



Engineering Test Report No. 2201781-02 Rev A

Report Date	May 27, 2022	
Manufacturer Name	Chamberlain Group, Inc.	
Manufacturer Address	300 Windsor Dr Oak Brook, IL 60523	
Test Item Name Model No.	Phoenix AC Logic Board 003-0458-3	
Date Received	April 26, 2022	
Test Dates	May 26, 2022 to May 27, 2022	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 Innovation, Science, and Economic Development Canada, RSS-247	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature		
Tested by	Javier Cardenas	
Signature		
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	4900083434	

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1. Report Revision History

Revision	Date	Description
–	03 JUN 2022	Initial Release of Engineering Test Report No. 2201781-02
A	05 JUL 2022 By Javier Cardenas	Throughout the report: - “Rev A” was added to the report number in the header. - The model number was changed from 003-0458-4 to 003-0458-3.

2. Introduction

2.1. Scope of Tests

This document presents the results of a limited series of RF emissions tests that were performed on the Chamberlain Group, Inc. Phoenix AC Logic Board (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured and submitted for testing by Chamberlain Group, Inc. located in Oak Brook, IL.

2.2. Purpose

The test series was performed to determine if the EUT meets the RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, §15.247 for a Digital Modulation intentional radiator operating within the 2400 – 2483.5MHz band.

The test series was also performed to determine if the EUT meets the RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-247 for a Digital Modulation intentional radiator operating within the 2400 – 2483.5MHz band.

Testing was performed in accordance with ANSI C63.10-2013.

2.3. Identification of the EUT

The EUT was identified as follows:

EUT Identification	
Product Description	Phoenix AC Logic Board
Model/Part No.	003-0458-3
Serial No.	N/A
Size of EUT	3" Length x 8" Width x 1.5" Depth
Software/Firmware Version	mp_flash_is_zii_7_1d_p_v12_52027.bin GDO Firmware: Motor Forever Run 126A0542-Silabs-Application Rev C.6
Device Type	Digitally Modulated Transmission Device
Band of Operation	2400 – 2483.5MHz
Modulation Type	QPSK, BPSK, 64-QAM
Antenna Type	Integrated meandered inverted F PCB antenna
Antenna Gain (dBi) ¹	±1
Conducted Output Power	See report ETR2201780-02
EIRP	2.3mW (3.7dBm)
6dB Bandwidth	See report ETR2201780-02
Occupied Bandwidth (99% CBW)	See report ETR2201780-02
Emission Classification	1M03F1D
Product FCC ID & ISSED UPN Number	FCC ID: HBW0458X1 ISED ID: 2666A-0458X1

Note 1 – Antenna gain is supplied by the manufacturer and Elite is not responsible for the accuracy of the antenna gain.

The EUT listed above was used throughout the test series.

3. Power Input

The EUT obtained 115V 60Hz power via a 3-wire, 1-meter, unshielded power cord.

4. Grounding

The EUT was connected to ground through the third wire of its input power cord.

5. Support Equipment

The EUT was submitted for testing along with the following support equipment:

Description	Model #	S/N
1 Dell Laptop	Latitude 7480	---
Motion Sensor	041-0136	N/A
Light/Motor Switch	880LMW	N/A

6. Interconnect Leads

The following interconnect cables were submitted with the test item:

Item	Description
1 USB A Cable	Connects laptop to EUT to configure radios
1 Micro-USB Cable	Connects laptop to EUT to configure radios
FTDI UART Bridge	Connects laptop to EUT to configure radios
FT232 UART Bridge	Connects laptop to EUT to configure radios
Double Wire I/O	Connects Motion Sensor to EUT
Double Wire I/O	Connects Light Switch to EUT

7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

8. Mode of Operation

The EUT and all peripheral equipment were energized. The unit was programmed to transmit at one of the following 802.11 protocols:

8.1. TX

Protocol	Description
BLE	- 2402MHz, Power Setting ~4.5dBm - 2480MHz, Power Setting ~4.5dBm

9. Test Specifications

The tests were performed to selected portions of, and in accordance with, the test specifications.

- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 15, Subpart C
- 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"
- ANSI C63.10-2013, "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"
- Federal Communications Commission Office of Engineering and Technology Laboratory Division, Guidance for Compliance Measurements On Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 April 2, 2019 KDB 558074 D01v05r02

- RSS-Gen Issue 5, February 2020, Amendment 2, Innovation, Science, and Economic Development Canada, "General Requirements for Compliance of Radio Apparatus"
- RSS-247 Issue 2, February 2017, "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices"

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Chamberlain Group, Inc. and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247, Innovation, Science, and Economic Development Canada, RSS-247, and ANSI C63.4-2014 specifications.

11. Deviation, Additions to, or Exclusions from Test Specifications

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

The ambient parameters of the laboratory during testing were as follows:

Ambient Parameters	Value
Temperature	22.8°C
Relative Humidity	18%
Atmospheric Pressure	1024.5mb

13. Summary

The following EMC tests were performed, and the results are shown below:

Test Description	Requirements	Test Method	S/N	Results
Effective Isotropic Radiated Power (EIRP)	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	N/A	Conforms
Case Spurious Radiated Emissions	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	N/A	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

$$\text{Formula 1: } VL \text{ (dB}\mu\text{V)} = \text{MTR (dB}\mu\text{V)} + \text{CF (dB)}.$$

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

$$\text{Formula 1: } FS \text{ (dB}\mu\text{V/m)} = \text{MTR (dB}\mu\text{V)} + \text{AF (dB/m)} + \text{CF (dB)} + (-PA \text{ (dB)}) + \text{DC (dB)}$$

To convert the Field Strength dB μ V/m term to μ V/m, the dB μ V/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in μ V/m terms.

$$\text{Formula 2: } FS \text{ (}\mu\text{V/m)} = \text{AntiLog} [(FS \text{ (dB}\mu\text{V/m)})/20]$$

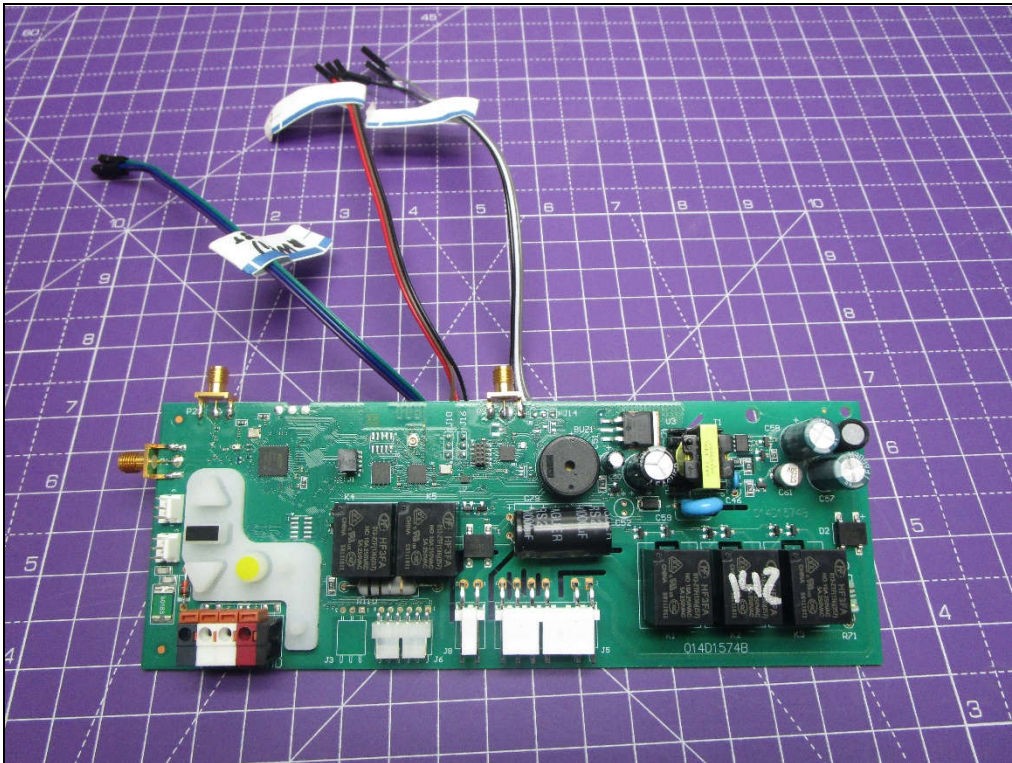
15. Statement of Conformity

The Chamberlain Group, Inc. Phoenix AC Logic Board, Model No. 003-0458-3, did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and Innovation, Science, and Economic Development Canada, RSS-247.

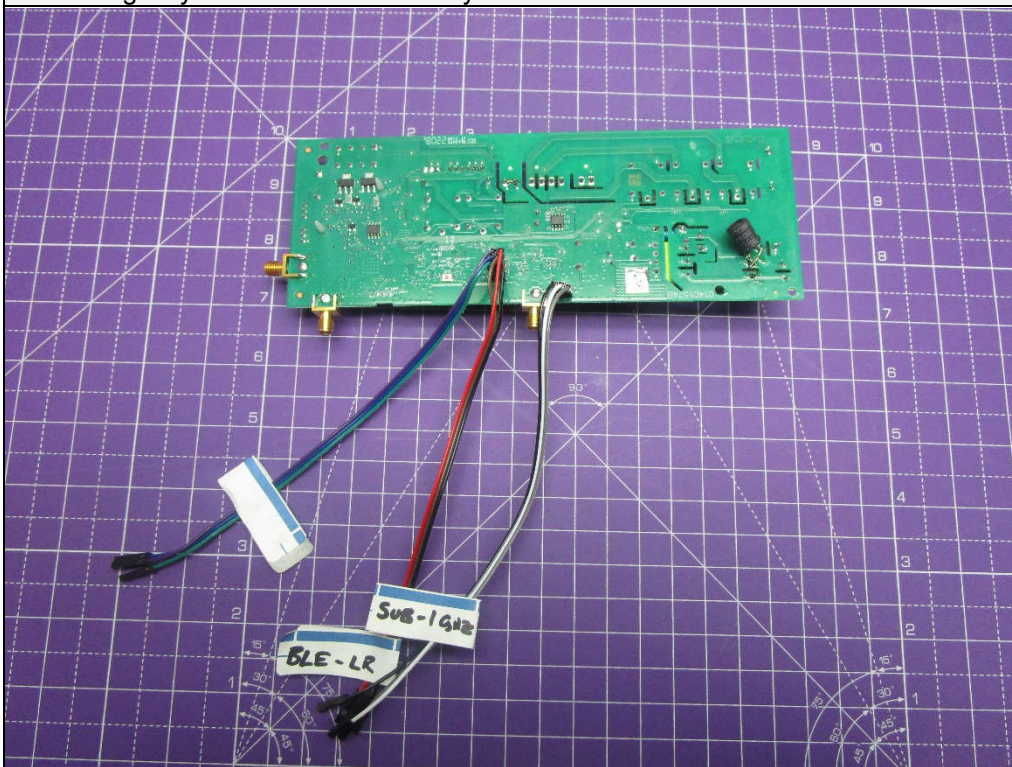
16. Certification

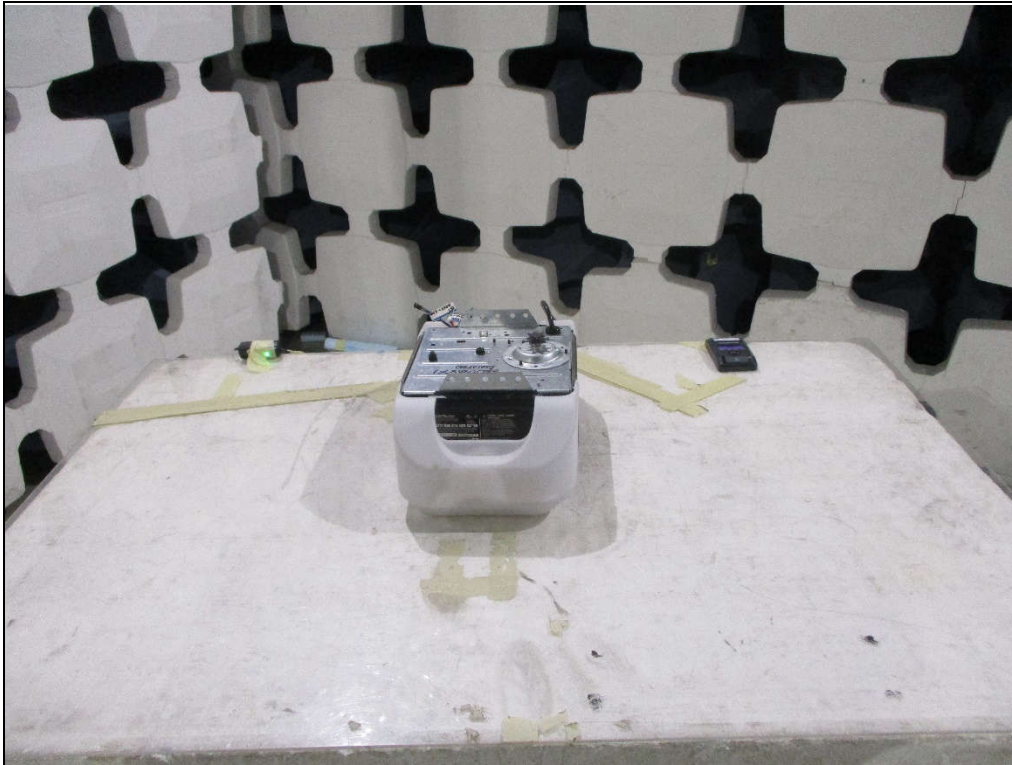
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17. Photographs of EUT



EUT top and bottom. EUT modified with external connectors for antenna conducted testing only. EUT does not normally have the external connectors attached.





EUT tested in a host GDO



18. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	3/9/2022	3/9/2023
CDZ4	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	10/5/2020	10/5/2022
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/13/2020	6/13/2022
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	4/7/2022	4/7/2023
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ7	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-Q	5	1.8-10GHZ	2/3/2021	2/3/2023

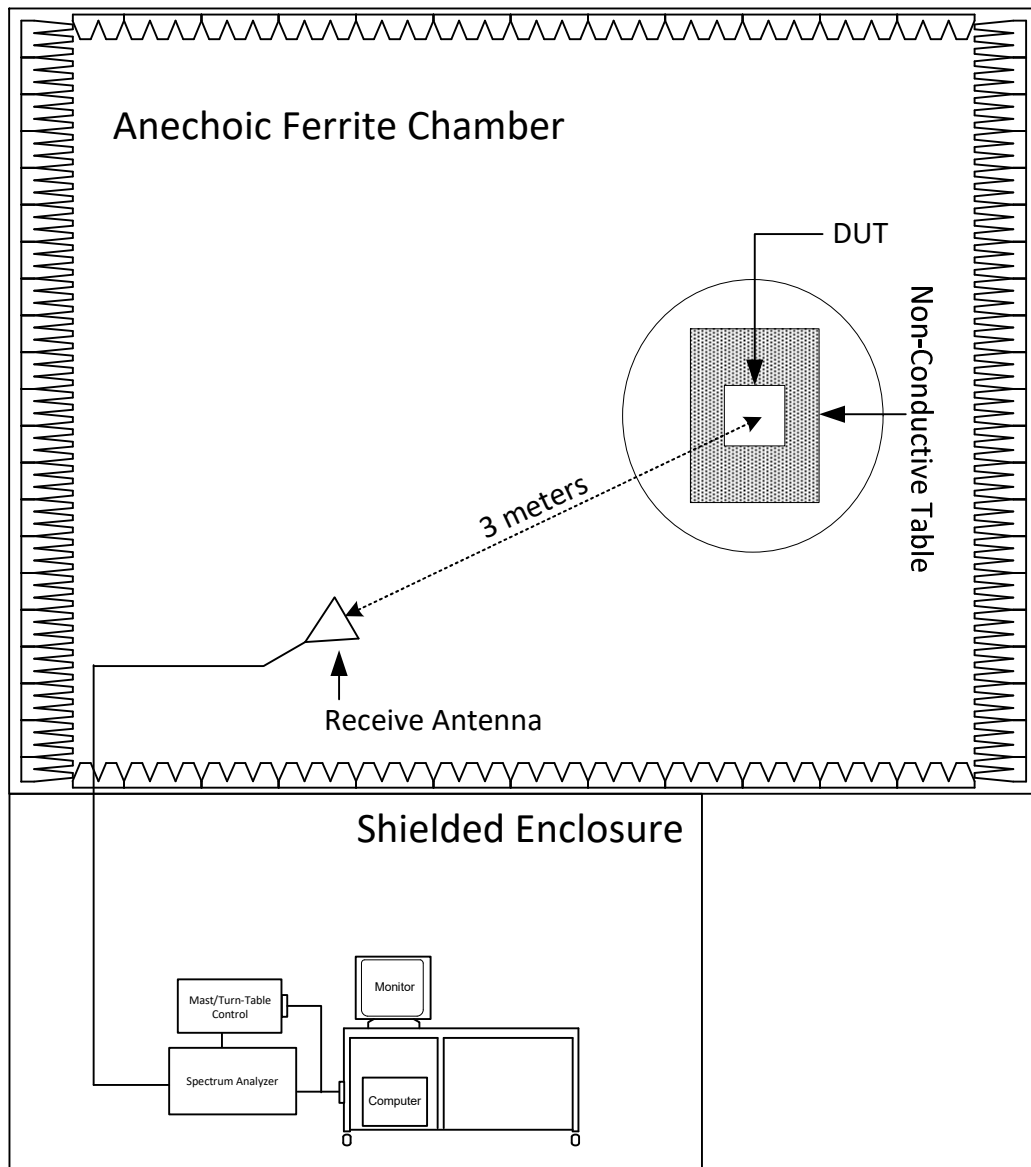
N/A: Not Applicable

I/O: Initial Only

CNR: Calibration Not Required

NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

19. Block Diagram of Test Setup



Radiated Measurements Test Setup

20. Effective Isotropic Radiated Power (EIRP)

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R21F
Type of Antennas Used	Double-ridged waveguide (or equivalent)
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1

Requirements
The output power shall not exceed 4W (36dBm).

Procedure
The EUT was placed on the non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 6dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle, and high channels. The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss (and antenna gain for all measurements above 1GHz), as required. The peak power output was calculated for low, middle, and high hopping frequencies.

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Result	Max EIRP = 2.3mW (3.7dBm)
Test Date	May 27, 2022
Notes	802.11b 11Mbps

Freq (MHz)	Ant Pol	Wide BW Meter Reading (dBμV)	Matched Sig Gen Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2402.00	H	61.1	-1.1	5.2	2.7	1.3	36.0	-34.7
	V	58.4	-3.6	5.2	2.7	-1.2	36.0	-37.2
2480.00	H	63.4	1.5	5.0	2.8	3.7	36.0	-32.3
	V	58.2	-3.8	5.0	2.8	-1.6	36.0	-37.6

21. Case Spurious Radiated Emissions

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R21F
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) 1 – 18GHz: Double-Ridged Waveguide (or equivalent) Above 18GHz: Horn (or equivalent)
Notes	None

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

Procedure

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3-meter distance from the EUT. The entire frequency range from 30MHz to 18GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 18GHz.

1) For all harmonics not in the restricted bands, the following procedure was used:

- a) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
- b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
- c) To ensure that maximum or worst-case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
 - i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
 - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
- d) All harmonics not in the restricted bands must be at least 20dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:

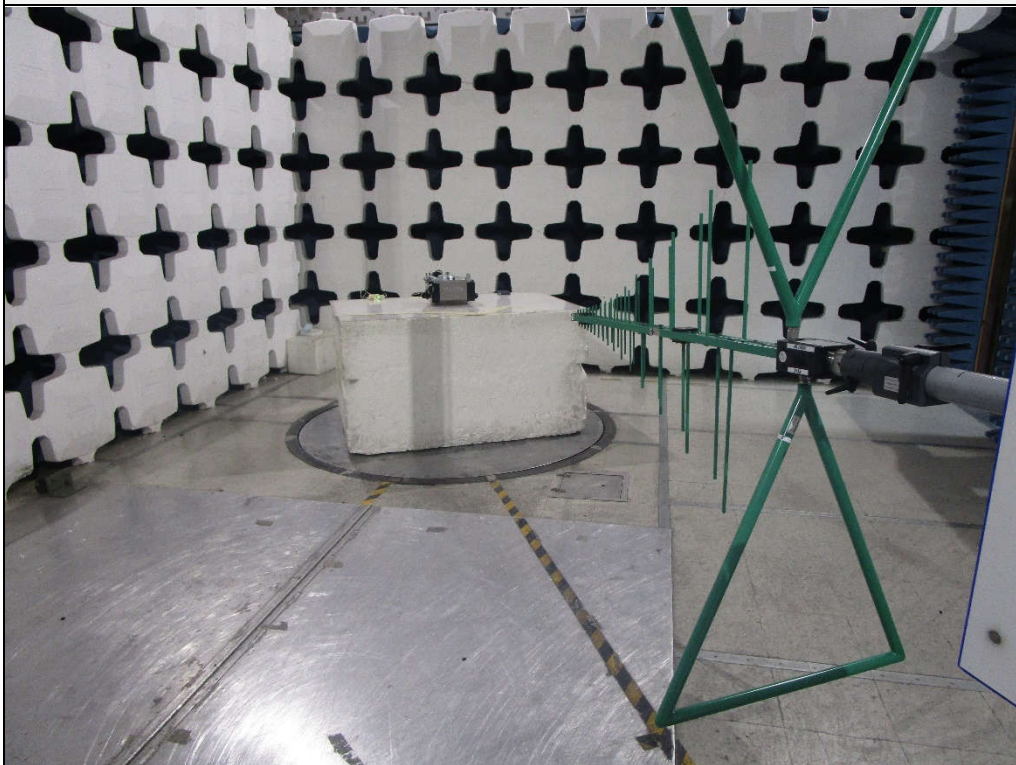
- a) The field strengths of all emissions below 1GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
- b) The field strengths of all emissions above 1GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 1MHz was used on the spectrum analyzer.
- c) To ensure that maximum or worst-case emission levels were measured, the following steps were taken when taking all measurements:
 - i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components

were measured.

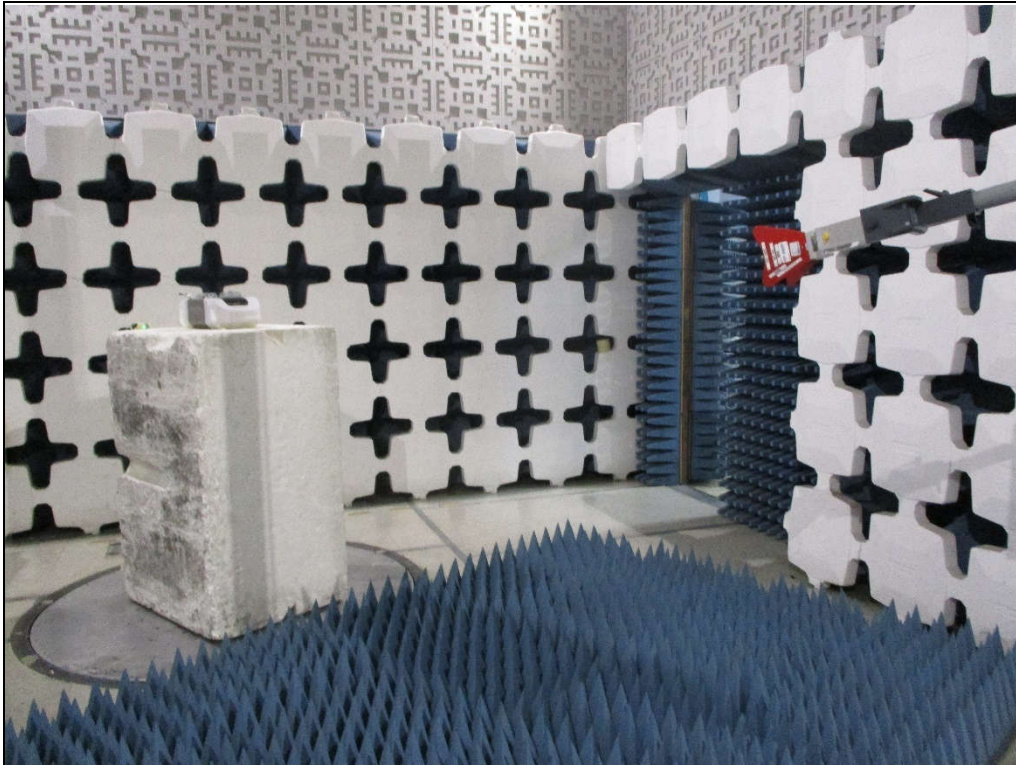
- iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
- iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
- d) For all radiated emissions measurements below 1GHz, if the peak reading is below the limits listed in §15.209(a), no further measurements are required. If, however, the peak readings exceed the limits listed in §15.209(a), then the emissions are remeasured using a quasi-peak detector.
- e) For all radiated emissions measurements above 1GHz, the peak readings must comply with the §15.35(b) limits. §15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1GHz must be no greater than 20dB above the limits specified in §15.209(a).
- f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken.



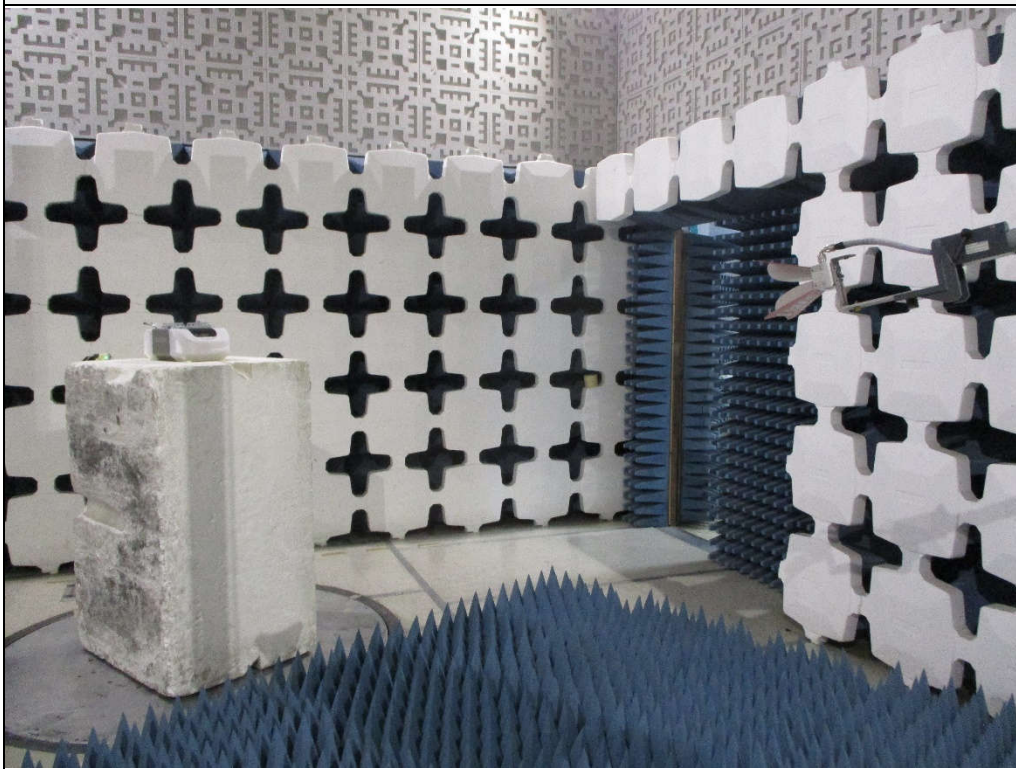
Test Setup for Spurious Radiated Emissions, 30MHz – 1GHz – Antenna
Polarization Horizontal



Test Setup for Spurious Radiated Emissions, 30MHz – 1GHz – Antenna
Polarization Vertical



Test Setup for Spurious Radiated Emissions, 1 – 18GHz – Antenna Polarization
Horizontal



Test Setup for Spurious Radiated Emissions, 1 – 18GHz – Antenna Polarization
Vertical

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2402MHz
Test Date	May 27, 2022
Notes	Peak Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	Cable Factor (dB)	Antenna Factor (dB/m)	Pre Amp (dB)	Peak Total at 3m (dBμV/m)	Peak Total at 3m (μV/m)	Peak Limit at 3m (μV/m)	Margin (dBm)
4804.00	H	48.5	*	3.7	36.1	-39.7	48.6	268.6	5000.0	-25.4
	V	48.8	*	3.7	36.1	-39.7	48.9	278.3	5000.0	-25.1

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2402MHz
Test Date	May 27, 2022
Notes	Average Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle Factor (dB)	Average Total at 3m (dBμV/m)	Average Total at 3m (μV/m)	Average Limit at 3m (μV/m)	Margin (dB)
4804.00	H	34.37	*	3.7	36.1	-39.7	4.1	38.5	84.2	500.0	-15.5
	V	34.43	*	3.7	36.1	-39.7	4.1	38.6	84.8	500.0	-15.4

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2402MHz
Test Date	May 27, 2022
Notes	Peak Measurements in Non-Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	Cable Factor (dB)	Antenna Factor (dB/m)	Pre Amp (dB)	Peak Total at 3m (dBμV/m)	Peak Total at 3m (μV/m)	Peak Limit at 3m (μV/m)	Margin (dBm)
2402.00	H	60.53		2.6	32.7	0.0	95.8	61645.2	NA	NA
	V	57.27		2.6	32.7	0.0	92.5	42354.5	NA	NA
7206.00	H	38.37	*	4.6	38.4	-39.7	41.8	122.7	6164.5	-34.0
	V	38.08	*	4.6	38.4	-39.7	41.5	118.6	6164.5	-34.3
9608.00	H	39.91	*	5.2	39.2	-39.3	44.9	176.7	6164.5	-30.9
	V	40.86	*	5.2	39.2	-39.3	45.9	197.1	6164.5	-29.9

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2480MHz
Test Date	May 27, 2022
Notes	Peak Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	Cable Factor (dB)	Antenna Factor (dB/m)	Pre Amp (dB)	Peak Total at 3m (dBμV/m)	Peak Total at 3m (μV/m)	Peak Limit at 3m (μV/m)	Margin (dBm)
4960.00	H	48.8	*	4.9	36.4	-40.3	49.8	308.6	5000.0	-24.2
	V	49.7	*	4.9	36.4	-40.3	50.7	341.5	5000.0	-23.3
7440.00	H	49.7	*	6.2	37.8	-40.0	53.7	486.6	5000.0	-20.2
	V	49.6	*	6.2	37.8	-40.0	53.7	481.6	5000.0	-20.3

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2480MHz
Test Date	May 27, 2022
Notes	Average Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle Factor (dB)	Average Total at 3m (dBμV/m)	Average Total at 3m (μV/m)	Average Limit at 3m (μV/m)	Margin (dB)
4960.00	H	34.70	*	4.9	36.4	-40.3	4.1	39.8	97.8	500.0	-14.2
	V	34.43	*	4.9	36.4	-40.3	4.1	39.5	94.8	500.0	-14.4
7440.00	H	33.70	*	6.2	37.8	-40.0	4.1	41.8	123.2	500.0	-12.2
	V	33.76	*	6.2	37.8	-40.0	4.1	41.9	124.1	500.0	-12.1

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Phoenix AC Logic Board
Model No.	003-0458-3
Serial No.	N/A
Mode	TX
Frequency Tested	2480MHz
Test Date	May 27, 2022
Notes	Peak Measurements in Non-Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBμV)	Ambient	Cable Factor (dB)	Antenna Factor (dB/m)	Pre Amp (dB)	Peak Total at 3m (dBμV/m)	Peak Total at 3m (μV/m)	Peak Limit at 3m (μV/m)	Margin (dBm)
2480.00	H	62.69		3.5	33.2	0.0	99.4	93739.6	NA	NA
	V	57.82		3.5	33.2	0.0	94.6	53508.5	NA	NA
9920.00	H	39.82	*	7.0	39.6	-39.5	46.8	219.5	9374.0	-32.6
	V	40.94	*	7.0	39.6	-39.5	47.9	249.7	9374.0	-31.5

22. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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ELECTRICAL

Valid To: June 30, 2023

Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:**Test Method(s) ¹:*****Transient Immunity***

ISO 7637-2 (including emissions); ISO 7637-3;
ISO 16750-2:2012, Sections 4.6.3 and 4.6.4;
CS-11979, Section 6.4; CS.00054, Section 5.9;
EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222);
GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12;
ECE Regulation 10.06 Annex 10

Electrostatic Discharge (ESD)

ISO 10605 (2001, 2008);
CS-11979 Section 7.0; CS.00054, Section 5.10;
EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13;
GMW 3097 Section 3.6

Conducted Emissions

CISPR 25 (2002, 2008), Sections 6.2 and 6.3;
CISPR 25 (2016), Sections 6.3 and 6.4;
CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2;
GMW 3097, Section 3.3.2;
EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421)

Radiated Emissions Anechoic

CISPR 25 (2002, 2008), Section 6.4;
CISPR 25 (2016), Section 6.5;
CS-11979, Section 5.3; CS.00054, Section 5.6.3;
GMW 3097, Section 3.3.1;
EMC-CS-2009.1 (RE 310); FMC1278 (RE310);
ECE Regulation 10.06 Annex 7 (Broadband)
ECE Regulation 10.06 Annex 8 (Narrowband)

(A2LA Cert. No. 1786.01) Revised 12/17/2021



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Test Technology:
Test Method(s) 1:
Vehicle Radiated Emissions

CISPR 12; CISPR 36; ICES-002;
ECE Regulation 10.06 Annex 5

Bulk Current Injection (BCI)

ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1;
GMW 3097, Section 3.4.1; SAE J1113-4;
EMC-CS-2009.1 (RI112); FMC1278 (RI112);
ECE Regulation 10.06 Annex 9

**Radiated Immunity Anechoic
(Including Radar Pulse)**

ISO 11452-2; ISO 11452-5;
CS-11979, Section 6.2; CS.00054, Section 5.8.2;
GMW 3097, Section 3.4.2;
EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21;
ECE Regulation 10.06 Annex 9

Radiated Immunity Magnetic Field

ISO 11452-8

Radiated Immunity Reverb

ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3;
EMC-CS-2009.1 (RI114); FMC1278 (RI114);
ISO 11452-11

**Radiated Immunity
(Portable Transmitters)**

ISO 11452-9;
EMC-CS-2009.1 (RI115); FMC1278 (RI115)

Vehicle Radiated Immunity (ALSE)

ISO 11451-2; ECE Regulation 10.06 Annex 6

**Vehicle Product Specific EMC
Standards**

EN 14982; EN ISO 13309; ISO 13766; EN 50498;
EC Regulation No. 2015/208; EN 55012

Electrical Loads

ISO 16750-2

Emissions

Radiated and Conducted
(3m Semi-anechoic chamber,
up to 40 GHz)

47 CFR, FCC Part 15 B (using ANSI C63.4:2014);
47 CFR, FCC Part 18 (using FCC MP-5:1986);
ICES-001; ICES-003; ICES-005;
IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004);
IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010);
KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008);
CISPR 11; EN 55011; KS C 9811; CNS 13803 (1997, 2003);
CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1;
KS C 9814-1; KN 14-1; IEC/CISPR 22 (1997);
EN 55022 (1998) + A1(2000);
EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006);
IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004);
AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz);
CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz);
CISPR 32; EN 55032; KS C 9832; KN 32;
ECE Regulation 10.06 Annex 14

Cellular Radiated Spurious Emissions

ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12;
ETSI TS 134 124 UMTS; 3GPP TS 34.124;
ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124

Test Technology:
Test Method(s) 1:
Emissions (cont'd)

Current Harmonics

IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2;
KS C 9610-3-2; ECE Regulation 10.06 Annex 11

Flicker and Fluctuations

IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3;
KS C 9610-3-3; ECE Regulation 10.06 Annex 12

Immunity

Electrostatic Discharge

IEC 61000-4-2, Ed. 1.2 (2001);
IEC 61000-4-2 (1995) + A1(1998) + A2(2000);
EN 61000-4-2 (1995); EN 61000-4-2 (2009-05);
KN 61000-4-2 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2;
KS C 9610-4-2; IEEE C37.90.3 2001

Radiated Immunity

IEC 61000-4-3 (1995) + A1(1998) + A2(2000);
IEC 61000-4-3, Ed. 3.0 (2006-02);
IEC 61000-4-3, Ed. 3.2 (2010);
KN 61000-4-3 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3;
KS C 9610-4-3; IEEE C37.90.2 2004

Electrical Fast Transient/Burst

IEC 61000-4-4, Ed. 2.0 (2004-07);
IEC 61000-4-4, Ed. 2.1 (2011);
IEC 61000-4-4 (1995) + A1(2000) + A2(2001);
KN 61000-4-4 (2008-5);
RRL Notice No. 2008-5 (May 20, 2008);
IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4;
KS C 9610-4-4; ECE Regulation 10.06 Annex 15

Surge

IEC 61000-4-5 (1995) + A1(2000);
IEC 61000-4-5, Ed 1.1 (2005-11);
EN 61000-4-5 (1995) + A1(2001);
KN 61000-4-5 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5;
KS C 9610-4-5;
IEEE C37.90.1 2012; IEEE STD C62.41.2 2002;
ECE Regulation 10.06 Annex 16

Conducted Immunity

IEC 61000-4-6 (1996) + A1(2000);
IEC 61000-4-6, Ed 2.0 (2006-05);
IEC 61000-4-6 Ed. 3.0 (2008);
KN 61000-4-6 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6;
EN 61000-4-6; KN 61000-4-6; KS C 9610-4-6

Test Technology:
Test Method(s) 1:
Immunity (cont'd)

Power Frequency Magnetic Field
Immunity (*Down to 3 A/m*)

IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009);
EN 61000-4-8 (1994) + A1(2000);
KN 61000-4-8 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8; KS C 9610-4-8

Voltage Dips, Short Interrupts, and Line
Voltage Variations

IEC 61000-4-11, Ed. 2 (2004-03);
KN 61000-4-11 (2008-5);
RRL Notice No. 2008-4 (May 20, 2008);
IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11;
KS C 9610-4-11

Ring Wave

IEC 61000-4-12, Ed. 2 (2006-09);
EN 61000-4-12:2006;
IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12;
IEEE STD C62.41.2 2002

Generic and Product Specific EMC
Standards

IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1;
KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2;
KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3;
AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3;
IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4;
KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2;
EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3;
EN 55015; EN 60730-1; EN 60945; IEC 60533;
EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2;
AS/NZS CISPR 14-2; KN 14-2; KS C 9814-2;
IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24;
IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35;
KS C 9835; IEC 60601-1-2; JIS T0601-1-2

TxRx EMC Requirements

EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17;
EN 301 489-19; EN 301 489-20

European Radio Test Standards

ETSI EN 300 086-1; ETSI EN 300 086-2;
ETSI EN 300 113-1; ETSI EN 300 113-2;
ETSI EN 300 220-1; ETSI EN 300 220-2;
ETSI EN 300 220-3-1; ETSI EN 300 220-3-2;
ETSI EN 300 330-1; ETSI EN 300 330-2;
ETSI EN 300 440-1; ETSI EN 300 440-2;
ETSI EN 300 422-1; ETSI EN 300 422-2;
ETSI EN 300 328; ETSI EN 301 893;
ETSI EN 301 511; ETSI EN 301 908-1;
ETSI EN 908-2; ETSI EN 908-13;
ETSI EN 303 413; ETSI EN 302 502;
EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4

Test Technology:
Test Method(s) 1:
Canadian Radio Tests

RSS-102 (RF Exposure Evaluation only); RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-247; RSS-248; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN

Mexico Radio Tests

IFT-008-2015; NOM-208-SCFI-2016

Japan Radio Tests

Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18

Taiwan Radio Tests

LP-0002 (July 15, 2020)

Australia/New Zealand Radio Tests

AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)

Hong Kong Radio Tests

HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073

Korean Radio Test Standards

KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52; KS X 3124; KS X 3125; KS X 3130; KS X 3126; KS X 3129

Vietnam Radio Test Standards

QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT; QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT; QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT; QCVN 112:2017/BTTTT; QCVN 117:2020/BTTTT

Vietnam EMC Test Standards

QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT; QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT

**Unlicensed Radio Frequency Devices
(3 Meter Semi-Anechoic Room.)**

47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))

Licensed Radio Service Equipment

47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E, ANSI C63.26:2015)

Test Technology:

OTA (Over the Air) Performance
GSM, GPRS, EGPRS
UMTS (W-CDMA)
LTE including CAT M1
A-GPS for UMTS/GSM
LTS A-GPS, A-GLONASS,
SB8/SB16
Large Device/Laptop/Tablet Testing
Integrated Device Testing
WiFi 802.11 a/b/g/n/a

Test Method(s) ¹:

CTIA Test Plan for Wireless Device Over-the-Air
Performance (Method for Measurement for Radiated Power
and Receiver Performance) V3.8.2;
CTIA Test Plan for RF Performance Evaluation of WiFi
Mobile Converged Devices V2.1.0

Electrical Measurements and Simulation
AC Voltage / Current

(1mV to 5kV) 60 Hz

(0.1V to 250V) up to 500 MHz

(1μA to 150A) 60 Hz

FAA AC 150/5345-10H

FAA AC 150/5345-43J

FAA AC 150/5345-44K

DC Voltage / Current

(1mV to 15-kV) / (1μA to 10A)

FAA AC 150/5345-46E

FAA AC 150/5345-47C

Power Factor / Efficiency / Crest Factor

(Power to 30kW)

FAA EB 67D

Resistance

(1mΩ to 4000MΩ)

Surge

(Up to 10 kV / 5 kA) (Combination
Wave and Ring Wave)

On the following products and materials:

Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

¹ When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA R101 - General Requirements - Accreditation of ISO-IEC 17025 Laboratories.

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology
Test Method
Maximum Frequency (MHz)
Unintentional Radiators

Part 15B

ANSI C63.4:2014

40000

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Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Industrial, Scientific, and Medical Equipment</u> Part 18	FCC MP-5 (February 1986)	40000
<u>Intentional Radiators</u> Part 15C	ANSI C63.10:2013	40000
<u>Unlicensed Personal Communication Systems Devices</u> Part 15D	ANSI C63.17:2013	40000
<u>U-NII without DFS Intentional Radiators</u> Part 15E	ANSI C63.10:2013	40000
<u>U-NII with DFS Intentional Radiators</u> Part 15E	FCC KDB 905462 D02 (v02)	40000
<u>UWB Intentional Radiators</u> Part 15F	ANSI C63.10:2013	40000
<u>BPL Intentional Radiators</u> Part 15G	ANSI C63.10:2013	40000
<u>White Space Device Intentional Radiators</u> Part 15H	ANSI C63.10:2013	40000
<u>Commercial Mobile Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>General Mobile Radio Services (FCC Licensed Radio Service Equipment)</u> Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment)</u> Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000

Testing Activities Performed in Support of FCC Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1²

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
<u>Maritime and Aviation Radio Services</u> Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
<u>Microwave and Millimeter Bands Radio Services</u> Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Broadcast Radio Services</u> Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
<u>Signal Boosters</u> Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

² Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (<https://apps.fcc.gov/oetcf/eas/>) for a listing of FCC approved laboratories.



Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 19th day of May 2021.



Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.