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Akron Brass Company TEST REPORT

SCOPE OF WORK

FCC TITLE 47 CFR PART 15 SUBPART B
ICES-003 ISSUE 7

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104917132LEX-001

Project Number: G104917132

Report Issue Date: 12/8/2022

Model(s) Tested: 6055 SAM Smart Nozzle

Standards: FCC Title 47 CFR Part 15 Subpart B
ICES-003 ISSUE 7
FCC Part 15C
RSS-247 Issue 2
(Radiated Spurious Emissions)

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


Client:
Akron Brass Company
343 Venture Blvd.
PO Box 86
Wooster, OH 44691-4681
USA

Report prepared by



Brian Lackey, Team Leader

Report reviewed by



James Sudduth, Senior Staff Engineer

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Table of Contents

1	<i>Introduction and Conclusion.....</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models.....</i>	6
5	<i>System Setup and Method</i>	7
6	<i>Radiated Emissions</i>	10
7	<i>Revision History</i>	21



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
-	Conducted Emissions (ANSI C63.4:2014)	N/A ¹

¹ The test is not applicable. The EUT does not connect to AC mains.



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Akron Brass Company
Address:	343 Venture Blvd. PO Box 86 Wooster, OH 44691-4681 USA
Contact:	Tom Bertosa
Telephone:	+1 (330) 988-3371
Email:	tbertosa@idexcorp.com
Manufacturer Information	
Manufacturer Name:	Akron Brass Company
Manufacturer Address:	343 Venture Blvd. PO Box 86 Wooster, OH 44691-4681 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	6055 SAM Smart Nozzle
Model Number	6055 SAM Smart Nozzle
Serial Number	Unit 1
Embedded Modules	Digi XBee-PRO SX Espressif ESP-WROOM-02D
Supported Transmit Modes	Digi XBee-PRO SX: FHSS, 110kbps, 250kHz channel spacing, GFSK Espressif ESP-WROOM-02D: 802.11b/g/n
Embedded Modules FCCID / ICID	Digi XBee-PRO SX FCCID: MCQ-XBPSX ICID: 1846A-XBPSX Espressif ESP-WROOM-02D FCCID: 2AC7Z-ESPWROOM02D, ICID: 21098-ESPWROOM02D
Test Channels	Digi XBee-PRO SX: 915 MHz, 921.25 MHz, 927.25 MHz Espressif ESP-WROOM-02D: None ²
Receive Date	6/16/2022
Test Start Date	6/21/2022
Test End Date	6/21/2022
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	3.7 VDC (Battery)
Antenna Gain ³	-7.3dBi (Measured)
Description of Equipment Under Test ³	
<p>The SAM Smart Nozzle is an industry-first product that serves as part of the SAM Advanced Flow System (AFS). It provides firefighters with enhanced situational awareness capability and aids in automating the firefighting process. This is accomplished via the following functionality:</p> <ul style="list-style-type: none"> • The ability to open the valve and charge the fire hose from the nozzle; • Provision of water status information to the nozzle operator; • Provision of local pressure sensor measurements from the nozzle to the SAM system to account for friction loss. <p>The 6055 SAM Smart Nozzle contains a Wi-Fi module (Espressif ESP-WROOM-02D) that is used for diagnostic and troubleshooting purposes and does not transmit during normal operation or at the same time as the Digi XBee-PRO SX module.</p>	

4.1 Variant Models:

There were no variant models covered by this evaluation.

² The Espressif ESP-WROOM-02D was not tested under this evaluation.

³ This information was provided by the client and may affect compliance. Intertek makes no claims of compliance for any device(s) other than those identified herein. Intertek cannot attest to the accuracy of any client-provided data.



4.2 Duty Cycle Correction Factor Derivation

The following measurements were performed by the client. Deviations from these values may affect compliance. Intertek does not make any claim of compliance for values other than those shown below.

A series of current draw measurements were taken on a prototype 6055 SAM Smart Nozzle unit while it was responding to poll requests every 100 ms. A series of traces showing the captured time deltas for TX ON and TX OFF are provided. The resulting measurements show a cumulative TX time of 17.4 ms for every 100 ms polling period.

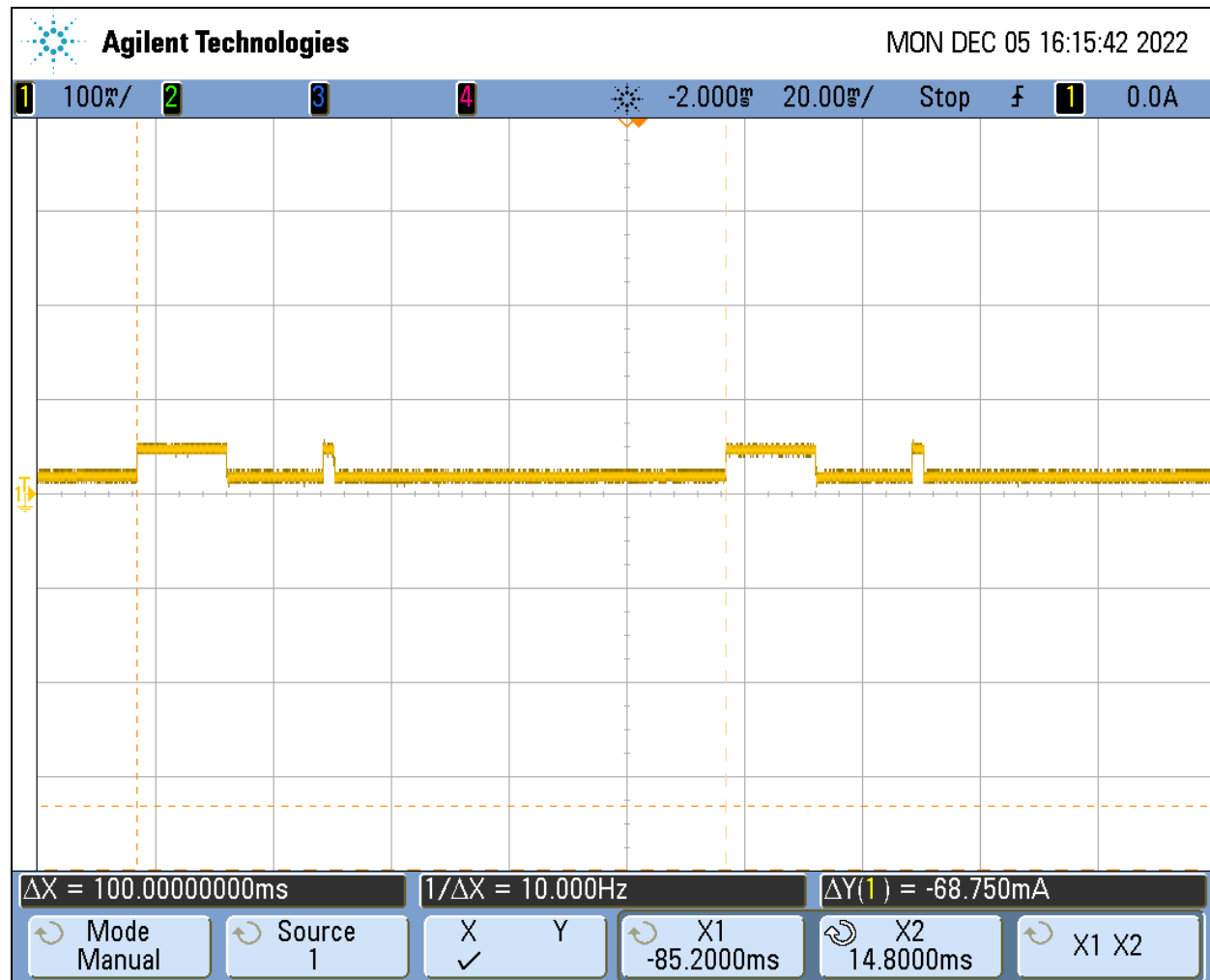


Figure 1 – Measured Time Between Pulses = 100ms



Figure 2 – Accumulated Transmit Time of 15.4ms (left) and 2ms (right) = 17.4ms

Per 15.35c of FCC Title 47, given that pulsed operation of the radio module is being employed, the measurement field strength can be determined by averaging over a 100 ms pulse train. Consequently, the measurement field strength for the unit being tested can be multiplied by 17.4% (equivalent to an addition of -15.19dB to logarithmic values).

The equipment used for taking these measurements included an Agilent InfiniVision MSO7034A oscilloscope with an Agilent N2774A current probe, which received power from an Agilent N2775A power supply.



5 System Setup and Method

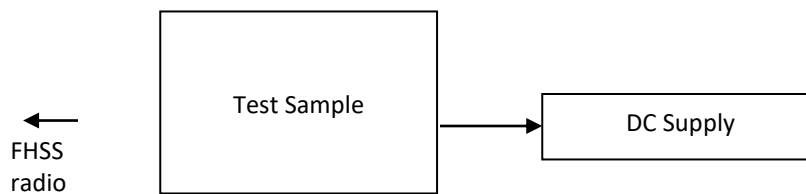
5.1 Method:

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

No.	Descriptions of EUT Exercising
1	The EUT was powered by an external supply in place of its battery. The radio was idle.
2	The EUT was powered by an external supply in place of its battery. The radio was configured to transmit continuously on a low, middle, or high channel.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	DC Power	1	No	No	DC Supply

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)	Ucispr
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.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

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

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

$$NF = \text{Net Reading in dB}\mu\text{V}$$

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 Test Equipment Used:**

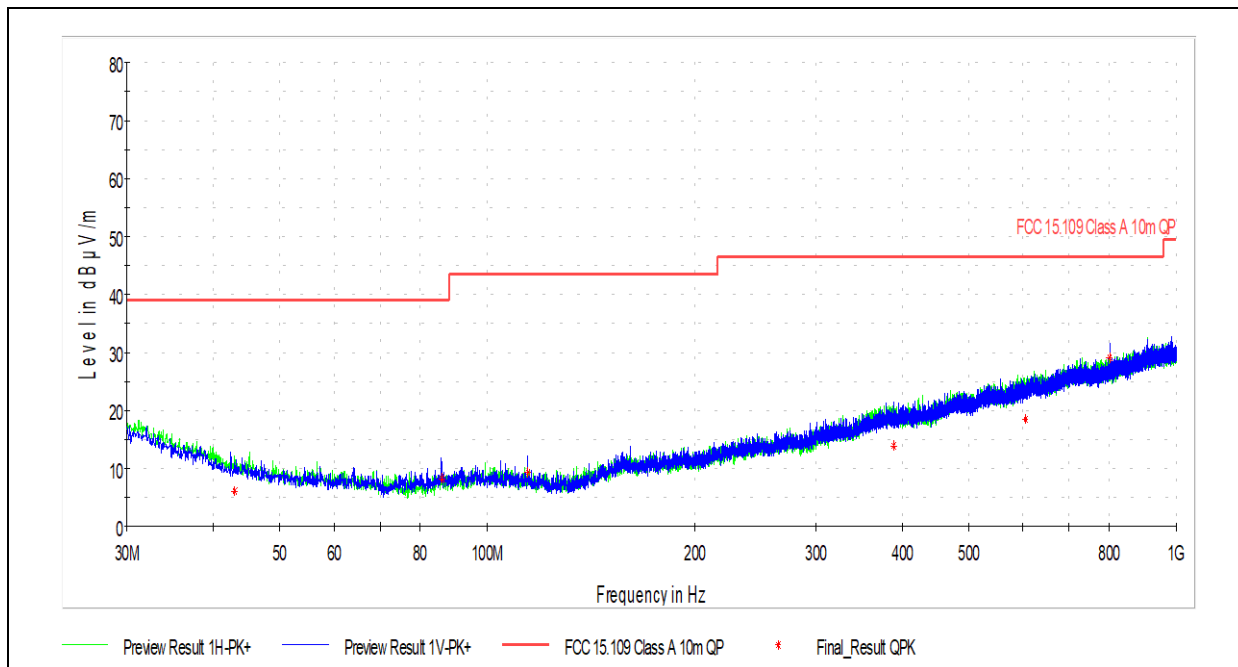
Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	8181	Rohde & Schwarz	ESW44	11/16/2021	11/16/2022
Bilog Antenna	3133	ETS	3142C	8/26/2021	8/26/2022
Horn Antenna	3780	ETS	3117	6/28/2021	6/28/2022
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Preamplifier	3918	Rohde&Schwarz	TS-PR18	1/13/2022	1/13/2023
Preamplifier	3920	Rohde & Schwarz	TS-PR26	1/13/2022	1/13/2023
Coaxial Cable	3074			1/13/2022	1/13/2023
Coaxial Cable	2588			1/13/2022	1/13/2023
Coaxial Cable	2593			1/13/2022	1/13/2023
Coaxial Cable	2592			1/13/2022	1/13/2023
Coaxial Cable	3339			1/13/2022	1/13/2023

6.4 Software Utilized:

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 10.60.20

6.5 Results:

The sample tested was found to Comply.

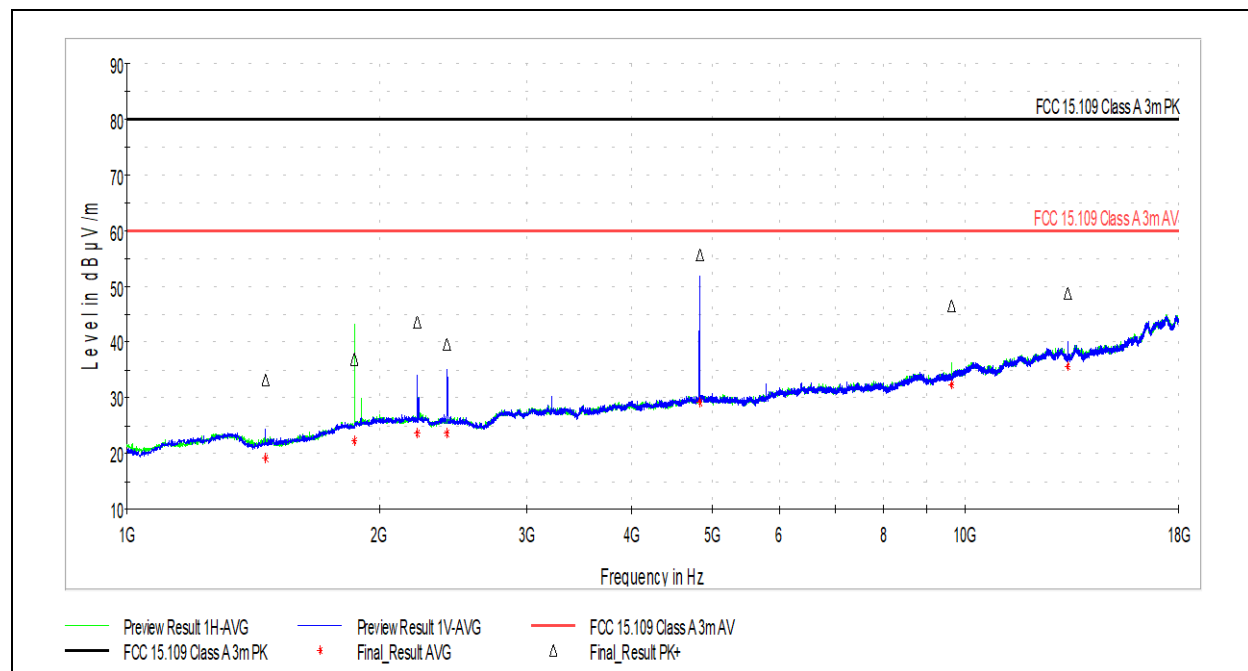
**6.6 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
42.987222	6.13	39.085	32.95	120.000	395.0	H	260.0	-12.03
85.912778	8.31	39.085	30.77	120.000	363.0	V	322.0	-14.68
114.531667	9.38	43.522	34.14	120.000	396.0	V	269.0	-14.23
388.904444	13.92	46.444	32.52	120.000	192.0	V	69.0	-3.44
603.930000	18.47	46.444	27.97	120.000	396.0	H	174.0	2.51
801.810556	29.22	46.444	17.23	120.000	101.0	V	90.0	6.13

Test Personnel: Seth Parker
Supervising/Reviewing Engineer: Brian Lackey
(Where Applicable) FCC Part 15B
Product Standard: ICES-003 Issue 7
Input Voltage: 3.7VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 6/21/2022
Limit Applied: Class A
Ambient Temperature: 24.0C
Relative Humidity: 46.5%
Atmospheric Pressure: 990.3mbar

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

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

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1462.000000	33.08	80.000	46.92	1000.000	410.0	V	170.0	-1.56
1868.500000	37.07	80.000	42.93	1000.000	125.0	H	350.0	2.73
2220.000000	43.66	80.000	36.34	1000.000	410.0	V	0.0	3.57
2409.500000	39.74	80.000	40.26	1000.000	410.0	V	1.0	4.38
4824.000000	55.76	80.000	24.24	1000.000	127.0	V	119.0	9.45
9648.000000	46.60	80.000	33.40	1000.000	208.0	H	71.0	16.37
13267.000000	48.81	80.000	31.19	1000.000	342.0	V	283.0	21.15

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1462.000000	19.19	60.000	40.81	1000.000	410.0	V	170.0	-1.56
1868.500000	22.20	60.000	37.80	1000.000	125.0	H	350.0	2.73
2220.000000	23.51	60.000	36.49	1000.000	410.0	V	0.0	3.57
2409.500000	23.51	60.000	36.49	1000.000	410.0	V	1.0	4.38
4824.000000	29.16	60.000	30.84	1000.000	127.0	V	119.0	9.45
9648.000000	32.35	60.000	27.65	1000.000	208.0	H	71.0	16.37
13267.000000	35.64	60.000	24.36	1000.000	342.0	V	283.0	21.15

Test Personnel: Seth Parker
Supervising/Reviewing Engineer: Brian Lackey
(Where Applicable) FCC Part 15B
Product Standard: ICES-003 Issue 7
Input Voltage: 3.7VDC
Pretest Verification w / Ambient Signals or BB Source: Yes

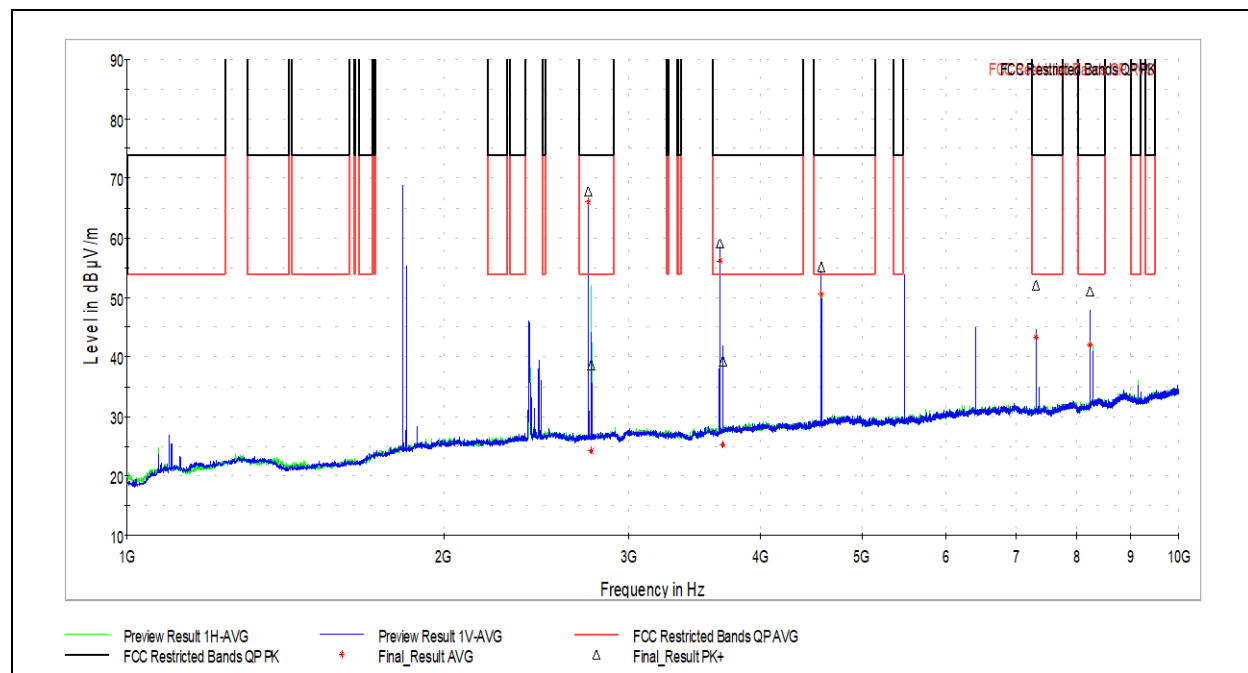
Test Date: 6/21/2022
Limit Applied: Class A
Ambient Temperature: 24.0C
Relative Humidity: 46.5%
Atmospheric Pressure: 990.3mbar

Deviations, Additions, or Exclusions: None



6.8 FCC Part 15.247 Radiated Spurious Emissions

6.8.1 Radiated Spurious Emissions, 1 GHz – 18 GHz (Low Channel)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2745.000000	67.92	73.979	6.06	1000.000	327.0	V	10.0	4.91
2763.500000	38.72	73.979	35.26	1000.000	180.0	H	227.0	5.01
3660.000000	59.10	73.979	14.88	1000.000	283.0	V	328.0	6.64
3685.000000	39.27	73.979	34.71	1000.000	265.0	V	0.0	6.91
4575.000000	55.06	73.979	18.92	1000.000	180.0	V	342.0	9.17
7319.500000	52.02	73.979	21.96	1000.000	126.0	V	316.0	12.57
8235.500000	51.03	73.979	22.95	1000.000	218.0	V	12.0	13.80

Frequency (MHz)	Measured Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2745.000000	66.08	53.979	-12.10	1000.000	327.0	V	10.0	4.91
2763.500000	24.32	53.979	29.66	1000.000	180.0	H	227.0	5.01
3660.000000	56.14	53.979	-2.16	1000.000	283.0	V	328.0	6.64
3685.000000	25.27	53.979	28.71	1000.000	265.0	V	0.0	6.91
4575.000000	50.63	53.979	3.35	1000.000	180.0	V	342.0	9.17
7319.500000	43.33	53.979	10.65	1000.000	126.0	V	316.0	12.57
8235.500000	42.06	53.979	11.92	1000.000	218.0	V	12.0	13.80

**DCCF Applied (-15.19dB, 17.4%)**

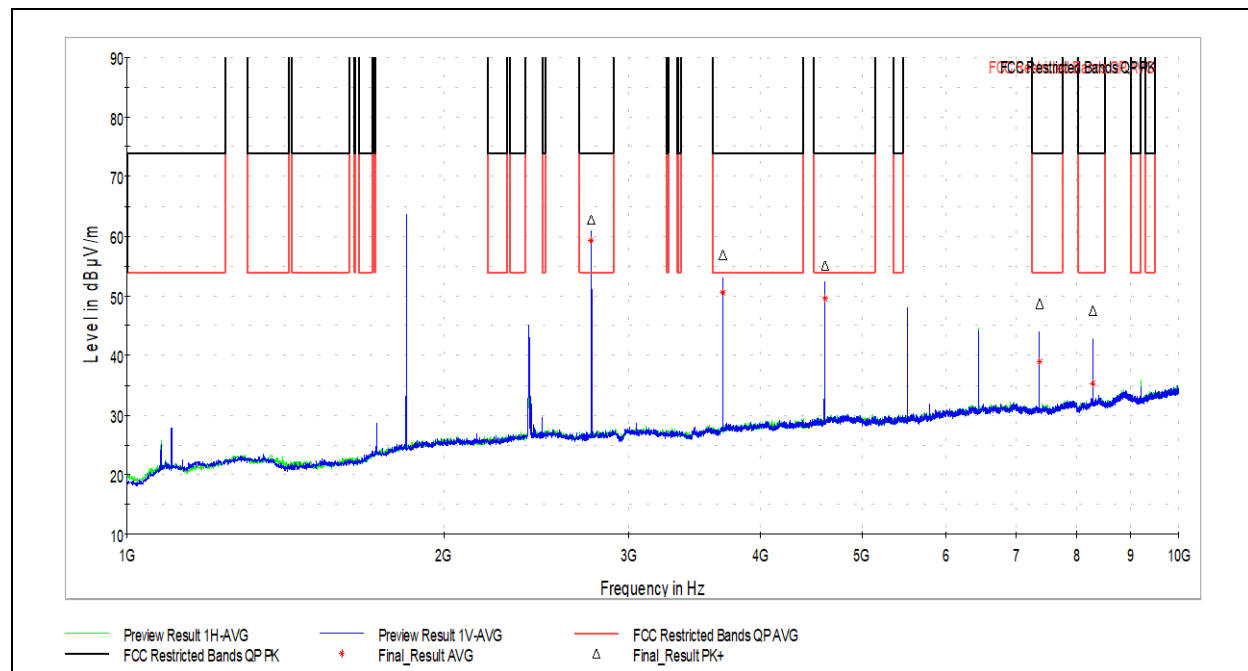
Frequency (MHz)	Calculated Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2745.000000	52.73	53.98	1.25	1000.000	327.0	V	10.0	4.91
3660.000000	43.91	53.98	10.07	1000.000	283.0	V	328.0	6.64
4575.000000	39.87	53.98	14.11	1000.000	180.0	V	342.0	9.17

Test Personnel:	Brian Lackey	Test Date:	6/8/2022
Supervising/Reviewing Engineer:			FCC Part 15.209 in Restricted
(Where Applicable)	NA	Limit Applied:	Bands from FCC Part 15.205
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.6C
Input Voltage:	3.7VDC	Relative Humidity:	54.1%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	981.2mbar

Deviations, Additions, or Exclusions: Average emissions from harmonics of the fundamental were calculated based on a duty cycle correction factor applied to the peak measurement based on worst case operating conditions of the device. Only harmonics where the peak emission was above the average limit were corrected.



6.8.2 Radiated Spurious Emissions, 1 GHz – 18 GHz (Mid Channel)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2763.500000	62.84	73.979	11.14	1000.000	321.0	V	12.0	4.95
3685.000000	56.88	73.979	17.10	1000.000	100.0	V	0.0	6.91
4606.000000	55.14	73.979	18.84	1000.000	265.0	V	35.0	9.29
7369.500000	48.80	73.979	25.18	1000.000	100.0	V	314.0	12.56
8292.000000	47.61	73.979	26.37	1000.000	100.0	H	284.0	13.97

Frequency (MHz)	Measured Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2763.500000	59.34	53.979	-5.36	1000.000	321.0	V	12.0	4.95
3685.000000	50.64	53.979	3.34	1000.000	100.0	V	0.0	6.91
4606.000000	49.57	53.979	4.41	1000.000	265.0	V	35.0	9.29
7369.500000	39.01	53.979	14.97	1000.000	100.0	V	314.0	12.56
8292.000000	35.36	53.979	18.62	1000.000	100.0	H	284.0	13.97

**DCCF Applied (-15.19dB, 17.4%)**

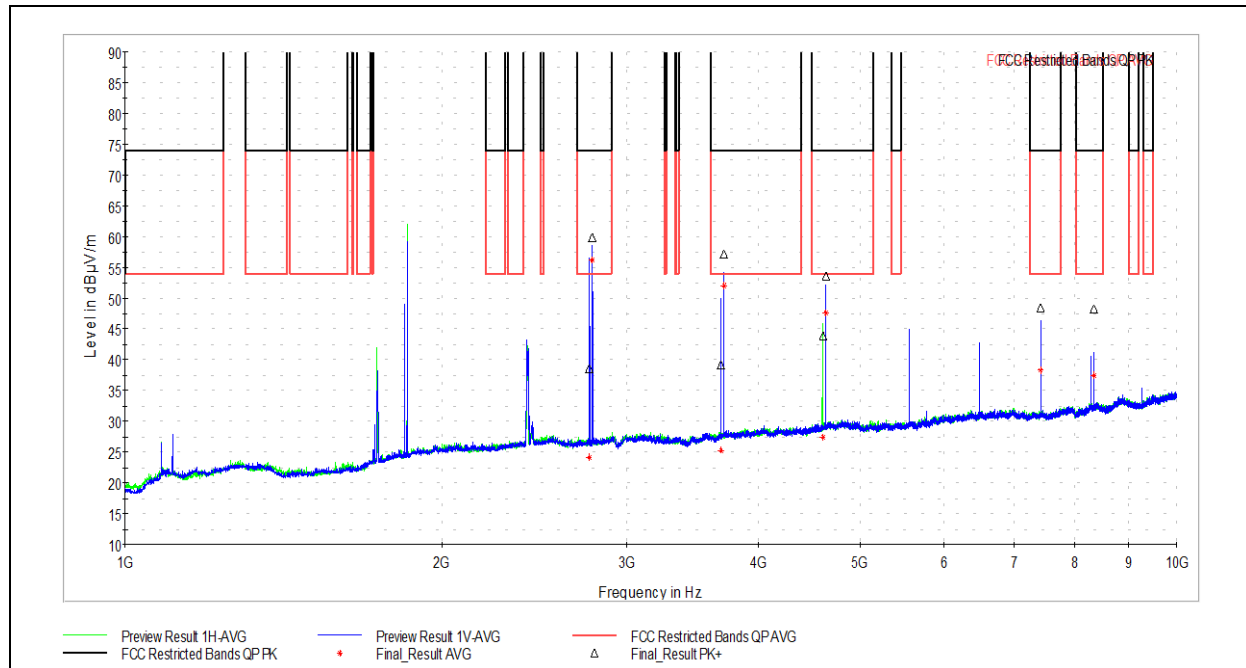
Frequency (MHz)	Calculated Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2763.500000	47.65	53.98	6.33	1000.000	321.0	V	12.0	4.95
3685.000000	41.69	53.98	12.29	1000.000	100.0	V	0.0	6.91
4606.000000	39.95	53.98	14.03	1000.000	265.0	V	35.0	9.29

Test Personnel:	Brian Lackey	Test Date:	6/8/2022
Supervising/Reviewing Engineer:			FCC Part 15.209 in Restricted
(Where Applicable)	NA	Limit Applied:	Bands from FCC Part 15.205
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.6C
Input Voltage:	3.7VDC	Relative Humidity:	54.1%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	981.2mbar

Deviations, Additions, or Exclusions: Average emissions from harmonics of the fundamental were calculated based on a duty cycle correction factor applied to the peak measurement based on worst case operating conditions of the device. Only harmonics where the peak emission was above the average limit were corrected.



6.8.3 Radiated Spurious Emissions, 1 GHz – 18 GHz (High Channel)



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2763.500000	38.68	73.979	35.30	1000.000	390.0	V	0.0	4.95
2781.500000	59.92	73.979	14.06	1000.000	283.0	V	0.0	5.05
3684.500000	39.19	73.979	34.79	1000.000	100.0	V	0.0	6.90
3709.000000	57.24	73.979	16.74	1000.000	100.0	V	0.0	7.09
4606.000000	43.86	73.979	30.12	1000.000	394.0	H	205.0	9.32
4636.500000	53.58	73.979	20.40	1000.000	276.0	V	45.0	9.31
7418.500000	48.45	73.979	25.53	1000.000	117.0	V	314.0	12.61
8345.000000	48.42	73.979	25.56	1000.000	410.0	V	60.0	14.05

Frequency (MHz)	Measured Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2763.500000	24.23	53.979	29.75	1000.000	390.0	V	0.0	4.95
2781.500000	56.22	53.979	-2.24	1000.000	283.0	V	0.0	5.05
3684.500000	25.25	53.979	28.73	1000.000	100.0	V	0.0	6.90
3709.000000	52.06	53.979	1.92	1000.000	100.0	V	0.0	7.09
4606.000000	27.50	53.979	26.48	1000.000	394.0	H	205.0	9.32
4636.500000	47.59	53.979	6.39	1000.000	276.0	V	45.0	9.31
7418.500000	38.35	53.979	15.63	1000.000	117.0	V	314.0	12.61
8345.000000	37.47	53.979	16.51	1000.000	410.0	V	60.0	14.05

**DCCF Applied (-15.19dB, 17.4%)**

Frequency (MHz)	Calculated Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2781.500000	44.73	53.98	9.25	1000.000	283.0	V	0.0	5.05
3709.000000	42.05	53.98	11.93	1000.000	100.0	V	0.0	7.09

Test Personnel:	Brian Lackey	Test Date:	6/8/2022
Supervising/Reviewing Engineer:			FCC Part 15.209 in Restricted
(Where Applicable)	NA	Limit Applied:	Bands from FCC Part 15.205
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	23.6C
Input Voltage:	3.7VDC	Relative Humidity:	54.1%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	981.2mbar

Deviations, Additions, or Exclusions: Average emissions from harmonics of the fundamental were calculated based on a duty cycle correction factor applied to the peak measurement based on worst case operating conditions of the device. Only harmonics where the peak emission was above the average limit were corrected.

**7 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/8/2022	104917132LEX-001	BZ	JTS	Original Issue