



Engineering Test Report No. 2200527-04

Report Date	May 13, 2022		
Manufacturer Name	Chamberlain Group, Inc.		
Manufacturer Address	300 Windsor Dr Oak Brook, IL 60523		
Test Item Name Model No.	Falcon GDO Logic Board GDO 003-0454-8 Rev B		
Date Received	May 2, 2022		
Test Dates	May 2 – 13, 2022		
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 Innovation, Science, and Economic Development Canada, RSS-GEN 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	
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Signature			
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894		
PO Number	4900081875		

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1. Report Revision History

Revision	Date	Description
–	03 JUN 2022	Initial Release of Engineering Test Report No. 2200527-04

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, Inc. Falcon GDO 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-Gen and 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	
Test Item #1	
Product Description	Falcon GDO Logic Board
Model/Part No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Size of EUT	10.5 in x 10 in x 7.5 in
Software/Firmware Version	Realtek WiFi/BLE: 126A0582 Rev A.1 Sec+3.0 BLELR: Preliminary test image Rev 1 GDO Firmware: 126A0543 Rev 2.9
Device Type	Digitally Modulated Transmission Device
Band of Operation	2400 – 2483.5MHz
Modulation Type	FSK
Antenna Type	20AWG wire antenna
Antenna Gain (dBi) ¹	4.9
Conducted Output Power	7.3dBm (6.8mW)
EIRP	9.9dBm (9.8mW)
6dB Bandwidth	831.7kHz
Occupied Bandwidth (99% CBW)	1.13MHz
Emission Classification	1M13F1D
Product FCC ID & ISED UPN Number	FCC ID: HBW0454X3 ISED UPN: 266A-0454X3

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	---

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

7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

8. Modes of Operation

The EUT and all peripheral equipment were energized. The unit was programmed to transmit in one of the following modes:

8.1. TX

Protocol	Description
BLE	- 2402MHz, Power Setting = 9dBm - 2440MHz, Power Setting = 9dBm - 2480MHz, Power Setting = 9dBm

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	23°C
Relative Humidity	25%
Atmospheric Pressure	1007.5mb

13. Summary

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

Test Description	Requirements	Test Method	S/N	Results
Transmitter Conducted Emissions (AC Mains)	FCC 15.207 ISED RSS-GEN	ANSI C63.10:2013	Sample 2 Sample 3	Conforms (1)
6dB Bandwidth	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Occupied Bandwidth (99%)	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Maximum Peak Conducted Output Power	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Effective Isotropic Radiated Power (EIRP)	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Duty Cycle Factor Measurements	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	—
Case Spurious Radiated Emissions	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Band-Edge Compliance	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms
Power Spectral Density	FCC 15.247 ISED RSS-247	ANSI C63.10:2013	Sample 1	Conforms

Note: (1) See Elite Electronic Engineering test report ETR2200527-07 for data and results.

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.

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

To convert the Field Strength dB 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.

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

15. Statement of Conformity

The Chamberlain Group, Inc. Falcon GDO Logic Board (Model No. GDO 003-0454-8 Rev B) 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

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 15.247 and Innovation, Science, and Economic Development Canada, RSS-247 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

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

Picture removed for short term confidentiality purposes.

EUT tested in a host GDO

Picture removed for short term confidentiality purposes.

18. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	9/21/2021	9/21/2022
APW14	PREAMPLIFIER	PLANAR	PE2-35-120-5R0-10-12-SFF	PL22671	1-20GHZ	9/21/2021	9/21/2022
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
GCM0	SFC COMPACT MODULATOR	ROHDE & SCHWARZ	2115.3510K02	100552	---	3/23/2022	3/23/2024
GRE2	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	3/4/2022	3/4/2023
GSF0	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	260452	9kHz to 6GHz	8/24/2021	8/24/2022
GSFB	OSP120 BASE UNIT	ROHDE & SCHWARZ	OSP120	101246	---	5/11/2021	5/11/2023
GSFE	OSP120	ROHDE & SCHWARZ	OSP120	101288	.01-40GHZ	6/11/2021	6/11/2023
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHZ	10/20/2020	10/20/2022
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/13/2020	5/13/2022
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/31/2022	3/31/2023
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	4/7/2022	4/7/2023
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
T1ED	10DB 25W ATTENUATOR	WEINSCHL	46-10-34	BN2320	DC-18GHZ	1/6/2022	1/6/2024
T2D1	20DB, 25W ATTENUATOR	WEINSCHL	46-20-43	AV5814	DC-18GHZ	1/18/2022	1/18/2024
VBV2	CISPR EN FCC ICES RE.EXE	ELITE	CISPR EN FCC ICES RE.EXE	---	---	N/A	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ4	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000-O/O	1	4.8-20GHZ	9/7/2021	9/7/2023

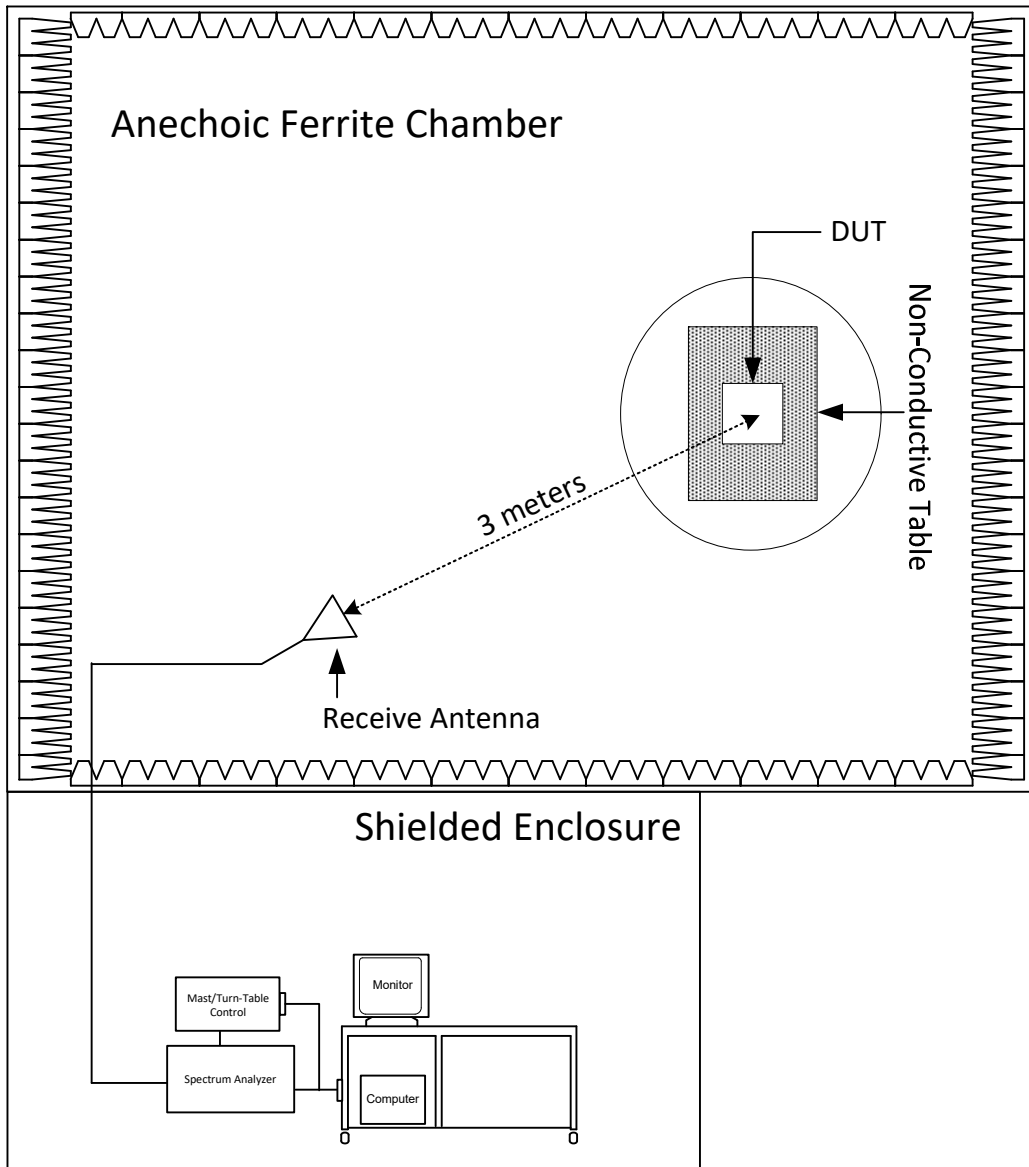
N/A: Not Applicable

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. 6dB Bandwidth

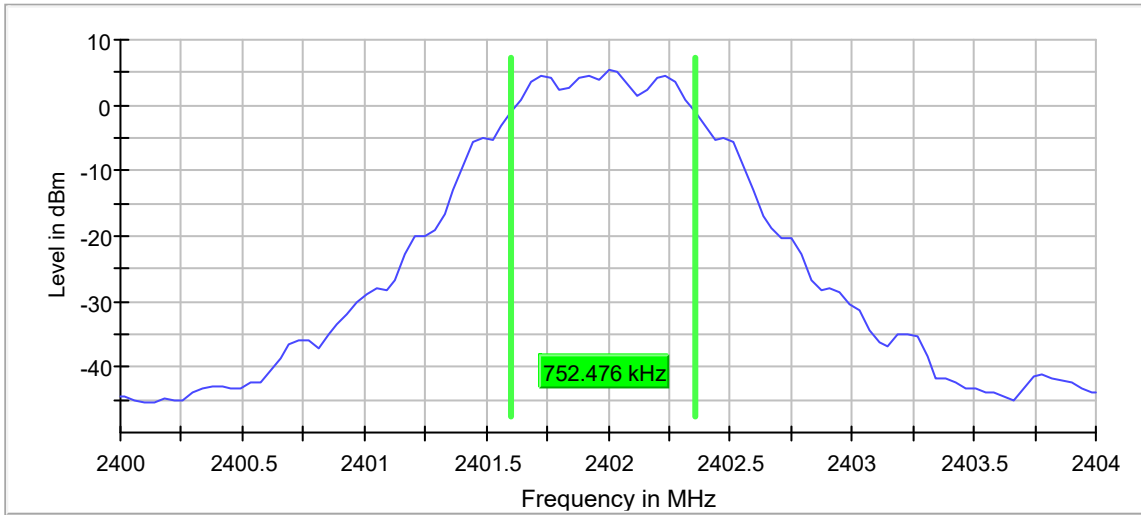
EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Type of Test Site	Tabletop
Test Site Used	N/A
Type of Antennas Used	N/A
Notes	None

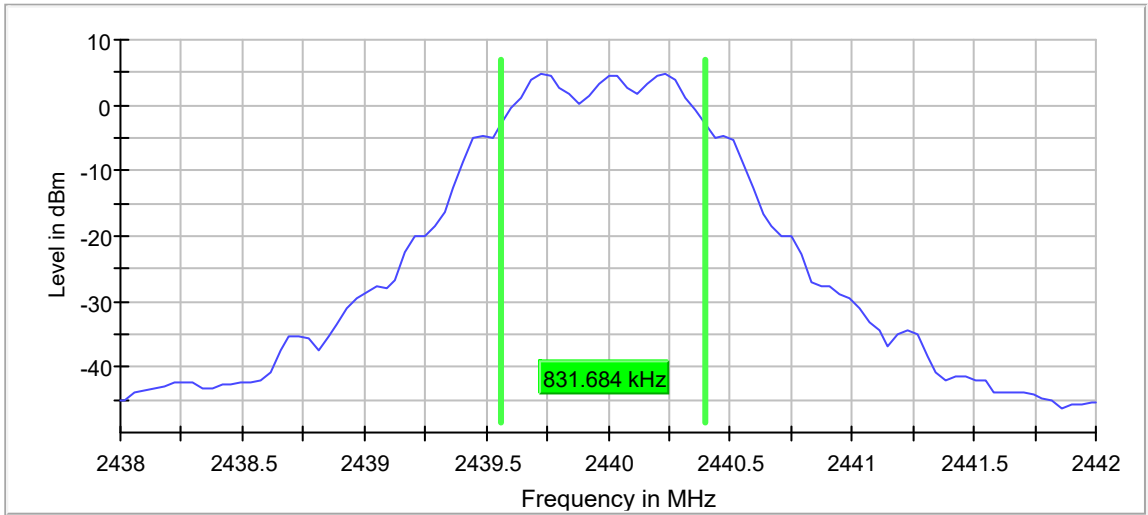
Requirements
Systems using digital modulation techniques shall have a minimum 6dB bandwidth of 500kHz

Procedure
<p>The antenna port of the EUT was connected to the spectrum analyzer through A R&S OSP 120. The EUT was allowed to transmit continuously.</p> <p>The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 100kHz, the video bandwidth (VBW) was set to the same as or 3 times greater than the RBW, and the span was set to 3 times the RBW.</p> <p>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 then screenshot and saved.</p>

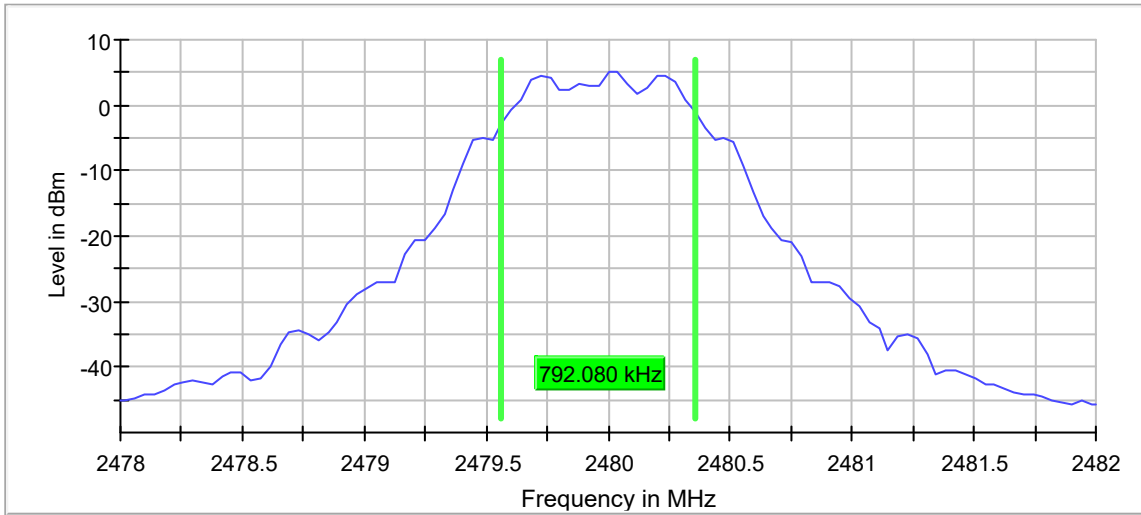
Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Result	6dB BW = 752.476kHz
Notes	None



Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
Result	6dB BW = 831.684kHz
Notes	None



Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Result	6dB BW = 792.08kHz
Notes	None



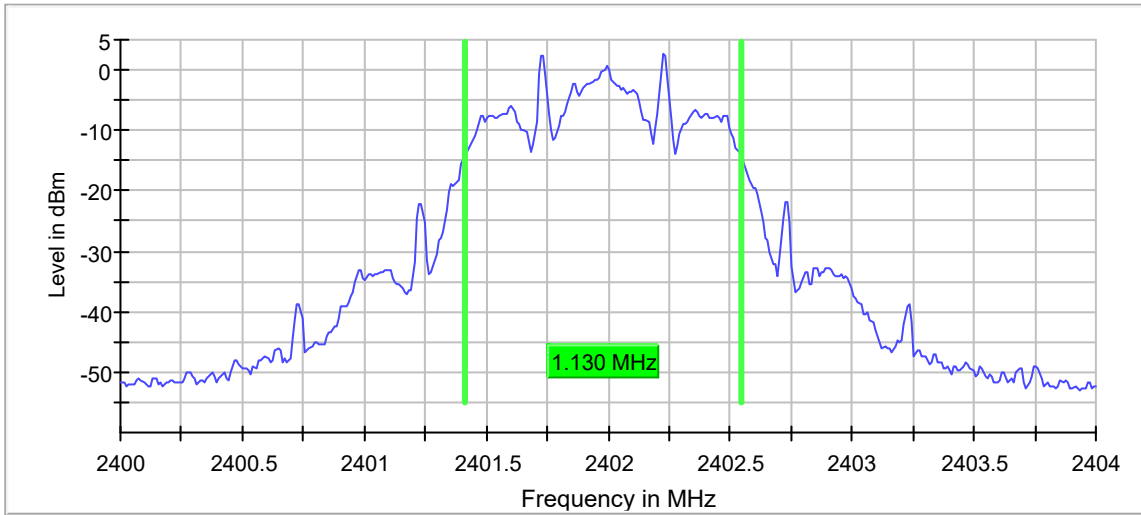
21. Occupied Bandwidth (99%)

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

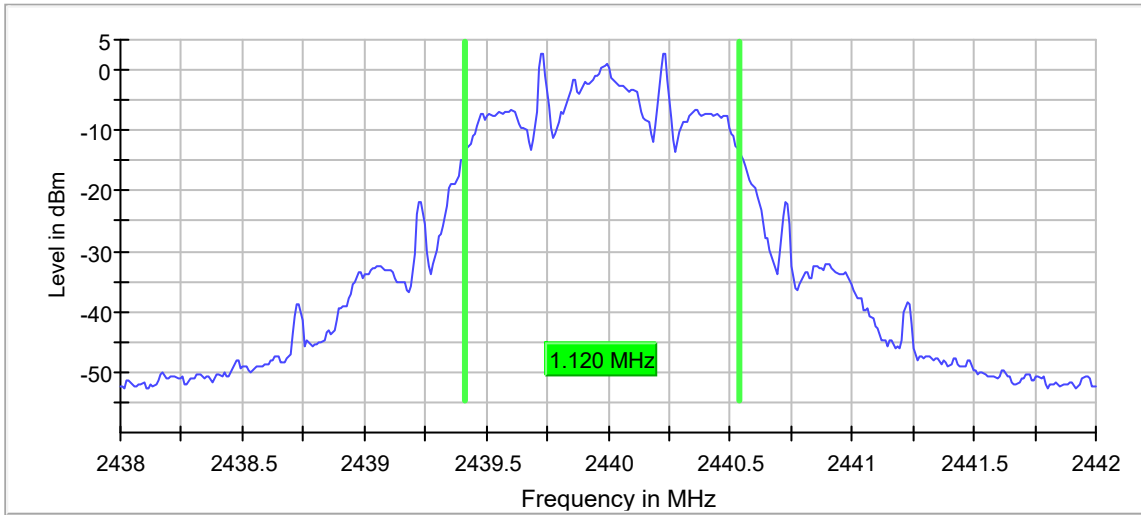
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Type of Test Site	Tabletop
Test Site Used	N/A
Type of Antennas Used	N/A
Notes	None

Procedure	
<p>The antenna port of the EUT was connected to the spectrum analyzer through A R&S OSP 120. The EUT was allowed to transmit continuously.</p> <p>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.</p> <p>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.</p>	

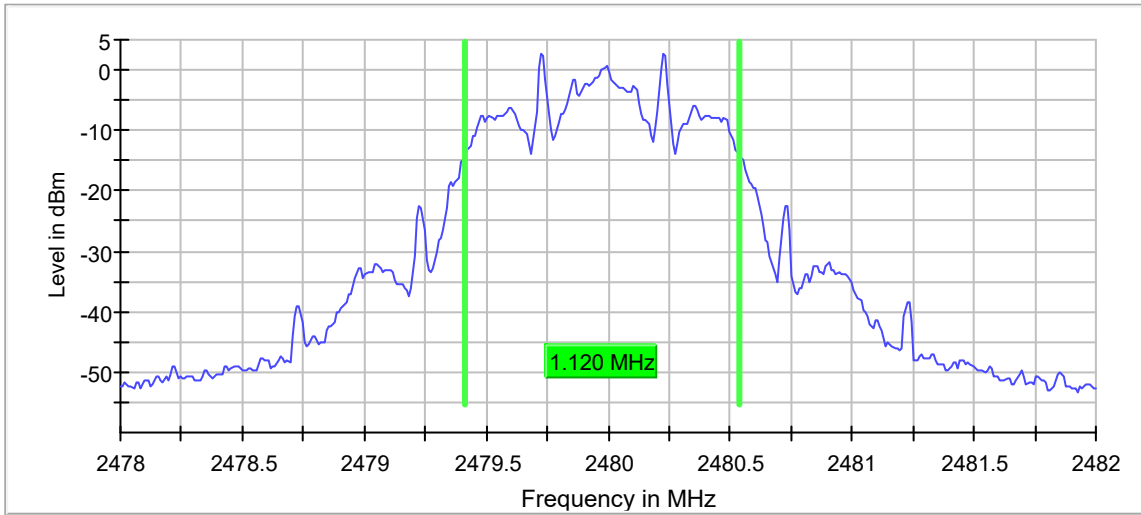
Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Result	OBW = 1.13MHz
Notes	None



Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
Result	OBW = 1.12MHz
Notes	None



Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Result	OBW = 1.12MHz
Notes	None



22. Maximum Peak Conducted Output Power

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

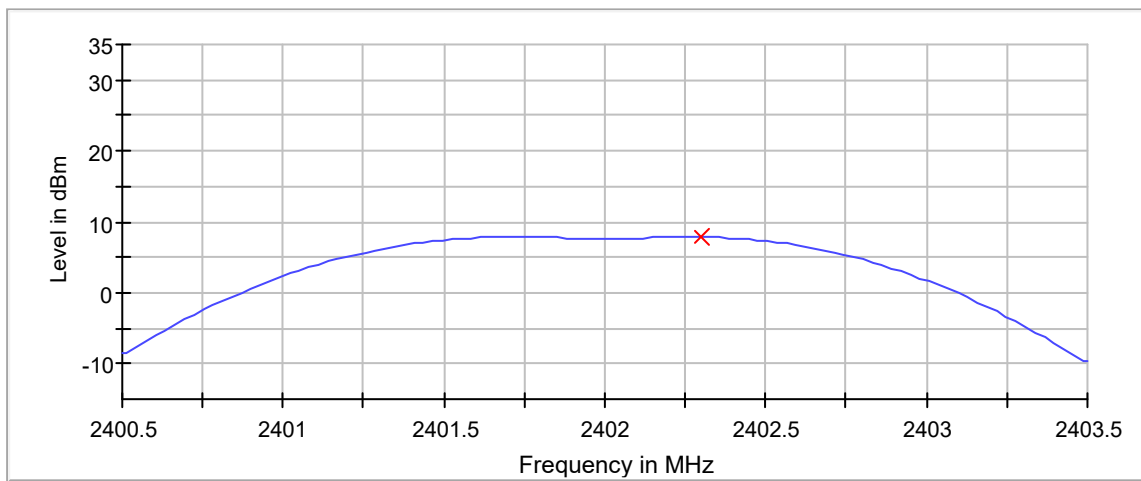
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Type of Test Site	Tabletop
Test Site Used	N/A
Notes	None

Requirements
The output power shall not exceed 1W (30dBm).

Procedure
The antenna port of the EUT was connected to the spectrum analyzer through an R&S OSP 120. The EUT was set to transmit separately at the low, middle, and high channels. The resolution bandwidth (RBW) was set to greater than the 6dB bandwidth. The span was set to greater than 3 times the RBW. The 'Max-Hold' function was engaged. The maximum meter reading was recorded. The peak power output was calculated for the low, middle, and high channels.

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Result	Output Power = 6.02mW (7.8dBm)
Notes	None

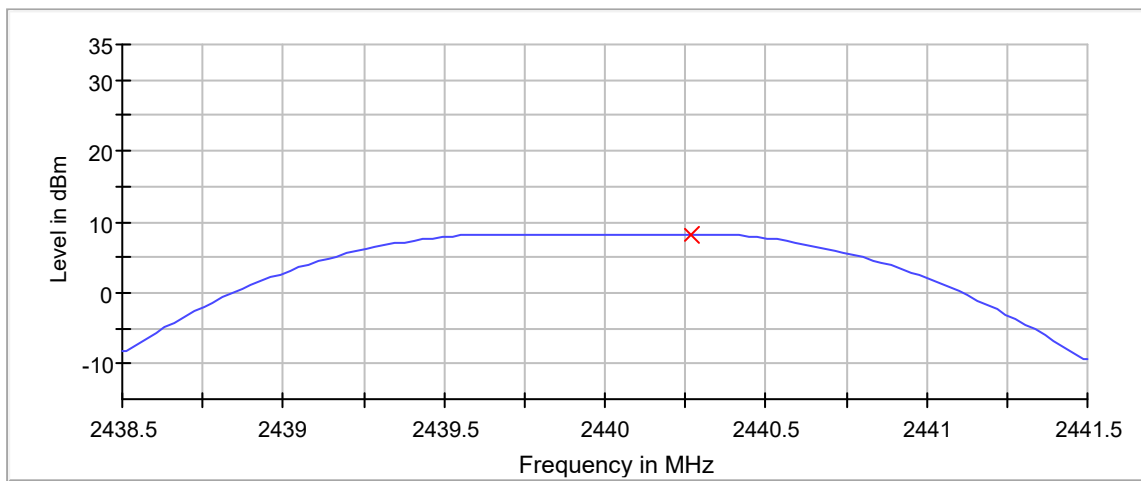
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	7.8	30.0	PASS



— Connector 1 × Peak Connector 1

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
Result	Output Power = 6.76mW (8.3dBm)
Notes	None

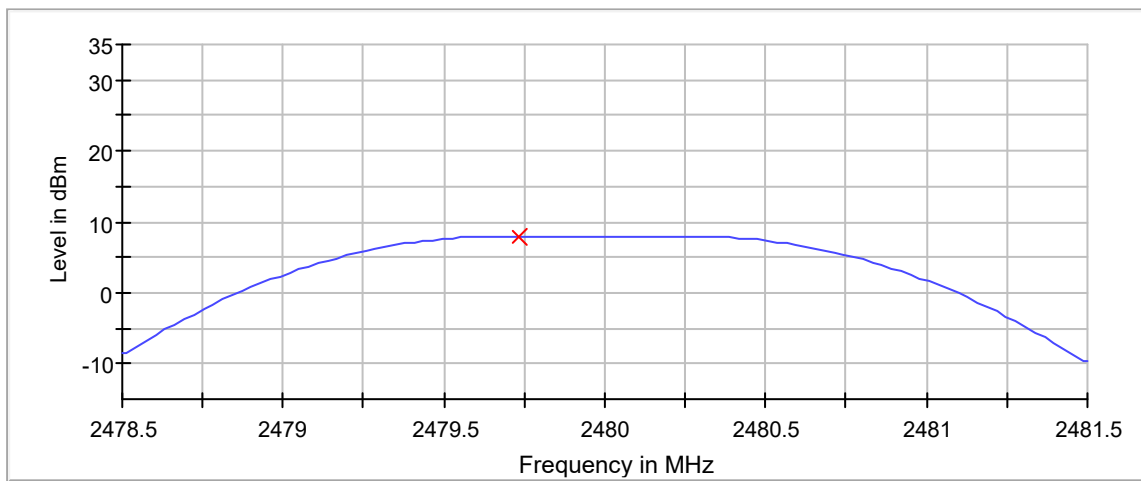
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2440.000000	8.3	30.0	PASS



— Connector 1 × Peak Connector 1

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Result	Output Power = 6.30mW (8dBm)
Notes	None

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	8.0	30.0	PASS



— Connector 1 × Peak Connector 1

23. Effective Isotropic Radiated Power (EIRP)

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
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	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
<p>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.</p> <p>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.</p>

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Result	Max EIRP = 9.8mW (9.9dBm)
Notes	None

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	66.1	6.3	5.2	3.4	8.0	36.0	-28.0
	V	67.5	6.2	5.2	3.4	7.9	36.0	-28.1
2440.00	H	68.5	7.0	5.1	3.5	8.6	36.0	-27.4
	V	69.7	8.3	5.1	3.5	9.9	36.0	-26.1
2480.00	H	67.6	7.0	5.0	3.5	8.5	36.0	-27.5
	V	68.2	7.0	5.0	3.5	8.5	36.0	-27.5

24. Duty Cycle Factor Measurements

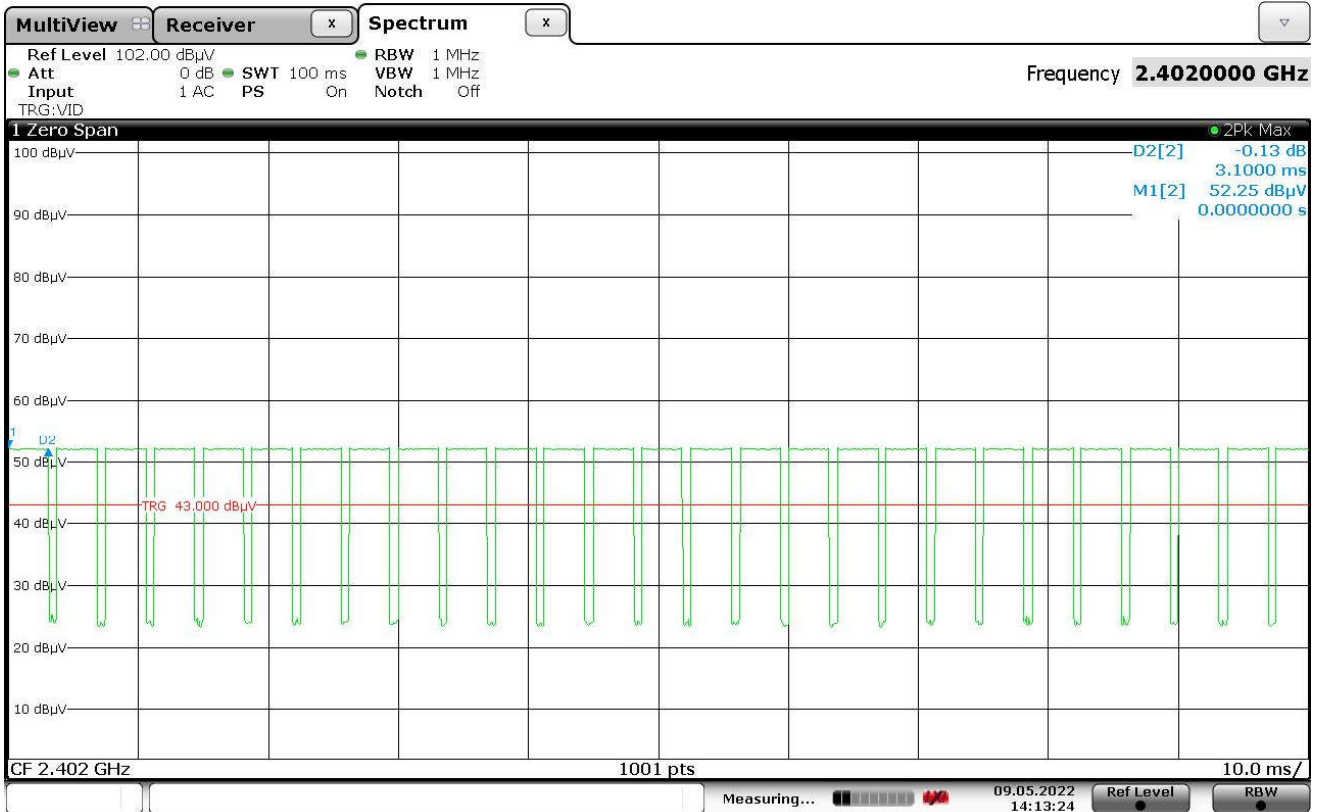
EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated
Type of Test Site	R29F
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

Procedure
<p>The duty cycle factor is used to convert peak detected readings to average readings when pulsed modulation is employed. This factor is computed from the time domain trace of the pulse modulation signal.</p> <p>With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero-span width with 10msec/div. The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of the “on-time”. The trace is recorded.</p> <p>Next the spectrum analyzer center frequency is set to the transmitter frequency with a zero-span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less than 100msec, the display is set to show at least one word. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period.</p> <p>The duty cycle is then computed as $\left(\frac{1}{Duty\ Cycle}\right)$, where $Duty\ Cycle = (On\ Time\ ms/100ms)$.</p>

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Result	Duty Cycle = 1.55dB
Notes	Duty Cycle Factor Calculation: $\text{Duty Cycle Factor} = 20 \log \left(\frac{100\text{ms}}{83.7\text{ms}} \right) = 1.55\text{dB}$



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25. Case Spurious Radiated Emissions

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	R29F
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 25GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 25GHz.

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).

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.

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

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

Picture removed for short term confidentiality purposes.

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

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
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	60.0		3.7	36.6	-39.7	60.6	1073.2	5000.0	-13.4
	V	61.4		3.7	36.6	-39.7	62.0	1259.4	5000.0	-12.0
12010.00	H	52.9		6.1	41.5	-39.0	61.4	1176.8	5000.0	-12.6
	V	55.2		6.1	41.5	-39.0	63.7	1537.0	5000.0	-10.2
19216.00	H	32.0	*	2.2	40.4	-28.2	46.4	208.1	5000.0	-27.6
	V	32.5	*	2.2	40.4	-28.2	46.8	219.1	5000.0	-27.2

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Notes	Average Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dB μ V)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle Factor (dB)	Average Total at 3m (dB μ V/m)	Average Total at 3m (μ V/m)	Average Limit at 3m (μ V/m)	Margin (dB)
4804.00	H	51.20		3.7	36.6	-39.7	1.6	53.4	465.8	500.0	-0.6
	V	51.65		3.7	36.6	-39.7	1.6	53.8	490.5	500.0	-0.2
12010.00	H	38.94		6.1	41.5	-39.0	1.6	49.0	282.6	500.0	-5.0
	V	40.35		6.1	41.5	-39.0	1.6	50.4	332.4	500.0	-3.5
19216.00	H	15.58	*	2.2	40.4	-28.2	1.6	31.5	37.6	500.0	-22.5
	V	15.66	*	2.2	40.4	-28.2	1.6	31.6	37.9	500.0	-22.4

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Notes	Peak Measurements in Non-Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dB μ V)	Ambient	Cable Factor (dB)	Antenna Factor (dB/m)	Pre Amp (dB)	Peak Total at 3m (dB μ V/m)	Peak Total at 3m (μ V/m)	Peak Limit at 3m (μ V/m)	Margin (dBm)
2402.00	H	62.02		2.6	32.8	0.0	97.4	74342.3	NA	NA
	V	64.53		2.6	32.8	0.0	99.9	99251.3	NA	NA
7206.00	H	53.09		4.6	37.7	-39.7	55.8	615.9	9925.1	-24.1
	V	51.35		4.6	37.7	-39.7	54.1	504.1	9925.1	-25.9
9608.00	H	37.05	*	5.2	39.3	-39.3	42.3	129.6	9925.1	-37.7
	V	37.21	*	5.2	39.3	-39.3	42.4	132.0	9925.1	-37.5
14412.00	H	37.21	*	6.6	41.9	-38.6	47.2	228.6	9925.1	-32.8
	V	37.57	*	6.6	41.9	-38.6	47.5	238.2	9925.1	-32.4
16814.00	H	43.56		7.2	44.8	-37.4	58.1	807.9	9925.1	-21.8
	V	47.22		7.2	44.8	-37.4	61.8	1231.4	9925.1	-18.1
21618.00	H	24.09		2.2	40.6	-28.5	38.4	83.2	9925.1	-41.5
	V	29.99		2.2	40.6	-28.5	44.3	164.1	9925.1	-35.6
24020.00	H	22.72	*	2.2	40.6	-29.3	36.3	65.4	9925.1	-43.6
	V	21.21	*	2.2	40.6	-29.3	34.8	55.0	9925.1	-45.1

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
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)
4880.00	H	56.1		3.7	36.4	-39.6	56.6	678.2	5000.0	-17.4
	V	59.7		3.7	36.4	-39.6	60.2	1018.3	5000.0	-13.8
7320.00	H	56.8		4.7	37.8	-39.6	59.7	970.2	5000.0	-14.2
	V	55.4		4.7	37.8	-39.6	58.2	817.3	5000.0	-15.7
12200.00	H	53.2		6.1	41.7	-38.9	62.1	1271.6	5000.0	-11.9
	V	53.0		6.1	41.7	-38.9	61.9	1241.3	5000.0	-12.1
19520.00	H	32.4	*	2.2	40.4	-27.8	47.3	230.4	5000.0	-26.7
	V	32.2	*	2.2	40.4	-27.8	47.1	226.0	5000.0	-26.9

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
Notes	Average Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dB μ V)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle Factor (dB)	Average Total at 3m (dB μ V/m)	Average Total at 3m (μ V/m)	Average Limit at 3m (μ V/m)	Margin (dB)
4880.00	H	47.50		3.7	36.4	-39.6	1.6	49.5	300.2	500.0	-4.4
	V	50.72		3.7	36.4	-39.6	1.6	52.8	434.9	500.0	-1.2
7320.00	H	44.53		4.7	37.8	-39.6	1.6	49.0	281.1	500.0	-5.0
	V	42.29		4.7	37.8	-39.6	1.6	46.7	217.2	500.0	-7.2
12200.00	H	38.32		6.1	41.7	-38.9	1.6	48.7	272.8	500.0	-5.3
	V	39.17		6.1	41.7	-38.9	1.6	49.6	300.9	500.0	-4.4
19520.00	H	15.85	*	2.2	40.4	-27.8	1.6	32.3	41.0	500.0	-21.7
	V	15.78	*	2.2	40.4	-27.8	1.6	32.2	40.7	500.0	-21.8

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
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)
2440.00	H	64.61		2.6	33.0	0.0	100.2	102487.6	NA	NA
	V	67.77		2.6	33.0	0.0	103.4	147459.0	NA	NA
9760.00	H	42.46		5.2	39.4	-39.3	47.8	246.1	14745.9	-35.6
	V	39.97		5.2	39.4	-39.3	45.3	184.8	14745.9	-38.0
14640.00	H	36.96	*	6.7	42.4	-38.6	47.5	235.9	14745.9	-35.9
	V	36.16	*	6.7	42.4	-38.6	46.7	215.1	14745.9	-36.7
17080.00	H	39.20		7.3	44.8	-37.4	53.9	494.0	14745.9	-29.5
	V	37.08		7.3	44.8	-37.4	51.8	387.0	14745.9	-31.6
21960.00	H	23.30		2.2	40.6	-28.9	37.2	72.5	14745.9	-46.2
	V	23.61		2.2	40.6	-28.9	37.5	75.1	14745.9	-45.9
24400.00	H	22.04	*	2.2	40.6	-29.3	35.6	60.3	14745.9	-47.8
	V	22.52	*	2.2	40.6	-29.3	36.1	63.7	14745.9	-47.3

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
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	58.4		3.7	36.4	-39.6	58.9	883.0	5000.0	-15.1
	V	60.3		3.7	36.4	-39.6	60.7	1090.1	5000.0	-13.2
7440.00	H	56.7		4.7	37.8	-39.6	59.7	963.8	5000.0	-14.3
	V	50.6		4.7	37.8	-39.6	53.6	480.3	5000.0	-20.3
12400.00	H	52.7		6.1	41.8	-38.8	61.8	1232.5	5000.0	-12.2
	V	55.4		6.1	41.8	-38.8	64.5	1674.2	5000.0	-9.5
19840.00	H	32.4	*	2.2	40.4	-28.0	47.0	224.5	5000.0	-27.0
	V	32.3	*	2.2	40.4	-28.0	46.9	220.2	5000.0	-27.1
22320.00	H	34.5		2.2	40.6	-28.8	48.5	264.7	5000.0	-25.5
	V	33.6		2.2	40.6	-28.8	47.6	239.2	5000.0	-26.4

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Notes	Average Measurements in the Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dB μ V)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle Factor (dB)	Average Total at 3m (dB μ V/m)	Average Total at 3m (μ V/m)	Average Limit at 3m (μ V/m)	Margin (dB)
4960.00	H	48.89		3.7	36.4	-39.6	1.6	50.9	351.5	500.0	-3.1
	V	51.54		3.7	36.4	-39.6	1.6	53.6	476.9	500.0	-0.4
7440.00	H	47.51		4.7	37.8	-39.6	1.6	52.1	401.8	500.0	-1.9
	V	39.11		4.7	37.8	-39.6	1.6	43.7	152.8	500.0	-10.3
12400.00	H	42.01		6.1	41.8	-38.8	1.6	52.7	430.8	500.0	-1.3
	V	41.50		6.1	41.8	-38.8	1.6	52.2	406.3	500.0	-1.8
19840.00	H	16.09	*	2.2	40.4	-28.0	1.6	32.2	40.9	500.0	-21.7
	V	16.07	*	2.2	40.4	-28.0	1.6	32.2	40.8	500.0	-21.8
22320.00	H	19.29		2.2	40.6	-28.8	1.6	34.8	55.0	500.0	-19.2
	V	16.54		2.2	40.6	-28.8	1.6	32.1	40.1	500.0	-21.9

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
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	63.74		2.7	33.2	0.0	99.6	96032.3	NA	NA
	V	66.09		2.7	33.2	0.0	102.0	125868.5	NA	NA
9920.00	H	40.45		5.3	39.6	-39.2	46.1	201.2	12586.9	-35.9
	V	38.91		5.3	39.6	-39.2	44.5	168.5	12586.9	-37.5
14880.00	H	36.85	*	6.8	42.6	-38.5	47.7	243.5	12586.9	-34.3
	V	36.98	*	6.8	42.6	-38.5	47.9	247.2	12586.9	-34.1
17360.00	H	38.14		7.4	44.1	-37.4	52.2	408.1	12586.9	-29.8
	V	37.16		7.4	44.1	-37.4	51.2	364.6	12586.9	-30.8
24800.00	H	22.77	*	2.2	40.6	-29.3	36.3	65.3	12586.9	-45.7
	V	23.51	*	2.2	40.6	-29.3	37.0	71.1	12586.9	-45.0

26. Band-Edge Compliance

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

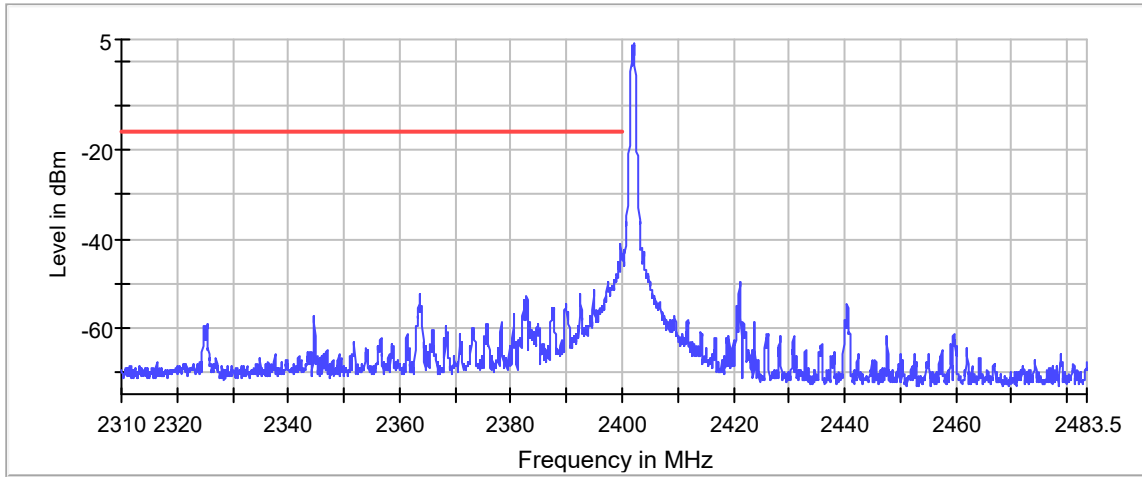
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Radiated Antenna Conducted
Type of Test Site	Semi-Anechoic Chamber Elite Test Bench
Type of Antennas Used	Double-Ridged Waveguide (or equivalent)
Notes	None

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

Procedure
<p>1) Low Band Edge:</p> <ul style="list-style-type: none"> a) The antenna port of the EUT was connected to the spectrum analyzer through an R&S OSP 120. b) The EUT was set to transmit continuously at the channel closest to the low band-edge. c) To determine the band edge compliance, the following spectrum analyzer settings were used: <ul style="list-style-type: none"> o Center Frequency = 2400MHz (low band-edge frequency). o Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation. o Resolution Bandwidth (RBW) = $\geq 1\%$ of the span. o 'Max-Hold' function was engaged. d) The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. e) The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.) f) The analyzer's display was then screenshot and saved. <p>2) High Band Edge:</p> <ul style="list-style-type: none"> a) The EUT was setup inside the test chamber on a non-conductive stand and set to transmit continuously at the channel closest to the high band-edge.

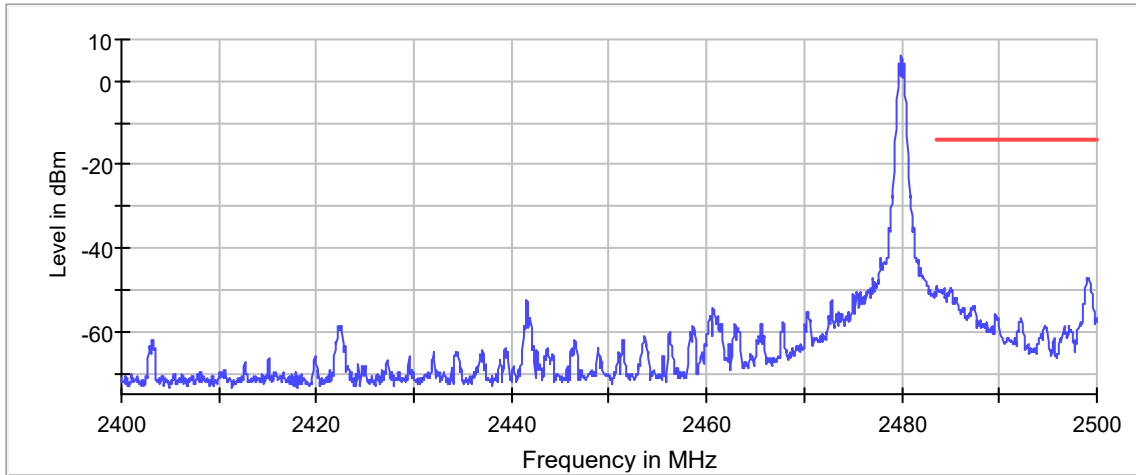
- b) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT. The antenna was connected to the input of a spectrum analyzer.
- c) The center frequency of the analyzer was set to the high band edge (2483.5MHz).
- d) The Resolution Bandwidth was set to 1MHz.
- e) To ensure that the maximum or worst-case emission level was measured, the following steps were taken:
 - o The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - o Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
 - o The EUT was rotated so that all of its sides were exposed to the receiving antenna.
 - o The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
- a) The highest measured peak reading and the highest measured average reading were recorded.

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Notes	Low Band Edge



— Limit — Sum Level × Fail

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Notes	High Band Edge – Peak and Average Measurements



— Limit — Sum Level × Fail

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)
2483.50	H	24.1		2.7	33.3	0.0	60.0	1004.3	5000.0	-13.9
	V	22.3		2.7	33.3	0.0	58.2	811.7	5000.0	-15.8

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)
2483.50	H	8.86		2.7	33.3	0.0	1.6	46.3	207.7	500.0	-7.6
	V	6.46		2.7	33.3	0.0	1.6	43.9	157.5	500.0	-10.0

27. Power Spectral Density

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX

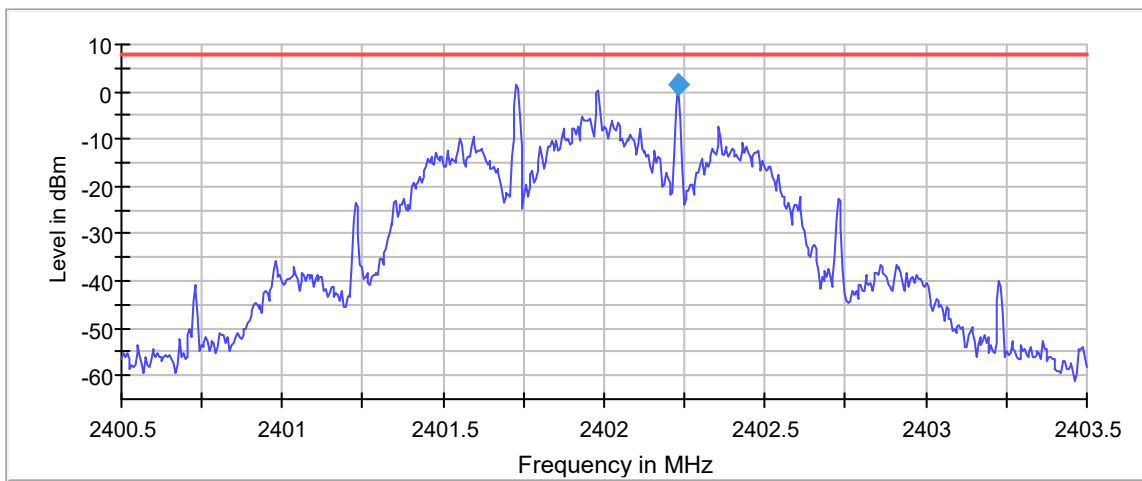
Test Setup Details	
Setup Format	Tabletop
Height of Support	N/A
Measurement Method	Antenna Conducted
Type of Test Site	Elite Test Bench
Test Site Used	N/A
Type of Antennas Used	N/A
Notes	None

Requirement
The power spectral density from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Procedure
<ol style="list-style-type: none"> 1) The antenna port of the EUT was connected to the spectrum analyzer through an R&S OSP 120. 2) The EUT was then placed in the normal operation mode. 3) To determine the power spectral density, the following spectrum analyzer settings were used: <ol style="list-style-type: none"> a) Center Frequency = Transmit Frequency b) Span = 1.5× the DTS (6dB) bandwidth c) Resolution Bandwidth (RBW) = 3kHz ≤ RBW ≤ 100kHz d) Sweep time = Auto e) Detector = Peak f) Trace Function = Max-Hold 4) A display line was then placed on the corresponding +8dBm level. <p style="text-align: center;">The analyzers display was then screenshot and saved.</p>

Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2402MHz
Result	PSD = 1.455dBm
Notes	

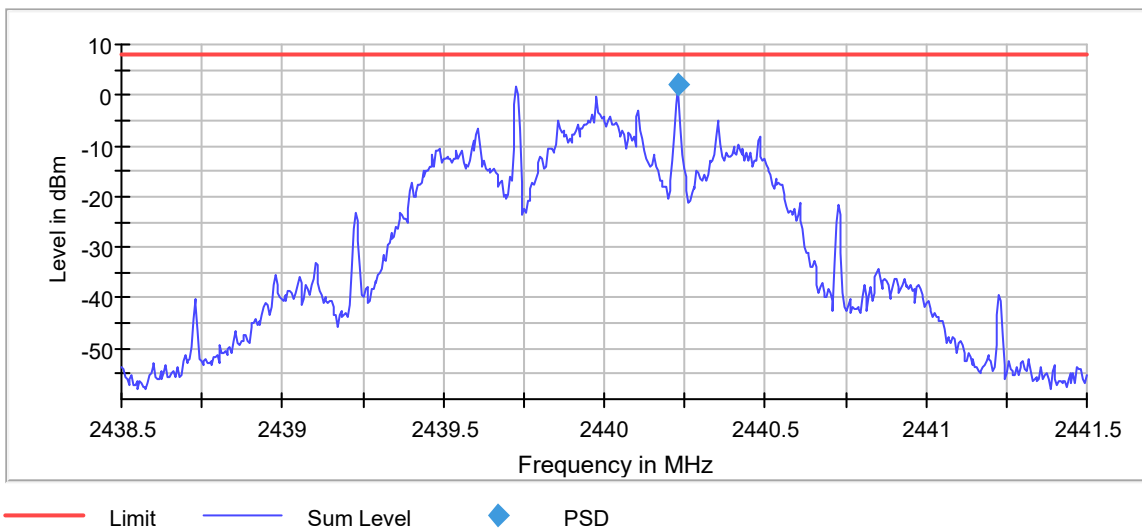
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2402.227500	1.455	8.0	PASS



— Limit — Sum Level ◆ PSD

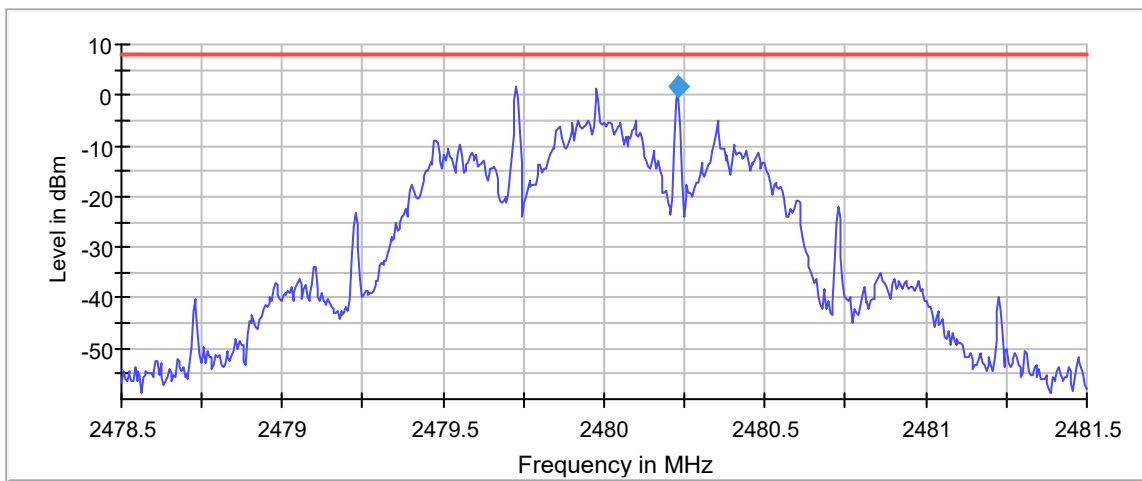
Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2440MHz
Result	PSD = 1.954dBm
Notes	

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2440.227500	1.954	8.0	PASS



Test Details	
Manufacturer	Chamberlain Group, Inc.
EUT	Falcon GDO Logic Board
Model No.	GDO 003-0454-8 Rev B
Serial No.	Sample 1
Mode	TX
Frequency Tested	2480MHz
Result	PSD = 1.735dBm
Notes	

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2480.227500	1.735	8.0	PASS



— Limit — Sum Level ◆ PSD

28. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELITE ELECTRONIC ENGINEERING, INC.
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Downers Grove, IL 60515
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Brandon Lugo (Automotive Team Leader) Phone: 630 495 9770 ext. 163
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Email: reking@elitetest.com
Website: www.elitetest.com

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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<u>Test Technology:</u>	<u>Test Method(s) 1:</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); FMCI278 (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); FMCI278 (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/TEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMCI278 (RI114); ISO 11452-11
<i>Radiated Immunity (Portable Transmitters)</i>	ISO 11452-9; EMC-CS-2009.1 (RI115); FMCI278 (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
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-SCFT-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
 LRS A-GPS, A-GLONASS,
 STB8/STB16
 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

Power Factor / Efficiency / Crest Factor

(Power to 30kW)

FAA AC 150/5345-47C
 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)
<u>Unintentional Radiators</u> Part 15B	ANSI C63.4:2014	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>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.