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Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Aquana TEST REPORT

SCOPE OF WORK

EMC TESTING – AQUANA SV-2 SMART VALVE

REPORT NUMBER

105620787LEX-001

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 105620787LEX-001

Project Number: G105620787

Report Issue Date: 5/2/2024

Model(s) Tested: Aquana SV-2 Smart Valve

Standards: FCC Part 15B
ICES-003 Issue 7
FCC Part 15C
RSS-247 Issue 3
(Limited to Radiated Spurious Emissions)

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:
Aquana
7007 Pinemont Drive
Houston, TX 77040
USA

Report prepared by



Jordan Coughenour, EMC Technician

Report reviewed by



Michael Carlson, EMC Team Lead

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
6	Radiated Emissions (Transmitters Idle) (ANSI C63.4:2014)	Pass
6	Radiated Spurious Emissions (Transmitters Active) (ANSI C63.10:2013)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Aquana
Address:	7007 Pinemont Drive Houston, TX 77040 USA
Contact:	Jeff Askew
Telephone:	+1 (888) 404-2782
Email:	jeff.askew@aquana.com
Manufacturer Information	
Manufacturer Name:	Aquana
Manufacturer Address:	7007 Pinemont Drive Houston, TX 77040 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Aquana SV-2 Smart Valve
Model Number	SV-2-LORA
Serial Number	21135492
Hardware Version	Rev E
Software Version	3.0.6
Supported Transmit Bands	2402 – 2480MHz
FCCID	2AQSE-AQSV1
ICID	24363-AQSV1
Embedded Module	Multitech MTXDOT-NA1
Embedded Module Supported Transmit Bands	902.3 – 914.9MHz
Embedded Module FCCID	AU792U13A16858
Embedded Module ICID	125A-0055
Receive Date	10/31/2023
Test Start Date	3/19/2024
Test End Date	3/19/2024
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	3.6 VDC Via Battery
Description of Equipment Under Test (provided by client)	
The Aquana Smart Valve is a remotely controllable water valve that works over RF networks to provide monitoring and control via cloud-based software applications.	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 System Setup and Method

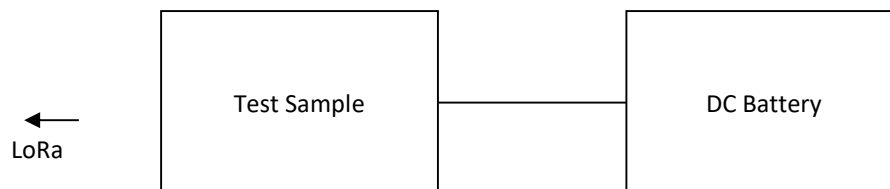
5.1 Method:

Configuration as required by ANSI C63.4:2014 and ANSI C63.10:2013.

No.	Descriptions of EUT Exercising
1	Dc Power: On, LoRa Radio: On and transmitting on a low/mid/high channel
2	DC Power: On, LoRa Radio: idle

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
	N/A	N/A	N/A	N/A	N/A

5.2 EUT Block Diagram:





6 Radiated Emissions

6.1 Method

Tests are performed in accordance with ANSI C63.4:2014 and ANSI C63.10:2013.

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.



6.2 Sample 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:

$$FS = RA + AF + CF - AG$$

Where

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

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a 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/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$
$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

6.3 Field Strength to Power Calculation

As allowable by ANSI C63.26: 2015 section 5.2.7, the output power of unwanted emissions can be calculated from a field strength measurement. The transmitter measurements that follow in this report have applied the following calculation to the -13dBm limit to arrive an equivalent field strength limit at 3 meters as follows:

$E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20\log(D) + 104.8$; where D is the measurement distance (in the far field region) in m.

Example:

$$\text{Limit (dB}\mu\text{V/m)} = -13 - 20\log(3) + 104.8 = 82.25 \text{ dB}\mu\text{V/m}$$

**6.4 Test Equipment Used:**

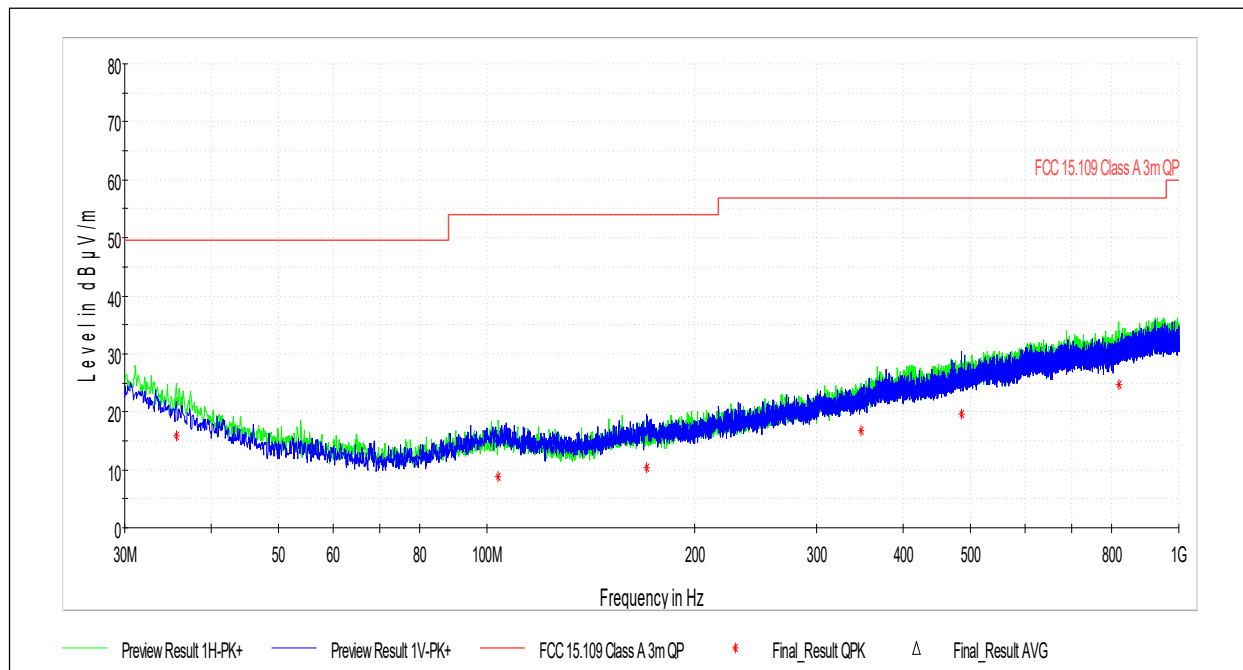
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	8285	Rohde&Schwarz	ESW44	9/19/2023	9/19/2024
Bilog Antenna	7085	SunAR	JB6	3/7/2023	3/7/2024
Bilog Antenna	7085	SunAR	JB6	3/18/2024	3/18/2025
Horn Antenna	3780	ETS Lindgren	3117	8/8/2023	8/8/2024
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Preamplifier	3918	TS-PR18	122005	1/12/2024	1/12/2025
Coaxial Cable	3074			1/12/2024	1/12/2025
Coaxial Cable	2588			1/12/2024	1/12/2025
Coaxial Cable	2593			1/12/2024	1/12/2025
Coaxial Cable	2592			1/12/2024	1/12/2025
Coaxial Cable	8188			1/12/2024	1/12/2025
Coaxial Cable	8185			1/12/2024	1/12/2025

6.5 Software Utilized:

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 10.60.20

6.6 Results:

The sample tested was found to Comply.

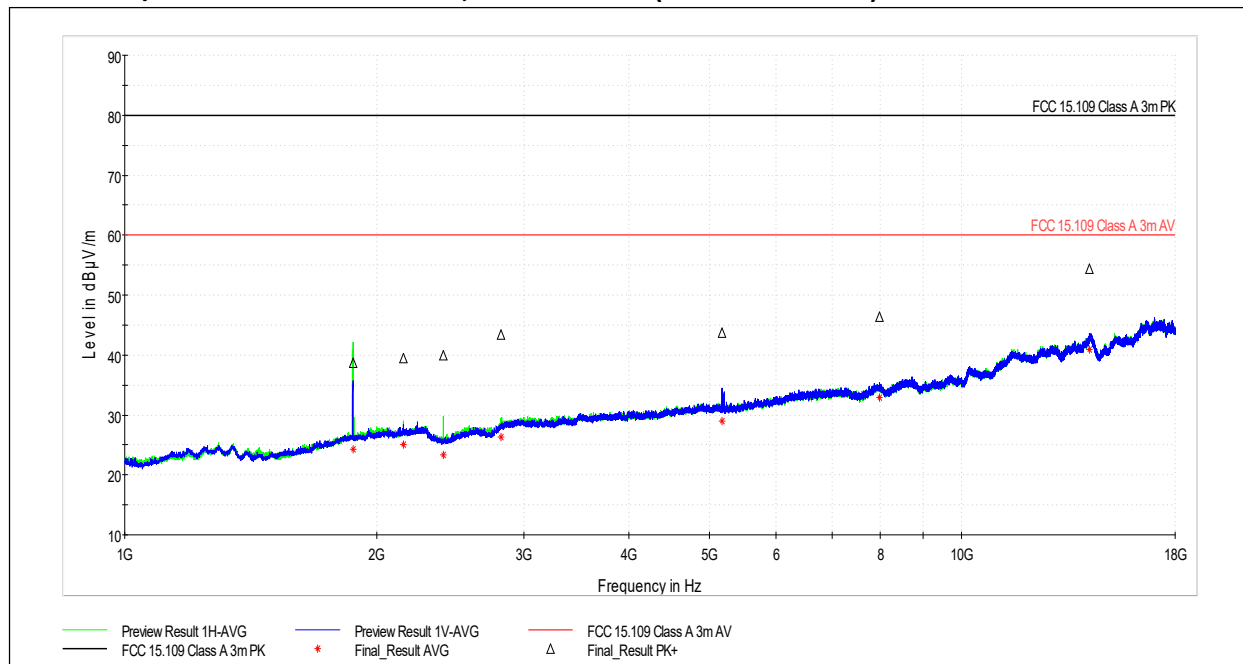
**6.7 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
35.604	15.76	49.54	33.78	105.0	H	0.0	21.7
103.882	8.91	53.98	45.07	170.0	H	206.0	15.7
170.434	10.42	53.98	43.56	146.0	V	263.0	17.3
347.621	16.66	56.90	40.24	269.0	H	16.0	23.1
485.199	19.63	56.90	37.28	170.0	V	178.0	25.9
818.448	24.76	56.90	32.14	297.0	H	174.0	31.4

Test Personnel: Jeremiah Andrade
Supervising/Reviewing Engineer: N/A
(Where Applicable)
FCC Part 15B
Product Standard: ICES-003 Issue 7
Input Voltage: 3.6VDC Via Battery
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 10/31/2023
Limit Applied: Class B
Ambient Temperature: 16.9 °C
Relative Humidity: 46.1 %
Atmospheric Pressure: 988.8 mbar

Deviations, Additions, or Exclusions: The FCC Part 15.109 limits are more stringent than the corresponding limits from ICES-003 Issue 7.

**6.8 Plots/Data: Radiated Emissions, 1GHz – 18GHz (Transmitters Idle)**

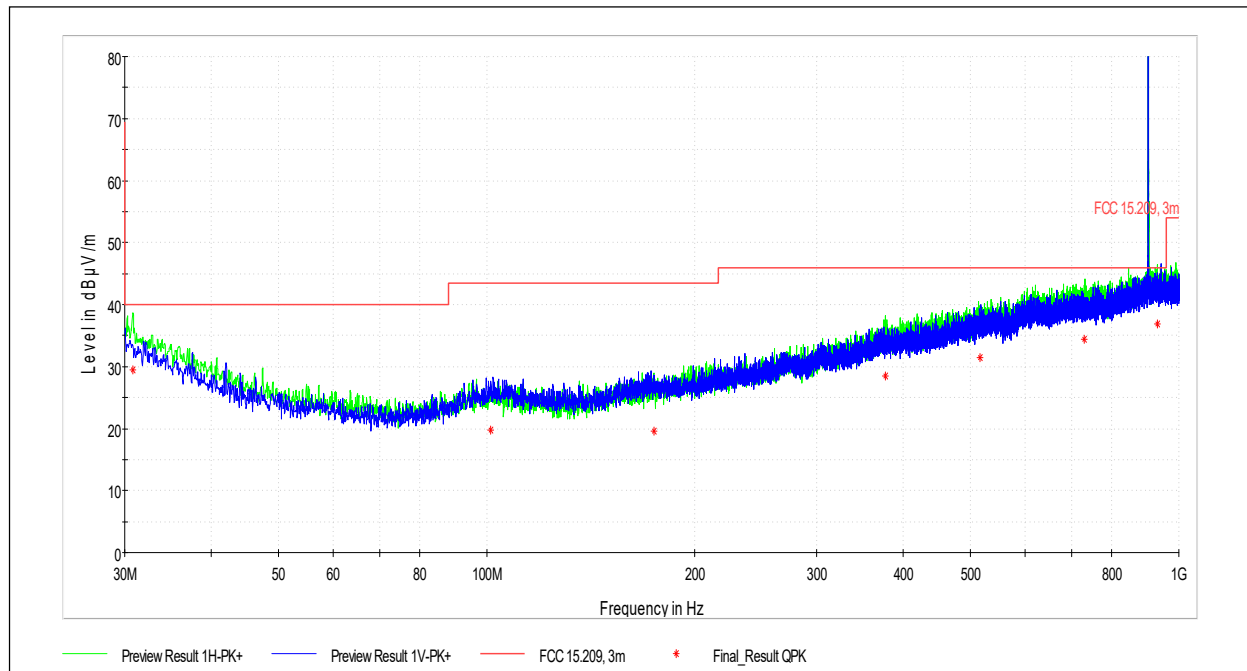
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1873.000	38.69	80.00	41.31	214.0	H	318.0	2.7
2154.000	39.46	80.00	40.54	170.0	H	-1.0	3.6
2402.000	40.03	80.00	39.97	127.0	H	0.0	4.5
2818.000	43.47	80.00	36.53	100.0	H	181.0	5.5
5178.000	43.65	80.00	36.35	232.0	V	44.0	9.9
7978.000	46.37	80.00	33.63	394.0	V	207.0	14.4
14221.500	54.39	80.00	25.61	117.0	V	124.0	21.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1873.000	24.31	60.00	35.69	214.0	H	318.0	2.7
2154.000	25.12	60.00	34.88	170.0	H	-1.0	3.6
2402.000	23.38	60.00	36.62	127.0	H	0.0	4.5
2818.000	26.30	60.00	33.70	100.0	H	181.0	5.5
5178.000	28.93	60.00	31.07	232.0	V	44.0	9.9
7978.000	32.94	60.00	27.06	394.0	V	207.0	14.4
14221.500	40.90	60.00	19.10	117.0	V	124.0	21.2

Test Personnel: Jeremiah Andrade
Supervising/Reviewing Engineer: N/A
(Where Applicable)
Product Standard: FCC Part 15B
Input Voltage: ICES-003 Issue 7
Pretest Verification w / Ambient Signals or BB Source: 3.6VDC Via Battery
Yes

Test Date: 10/31/2023
Limit Applied: Class B
Ambient Temperature: 16.9 °C
Relative Humidity: 46.1 %
Atmospheric Pressure: 988.8 mbar

Deviations, Additions, or Exclusions: None

**6.9 FCC Part 15.247 Radiated Spurious Emissions (LoRa Radio)****6.9.1 Radiated Spurious Emissions, 30 MHz – 1 GHz****6.9.1.1 Low Channel (903MHz)**

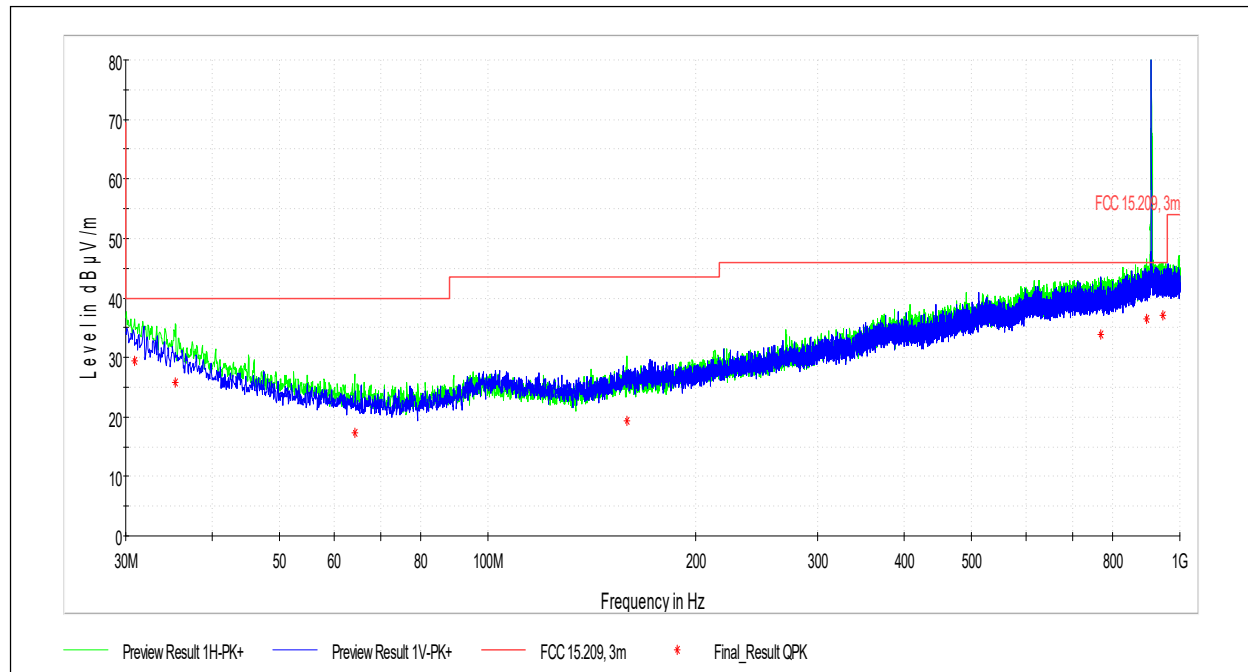
The large peak shown is the fundamental frequency of the operating band.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.808	29.45	40.00	10.55	250.0	H	241.0	24.4
101.457	19.79	43.50	23.71	273.0	V	0.0	16.7
174.314	19.61	43.50	23.89	298.0	H	348.0	16.8
377.098	28.46	46.00	17.54	261.0	H	109.0	24.1
516.239	31.47	46.00	14.53	338.0	H	115.0	27.3
730.502	34.34	46.00	11.66	100.0	H	90.0	30.7
931.184	36.87	46.00	9.13	206.0	H	272.0	32.9

Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: N/A
(Where Applicable)
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 3
Pretest Verification w / Ambient Signals or BB Source: 3.6VDC Via Battery
Yes

Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8 °C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None

**6.9.1.2 Mid Channel (909.4MHz)**

The large peak shown is the fundamental frequency of the operating band.

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.916	29.33	40.00	10.67	310.0	H	16.0	24.3
35.389	25.77	40.00	14.23	400.0	H	180.0	21.8
64.273	17.33	40.00	22.67	269.0	H	96.0	14.3
158.794	19.36	43.50	24.14	204.0	H	251.0	16.7
767.847	33.84	46.00	12.16	215.0	V	125.0	30.1
894.270	36.54	46.00	9.46	391.0	H	0.0	32.7
945.464	37.16	46.00	8.84	226.0	H	27.0	33.1

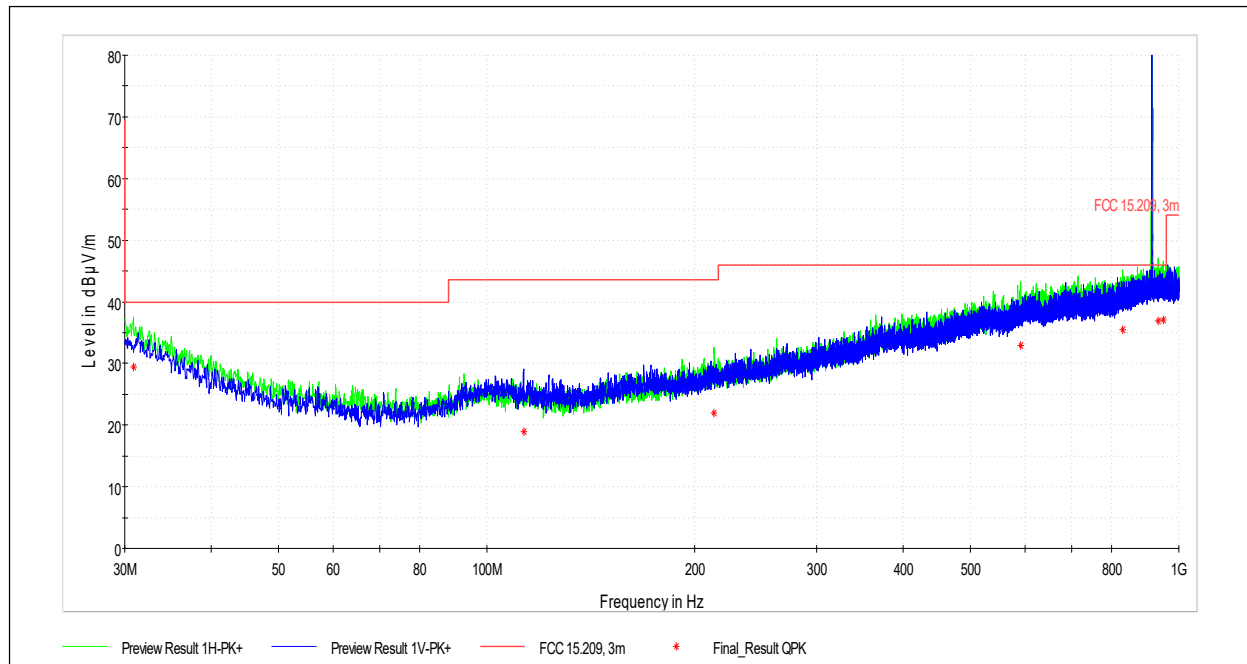
Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: N/A
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 3
Input Voltage: 3.6VDC Via Battery
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8 °C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None



6.9.1.3 High Channel (914.2MHz)



The large peak shown is the fundamental frequency of the operating band.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.862	29.41	40.00	10.59	400.0	H	168.0	24.4
113.097	18.93	43.50	24.57	322.0	V	138.0	15.7
213.168	21.89	43.50	21.61	127.0	H	58.0	18.7
591.037	32.97	46.00	13.03	204.0	H	270.0	28.9
830.196	35.48	46.00	10.52	96.0	H	0.0	31.9
933.447	36.88	46.00	9.12	100.0	H	204.0	32.9
949.560	37.12	46.00	8.88	185.0	H	288.0	33.2

Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: FCC Part 15.247
Input Voltage: RSS-247 Issue 3
Pretest Verification w / Ambient Signals or BB Source: 3.6VDC Via Battery Yes

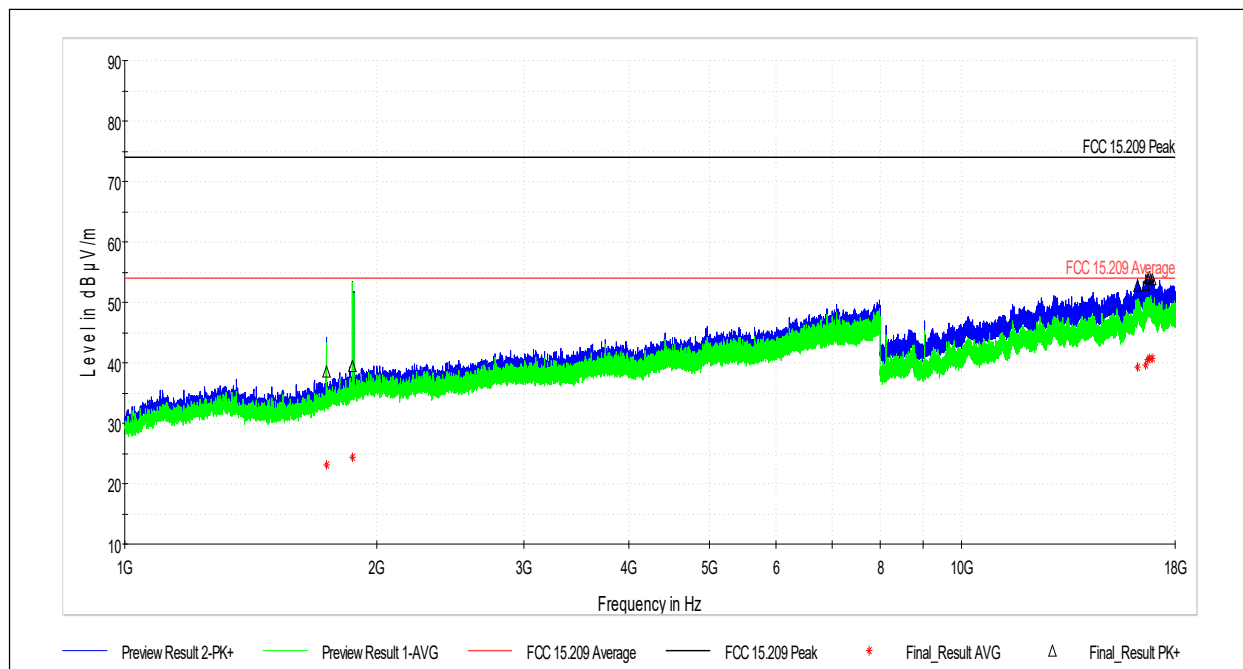
Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8 °C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None



6.9.2 Radiated Spurious Emissions, 1 GHz – 18 GHz

6.9.2.1 Low Channel (903MHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1741.045	38.51	74.00	35.49	100.0	V	253.0	1.8
1871.500	39.45	74.00	34.55	100.0	H	0.0	3.2
16242.500	52.69	74.00	21.31	410.0	H	67.0	25.3
16609.500	52.83	74.00	21.17	410.0	V	159.0	27.1
16688.000	54.04	74.00	19.96	100.0	V	0.0	27.2
16765.500	54.19	74.00	19.81	100.0	H	141.0	27.1
16903.500	53.89	74.00	20.11	375.0	V	45.0	26.9

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1741.045	23.06	54.00	30.94	100.0	V	253.0	1.8
1871.500	24.43	54.00	29.57	100.0	H	0.0	3.2
16242.500	39.35	54.00	14.65	410.0	H	67.0	25.3
16609.500	39.69	54.00	14.31	410.0	V	159.0	27.1
16688.000	40.47	54.00	13.53	100.0	V	0.0	27.2
16765.500	40.81	54.00	13.19	100.0	H	141.0	27.1

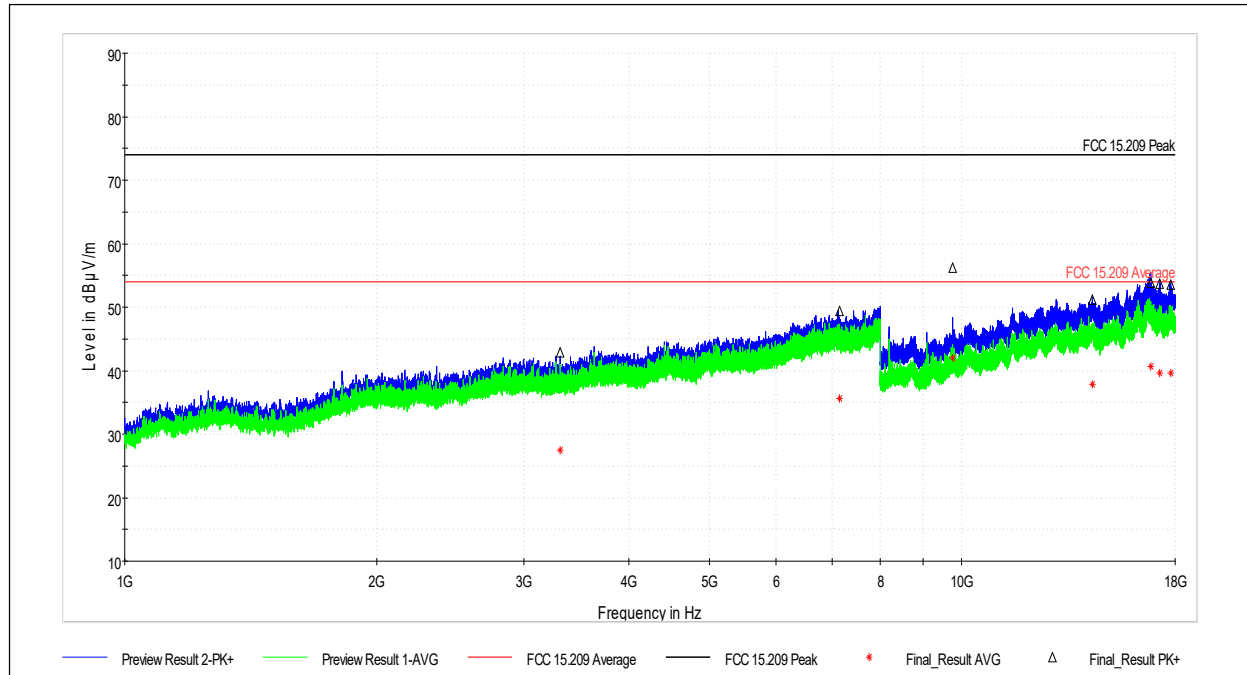
Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: N/A
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 3
Input Voltage: 3.6VDC Via Battery
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8°C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None



6.9.2.2 Mid Channel (909.4MHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3312.864	42.90	74.00	31.10	410.0	H	208.0	6.9
7152.682	49.48	74.00	24.52	410.0	H	104.0	13.4
9764.000	56.17	74.00	17.83	279.0	H	69.0	17.4
14319.000	51.17	74.00	22.83	100.0	V	163.0	22.1
16823.500	53.81	74.00	20.19	374.0	H	116.0	27.0
17232.000	53.63	74.00	20.37	384.0	V	68.0	26.1
17792.000	53.52	74.00	20.48	109.0	H	290.0	26.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3312.864	27.53	54.00	26.47	410.0	H	208.0	6.9
7152.682	35.64	54.00	18.36	410.0	H	104.0	13.4
9764.000	42.06	54.00	11.94	279.0	H	69.0	17.4
14319.000	37.91	54.00	16.09	100.0	V	163.0	22.1
16823.500	40.72	54.00	13.28	374.0	H	116.0	27.0
17232.000	39.57	54.00	14.43	384.0	V	68.0	26.1
17792.000	39.58	54.00	14.42	109.0	H	290.0	26.6

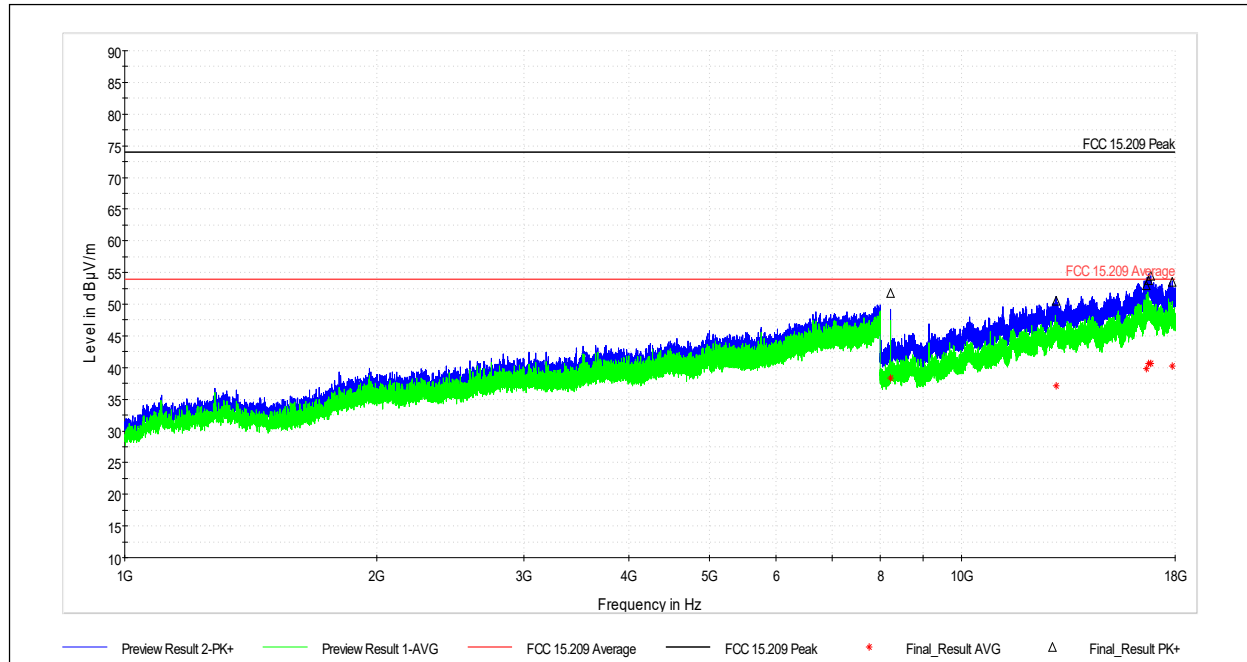
Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: N/A
(Where Applicable)
Product Standard: RSS-247 Issue 3
Input Voltage: 3.6VDC Via Battery
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8 °C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None



6.9.2.3 High Channel (914.2MHz)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8227.500	51.75	74.00	22.25	410.0	V	336.0	15.0
12962.000	50.55	74.00	23.45	410.0	H	292.0	21.4
16623.500	52.94	74.00	21.06	410.0	V	9.0	27.1
16728.000	53.77	74.00	20.23	391.0	V	279.0	27.2
16838.500	54.44	74.00	19.56	410.0	H	145.0	27.0
17863.500	53.49	74.00	20.51	410.0	V	247.0	26.9

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8227.500	38.40	54.00	15.60	410.0	V	336.0	15.0
12962.000	37.11	54.00	16.89	410.0	H	292.0	21.4
16623.500	39.80	54.00	14.20	410.0	V	9.0	27.1
16728.000	40.63	54.00	13.37	391.0	V	279.0	27.2
16838.500	40.71	54.00	13.29	410.0	H	145.0	27.0
17863.500	40.27	54.00	13.73	410.0	V	247.0	26.9

Test Personnel: Jordan Coughenour
Supervising/Reviewing Engineer: N/A
(Where Applicable) FCC Part 15.247
Product Standard: RSS-247 Issue 3
Input Voltage: 3.6VDC Via Battery
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 3/25/2024
Limit Applied: FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Ambient Temperature: 19.8 °C
Relative Humidity: 21.8 %
Atmospheric Pressure: 983.8 mbar

Deviations, Additions, or Exclusions: None

**7 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	5/2/2024	105620787LEX-001	<i>SL</i>	<i>MC</i>	Original Issue