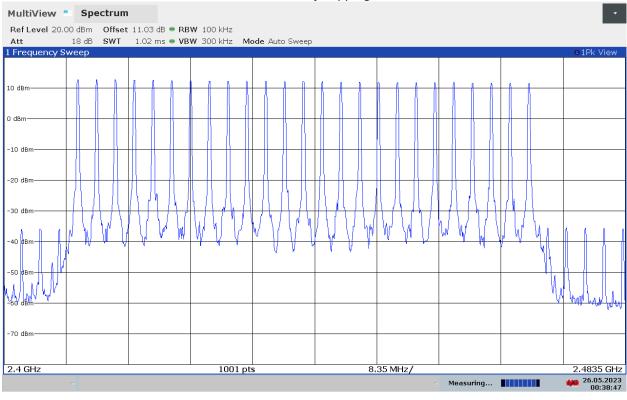
Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

With the analyzer set to MAX HOLD, readings were taken once channels were filled in. The channel peaks were recorded and compared to the minimum number of channels required in the regulation.

Tested By	Test Date					
Kenneth Roque	May 26, 2023					



4.4.3 Test Result



Plot 4.1 - Number of hopping channels

00:38:47 26.05.2023

Results

Complies, 25 Channels



4.5 Average Channel Occupancy Time FCC 15.247(a)(1)

4.5.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequencies of occupancy on any frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

4.5.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.4 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Average Channel Occupancy Time.

- The EUT must have its hopping function enabled.
- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW = 3 x RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. An oscilloscope may be used instead of a spectrum analyzer.

The spectrum analyzer center frequency was set to one of the known hopping channels, the SPAN was set to ZERO SPANS, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

Tested By	Test Date				
Kenneth Roque	May 26, 2023				



4.5.3 Test Results

Burst On Time (ms)	No. of Burst in 10 seconds	Dwell Time (ms) (Burst Time * No. of Burst * 10)	Dwell Time limit (ms)	
18.48	1	18.48	400	

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of the number of channels (25) multiplied by 0.4 second (10 seconds).

Results	Complies	



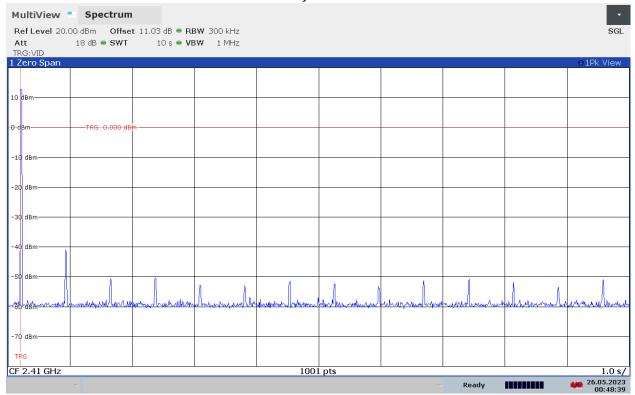
Burst Time

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00:42:34 26.05.2023



Number of Bursts in 10 s



00:48:39 26.05.2023



4.6 Out-of-Band Conducted Emissions FCC 15.247(d)

4.6.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.6.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.8 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Out-of-Band Conducted Emissions.

- Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
- RBW = 100 kHz
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 26 GHz.

Tested By	Test Date			
Kenneth Roque	May 26, 2023			



4.6.3 Test Result

Refer to the following plots and out-of-band conducted spurious emissions at the Band-Edge, Table 4.1 & 4.2 for the test results:

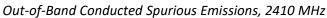
Out-of-Band Conducted Spurious Emissions

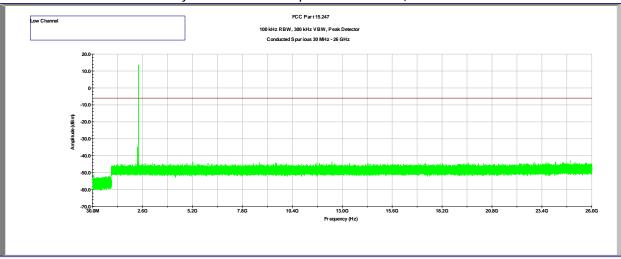
Frequency MHz	Description	Results
2410	Scan 30 MHz – 26 GHz	Complies, Greater than 20dB
2442	Scan 30 MHz – 26 GHz	Complies, Greater than 20dB
2474.5	Scan 30 MHz – 26 GHz	Complies, Greater than 20dB

Out-of-Band Conducted Spurious Emissions at the Band-Edge:

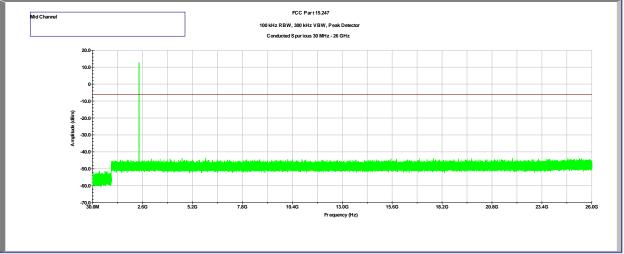
Channel	Frequency MHz	Results
0	2410	Complies, Greater than 20dB
Hopping	Low Band Edge	Complies, Greater than 20dB
255	2474.5	Complies, Greater than 20dB
Hopping	High Band Edge	Complies, Greater than 20dB



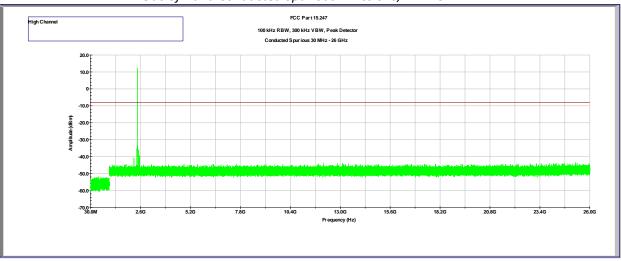




Out-of-Band Conducted Spurious Emissions, 2442 MHz







Out-of-Band Conducted Spurious Emissions, 2474.5 MHz



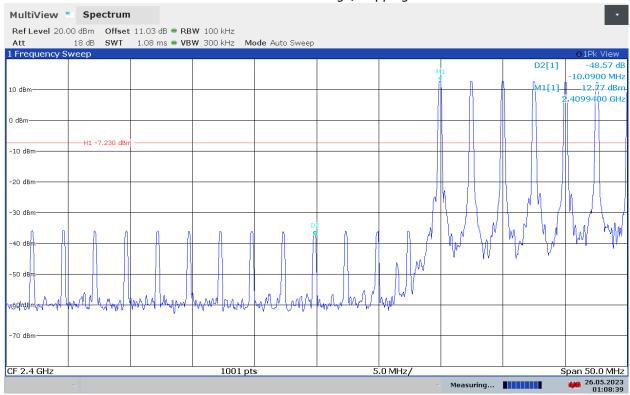
Out-of-Band Conducted Spurious Conducted Band Edge, Low Channel

MultiView	Spectr	um							•
Ref Level 20.0	00 dBm Off	iset 11.03 dB 🖷 R	BW 100 kHz						
Att	18 dB 🛛 SW	/T 1.08 ms 🖷 VI	300 kHz Me	ode Auto Sweep					
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10 dBm								M1[1]_	12.78 dBm
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01:09:59 26.05.2023



Out-of-Band Conducted Spurious Conducted Band Edge, Hopping



01:08:40 26.05.2023



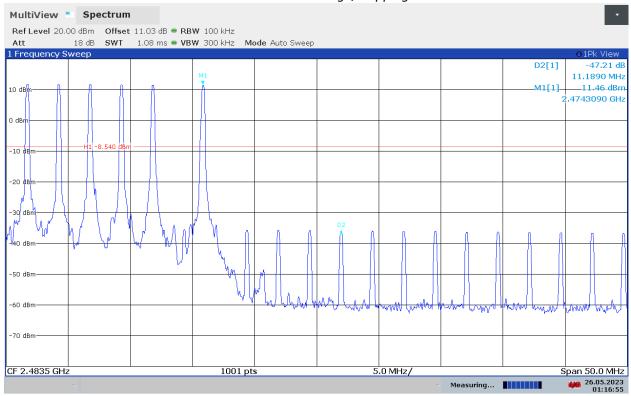
Out-of-Band Conducted Spurious Conducted Band Edge, High Channel

MultiView Spectru	m							•
Ref Level 20.00 dBm Offs	et 11.03 dB 🖷 RBW	/ 100 kHz						
Att 18 dB SWT	1.08 ms 👄 VBW	300 kHz Mc	de Auto Sweep					
1 Frequency Sweep								●1Pk View
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CF 2.4835 GHz		1001 pts	<u> </u>	5	.0 MHz/		S	pan 50.0 MHz
~						Measuring		26.05.2023 01:11:44

01:11:44 26.05.2023



Out-of-Band Conducted Spurious Conducted Band Edge, Hopping



01:16:55 26.05.2023



4.7 Transmitter Radiated Emissions FCC Rule 15.247(d), 15.209, 15.205

4.7.1 Requirement

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.7.2 Procedure

Radiated emission measurements were performed from 9kHz to 25GHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz.

If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Spurious measurements are made with a preamp from 9kHz MHz to 25 GHz.

Measurements may be made with a Peak Detector and compared to QP limits for 9kHz – 1 GHz and Average limits for 1 GHz – 25 GHz.

Correlation measurements were performed below 30MHz between 10m ALSE and Open Field site according to FCC KDB 414788 D01 Radiated Test Site v01r01 section 2. All readings were within the acceptable tolerance.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).



4.7.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μ V/m) RA = Receiver Amplitude (including preamplifier) in dB(μ V); AF = Antenna Factor in dB(1/m) CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μ V/m). This value in dB(μ V/m) was converted to its corresponding level in μ V/m.

RA = 52.0 dB(μ V) AF = 7.4 dB(1/m) CF = 1.6 dB AG = 29.0 dB FS = 52.0+7.4+1.6-29.0 = 32 dB(μ V/m). Level in μ V/m = Common Antilogarithm [(32 dB μ V/m)/20] = 39.8 μ V/m.



4.7.2.1 Duty Cycle Correction Factor (DCCF)

Per 558074 D01 15.247 Meas Guidance, the use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (*e.g.*, within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (*i.e.*, not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

Duty Cycle Correction Factor Calculation

Subclause 7.5 of ANSI C63.10 was used to determine the DCCF.

DCCF = 20*log(18.48/100) = -14.67

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									00:42:34

00:42:34 26.05.2023



4.7.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

4.7.5 General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified for determining quasipeak, peak, and average conducted output power, respectively.

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies \leq 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

E = EIRP – 20log D + 104.8+DCF (DCF for Average measurements)

where:

E = electric field strength in $dB\mu V/m$,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

DCF = Duty Cycle Correction Factor

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test

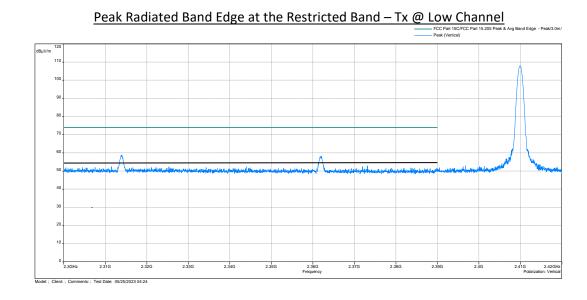
4.7.6 Test Results

Tested By	Test Date
Kenneth Roque	May 25 – June 2, 2023

These measurements were performed with antenna in place.



4.7.6 Test Results (Continued)

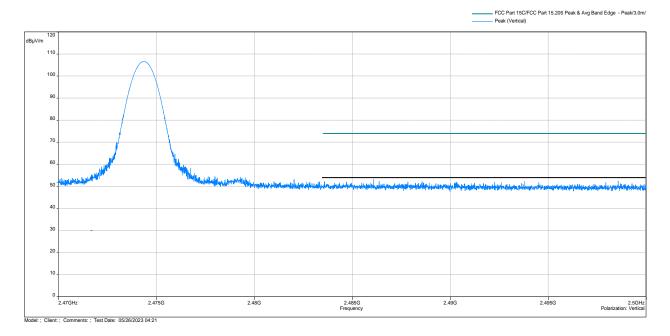


Test Results: 15.209/15.205 Radiated Restricted Band Emissions

Frequency (MHz)	Peak@3m (dBµV/m)	Duty Cycle Correction Factor	Final Field Strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Height (m)	Azimuth (deg)	Polarity	Detection	Correction (dB)
2313.940	58.82	0.00	58.82	74.00	-15.18	2.89	0.25	V	Pk	31.76
2313.940	58.82	-14.67	44.15	54.00	-9.85	2.89	0.25	V	Avg	31.76
2362.100	58.21	0.00	58.21	74.00	-15.79	2.89	251.50	V	Pk	31.51
2362.100	58.21	-14.67	43.54	54.00	-10.46	2.89	251.50	V	Avg	31.51
2390.000	49.85	0.00	49.85	74.00	-24.15	2.89	285.25	V	Pk	31.44

Note: Correction = AF + CF – Preamp





Radiated Band Edge at the Restricted Band – Tx @ High Channel, Peak

Frequency Peak Lim. Avg Peak-Lim Height Angle Correction Comment (MHz) (dBµV/m) (°) (dB) (dBµV/m) (dB) (m) 2483.500 49.91 54 -4.09 2.89 10.75 Vertical 31.76



Out-of-Band Radiated Spurious Emissions

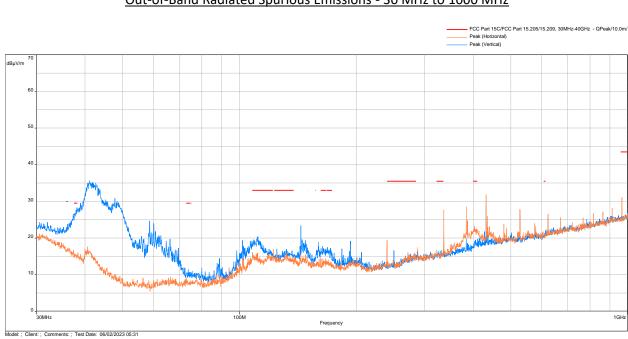
Test Results: 15.209 Radiated Spurious Emissions

FCC Part 15C/FCC 15.209, 9kHz - 30MHz at 10m - QPe Antenna Position mone Coaxial White Mary Abolited on ···· 30MHz Polarization: Horizonta Frequency - FCC Part 15C/FCC 15.209, 9kHz - 30MHz at 10m - QPe - Peak (Vertical) Antenna Position m.m. Coplanar 30MH Freq Pola Model: Client: Comments: Test Date: 06/01/2023 03:19 FCC Part 15C/FCC 15:209, 9kHz - 30MHz at 10m - QPeak/10.0m/ Peak (Horizontal) Antenna Position -Horizontal M minim they had my Frequenc ents: : Test Date: 06/01/2023 02:52 del: : Client: : Con

Radiated Spurious Emissions 9 kHz to 30 MHz, Peak Scan vs QP Limit

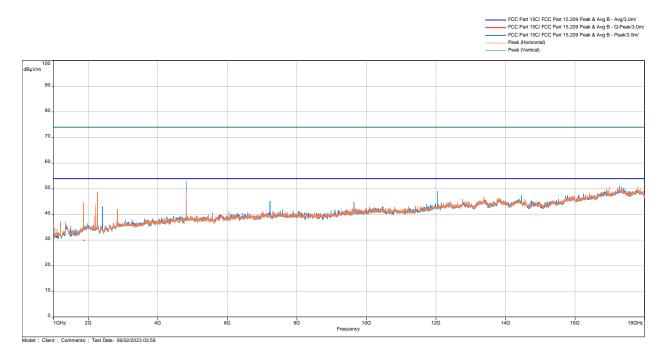


Test Results: Test Results: 15.209 Radiated Spurious Emissions, Tx at 2410 MHz



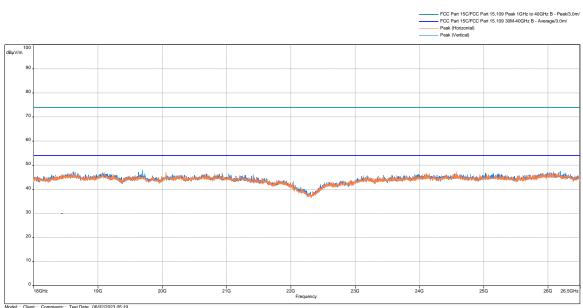
Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Avg & Peak Limit





Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak & Avg Limit



del: ; Client: ; Comments: ; Test Date: 06/02/2023 05:19

Frequency (MHz)	Pk@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Height (m)	Azimuth (deg)	Polarity	Correction (dB)
403.579	23.25	35.50	-12.25	1.96	40.50	Horizontal	-9.27
966.697	31.12	43.50	-12.38	2.97	312.50	Horizontal	0.35
111.609	20.38	33.00	-12.62	1.00	247.50	Vertical	-13.43
163.860	17.76	33.00	-15.24	2.00	202.50	Vertical	-14.09
168.645	17.44	33.00	-15.56	2.00	196.00	Vertical	-14.21
171.685	17.26	33.00	-15.74	2.00	231.50	Vertical	-14.35

Note: Correction = AF + CF – Preamp

Results Complies

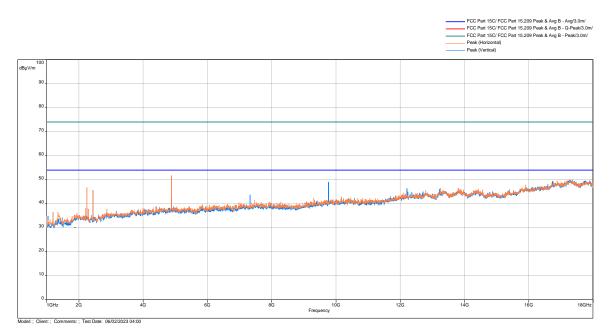
Note: Radiated emission measurements were performed up to from 9kHz to 26GHz. No Emissions were identified when scanned from 9k to 30MHz.



Test Results: Test Results: 15.209 Radiated Spurious Emissions, Tx at 2442MHz

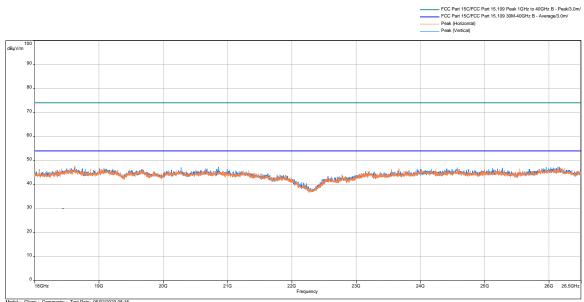
Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Avg & Peak Limit





Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak & Avg Limit



Model: ;	Client: ;	Comments: ;	Test Date:	06/02/2023 05:16

Frequency (MHz)	Pk@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Height (m)	Azimuth (deg)	Polarity	Correction (dB)
966.6967	32.99	43.50	-10.51	1.00	289.00	Horizontal	0.35
401.2837	23.72	35.50	-11.78	2.00	54.75	Horizontal	-9.39
111.6093	20.29	33.00	-12.71	1.00	107.50	Vertical	-13.43
114.681	18.46	33.00	-14.54	1.00	77.00	Vertical	-12.95
134.566	16.64	33.00	-16.36	2.00	346.50	Vertical	-12.45
170.262	16.59	33.00	-16.41	4.00	50.75	Vertical	-14.28

Note: Correction = AF + CF – Preamp

|--|

Note: Radiated emission measurements were performed up to from 9kHz to 26GHz. No Emissions were identified when scanned from 9k to 30MHz.



dBµV/m

60

40

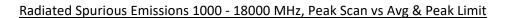
31

Model: ; Client: ; Comments: ; Test Date: 06/02/2023 05:48

Test Results: Test Results: 15.209 Radiated Spurious Emissions, Tx at 2474.5MHz

PCP Part 15:0FCC Part 15:05/15:209, 30MHz-40GHz - 0Peak 110.0m Peak (Matcata) Peak (Vertica) Peak (V

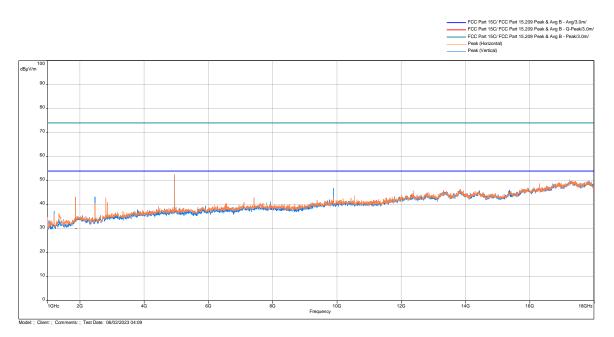
Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



100M

ALAMANNI,

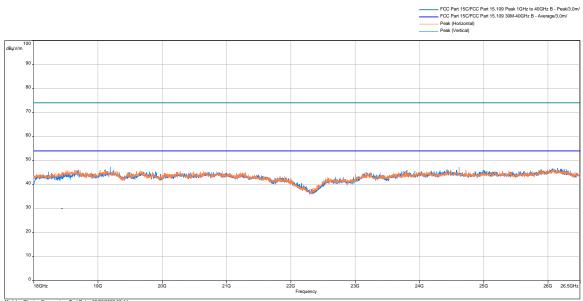
Frequency



1GH



Radiated Spurious Emissions 18000 - 26000 MHz, Peak Scan vs Peak & Avg Limit



Model: ;	Client: ;	Comments: ;	Test Date:	06/02/2023 05:14
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Frequency (MHz)	Pk@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Height (m)	Azimuth (deg)	Polarity	Correction (dB)
966.697	33.92	43.50	-9.58	1.00	295.00	Horizontal	0.35
400.734	22.49	35.50	-13.01	1.97	66.75	Horizontal	-9.41
168.775	18.66	33.00	-14.34	2.00	52.75	Vertical	-14.22
172.784	18.27	33.00	-14.73	2.00	0.25	Vertical	-14.40
170.747	17.94	33.00	-15.06	3.00	15.75	Vertical	-14.30
165.121	17.78	33.00	-15.22	2.00	17.50	Vertical	-14.05

Note: Correction = AF + CF – Preamp

Results Complies

Note: Radiated emission measurements were performed up to from 9kHz to 26GHz. No Emissions were identified when scanned from 9k to 30MHz.



4.8 AC Line Conducted Emission FCC: 15.207; RSS-GEN;

4.8.1 Requirement

Frequency Band	Class B Limit dB(μV)		Class A Lir	nit dB(µV)
MHz	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

Note: *Decreases linearly with the logarithm of the frequency. At the transition frequency the lower limit applies.

4.8.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.10-2013.

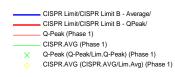
Tested By	Test Date	Results
Bryce Toma	June 29, 2023	Complies



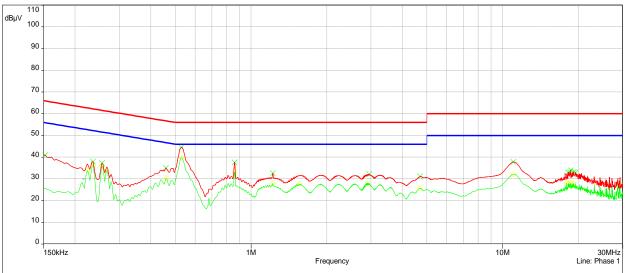
4.8.3 Test Result

15.207: Conducted Emissions 120VAC 60Hz

Phase 1



Sub-range 1 Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz) Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 2e+03 ms, Attenuation: 10 dB, Sweep count 10, Preamp: Off, LN Preamp: Off, Preselector: On Line:Phase 1



Model: ; Client: ; Comments: ; Test Date: 06/29/2023 22:12



Phase 2

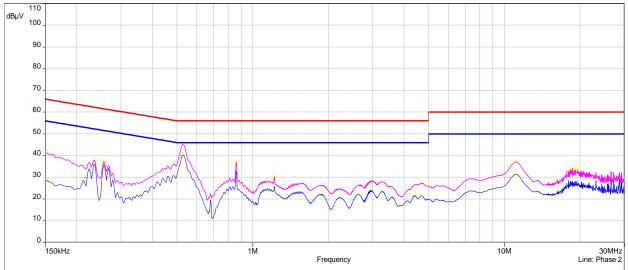
CISPR Limit/CISPR Limit B - Average/ CISPR Limit/CISPR Limit B - QPeak/ Q-Peak (Phase 2)

CISPR.AVG (Phase 2) Q-Peak (Q-Peak/Lim.Q-Peak) (Phase 2)

CISPR.AVG (CISPR.AVG/Lim.Avg) (Phase 2)

Sub-range 2 Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)

Settings: RBW: 9Hz, VBW: 30kHz, Sweep time: 2e+03 ms, Attenuation: 10 dB, Sweep count 10, Preamp: Off, LN Preamp: Off, Preselector: On Line:Phase 2



Model: ; Client: ; Comments: ; Test Date: 06/29/2023 22:12



4.8.3 Test Results (Continued)

Frequency	Q-Peak (dBµV)	Limit	Margin	Line	Correction (dB)
(MHz)		Q-Peak (dBµV)	Q-Peak (dB)		
0.528	45.22	56.00	-10.78	Phase 2	10.55
0.528	44.57	56.00	-11.43	Phase 1	10.55
0.861	37.64	56.00	-18.36	Phase 1	10.57
0.861	36.95	56.00	-19.05	Phase 2	10.57
0.490	36.27	56.17	-19.90	Phase 2	10.55
0.458	35.06	56.72	-21.67	Phase 1	10.54
11.018	37.84	60.00	-22.16	Phase 1	10.86
11.040	37.07	60.00	-22.93	Phase 2	10.86
1.221	32.58	56.00	-23.42	Phase 1	10.58
2.947	32.16	56.00	-23.84	Phase 1	10.67
0.256	37.35	61.57	-24.21	Phase 2	10.53
0.256	37.31	61.57	-24.25	Phase 1	10.53
0.236	37.89	62.25	-24.36	Phase 1	10.53
0.236	37.89	62.25	-24.37	Phase 2	10.53
0.152	41.35	65.88	-24.53	Phase 2	10.53
4.700	31.16	56.00	-24.84	Phase 1	10.74
0.152	40.95	65.88	-24.92	Phase 1	10.53
1.221	30.28	56.00	-25.72	Phase 2	10.58
18.634	34.15	60.00	-25.85	Phase 2	10.97
18.634	33.98	60.00	-26.02	Phase 1	10.97
19.464	33.53	60.00	-26.47	Phase 2	10.99
19.149	33.45	60.00	-26.55	Phase 2	10.98
18.305	33.39	60.00	-26.61	Phase 2	10.97
19.041	33.32	60.00	-26.68	Phase 2	10.98
19.149	33.17	60.00	-26.83	Phase 1	10.98
18.488	33.11	60.00	-26.89	Phase 1	10.97
19.466	32.93	60.00	-27.07	Phase 1	10.99
18.188	32.92	60.00	-27.08	Phase 1	10.97
2.969	28.44	56.00	-27.56	Phase 2	10.67
4.700	27.34	56.00	-28.66	Phase 2	10.74

Frequency	CISPR	Limit	Margin Avg	Line	Correction (dB)	
(MHz)	AVG (dBµV)	Avg (dBμV)	(dB)			
0.528	40.31	46.00	-5.69	Phase 2	10.55	
0.530	39.68	46.00	-6.32	Phase 1	10.55	
0.861	33.33	46.00	-12.67	Phase 1	10.57	
0.861	32.82	46.00	-13.18	Phase 2	10.57	
0.485	30.80	46.25	-15.44	Phase 2	10.55	
0.256	35.89	51.57	-15.68	Phase 1	10.53	
0.256	35.89	51.57	-15.68	Phase 2	10.53	
0.236	36.22	52.25	-16.04	Phase 2	10.53	
0.236	36.21	52.25	-16.05	Phase 1	10.53	
0.461	30.22	46.68	-16.46	Phase 1	10.54	
0.267	33.99	51.21	-17.22	Phase 1	10.53	
0.267	33.99	51.21	-17.22	Phase 2	10.53	
11.020	32.17	50.00	-17.83	Phase 1	10.86	
2.902	28.14	46.00	-17.86	Phase 1	10.66	
1.221	27.96	46.00	-18.04	Phase 1	10.58	
1.559	27.72	46.00	-18.28	Phase 1	10.60	
11.040	31.35	50.00	-18.65	Phase 2	10.86	
0.224	33.99	52.66	-18.67	Phase 2	10.53	
0.224	33.96	52.66	-18.70	Phase 1	10.53	
1.221	25.83	46.00	-20.17	Phase 2	10.58	
29.236	29.70	50.00	-20.30	Phase 2	11.09	
4.679	25.70	46.00	-20.30	Phase 1	10.74	
28.685	29.27	50.00	-20.73	Phase 2	11.09	
26.610	29.15	50.00	-20.85	Phase 2	11.06	
27.159	28.86	50.00	-21.14	Phase 2	11.07	
26.486	28.77	50.00	-21.23	Phase 2	11.06	
18.634	28.21	50.00	-21.79	Phase 1	10.97	
2.947	24.05	46.00	-21.95	Phase 2	10.67	
17.963	28.05	50.00	-21.95	Phase 1	10.96	
18.305	27.93	50.00	-22.07	Phase 1	10.97	
19.149	27.92	50.00	-22.08	Phase 1	10.98	
29.236	27.90	50.00	-22.10	Phase 1	11.09	
1.867	22.29	46.00	-23.71	Phase 2	10.61	
4.416	21.53	46.00	-24.47	Phase 2	10.73	
0.152	28.71	55.88	-27.16	Phase 2	10.53	

intertek

Total Quality. Assured.

Complies by 5.69 dB



5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
EMI Receiver	Rohde and Schwarz	ESU40	ITS 00961	12	03/14/24
Horn Antenna	ETS Lindgren	3117PA	ITS 01325	12	11/19/23
Horn Antenna	ETS-Lindgren	3115	ITS 00982	12	05/22/24
Spectrum Analyzer	Rohde and Schwarz	FSW	ITS 01818	12	07/19/23
Loop Antenna	ETS Lindgren	6512	ITS 01573	12	11/21/24
BI-Log Antenna	SunAR RF Motion	JB1	ITS 01577	12	02/20/24
Pre-Amplifier	Sonoma Instrument	310	ITS 00942	12	04/21/24
18-40 GHz Preamplifier	uComp Nordic	MCNS-50- 18004000335P	ITS 01799	12	03/15/24
Horn Antenna EMCO		3160-09	ITS 00571	#	#
Notch Filter MICRO-TRONICS		BRM50702	ITS 01166	12	06/24/23
LISN COM-POWER		LIN-115A	ITS 01290	12	08/01/23
10m Semi-Anechoic	Panashield	10m Chamber	ITS 00984	36	07/29/23

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz Conducted Emissions
BAT-EMC	Nexio	3.20.0.23	Ampt (Comm) – 05-23-23.bpp



6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G105434881	KRQ	AS	July 14, 2023	Original Document



END OF REPORT