H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Aira

TESLA Wireless Charger

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 15.209

Prepared for:

Aira

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Prepared By:

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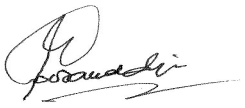
Reviewed By:



Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurement made, the equipment tested is capable of operation in accordance with the requirements of Part 15 of the FCC Rules under normal use and maintenance. All results contained herein relate only to the sample tested.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	December 12, 2022	Initial Issue

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EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15.209. All tests were conducted using measurement procedure from ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9kHz to 40GHz and ANSI C63.10-2013 Procedures for Compliance Testing of Unlicensed Wireless Devices as appropriate.

Test Name	Test Method/Standard	Result	Comments
Unintentional Radiated Emissions	15.109	Pass	
A/C Power Line Conducted Emissions	15.207(a)	Pass	
Occupied Bandwidth	15.215	Pass	
Radiated Fundamental Emissions	15.209(a)	Pass	
Radiated Spurious Emissions	15.209(a), 15.205, 15.35(C)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Aira to perform testing on the Tesla Wireless Charger under the purchase order number 1148.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Aira, Tesla Wireless Charger.

The tests were based on FCC Part 15 Rules. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. Aira should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	TESLA Wireless Charger
Model(s) Tested:	1799799
FCC ID:	2AWGG-WH1257500
ISED ID:	29612-WH1257500
Supply Voltage Input:	Primary Power: 120VAC
Frequency Range:	127-185kHz
No. of Channels:	N/A
Type(s) of Modulation:	Sinewave
Range of Operation Power:	0.1mW (Radiated)
Emission Designator:	N/A
Channel Spacing(s)	None
Test Item:	Pre-Production
Type of Equipment:	Fixed
Antenna Requirement (§15.203):	Type of Antenna: Integral Loop Gain of Antenna: 0dBi
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at H.B Compliance Solutions
Test Date(s):	12/01/2022 till 12/07/2022
Firmware Number	0.9.5
PCBA Version	-

2. Test Facility

All testing was performed at H.B. Compliance Solutions. This facility is located at 5005 S. Ash Avenue, Suite # A-10, Tempe AZ-85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a GTEM chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at H.B. Compliance Solutions.

Test facility H.B. Compliance Solutions is an ANAB accredited test site. The ANAB certificate number is L2458. The scope of accreditation can be found on ANAB website www.anab.org

3. Description of Test Sample

The Tesla wireless charging device uses FreePower wireless charging technology and operates as a 127kHz to 185kHz inductive coupling wireless charging radio. The wireless charger allows for up to 3 devices to charge anywhere while resting on the top of the charging surface of the product.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	TESLA Wireless Charger	1799799	-
# 2	AC/DC Power Adapter	S00080	-

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
# 3	Resistive Load (3 ea)	Aira	None	None

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
# 4	Power	USB C	1	1.5	N	# 2

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

A test receiver will be used to monitor the data transmission from the EUT.

8. Mode of Operation

The EUT will be configured to transmit at maximum power level. Three resistive loads were placed on the charging pad to simulate charging an electronic device while allowing for continuous power delivery. Both power delivery and standby/idle mode were checked to determine worst case emissions for each test.

9. Modifications

9.1 Modifications to EUT

No modifications were made to the EUT

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to Aira upon completion of testing & certification.

Criteria for Intentional Radiators

1. Radiated Emissions

Test Requirement(s):	§15.109	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	12/06/2022

Test Procedures:

The final radiated emissions test was performed using the parameters described above as worst case. That final test was conducted at a facility that meets the ANSI C63.4 TEM waveguides requirements. The frequency range noted in the data sheets was scanned/tested at that facility. Emissions were maximized as specified, by varying table azimuth, and manipulating cables.

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth such that the maximum radiated emissions level will be detected. This requires the use of a turntable.

Tests were made with the EUT rotated on X,Y,Z planes to obtain the maximum signal strength. Though specified in the report, the measurement distance shall be 3 meters.

Test Limits:

Frequency Range (MHz)	Distance (Meters)	Field Strength	
		uV/m	dBuV/m
0.009 – 0.490	300	2400/F(kHz)	67.6-20log(F)
0.490 – 1.705	30	2400/F(kHz)	87.6-20log(F)
1.705 – 30.0	30	30	29.54
30 – 88	3	100	40.0
88 – 216	3	150	43.5
216 – 960	3	200	46.0
960 – 1000	3	500	54.0
Note: Emissions limits are based on measurements employing CISPR QP detector except for bands 9-90kHz, 110-490kHz and above 1000MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector			

Table 4. Radiated Emissions Limit – FCC Limits from Section 15.209

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
30 MHz to 1 GHz	120 kHz	120 kHz	N/A
1 GHz to 11 GHz	1MHz	N/A	1MHz
Measurements were made using the bandwidths and detectors specified. The video filter was at least as wide as the IF bandwidth of the measuring receiver.			

Table 5. Radiated Emissions – Measurement Bandwidth

Emissions Tests Calculations

In the case of indoor measurements, radiated emissions measurements are made by the manipulation of correction factors using TILE4 software. This is done automatically by the software during the final measurement process.

In both cases, the level of the Field Strength of the interfering signal is calculated by adding the Antenna Factor, Cable Factor and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + (CF –AG)

Where: FS = Field Strength

RA = Receiver (indicated) Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

This laboratory uses an approach of combining the CF and AG using an end-to-end measurement of the entire cabling system, including the test cable, any in-line amplifiers, attenuators, or transient protection networks, all measured in-situ.

For a sample calculation, assume a receiver reading of 52.5 dBuV is obtained. With an antenna factor of 7.4 and a combined cable factor (CF + AG) of -27.9:

FS = 52.5 + 7.4 + (-27.9) = 32 dBuV/m

FS = 32 dBuV/m

If desired, this can be converted into its corresponding level in uV/m:

FS = 10^((32 dBuV/m)/20) = 39.8 uV/m

Test Setup:

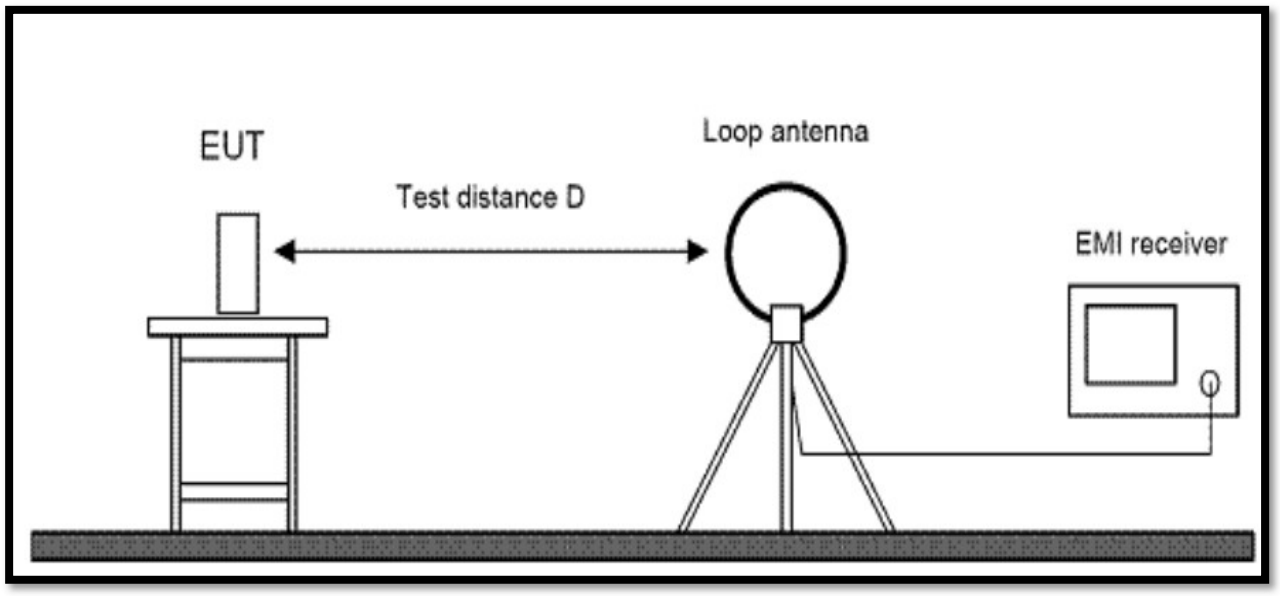


Figure 1. Radiated Emissions Test Setup (9kHz - 30MHz)

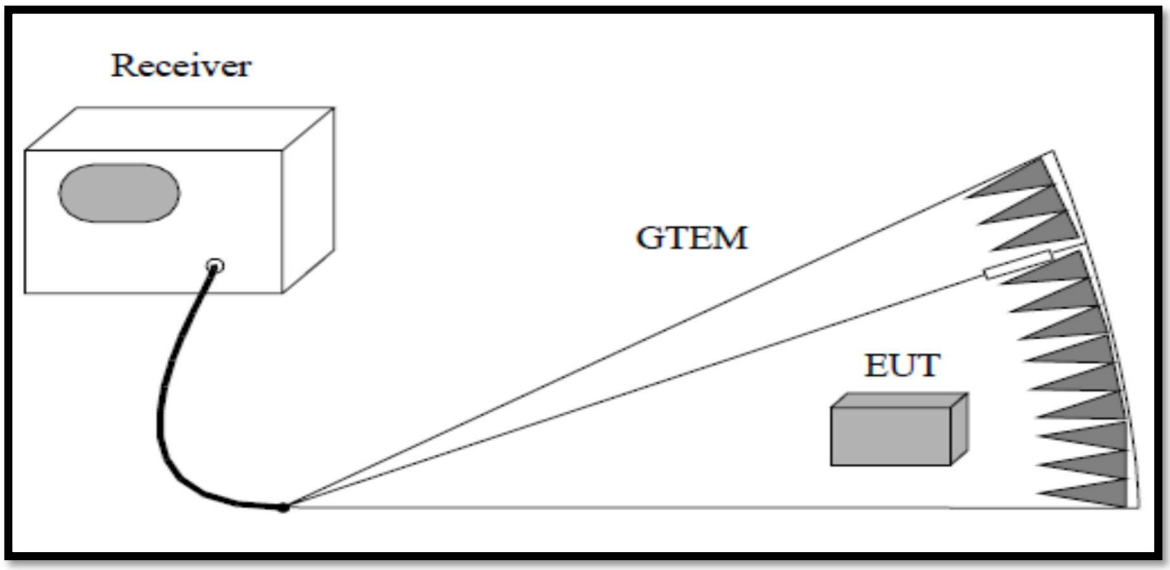
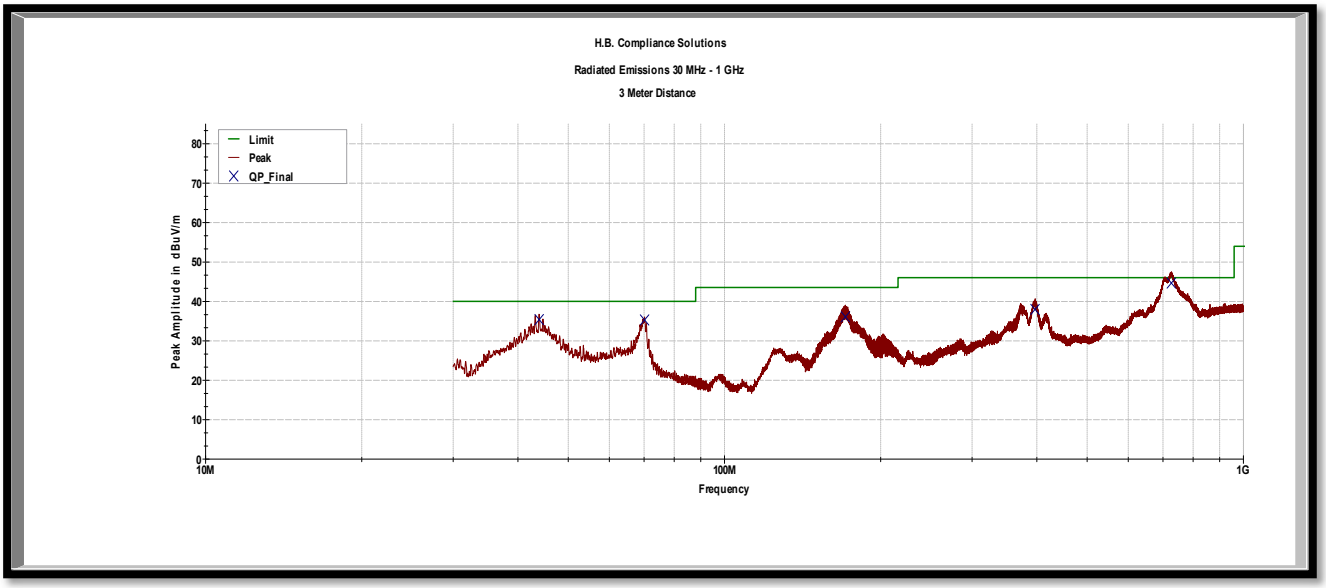


Figure 2. Radiated Emissions Test Setup (30MHz – 1GHz)



Plot 1 – Radiated Emissions – 30MHz to 1GHz

Frequency (MHz)	Measured Level (dBuV/m)	Measurement Detector	Limit (dBuV)	Margin (dB)
0.127	97.4	Peak	105.53	-8.13
0.885	64.63	Quasi Peak	68.67	-4.04
1.143	66.0	Quasi Peak	66.44	-0.44
1.65	56.2	Quasi Peak	63.25	-7.05
2.287	61.38	Quasi Peak	69.54	-8.16
2.54	53.88	Quasi Peak	69.54	-15.66
2.80	50.53	Quasi Peak	69.54	-19.01
3.05	48.72	Quasi Peak	69.54	-20.82

Table 6. Final Measurement Results for Radiated Emissions below 30MHz

Frequency (MHz)	Measured Level (dBuV/m)	Measurement Detector	Limit (dBuV)	Margin (dB)
43.95	35.37	Quasi Peak	40	-4.63
70.16	35.28	Quasi Peak	40	-4.71
171.04	36.07	Quasi Peak	43.5	-7.43
396.87	37.96	Quasi Peak	46	-8.04
726.45	44.65	Quasi Peak	46	-1.35

Table 7. Final Measurement Results for Radiated Emissions Above 30MHz

2. Conducted Emissions

Test Requirement(s):	§15.207	Test Engineer(s):	Sean E.
Test Results:	Pass	Test Date(s):	12/01/2022

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane inside a shielded enclosure. The EUT was powered through a 50Ω/50µH LISN. The conducted emissions tests were performed using the mode of operation and configuration noted within this report. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with power cords that are the same as those cords normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically, those measurements are made using a LISN (Line Impedance Stabilization Network). All 50 Ohm measuring ports of the LISN are terminated by 50 Ohms, either by the 50 Ohm EMI receiver or a 50 Ohm resistive load.

Refer to the Emissions Tests Calculations section in the Radiated Emissions section for sample calculations. For the purposes of the conducted emissions test, the Antenna Factor (AF) is replaced by the LISN correction factor.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.150 - 30	9.0	9.0	9.0
Measurements were made using the bandwidths and detectors specified. No video filter was used.			

Table 8. Conducted Emissions – Measurement Bandwidth

Frequency Range (MHz)	15.107(b), Class A Limits (dBuV)		15.107(a), Class B Limits (dBuV)	
	Quasi-Peak	Average	Quasi Peak	Average
0.15 – 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 – 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies.				

Table 9. Conducted Emissions Limits – FCC Limits from Section 15.207

Test Setup:

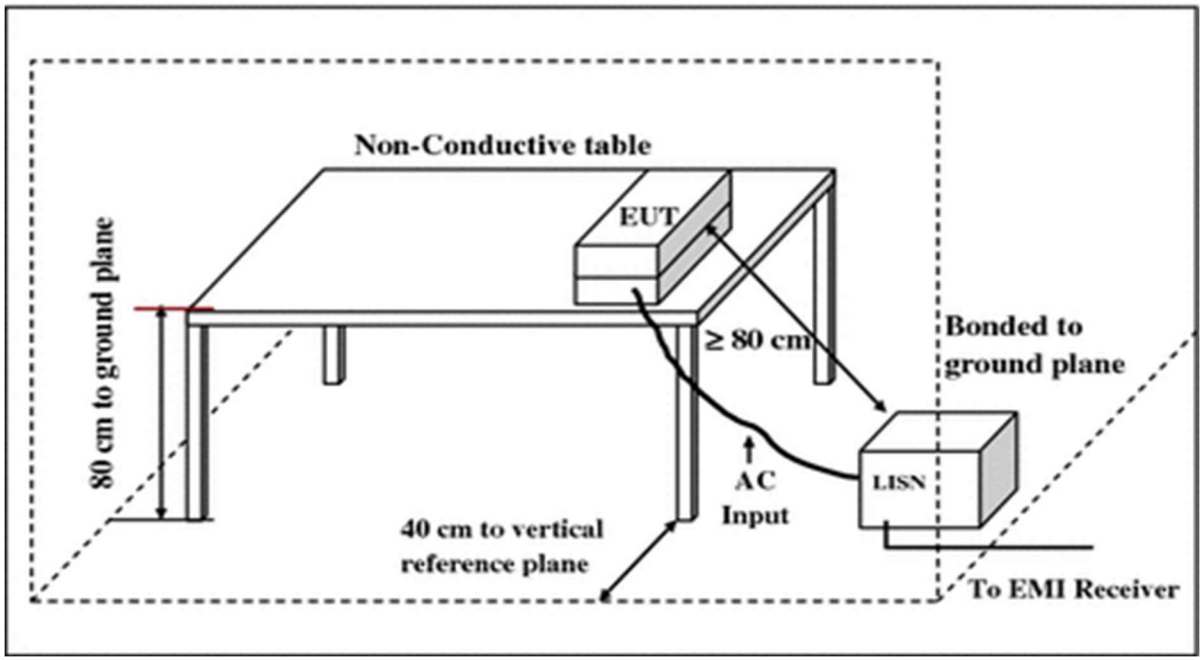
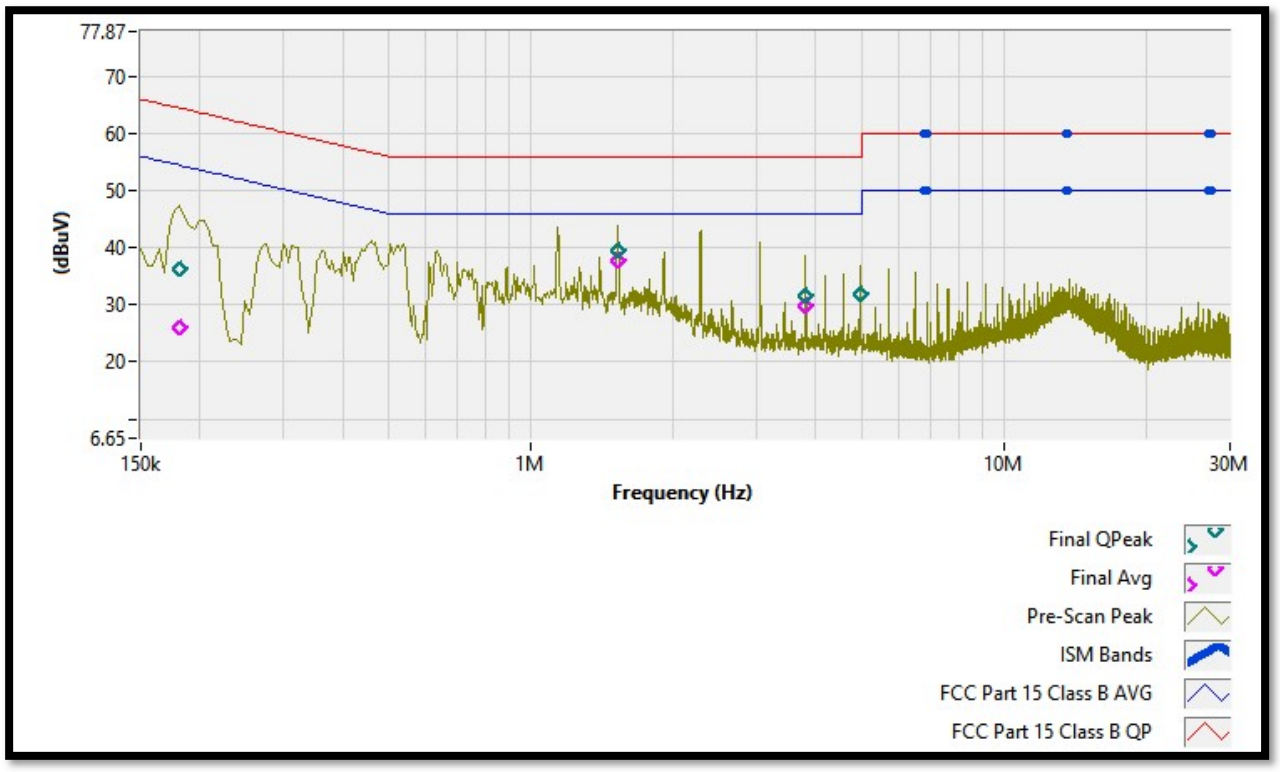


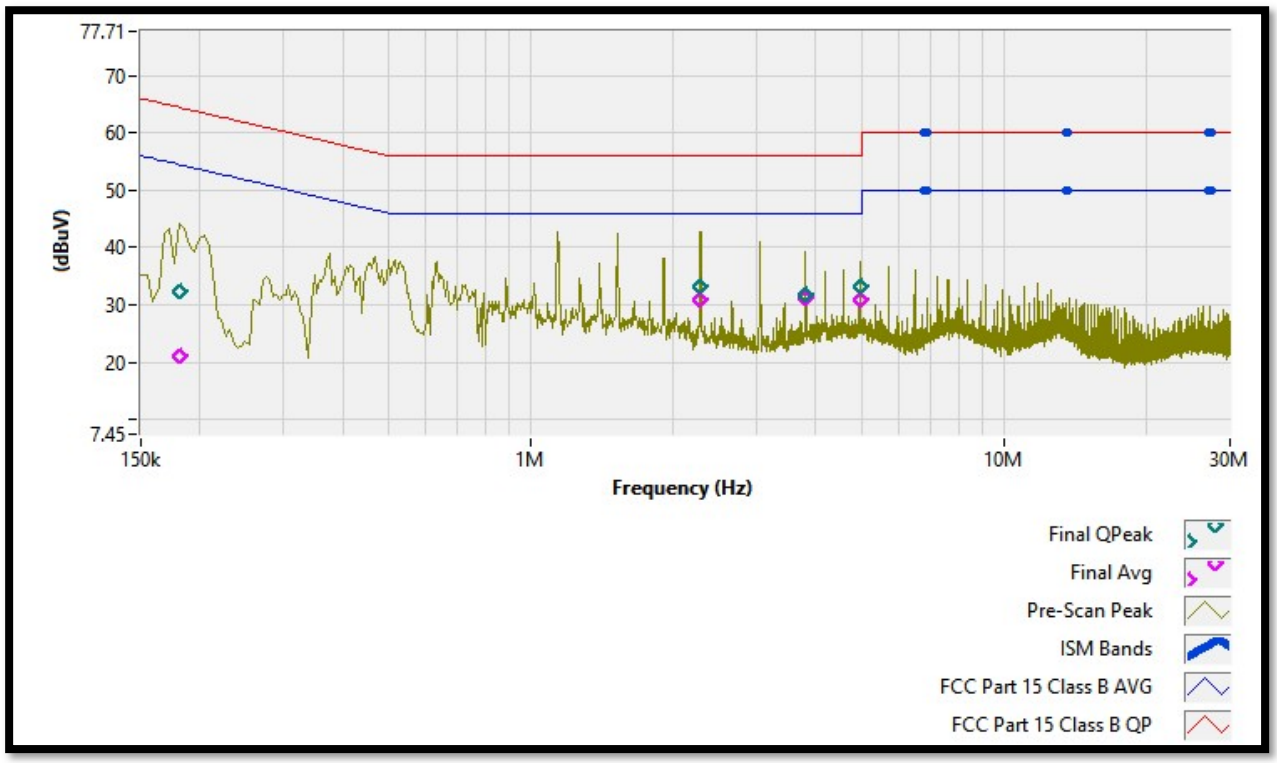
Figure 3. Conducted Emissions Test Setup



Plot 2 – Conducted Emission Plot – Line Side

Frequency (Hz)	Detector	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
181.579k	Peak	47.45	--	--
	QPeak	36.36	(2) 64.41	-28.04
	Avg	25.89	(1) 54.41	-28.51
1.526M	Peak	43.72	--	--
	QPeak	39.50	(2) 56	-16.49
	Avg	37.78	(1) 46	-8.21
3.804M	Peak	38.73	--	--
	QPeak	31.62	(2) 56	-24.37
	Avg	29.93	(1) 46	-16.06
4.954M	Peak	36.75	--	--
	QPeak	31.94	(2) 56	-24.05
	Avg	31.87	(1) 46	-14.12

Table 10. Measurement Results Summary



Plot 3 – Conducted Emissions – Neutral Side

Frequency (Hz)	Detector	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
181.579k	Peak	44.12	--	--
	QPeak	32.18	(2) 64.41	-32.22
	Avg	21.15	(1) 54.41	-33.25
2.279M	Peak	42.77	--	--
	QPeak	33.08	(2) 56	-22.91
	Avg	30.99	(1) 46	-15.00
3.804M	Peak	39.38	--	--
	QPeak	31.86	(2) 56	-24.13
	Avg	31.04	(1) 46	-14.95
4.954M	Peak	37.63	--	--
	QPeak	33.30	(2) 56	-22.69
	Avg	30.95	(1) 46	-15.04

Table 11. Measurement Results Summary

2. Occupied Bandwidth

Test Requirement(s):	15.215(c)	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	12/05/2022-12/06/2022

Test Procedure: As required by 47 CFR 15.215(c): The bandwidth of the emission shall be determined at the points 20dB down from the modulated carrier.

Customer provided a test mode internal to the EUT to control the RF modulation. The EUT antenna was attached and the waveform was received by the test antenna which was connected to the spectrum analyzer. The measured highest peak power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to 300Hz and VBW>RBW.

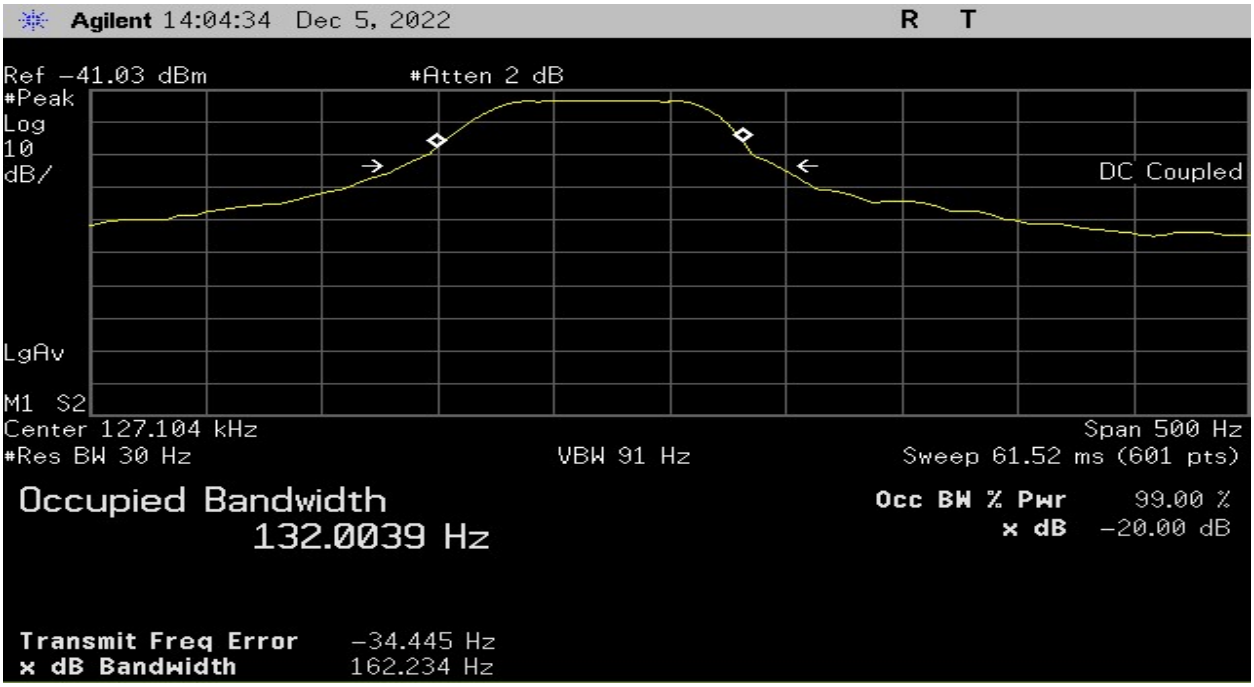
Operational Mode	Frequency (kHz)	20dB Bandwidth	99% Bandwidth
Power Delivery	127	162.2 Hz	132.0 Hz
Idle	127-185	62.11 kHz	64.27 kHz

Table 12. Occupied Bandwidth Summary, Test Results

Test Setup:

Figure 4. Occupied Bandwidth Test Setup

The following pages show measurements of Occupied Bandwidth plot:



Plot 4 – 20dB BW – Power Delivery Mode

Plot 5 – 20dB BW – Idle Mode

5. Radiated Spurious Emissions

Test Requirement(s):	§15.209	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	12/06/2022

Test Procedures: As required by 47 CFR 15.209, Radiated emission measurements were made in accordance with the procedures of the ANSI C63.10 - 2013.

The EUT was placed on a wooden table inside a GTEM chamber. The EUT was set on continuous transmit.

The measurement distance was set at 3 meters from the EUT. During the tests, EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The frequency range up to the 10th harmonic was investigated.

Frequency Range	Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
30MHz – 1000 MHz	Quasi Peak	120kHz	As Specified in §15.35(c)	Zero
1000 MHz – 5GHz	Peak	1MHz	1MHz	As necessary
1000 MHz – 5GHz	Average	1MHz	As Specified in §15.35(c)	As necessary

Table 13 - Analyzer Settings

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical

Frequency (MHz)	Quasi-Peak Amp. (dBuV/m)	FCC Quasi-Peak Limit (dBuV/m)	Quasi-Peak Margin (dB)	Comment
0.127	97.4	105.53	-8.13	Fundamental

Table 14 – Fundamental Field Strength

Frequency (MHz)	Quasi-Peak Amp. (dBuV/m)	FCC Quasi-Peak Limit (dBuV/m)	Quasi-Peak Margin (dB)	Comment
0.885	64.63	68.67	-4.04	
1.143	66.0	66.44	-0.44	
1.65	56.2	63.25	-7.05	
2.287	61.38	69.54	-8.16	
2.54	53.88	69.54	-15.66	
2.80	50.53	69.54	-19.01	
3.05	48.72	69.54	-20.82	

Table 15 - Radiated Spurious Emission Data

Remark:

To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-Axis. Worst case is X-axis.

Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Two Line V-Network - LISN	Teseq	NNB 51	43198	Nov-04-20	Nov-04-23
Spectrum Analyzer (PSA)	Agilent	E4443A	US41420164	Mar-15-22	Mar-15-23
Spectrum Analyzer	Hewlett Packard	8595EM	801A00177	May-04-22	May-04-23
EMI Receiver	Hewlett Packard	8566B	2747A05264	Dec-07-22	Dec-07-23
Amplifier	Amplifier Research	LN10000A	27023	NCR	None
Loop Antenna	A.H. Systems	SAS-565H	150	15-Sep-22	15-Sep-23
Antenna	EMCO	GTEM 5417	1063	Verified	

Table 16 – Test Equipment List

***Statement of Traceability:** Test equipment is maintained and calibrated on a regular basis. All calibrations have been performed by a 17025 accredited test facility, traceable to National Institute of Standards and Technology (NIST)

6. Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. These measurements figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2. Instrumentation measurement uncertainty has **not** been taken into account to determine compliance.

The following measurement uncertainty values have been calculated as show in the table below:

Measured Parameter	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions (AC Power)	dBuV or dBuA	150kHz – 30MHz	± 4.3dB
Radiated Emission below 30MHz	dBuV/m	9kHz-30MHz	± 2.96dB
Radiated Emissions below 1GHz	dBuV/m	30 – 1000MHz	± 5.6dB
Radiated Emissions above 1GHz	dBuV/m	1 – 26.5GHz	± 4.1dB

The reported expanded uncertainty has been estimated at a 95% confidence level (k=2)

END OF TEST REPORT