



Engineering Test Report No. 2300242-01	
Report Date	February 20, 2023
Manufacturer Name	The Chamberlain Group LLC
Manufacturer Address	300 Windsor Dr Oak Brook, IL 60523
Test Item Name Model No.	Homelink Repeater MC Homelink Rptr MC
Date Received	February 1, 2023
Test Dates	February 1 and 2, 2023
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231(e) Innovation, Science, and Economic Development Canada, RSS-210 Innovation, Science, and Economic Development Canada, RSS-GEN
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	Tylar Jozefczyk
Signature	
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894
PO Number	4900088949
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## 1. Report Revision History

Revision	Date	Description
–	20 FEB 2023	Initial Release of Engineering Test Report No. 2300242-01

## 2. Introduction

### 2.1. Scope of Tests

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

### 2.2. Purpose

The test series was performed to determine if the EUT meets the Class II Permissive Change requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.231(e).

The test series was also performed to determine if the EUT meets the Class II Permissive Change requirements of the Industry Canada Radio Standards Specification RSS-Gen and Industry Canada Radio Standards Specification RSS-210 for Transmitters.

The following modifications have been made to the original equipment:

- Added 343MHz frequency.

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	Homelink Repeater MC
Model/Part No.	Homelink Rptr MC
Serial No.	SMP-86978
Software/Firmware Version	127A0210 Rev D
Antenna Type	Whip Antenna ¼ wave
Antenna Gain (dBi)	N/A
Band of Operation	260 – 470MHz
Modulation Type	Rolling EF pay01 code
Occupied Bandwidth (99% CBW)	370kHz
Emission Classification	L1D
FCC ID & ISED UPN Number	FCC ID: HBW2555M ISED UPN: 2666A-2555M

The EUT listed above was used throughout the test series.

## 3. Power Input

The EUT obtained 120VAC 60Hz power by being directly plugged into a 120VAC 60Hz power source.

## 4. Grounding

The EUT was not grounded.

## 5. Support Equipment

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

Description	Model #	S/N
Repeater that accepts and converts a non-compatible HomeLink signal into a Chamberlain or LiftMaster Security+ 2.0® compatible signal	Homelink Repeater MC	001A6801-2

## 6. Interconnect Leads

No interconnect leads were used during the tests.

## 7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

## 8. Mode of Operation

The EUT was energized and programmed to transmit in the following mode:

Mode	Description
Tx	343MHz

## 9. Test Specifications

The tests were performed to selected portions of, and in accordance with, the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231 and Innovation, Science, and Economic Development Canada, RSS-210 test specifications.

- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 15, Subpart C – "Intentional Radiators"
- 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"
- KDB 558074 D01 v05r02, April 2, 2019 – "Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules"
- Radio Standards Specification RSS-Gen Issue 5, February 2021, Amendment 2 – "General Requirements for Compliance of Radio Apparatus"
- Radio Standards Specification RSS-210 Issue 10, April 2020, Amendment 1 – "License-Exempt Radio Apparatus: Category I Equipment"

## 10. Test Plan

No test plan was provided. Instructions were provided by personnel from The Chamberlain Group LLC and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231, Innovation, Science, and Economic Development Canada, RSS-210, and ANSI C63.10-2013 specifications.

## 11. Deviations, 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	21%
Atmospheric Pressure	1024.38mb

### 13. Summary

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

Test Description	Requirements	Test Method	Results
Duty Cycle Factor	FCC 15.231 ISED RSS-210	ANSI C63.10:2013	Conforms
Occupied Bandwidth – 20dB	FCC 15.231	ANSI C63.10:2013	Conforms
Occupied Bandwidth – 99%	ISED RSS-210	ANSI C63.10:2013	Conforms
Spurious Radiated Emissions	FCC 15.231 ISED RSS-210	ANSI C63.10:2013	Conforms

### 14. Sample Calculations

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.

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

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

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

### 15. Statement of Conformity

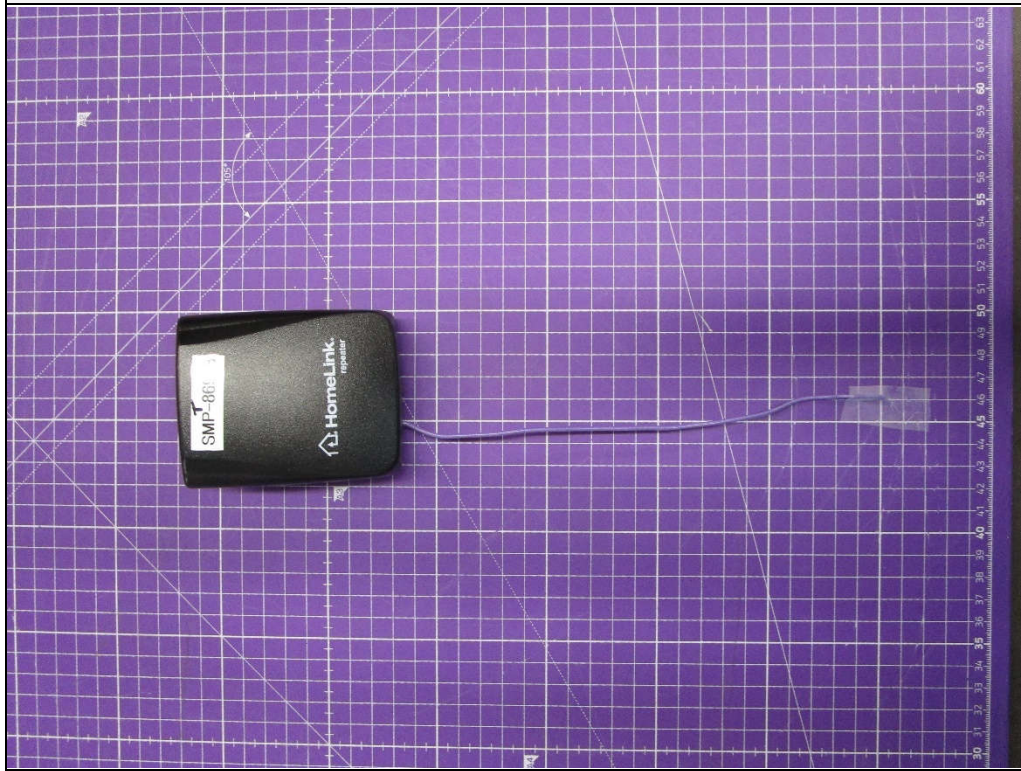
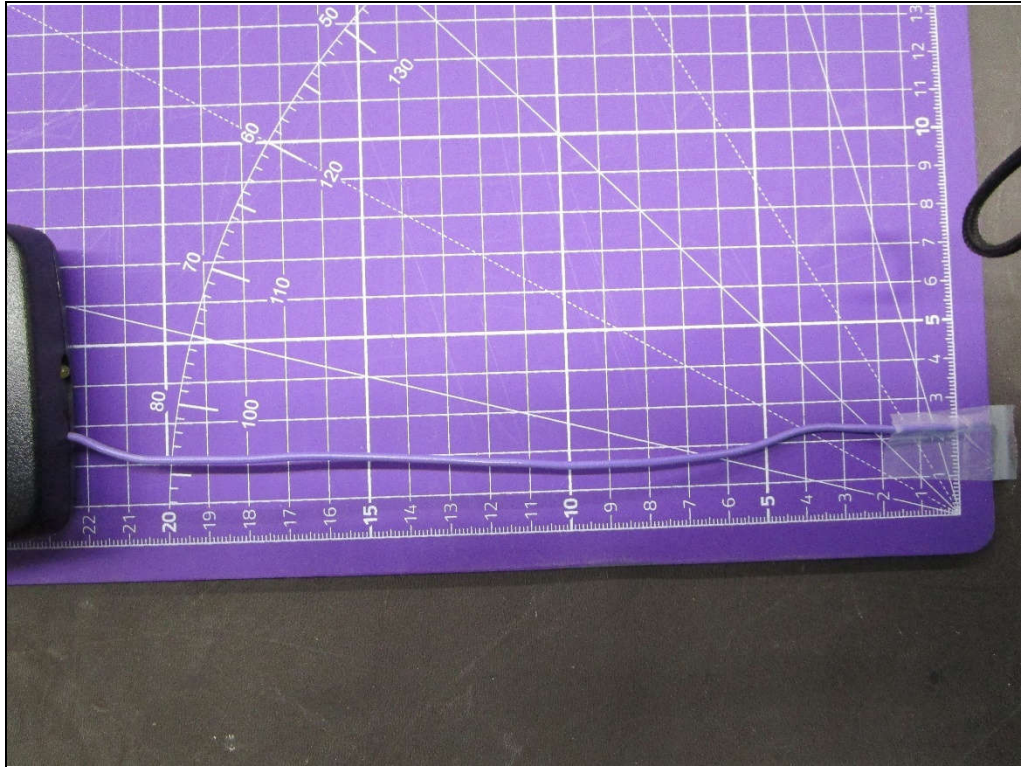
The Chamberlain Group LLC Homelink Repeater MC (Model No. Homelink Rptr MC, Serial No. SMP-86978) did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231 and Innovation, Science, and Economic Development Canada, RSS-210.

### 16. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.231 and Innovation, Science, and Economic Development Canada, RSS-210 test specifications. The data presented in this test report pertains to the EUT on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

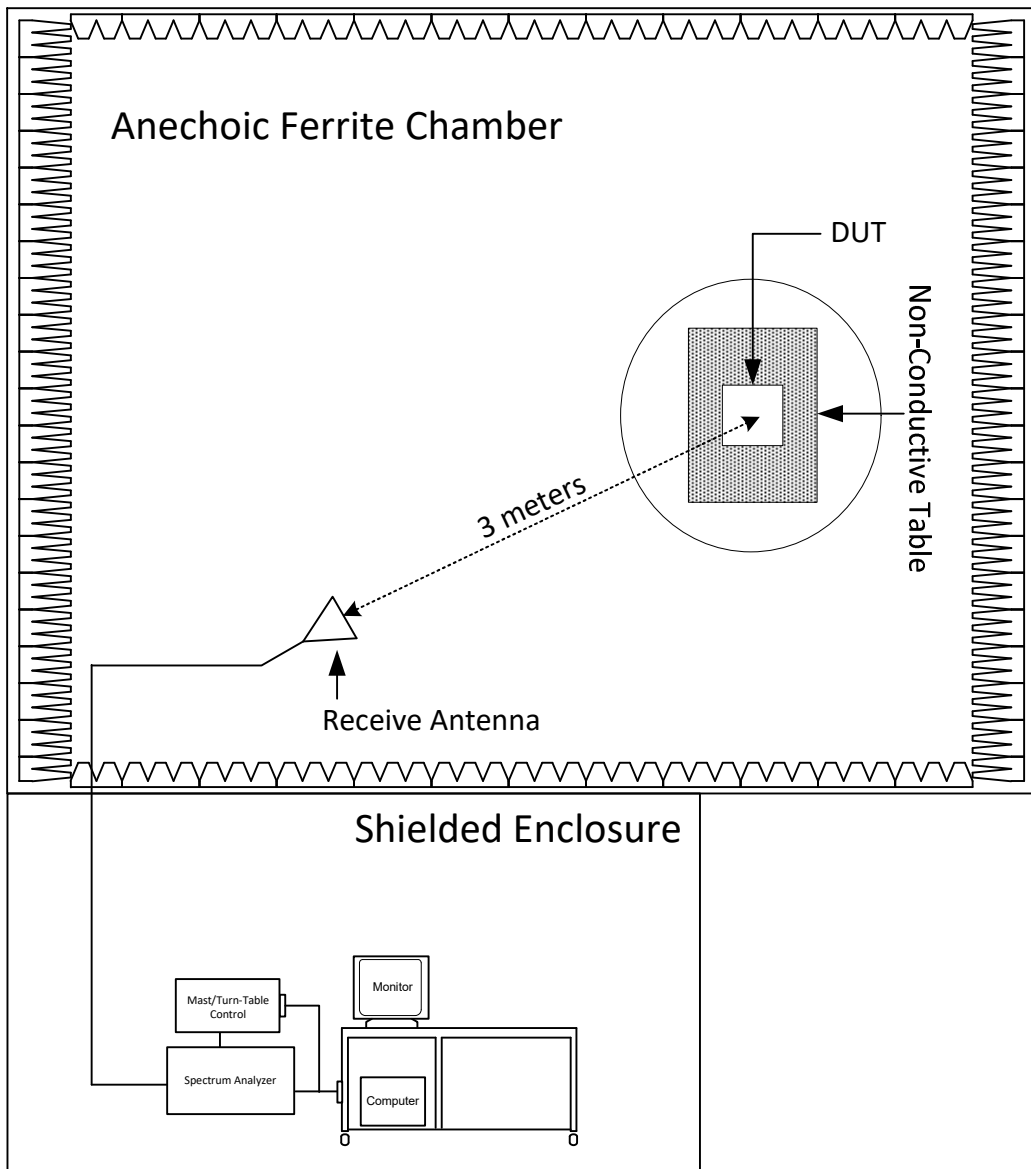
17. Photographs of EUT







### 18. Block Diagram of Test Setup



Radiated Measurements Test Setup

### 19. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
NLW2	MAGNETIC FIELD PROBE	ELECTRO-METRICS	MFC-25	---	20MHZ-230MHZ	NOTE 1	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHZ	11/17/2022	11/17/2024
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	4/27/2022	4/27/2024
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/31/2022	3/31/2023
RBG4	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	103007	2HZ-44GHZ	12/8/2022	12/8/2023

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.

20. Duty Cycle Factor

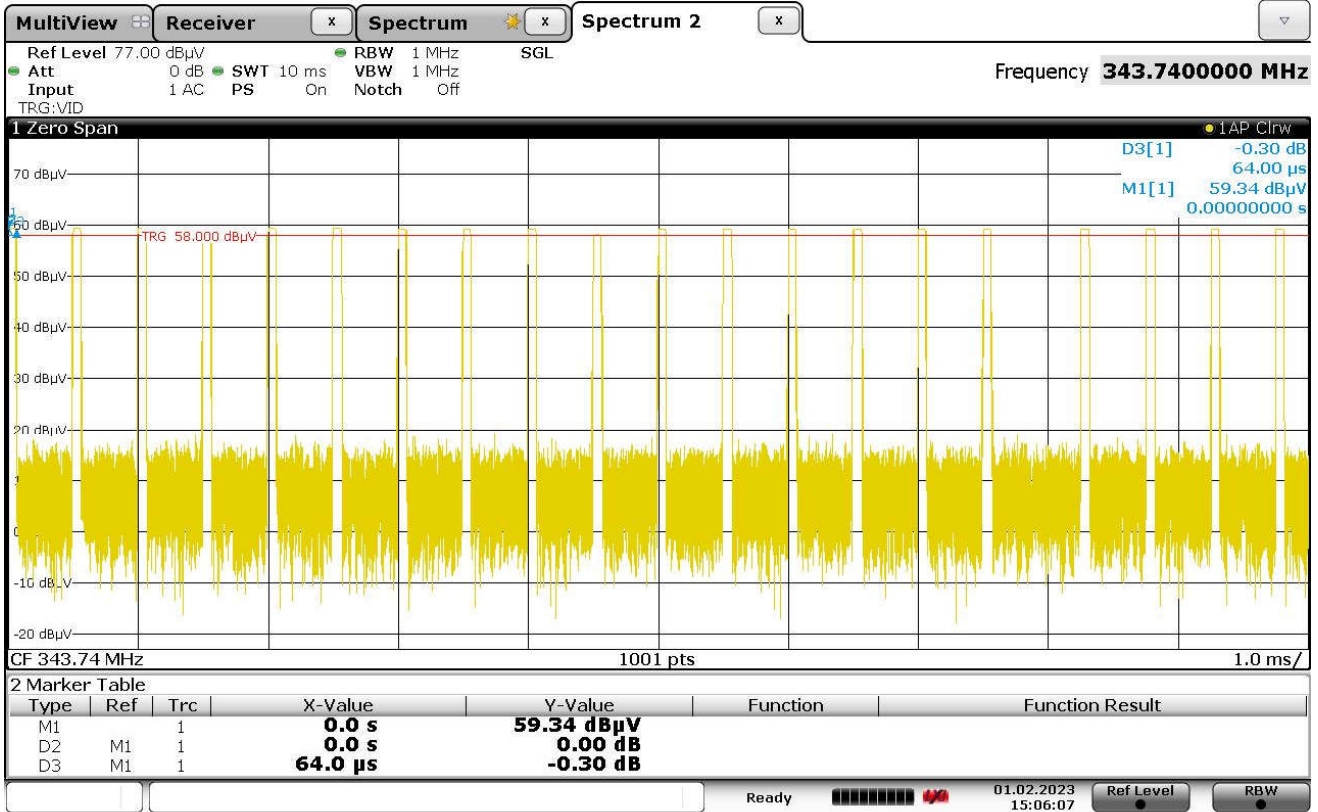
EUT Information	
Manufacturer	The Chamberlain Group LLC
Product	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R29F
Type of Antennas Used	Below 1GHz: Bilog (or equivalent)
Notes	<p>The data shown is a representative sample. The following information, supplied by The Chamberlain Group for the Rolling EF Code, was used to calculate the worst case duty cycle factor:</p> <p>Pay Load 00: <math>20 \cdot \log(15.5/100) = -16.19\text{dB}</math>  <b>Pay Load 01: <math>20 \cdot \log(21.5\text{ms}/100\text{ms}) = -13.35\text{ dB}</math></b>            Pay Load 10: <math>20 \cdot \log(21.5\text{ms}/100\text{ms}) = -13.35\text{ dB}</math></p> <p>All codes are Manchester encoded. It is also noted in the procedure below that the worst case (-13.35dB) used for the emission calculations.</p>

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

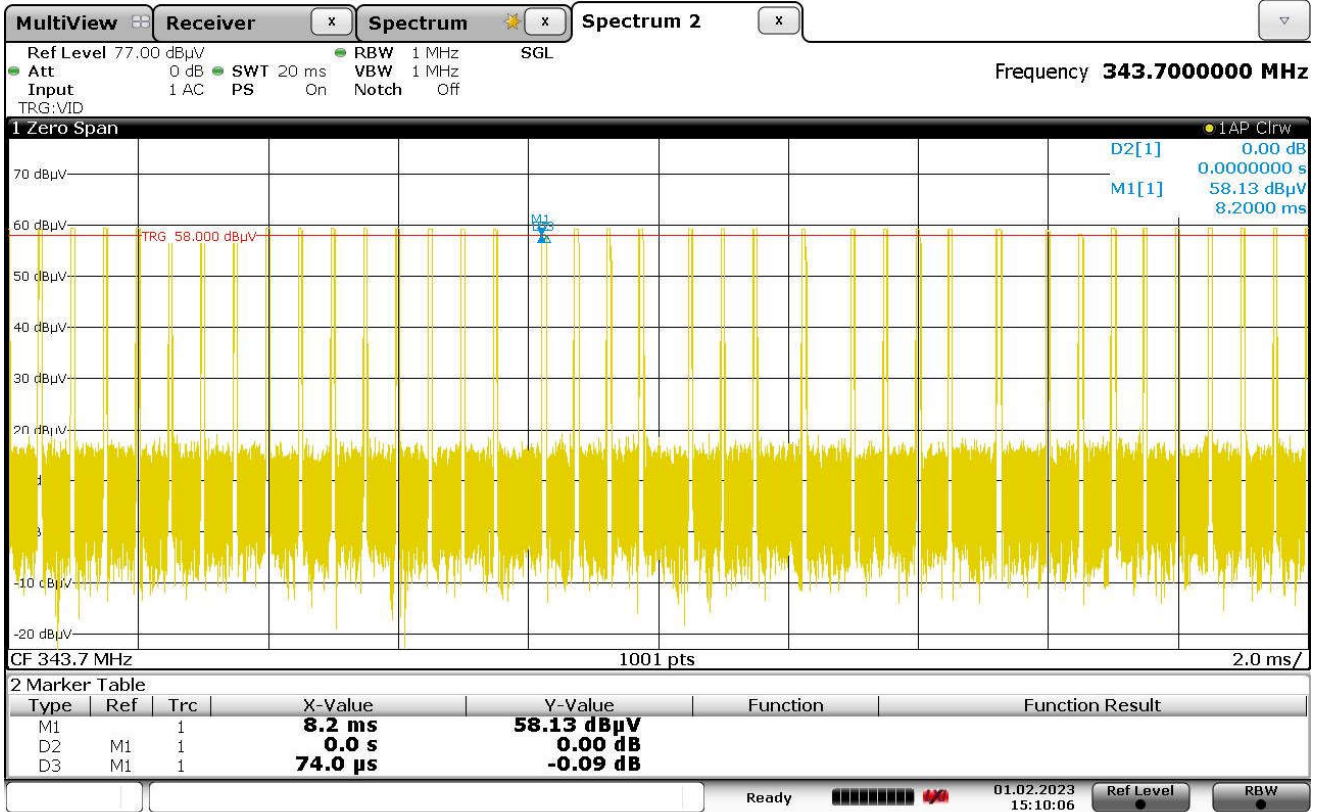
Procedure
<p>The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.</p> <p>Since this EUT utilizes a rolling code modulation, the duty is calculated based on the worst case. The following procedure was used to measure a representative sample:</p> <ol style="list-style-type: none"> <li>1) The EUT was set up to transmit for maximum pulse density, with the time domain trace displayed on the spectrum analyzer.</li> <li>2) The pulse width was measured, and a plot of this measurement was recorded.</li> <li>3) Next, the number of pulses in the word period was measured and a plot was recorded.</li> <li>4) Finally, the length of the word period was measured and a third plot was recorded. If the word period exceeded 100msec, the word period was limited to 100msec.</li> <li>5) The duty cycle is then computed as <math>\left(\frac{\text{On Time}}{\text{Word Period}}\right)</math>, where <math>\text{Word Period} = (\text{On Time} + \text{Off Time})</math>.</li> </ol>

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Frequency Tested	343.725MHz
Result	On Time = 0.064ms
Notes	



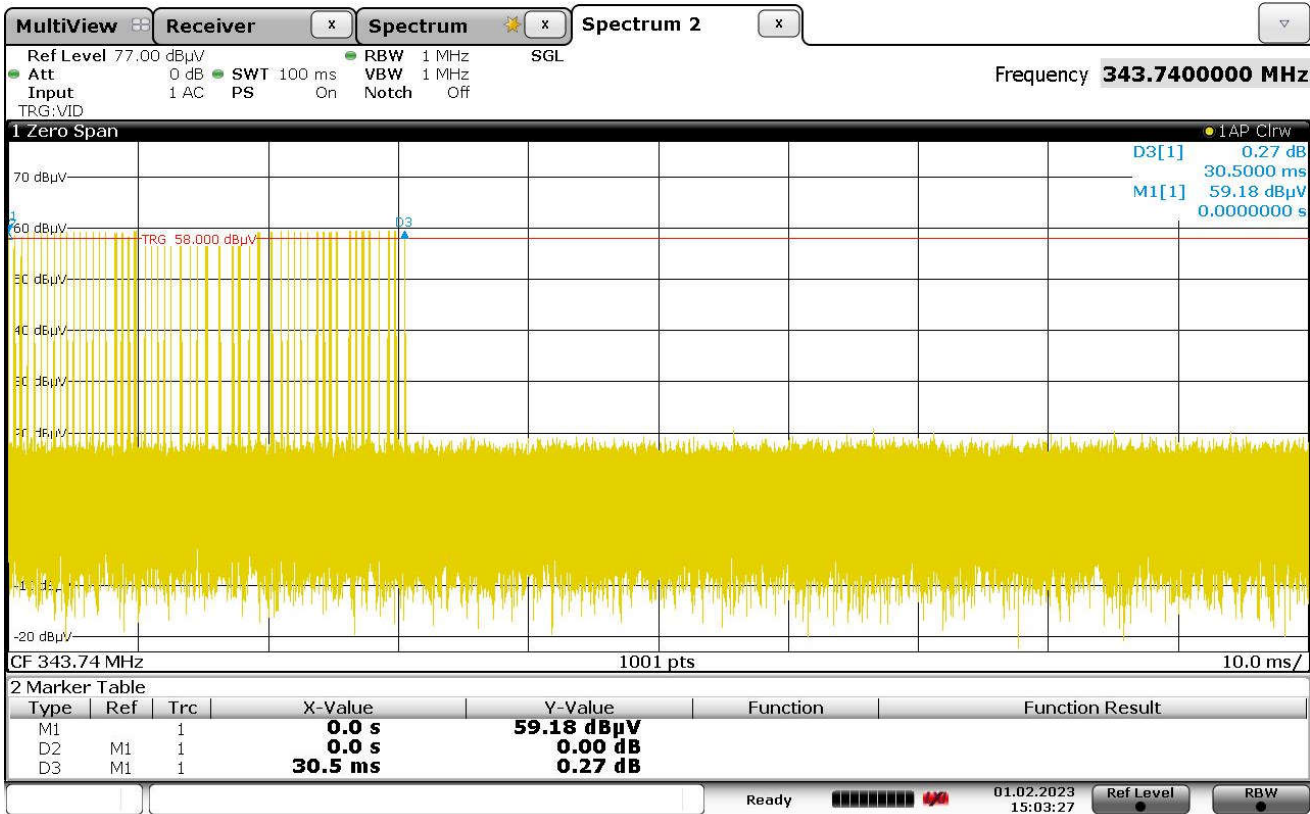
Date: 1.FEB.2023 15:06:07

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Frequency Tested	343.725MHz
Result	On Time = 0.074ms
Notes	



Date: 1.FEB.2023 15:10:07

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Frequency Tested	343.725MHz
Result	Duty Cycle = -28.687dB
Notes	Duty Cycle Factor Calculation: $17 \times 0.064\text{ms} = 1.0886\text{ms}$ $34 \times 0.074\text{ms} = 2.59\text{ms}$ $1.0886 + 2.59 = 3.678\text{ms}$ $\text{Duty Cycle Factor} = 20 \log \left( \frac{3.678\text{ms}}{100\text{ms}} \right) = -28.687\text{dB}$



Date: 1.FEB.2023 15:03:27

21. Occupied Bandwidth – 20dB

EUT Information	
Manufacturer	The Chamberlain Group LLC
Product	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx

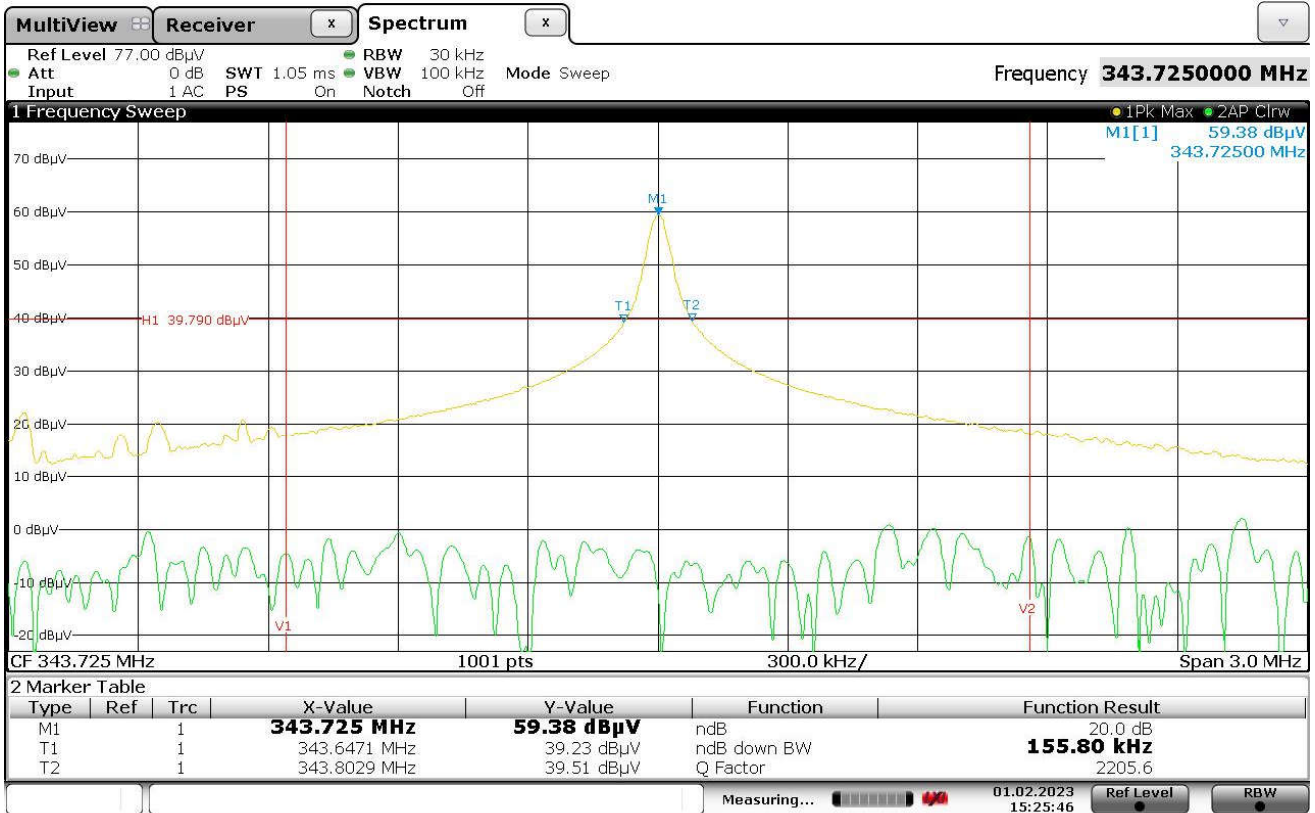
Test Setup Details	
Setup Format	Tabletop
Measurement Method	Radiated
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R29F
Type of Antenna Used	Below 1GHz: Bilog (or equivalent)
Notes	

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

Requirement
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

Procedure
<ol style="list-style-type: none"> <li>1) The EUT was set to transmit continuously.</li> <li>2) With an antenna positioned nearby, occupied bandwidth emissions were displayed on the receiver.</li> <li>3) The resolution bandwidth was set to 30kHz and span was set to 3MHz.</li> <li>4) A screen capture was taken of the frequency spectrum near the carrier using a screen dump function on the receiver.</li> </ol>

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Result	20dB BW = 155.8kHz
Notes	Vertical Lines V1 and V2 represent the 0.25% bandwidth of the center frequency of the EUT. Horizontal line H1 represents the level 20dB down from the peak of the modulated carrier. Max Allowed BW = (0.25% × Center Frequency) = 859.3125kHz



Date: 1.FEB.2023 15:25:46



22. Occupied Bandwidth – 99%

EUT Information	
Manufacturer	The Chamberlain Group LLC
Product	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx

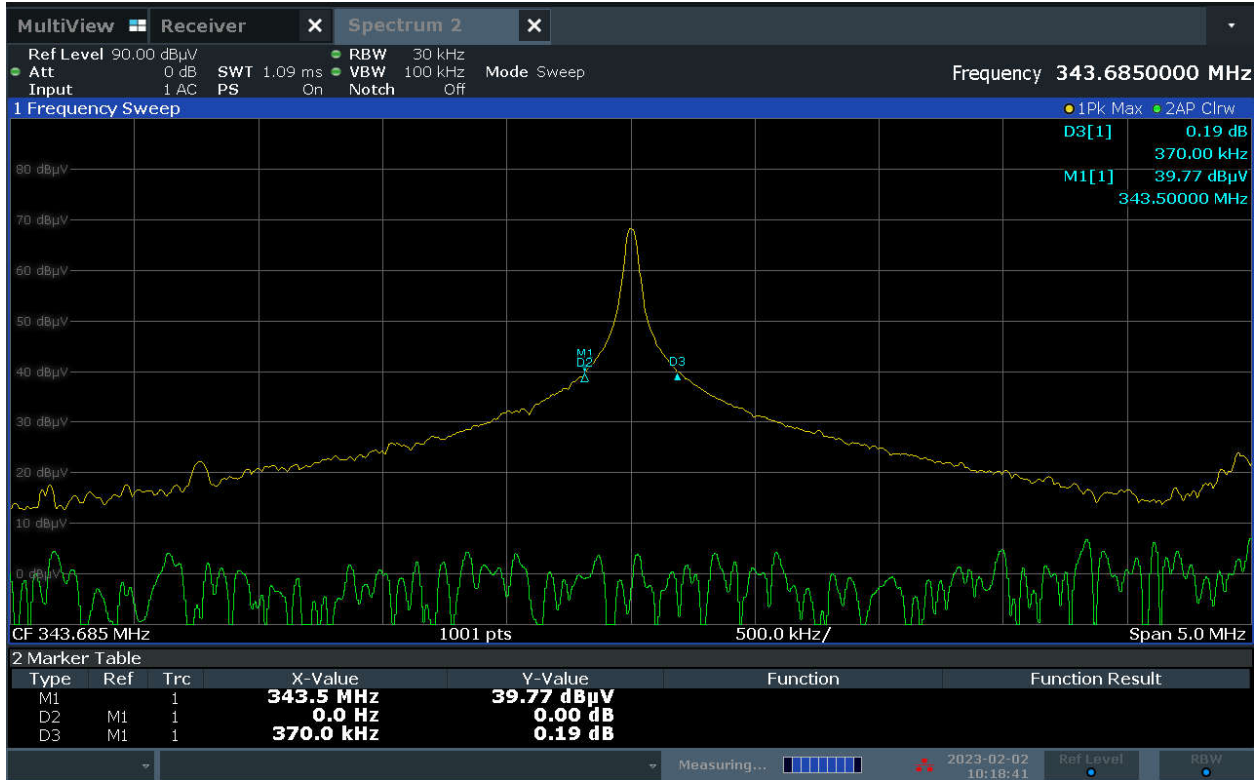
Test Setup Details	
Setup Format	Tabletop
Measurement Method	Radiated
Type of Test Site	Tabletop
Test Site Used	N/A
Type of Antenna Used	Loop (or equivalent)
Notes	

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

Requirement
Per RSS-210, Annex A, Section A.1.3, the occupied bandwidth (99% Bandwidth) of momentarily operated devices shall be less than or equal to 0.25% of the center frequency for devices operating between 70MHz and 900MHz. For devices operating above 900MHz, the occupied bandwidth shall be less than or equal to 0.5% of the center frequency.

Procedure
The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 1% to 5% of the actual occupied / x dB bandwidth, the video bandwidth (VBW) was set 3 times greater than the RBW, and the span was set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency.
The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Result	99% OBW = 370kHz
Notes	Max Allowed BW = (0.25% × Center Frequency) = 859.3125kHz



## 23. Spurious Radiated Emissions

EUT Information	
Manufacturer	The Chamberlain Group LLC
Product	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx

Test Setup Details	
Setup Format	Tabletop
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R29F
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-Ridged Waveguide (or equivalent)
Notes	N/A

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 EUT must comply with the requirements of §15.231(e) and FCC §15.205. The EUT must also comply with the requirements of RSS-210 Annex A.1 and RSS-Gen Section 8.10.

FCC §15.231(e) Field Strength Emissions		
Carrier Frequency (MHz)	Field Strength of Carrier ( $\mu\text{V}/\text{m}$ )	Field Strength of Spurious Emissions ( $\text{dB}\mu\text{V}/\text{m}$ )
40.66 – 40.70	1000	100
70 – 130	500	50
130 – 174	500 to 1500 <sup>1</sup>	50 to 150 <sup>1</sup>
174 – 260	1500	150
260 – 470	1500 to 5000 <sup>1</sup>	150 to 500 <sup>1</sup>
Above 470	5000	500

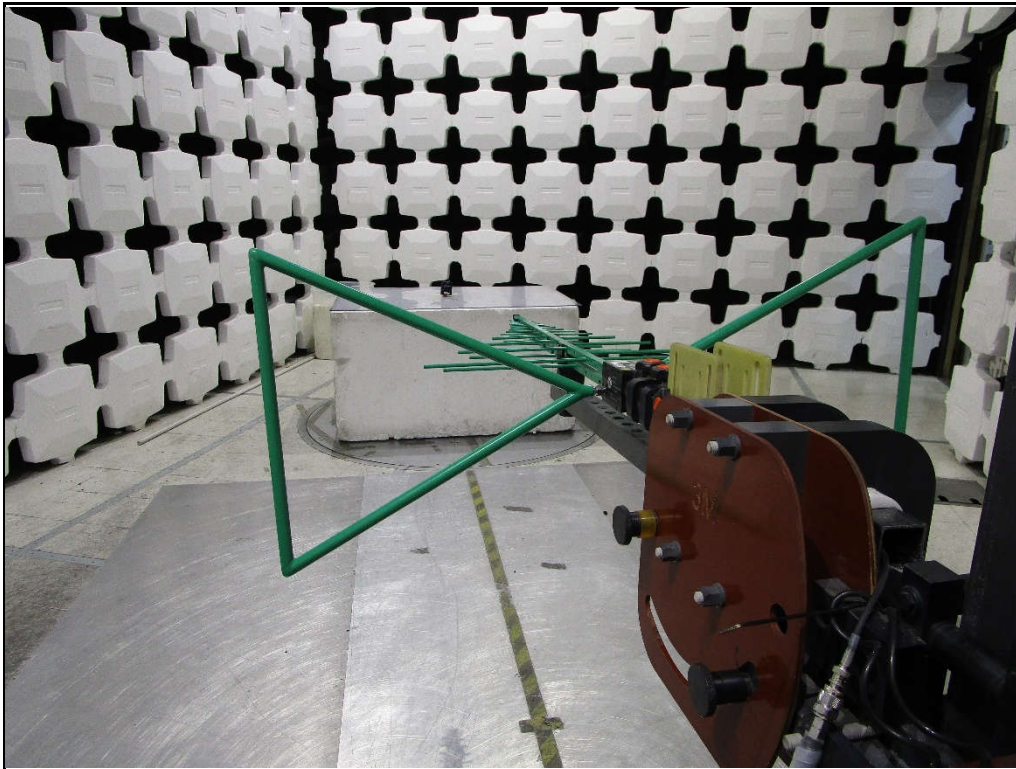
<sup>1</sup> Linear interpolation

RSS-210 Table A1 – Permissible Field Strength Limits for Momentarily Operated Devices	
Fundamental Frequency, excluding restricted frequency bands specified in RSS-Gen (MHz)	Field Strength of the Spurious Emissions ( $\mu\text{V}/\text{m}$ at 3m)
70 – 130	1250
130 – 174	1250 to 3750 <sup>1</sup>
174 – 260 <sup>2</sup>	3750
260 – 470 <sup>2</sup>	3750 to 12500 <sup>1</sup>
Above 470	12500

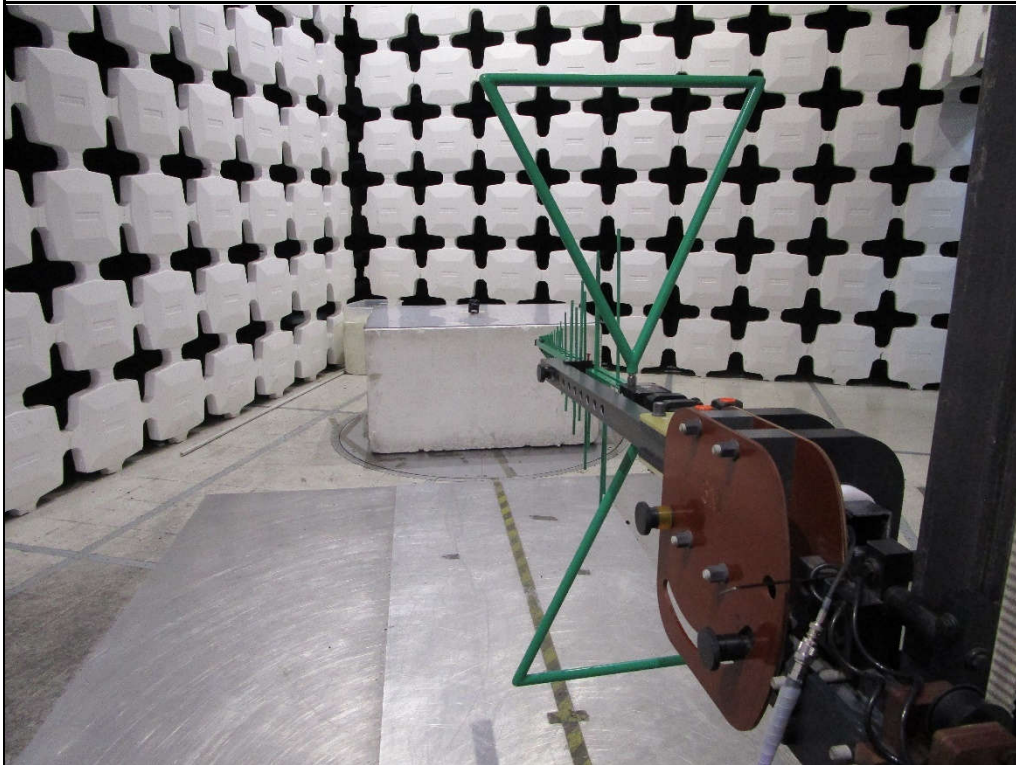
<sup>1</sup> Linear interpolation with frequency (f) in MHz:  
 ○ For 130 – 174MHz: Field Strength ( $\mu\text{V}/\text{m}$ ) =  $(56.82 \times f) - 6136$   
 ○ For 260 – 470MHz: Field Strength ( $\mu\text{V}/\text{m}$ ) =  $(41.67 \times f) - 7083$

<sup>2</sup> Frequency bands 225 – 328.6MHz and 335.4 – 399.9MHz are designated for the exclusive use of the Government of Canada. Manufacturers should be aware of possible harmful interference and degradation of their license-exempt radio equipment in these frequency bands.

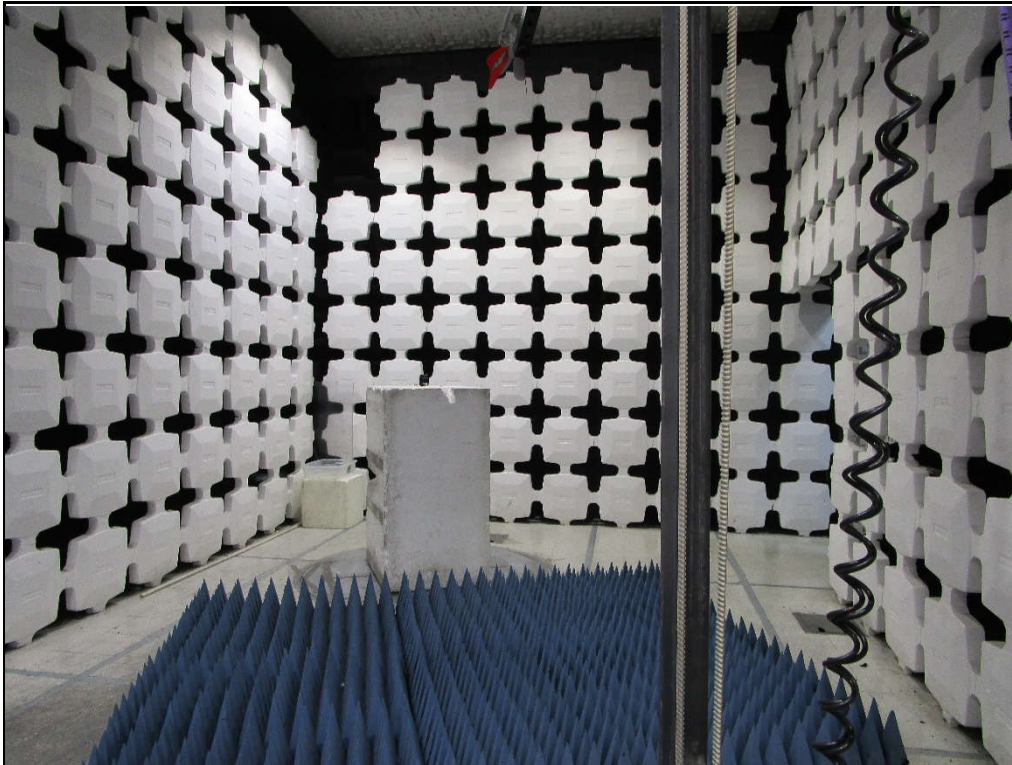
Procedure
<p>Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.</p> <p>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 4GHz was investigated using a peak detector function. The final emission tests were then manually performed over the frequency range of 30MHz to 4GHz.</p> <p>Between 30MHz and 1GHz, a bi-log antenna was used as the pick-up device. The EUT was placed on an 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.</p> <p>Above 1GHz, a broadband double ridged waveguide antenna was used as the pick-up device. The EUT was placed on an 150cm high non-conductive stand. A peak detector with a resolution bandwidth of 1MHz was used on the spectrum analyzer.</p> <p>The peak detected levels were then converted to average levels using a duty cycle factor which was computed from the pulse train.</p> <p>To ensure that maximum or worst case, emission levels were measured, the following steps were taken:</p> <ol style="list-style-type: none"> <li>i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.</li> <li>ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.</li> <li>iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.</li> <li>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.</li> </ol>



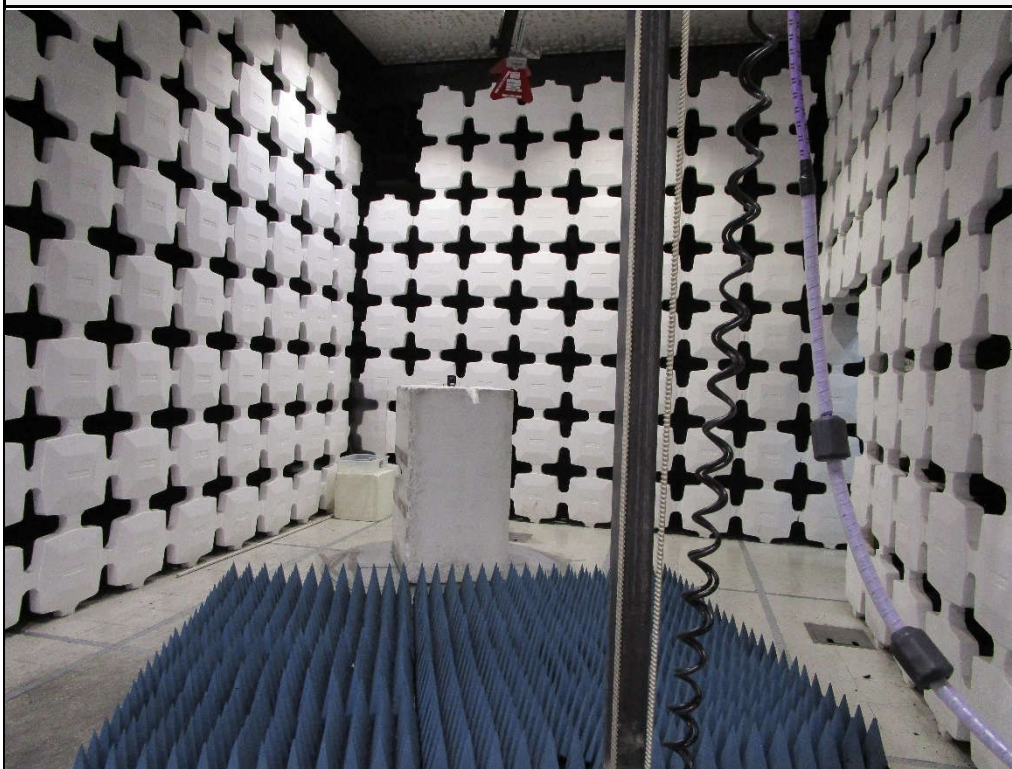
Test Setup for Spurious Radiated Emissions, 30MHz – 1GHz – Antenna Polarization Horizontal



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



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



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

Test Details	
Manufacturer	The Chamberlain Group LLC
EUT	Homelink Repeater MC
Model No.	Homelink Rptr MC
Serial No.	SMP-86978
Mode	Tx
Frequency Tested	342MHz
Notes	Field Strength of the Fundamental Limit = 2795.00µV/m Duty Cycle = -13.35dB

Freq. (MHz)	Ant Pol	Meter Reading (dBµV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBµV/m)	Total (µV/m)	Limit (µV/m)	Margin (dB)
342.000	H	59.40		1.86	19.92	0.00	-13.35	67.83	2462.53	2866.67	-1.32
342.000	V	60.50		1.86	19.92	0.00	-13.35	68.93	2795.00	2866.67	-0.22
684.000	H	16.48		2.62	24.99	0.00	-13.35	30.74	34.44	286.67	-18.41
684.000	V	18.56		2.62	24.99	0.00	-13.35	32.82	43.76	286.67	-16.33
1026.000	H	11.16	Ambient	2.95	27.22	0.00	-13.35	27.99	25.09	500.00	-25.99
1026.000	V	10.91	Ambient	2.95	27.22	0.00	-13.35	27.74	24.38	500.00	-26.24
1368.000	H	11.68	Ambient	3.11	28.67	0.00	-13.35	30.11	32.04	500.00	-23.87
1368.000	V	12.16	Ambient	3.11	28.67	0.00	-13.35	30.59	33.86	500.00	-23.39
1710.000	H	12.46	Ambient	3.22	29.72	0.00	-13.35	32.05	40.03	500.00	-21.93
1710.000	V	22.50		3.22	29.72	0.00	-13.35	42.09	127.17	500.00	-11.89
2052.000	H	12.04	Ambient	3.31	31.63	0.00	-13.35	33.63	48.03	500.00	-20.35
2052.000	V	12.84	Ambient	3.31	31.63	0.00	-13.35	34.43	52.66	500.00	-19.55
2394.000	H	12.31	Ambient	3.38	32.56	0.00	-13.35	34.91	55.62	500.00	-19.07
2394.000	V	12.47	Ambient	3.38	32.56	0.00	-13.35	35.07	56.66	500.00	-18.91
2736.000	H	12.76	Ambient	3.72	32.59	0.00	-13.35	35.73	61.15	500.00	-18.25
2736.000	V	12.96	Ambient	3.72	32.59	0.00	-13.35	35.93	62.58	500.00	-18.05
3078.000	H	13.90	Ambient	4.25	33.05	0.00	-13.35	37.85	78.06	500.00	-16.13
3078.000	V	12.91	Ambient	4.25	33.05	0.00	-13.35	36.86	69.65	500.00	-17.12
3420.000	H	14.55	Ambient	4.72	33.16	0.00	-13.35	39.08	89.90	500.00	-14.90
3420.000	V	13.94	Ambient	4.72	33.16	0.00	-13.35	38.47	83.80	500.00	-15.51

## 24. 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) <sup>1</sup>:*****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);

(A2LA Cert. No. 1786.01) Revised 08/08/2022

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<u>Test Technology:</u>	<u>Test Method(s) <sup>1</sup>:</u>
<i>Vehicle Radiated Emissions</i>	CISPR 12; CISPR 36; ICES-002; ECE Regulation 10.06 Annex 5
<i>Bulk Current Injection (BCI)</i>	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
<i>Radiated Immunity Anechoic (Including Radar Pulse)</i>	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
<i>Radiated Immunity Magnetic Field</i>	ISO 11452-8
<i>Radiated Immunity Reverb</i>	ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMC1278 (RI114); ISO 11452-11
<i>Radiated Immunity (Portable Transmitters)</i>	ISO 11452-9; EMC-CS-2009.1 (RI115); FMC1278 (RI115)
<i>Vehicle Radiated Immunity (ALSE)</i>	ISO 11451-2; ECE Regulation 10.06 Annex 6
<i>Vehicle Product Specific EMC Standards</i>	EN 14982; EN ISO 13309; ISO 13766; EN 50498; EC Regulation No. 2015/208; EN 55012
<i>Electrical Loads</i>	ISO 16750-2
<b>Emissions</b> 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; CISPR 16-2-1 (2008); CISPR 16-2-1; 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 7 (Broadband) ECE Regulation 10.06 Annex 8 (Narrowband) ECE Regulation 10.06 Annex 14 (Conducted)

**Test Technology:****Test Method(s) <sup>1</sup>:****Emissions (cont'd)**

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

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

**Test Technology:****Test Method(s) <sup>1</sup>:****Immunity (cont'd)**

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

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

**Test Technology:****Test Method(s) <sup>1</sup>:*****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

***Canadian Radio Tests***

RSS-102 (RF Exposure Evaluation<sup>MEAS</sup>);  
RSS-102 (Nerve Stimulation<sup>MEAS</sup>) (5Hz to 400kHz);  
SPR-002; 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

**Test Technology:**

**Test Method(s) <sup>1</sup>:**

***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)

***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,  
SIB8/SIB16  
Large Device/Laptop/Tablet Testing  
Integrated Device Testing  
WiFi 802.11 a/b/g/n/a

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

<sup>1</sup> 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.1<sup>2</sup>

<b>Rule Subpart/Technology</b>	<b>Test Method</b>	<b>Maximum Frequency (MHz)</b>
<u>Unintentional Radiators</u> Part 15B	ANSI C63.4:2014	40000
<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.1<sup>2</sup>

<b>Rule Subpart/Technology</b>	<b>Test Method</b>	<b>Maximum Frequency (MHz)</b>
<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

<sup>2</sup> 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 19<sup>th</sup> 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.