Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Powercast Corporation TEST REPORT

SCOPE OF WORK
EMC TESTING – POWERCAST RFID READER MODEL PCR91501

STANDARDS
Title 47 CFR Part 15 Subpart B
ICES-003 Issue 7

REPORT NUMBER
105207900LEX-001

ISSUE DATE
12/12/2022

PAGES
17

DOCUMENT CONTROL NUMBER
Non-Specific EMC Report Shell Rev. December 2017

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 105207900LEX-001
Project Number: G105207900

Report Issue Date: 12/12/2022

Model(s) Tested: Powercast RFID Reader model PCR91501

Standards: Title 47 CFR Part 15 Subpart B
ICES-003 Issue 7

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

Client:
Powercast Corporation
620 Alpha Drive
Pittsburgh, PA 15238-2912
USA

Report prepared by

Seth Parker, Associate Engineer

Report reviewed by

Brian Lackey, Team Leader

Table of Contents

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 (ANSI C63.4: 2014)	Pass
7	Conducted Emissions (ANSI C63.4: 2014)	Pass

3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Powercast Corporation
Address:	620 Alpha Drive Pittsburgh, PA 15238-2912 USA
Contact:	Jason Gill
Telephone:	+1 (413) 923-4796
Email:	jgill@powercastco.com
Manufacturer Information	
Manufacturer Name:	Powercast Corporation
Manufacturer Address:	620 Alpha Drive Pittsburgh, PA 15238-2912 USA

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Powercast RFID Reader
Model Number	PCR91501
Test Start Date	10/3/2022
Test End Date	10/19/2022
Device Received Condition	Good
Test Sample Type	Pre-Production
Transmit Band	902 MHz – 928 MHz
Test Channels	906.36 MHz, 915 MHz, 924 MHz
Equipment Time	Frequency Hopping Spread Spectrum (FHSS)
Antenna Make, Model, and Gain[1]	PCR91501 Integrated Patch Antenna Peak gain 3.8 (5.8 dBi, 3.65 dBd)
Input Rating	5V 1A USB-C
Description of Equipment Under Test (provided by client)	
RFID Reader.	

4.1 Variant Models:

There were no variant models covered by this evaluation.

[1] This information was provided by the client and deviations from these values may affect compliance. Intertek does not make any claim of compliance for other than these values.

5 System Setup and Method

5.1 Method:

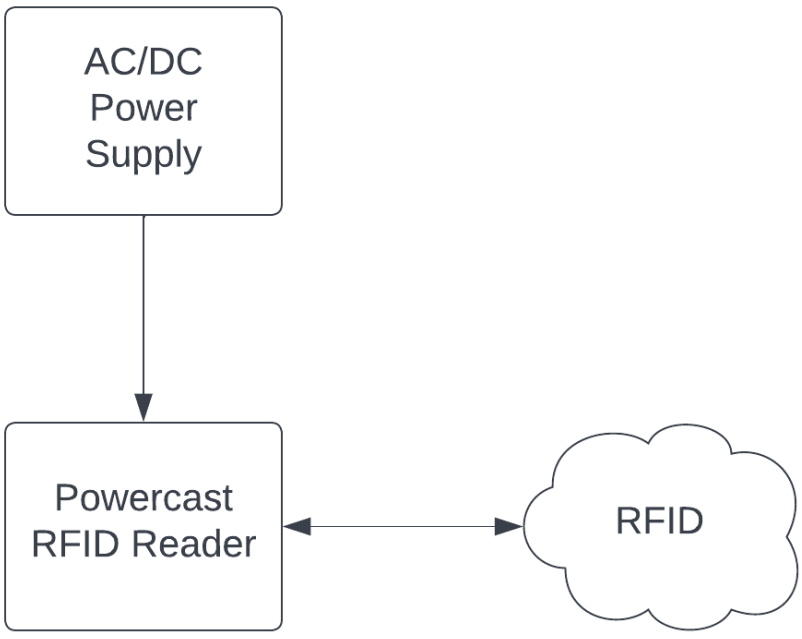
Configuration as required by ANSI C63.4: 2014

No.	Descriptions of EUT Exercising
1	The EUT was powered by 120V/60Hz and configured to transmit continuously.
2	The EUT was powered by 120V/60Hz. The transmitter was idle to measure unintentional emissions above 1GHz.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	USB-C2	2	No	No	AC/DC Adapter

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
None	-	-	-

5.2 EUT Block Diagram:



6 Radiated Emissions

6.1 Method

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

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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/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	8/10/2022	8/10/2023
Horn Antenna	4001	ETS	3117	2/23/2022	2/23/2023
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
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	8185			1/13/2022	1/13/2023
Coaxial Cable	8188			1/13/2022	1/13/2023
Coaxial Cable	3339			1/13/2022	1/13/2023
Preamplifier	3919	Rohde & Schwarz	TS-PR3	1/13/2022	1/13/2023
Coaxial Cable	3172			1/13/2022	1/13/2023
Coaxial Cable	2590			1/13/2022	1/13/2023
Coaxial Cable	8186			1/13/2022	1/13/2023
Coaxial Cable	8187			1/13/2022	1/13/2023

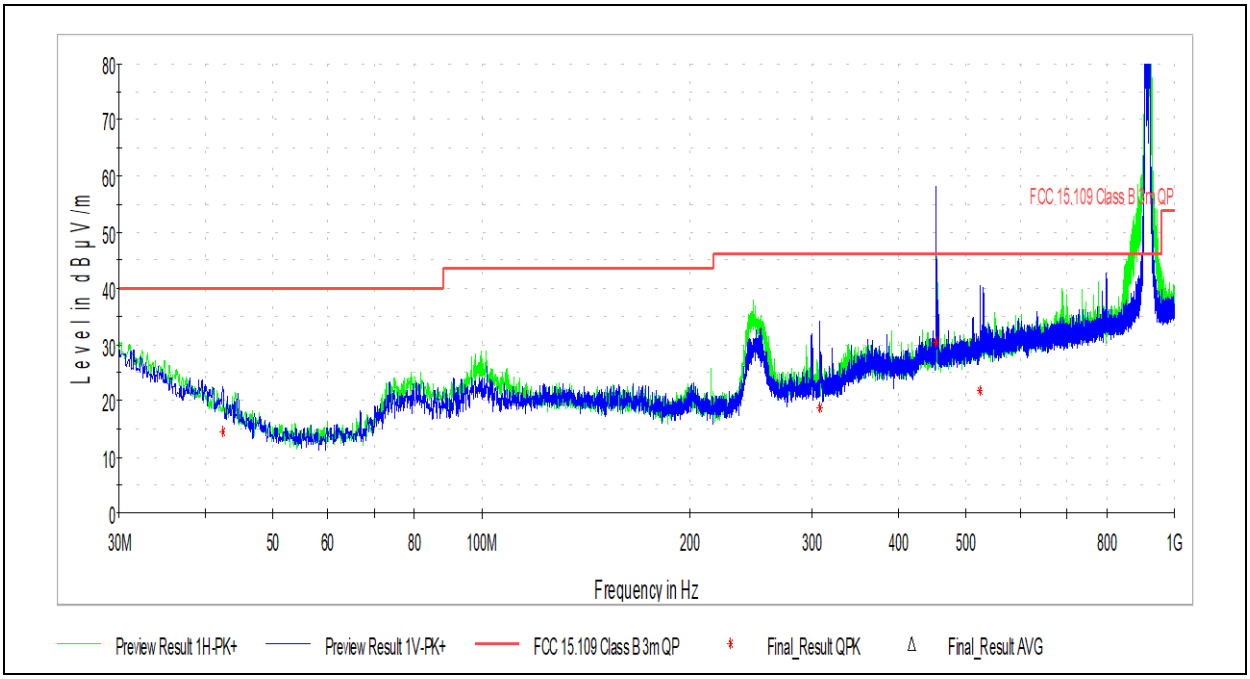
6.4 Software Utilized:

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



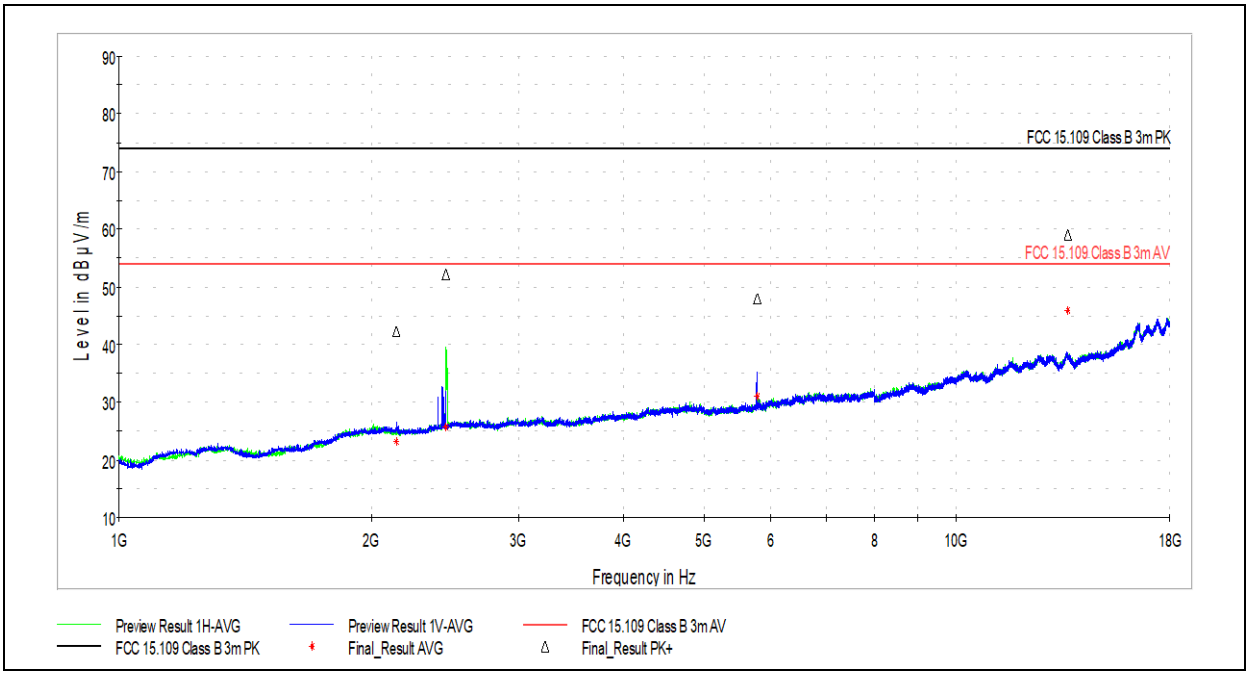
Note: The peak from 902-928MHz is the intentional emissions from the device

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
42.286667	14.48	40.000	25.52	120.000	100.0	V	182.0	18.83
307.635556	18.80	46.021	27.22	120.000	353.0	V	0.0	23.86
453.351111	30.37	46.021	15.65	120.000	307.0	V	324.0	27.85
523.999444	21.85	46.021	24.17	120.000	339.0	V	339.0	29.47

Test Personnel:	Seth Parker	Test Date:	10/3/2022
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	Class B
Product Standard:	FCC Part 15.109 ICES-003	Ambient Temperature:	23.1C
Input Voltage:	120V/60Hz to AC/DC adapter	Relative Humidity:	63.9%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	983.3mbar

Deviations, Additions, or Exclusions: None
Note: the limits used above are for FCC Part 15B and are more restrictive than the ICES-003 Issue 7 limits.

6.7 Plots/Data: Radiated Emissions, 1GHz – 18GHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2144.500000	42.22	73.979	31.76	1000.000	162.0	V	228.0	3.35
2459.500000	52.21	73.979	21.77	1000.000	320.0	H	160.0	4.21
5789.000000	47.98	73.979	26.00	1000.000	410.0	V	98.0	10.43
13588.000000	59.07	73.979	14.91	1000.000	301.0	V	282.0	20.88

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2144.500000	23.24	53.979	30.74	1000.000	162.0	V	228.0	3.35
2459.500000	25.75	53.979	28.23	1000.000	320.0	H	160.0	4.21
5789.000000	31.05	53.979	22.93	1000.000	410.0	V	98.0	10.43
13588.000000	45.88	53.979	8.10	1000.000	301.0	V	282.0	20.88

Test Personnel:	Seth Parker	Test Date:	10/19/2022
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	Class B
Product Standard:	FCC Part 15.109 ICES-003	Ambient Temperature:	18.2C
Input Voltage:	120V/60Hz to AC/DC adapater	Relative Humidity:	31.6%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	984.0mbar

Deviations, Additions, or Exclusions: None

7 Conducted Emissions

7.1 Method

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

TEST SITE: Ground Plane

Site Designation: Ground Plane

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Power Line Conducted Emissions	150 kHz - 30 MHz	3.1dB	3.4dB

As shown in the table above our conducted 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.

7.2 Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

7.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
LISN	2509	Fischer Custom Communication	FCC-LISN-50-50-2M	8/1/2022	8/1/2023
EMI Test Receiver	8181	Rohde & Schwarz	ESW44	11/16/2021	11/16/2022
Coaxial Cable	2593			1/13/2022	1/13/2023
Coaxial Cable	8185			1/13/2022	1/13/2023
Coaxial Cable	8188			1/13/2022	1/13/2023
Coaxial Cable	3339			1/13/2022	1/13/2023

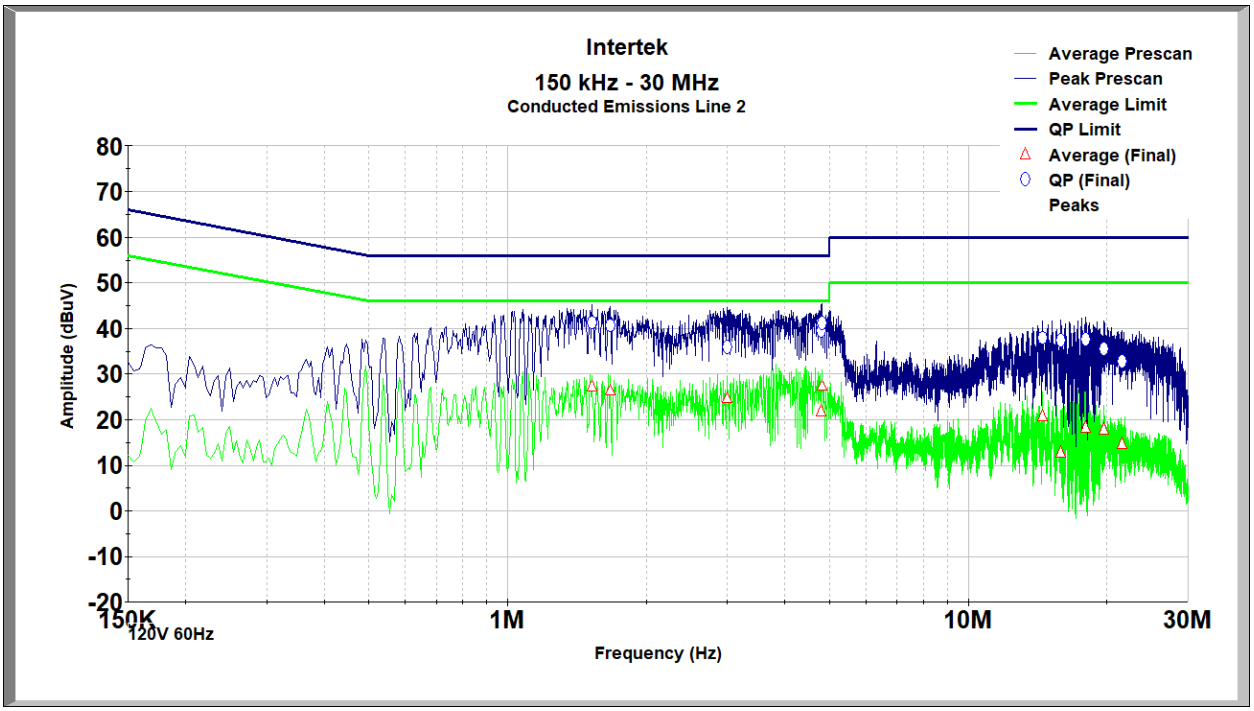
7.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

7.5 Results:

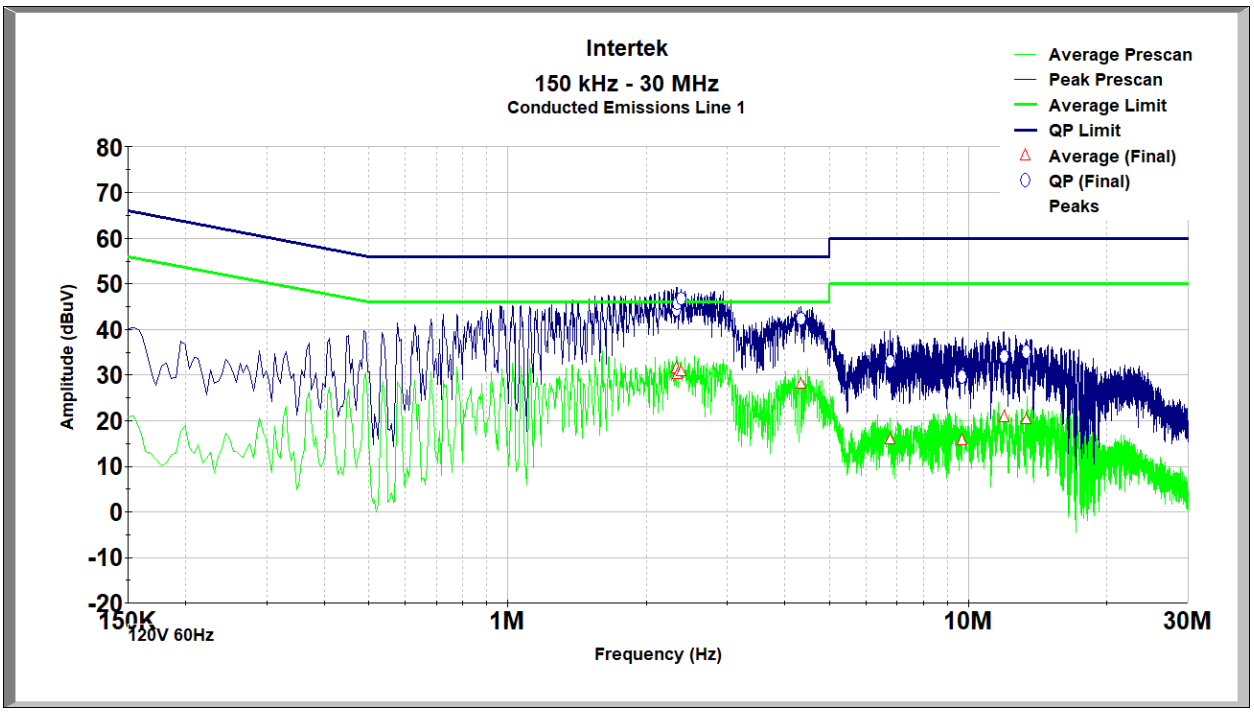
The sample tested was found to Comply.

7.6 Plots/Data: Conducted Emissions



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
2.324	44.369	56.000	11.631	31.568	46.000	14.432
2.337	45.741	56.000	10.259	30.333	46.000	15.667
2.377	46.881	56.000	9.119	31.004	46.000	14.996
4.326	42.365	56.000	13.635	28.235	46.000	17.765
6.779	33.057	60.000	26.943	16.007	50.000	33.993
9.710	29.618	60.000	30.382	15.648	50.000	34.352
11.955	33.957	60.000	26.043	20.720	50.000	29.280
13.336	35.130	60.000	24.870	20.400	50.000	29.600



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
1.523	41.337	56.000	14.663	27.254	46.000	18.746
1.667	40.709	56.000	15.291	26.575	46.000	19.425
2.994	36.037	56.000	19.963	24.857	46.000	21.143
4.794	39.493	56.000	16.507	21.799	46.000	24.201
4.808	41.103	56.000	14.897	27.585	46.000	18.415
14.515	37.998	60.000	22.002	20.722	50.000	29.278
15.903	37.477	60.000	22.523	12.819	50.000	37.181
17.959	37.595	60.000	22.405	18.363	50.000	31.637
19.728	35.563	60.000	24.437	17.921	50.000	32.079
21.555	32.706	60.000	27.294	14.597	50.000	35.403

Test Personnel:	Seth Parker	Test Date:	10/11/2022
Supervising/Reviewing Engineer: (Where Applicable)	Brian Lackey	Limit Applied:	Class B
Product Standard:	FCC Part 15.107 ICES-003	Ambient Temperature:	23.1C
Input Voltage:	120V/60Hz to AC/DC adapter	Relative Humidity:	63.9%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	983.3mbar

Deviations, Additions, or Exclusions: None

8 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	12/12/2022	105207900LEX-001			Original Issue