Engineering Test Report No. 2201780-06		
Report Date	June 7, 2022	
Manufacturer Name	Chamberlain Group, Inc.	
Manufacturer Address	300 Windsor Dr Oak Brook, IL 60523	
Product Name Brand/Model No.	Phoenix AC GDO Logic Board 003-0458-5	
Date Received	April 26, 2022	
Test Dates	April 27, 2022 – May 25, 2022	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart B Innovation, Science, and Economic Development Canada, ICES-003	
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	Nathaniel Bouchie	
Signature		
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	4900083434	

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 B and Innovation, Science, and Economic Development Canada, ICES-003 test specifications. The data presented in this test report pertains to the EUT on the test dates 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. This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Table of Contents

1. Report Revision History

Revision	Date	Description
–	08 JUN 2022	Initial Release of Engineering Test Report No. 2201780-06

2. Introduction

This document presents the results of a series of electromagnetic compatibility (EMC) tests that were performed on two (2) Phoenix AC GDO Logic Board (hereinafter referred to as the Equipment Under Test (EUT)).

The EUTs were identified as follows:

EUT Identification	
EUT #1	
Description	Phoenix AC GDO Logic Board
Model/Part No.	003-0458-5
Serial No.	151220510865
Software/Firmware Version	Realtek Wi-Fi/BLE= 126A0542-Realtek-Application Rev C.6 Sec+3.0 BLELR: Preliminary test image Rev 1 GDO Firmware: Motor Forever Run 126A0542-Silabs-Application Rev C.6
Size of EUT	3 in x 8 in x 1.5 in
Number of Interconnection Wires	4
Type of Interconnection Wires	Double Wire I/O
Highest Internal Frequency of the EUT	2412MHz
EUT #2	
Description	Phoenix AC GDO Logic Board
Model/Part No.	85780
Serial No.	151220510793
Software/Firmware Version	Realtek Wi-Fi/BLE= 126A0542-Realtek-Application Rev C.6 Sec+3.0 BLELR: Preliminary test image Rev 1 GDO Firmware: Motor Forever Run 126A0542-Silabs-Application Rev C.6
Size of EUT	3 in x 8 in x 1.5 in
Number of Interconnection Wires	4
Type of Interconnection Wires	Double Wire I/O
Highest Internal Frequency of the EUT	2412MHz

The EUTs listed above were used throughout the test series. EUT #2 was used for Powerline Conducted Emissions tests, and EUT #1 was used for all others.

3. Power Input

The EUTs were powered by 120VAC 60Hz from a twisted pair, 1-meter, harness.

4. Grounding

The EUTs were connected to ground through the third wire of the input power cord.

5. Support Equipment

The EUTs were submitted for testing along with the following support equipment:

Description	Model #	S/N
Motion Sensor	041-0136	n/a
Light Switch	880LMW	n/a

6. Interconnect Leads

The following interconnect cables were submitted with the test item:

Item	Description
Double Wire I/O	Connects Motion Sensor to EUT
Double Wire I/O	Connects Light Switch to EUT

7. Modifications Made to the EUT

No modifications were made to the EUTs during the testing.

8. Modes of Operation

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

Mode	Description
All Tx Off	Device was powered and all Tx's were turned off.
MultiTx WiFi	Device was powered and the following transmitters were turned on: - Realtek WiFi Low Channel (2412MHz) - 900MHz Low Channel (902.25MHz) - Security 3.0 BLE Low Channel (2402MHz)
MultiTx BLE	Device was powered and the following transmitters were turned on: - Realtek BLE Low Channel (2402MHz) - 900MHz Low Channel (902.25MHz)
MultiTx WiFi, Production Firmware	Device was powered and the following transmitters were turned on: - Realtek WiFi Low Channel (2412MHz) - 900MHz Low Channel (902.25MHz) - Security 3.0 BLE Low Channel (2402MHz) Regarding the WiFi Tx: This mode was required for the EUT to pass powerline conducted emissions (AC Mains). The WiFi Tx was turned on in a non-continuous mode that exceeded its intended use in the field.

9. Test Specifications

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

- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 15, Subpart B

- ICES-003, Issue 7, October 15, 2020, "Information Technology Equipment (including Digital Apparatus)"

- RSS-Gen, Issue 5, February 2021, Amendment 2, "General Requirements for Compliance of Radio Apparatus"

- 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 9 kHz to 40 GHz"

- 996369 D04 Module Integration Guide v02, October 13, 2020

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 B, Innovation, Science, and Economic Development Canada, ICES-003, 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 following were the laboratory conditions while the EMC tests were performed:

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

13. Summary

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

Test Description	Test Requirements	Test Methods	Equipment Class	EUT S/N	Results
RF Conducted Emissions (AC Mains)	FCC 15B 15.107 ISED ICES-003, Section 3.2.1	ANSI C63.4:2014	B	151220510793	Conforms
RF Radiated Emissions	FCC 15B 15.109 ISED ICES-003, Section 3.2.2	ANSI C63.4:2014	B	151220510865	Conforms
Multi Tx Emissions	FCC 15B 15.247, RSS-247	ANSI C63.10-2013	N/a	151220510865	Conforms

14. Sample Calculations

For Powerline Conducted Emissions:

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

Formula 1: VL (dBµV) = MTR (dBµV) + 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.

Formula 1: FS (dBµV/m) = MTR (dBµV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

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

Formula 2: FS (µV/m) = AntiLog [(FS (dBµV/m))/20]

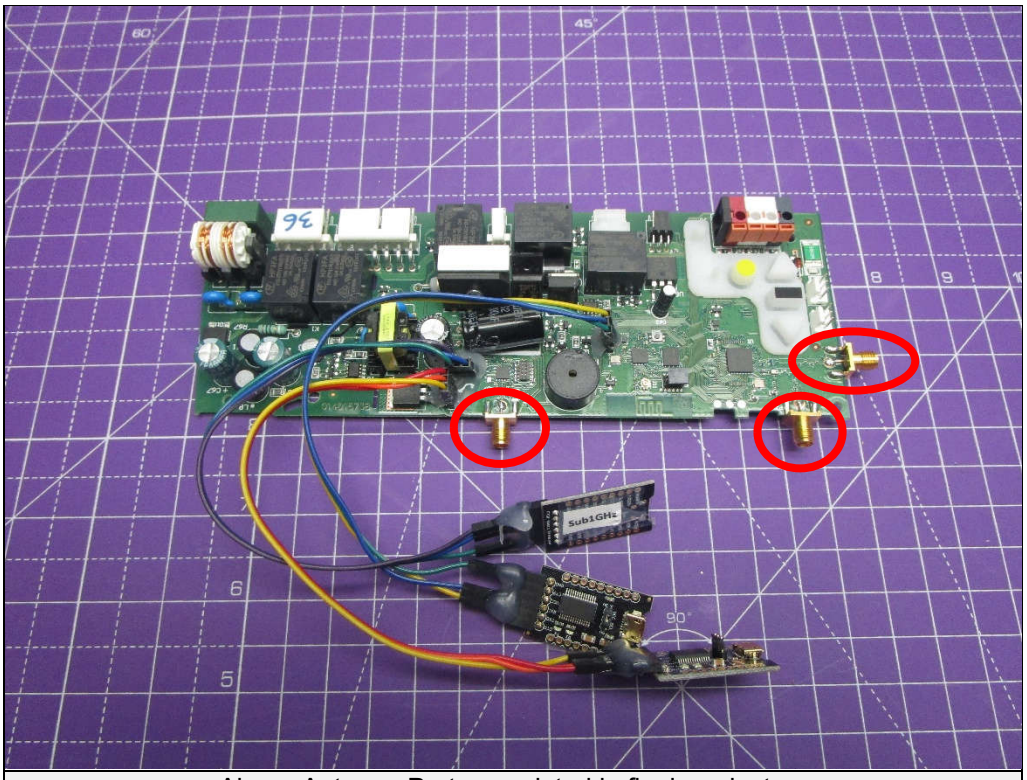
15. Statement of Conformity

The Chamberlain Group, Inc. Phoenix AC GDO Logic Board, Model No. 003-0458-5, Serial No. 151220510865 and 151220510793, did fully conform to the selected requirements of FCC "Code of Federal Regulations" Title 47 Part 15, Subpart B and Innovation, Science, and Economic Development Canada, ICES-003.

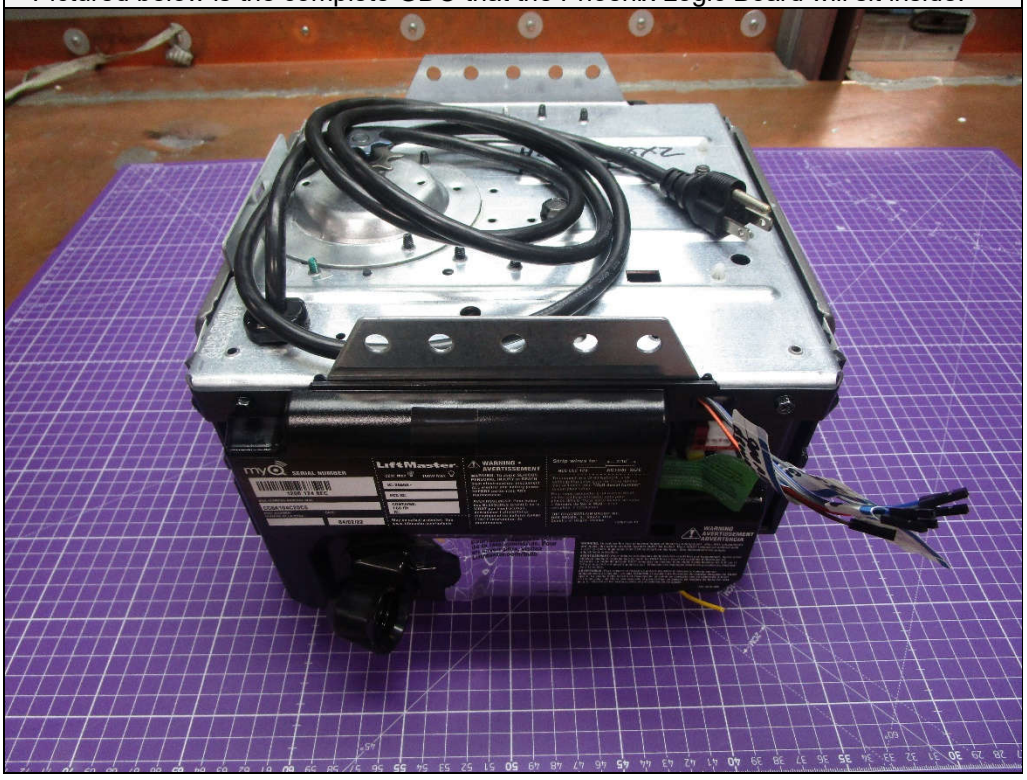
16. Certification

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 B and Innovation, Science, and Economic Development Canada, ICES-003 test specifications. The data presented in this test report pertains to the EUTs on the test date specified. Any electrical or mechanical modifications made to the EUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

17. Photographs of EUT



Above Antenna Ports populated in final product.
Pictured below is the complete GDO that the Phoenix Logic Board will sit inside.

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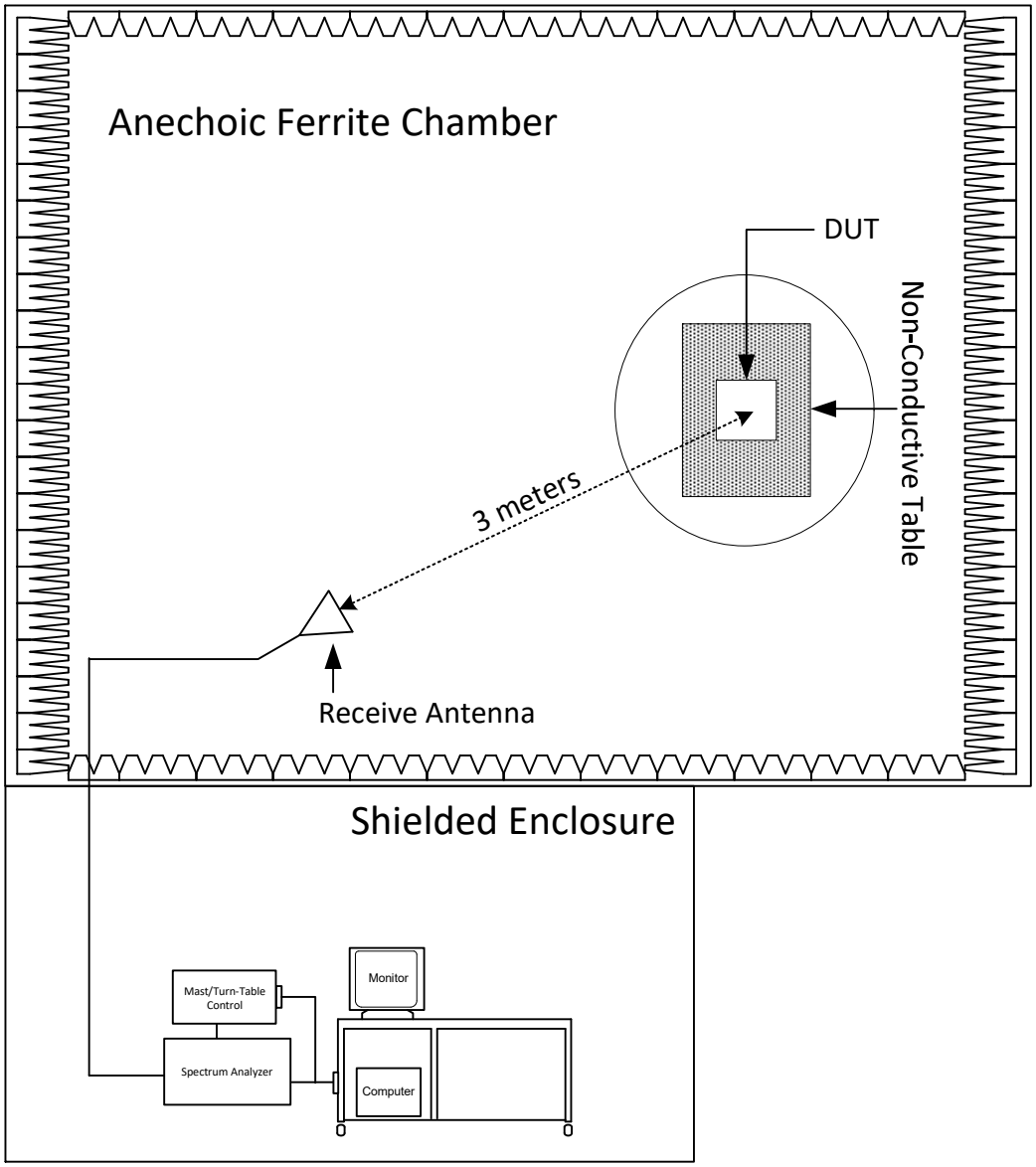
18. Equipment List

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
CDX9	COMPUTER	ELITE	WORKSTATION			N/A	
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
CDZ4	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
GCM0	SFC COMPACT MODULATOR	ROHDE & SCHWARZ	2115.3510K02	100552	---	3/23/2022	3/23/2024
GRB0	1MHZ, LISN SIGNAL CHECKER	ELITE	LISNCHKR1M	1	1MHZ	6/17/2021	6/17/2023
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
MEA3	MICRO-OHM METER	KEITHLEY	580	772667	0UOHM-200KOHM	6/3/2021	6/3/2022
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NSDS1	UNIVERSAL SPHERICAL DIPOLE SOURCE	AET	USDS-H	AET-1116		NOTE 1	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	10/5/2020	10/5/2022
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/13/2020	6/13/2022
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/28/2020	5/28/2022
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	4/27/2022	4/27/2024
PLF2	CISPR16 50UH LISN	ELITE	CISPR16/70A	002	.15-30MHz	4/5/2022	4/5/2023
PLF4	CISPR16 50UH LISN	ELITE	CISPR16/70A	003	.15-30MHz	4/5/2022	4/5/2023
R14ML	ROOM 14	ETS LINDGREN		14A	DC-DAYLIGHT	CNR	
R21F	3M ANECHOIC CHAMBER NSA	EMC TEST SYSTEMS	3M ANECHOIC		30MHZ-18GHZ	3/30/2022	3/30/2023
R29F	3M ANECHOIC CHAMBER NSA	EMC TEST SYSTEMS	3M ANECHOIC		30MHZ-18GHZ	3/25/2022	3/25/2023
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	11/15/2021	11/15/2022
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/31/2022	3/31/2023
T1ED	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BN2320	DC-18GHZ	1/6/2022	1/6/2024
T1EJ	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	CD6790	DC-18GHZ	1/12/2022	1/12/2024
T2D1	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AV5814	DC-18GHZ	1/18/2022	1/18/2024
VBR8	CISPR EN FCC CE VOLTAGE.exe					N/A	
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	
XLTK	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	1/5/2022	1/5/2024

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. RF Conducted Emissions (AC Mains)

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Phoenix AC GDO Logic Board
Model No.	85780
Serial No.	151220510793
Mode	All Tx Off MultiTx WiFi, Production Firmware

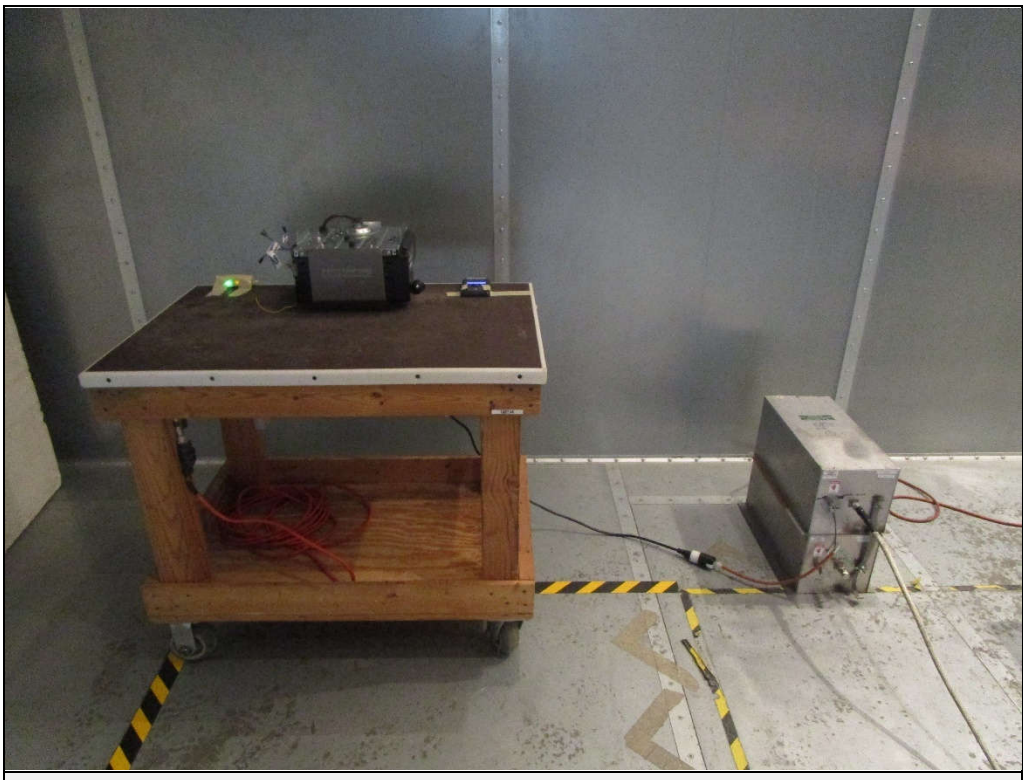
Test Site Information	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Reverberation Chamber
Test Site Used	Room 14
Note	N/a

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Conducted disturbance (mains port) (150 kHz – 30 MHz)	2.7

Requirements
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz shall not exceed the limits in the following table.

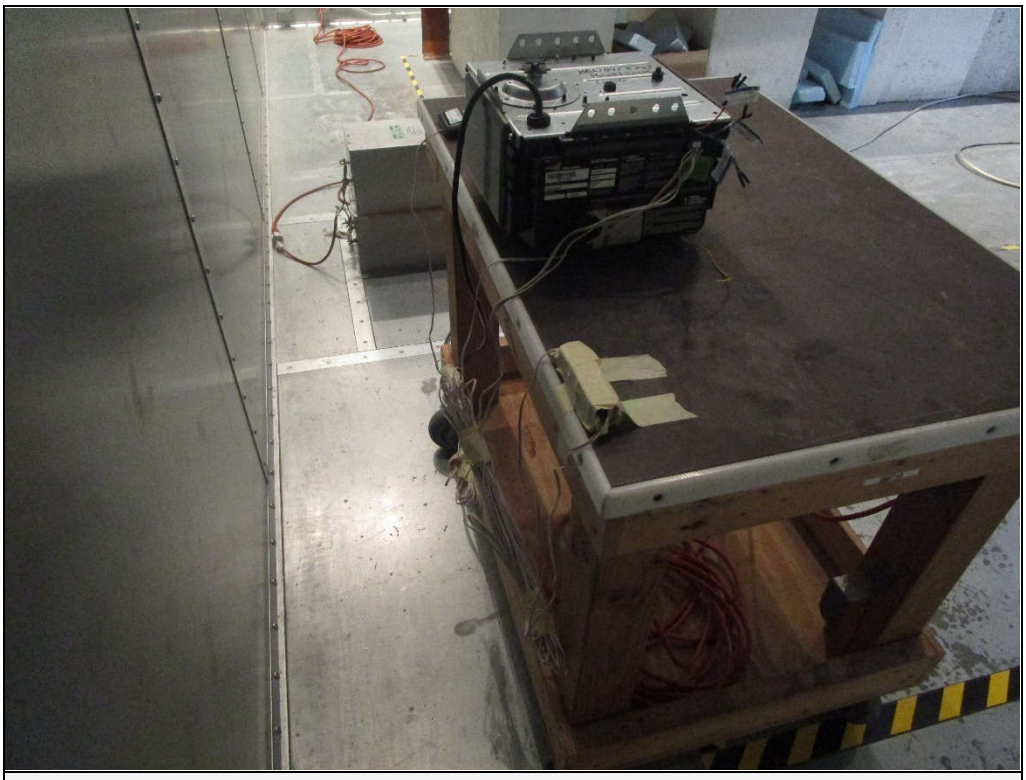
Conducted Emissions Class B Limits		
Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 – 5	56	46
5 – 30	60	50
Note 1: The lower limit shall apply at the transition frequencies. Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.		

Procedure
The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms. 1) The EUT was operated in the All Tx Off mode. 2) Measurements were first made on the 120VAC 60Hz high line. 3) The frequency range from 150kHz to 30MHz was broken up into smaller frequency sub-bands. 4) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector. 5) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 4dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.) 6) Steps (4) and (5) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits. The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF). Formula 1: VL (dBµV) = MTR (dBµV) + CF (dB) 7) Steps (3) through (6) were repeated on the 120VAC 60Hz return line. 8) Steps (2) through (7) were repeated with the EUT operated in the MultiTx WiFi mode.



Test Setup for RF Conducted Emissions (AC Mains)

Test Setup for RF Conducted Emissions (AC Mains)



Test Setup for RF Conducted Emissions (AC Mains)

Test Setup for RF Conducted Emissions (AC Mains)

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	
Serial Number	:	151220510793
DUT Mode	:	All Tx Off
Line Tested	:	High, PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 28, 2022 09:24:16 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

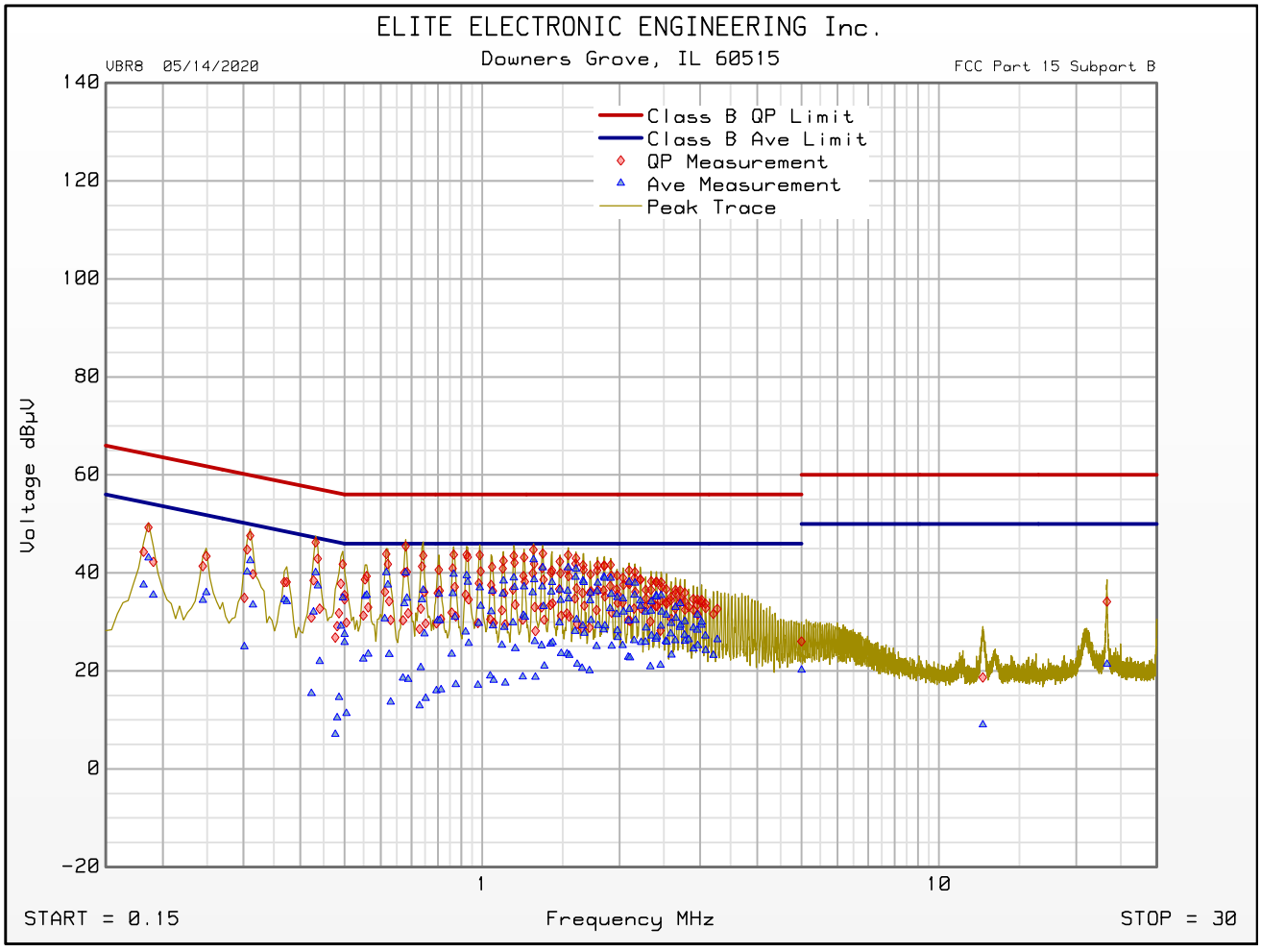
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.186	49.3	64.2		43.1	54.2	
0.311	47.6	60.0		42.5	50.0	
0.432	46.3	57.2		40.1	47.2	
0.617	43.9	56.0		40.1	46.0	
0.680	45.5	56.0		40.0	46.0	
0.743	43.5	56.0		36.5	46.0	
0.867	43.7	56.0		39.7	46.0	
0.925	43.7	56.0		39.4	46.0	
0.988	43.6	56.0		37.0	46.0	
1.051	41.2	56.0		36.3	46.0	
1.114	42.5	56.0		38.4	46.0	
1.173	43.5	56.0		39.0	46.0	
1.236	43.2	56.0		37.2	46.0	
1.295	44.7	56.0		42.7	46.0	
1.358	43.9	56.0		41.1	46.0	
1.421	40.5	56.0		38.1	46.0	
1.480	42.3	56.0		36.6	46.0	
1.543	43.6	56.0		41.1	46.0	
1.606	43.0	56.0		40.8	46.0	
1.664	41.6	56.0		38.4	46.0	
1.790	41.5	56.0		37.9	46.0	
1.849	41.5	56.0		39.2	46.0	
1.912	41.6	56.0		38.9	46.0	
2.097	40.5	56.0		38.2	46.0	
2.160	40.2	56.0		38.0	46.0	
3.271	32.7	56.0		26.4	46.0	
5.000	26.0	56.0		20.2	46.0	
12.474	18.7	60.0		9.0	50.0	
23.320	34.1	60.0		21.4	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	
Serial Number	:	151220510793
DUT Mode	:	All Tx Off
Line Tested	:	High, PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 28, 2022 09:24:16 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	
Serial Number	:	151220510793
DUT Mode	:	All Tx Off
Line Tested	:	Neutral, PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 28, 2022 09:46:20 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

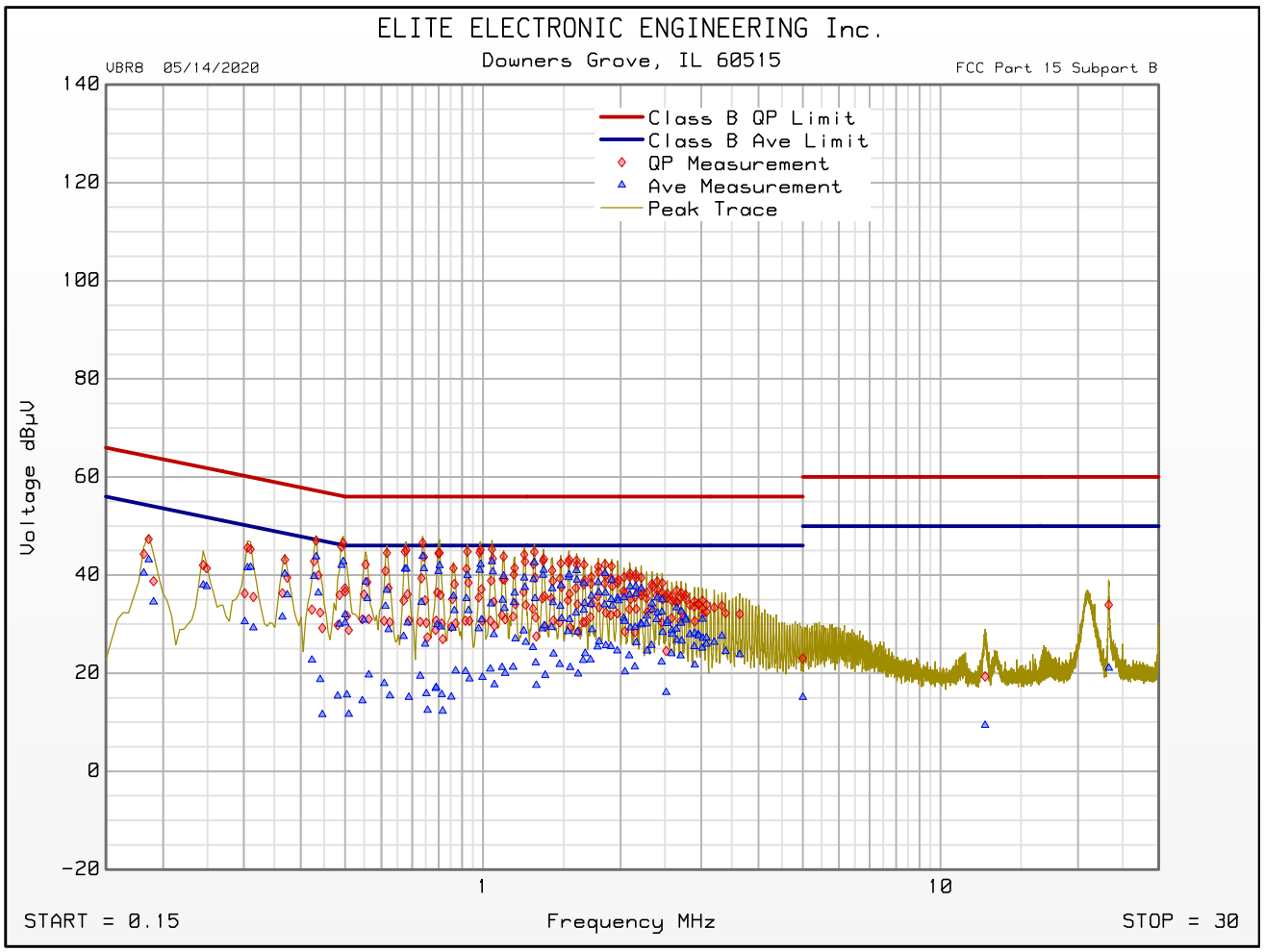
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.186	47.3	64.2		43.1	54.2	
0.311	45.3	60.0		41.6	50.0	
0.369	43.2	58.5		40.3	48.5	
0.432	47.0	57.2		43.8	47.2	
0.495	46.5	56.1		42.8	46.1	
0.554	42.1	56.0		38.6	46.0	
0.617	44.5	56.0		36.9	46.0	
0.676	44.7	56.0		41.3	46.0	
0.739	46.5	56.0		43.9	46.0	
0.804	44.5	56.0		41.9	46.0	
0.925	44.8	56.0		39.9	46.0	
0.988	45.1	56.0		42.2	46.0	
1.047	45.3	56.0		42.8	46.0	
1.110	43.8	56.0		39.8	46.0	
1.173	41.5	56.0		36.4	46.0	
1.231	44.2	56.0		39.4	46.0	
1.295	44.7	56.0		42.6	46.0	
1.358	43.3	56.0		41.0	46.0	
1.417	40.9	56.0		37.2	46.0	
1.480	42.4	56.0		37.9	46.0	
1.543	43.1	56.0		40.1	46.0	
1.601	43.0	56.0		40.9	46.0	
1.664	42.1	56.0		38.3	46.0	
1.786	41.7	56.0		38.5	46.0	
1.849	42.2	56.0		40.4	46.0	
1.912	41.8	56.0		39.0	46.0	
2.097	40.3	56.0		37.6	46.0	
2.156	40.1	56.0		37.7	46.0	
2.219	39.5	56.0		37.3	46.0	
3.329	33.7	56.0		27.6	46.0	
5.000	23.0	56.0		15.1	46.0	
12.524	19.3	60.0		9.4	50.0	
23.320	33.9	60.0		21.0	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	
Serial Number	:	151220510793
DUT Mode	:	All Tx Off
Line Tested	:	Neutral, PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	Apr 28, 2022 09:46:20 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	Production Firmware
Serial Number	:	151220510793
DUT Mode	:	MultiTx WiFi, Production Firmware
Line Tested	:	High, PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-4
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	May 03, 2022 11:07:10 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 4 dB margin below limit

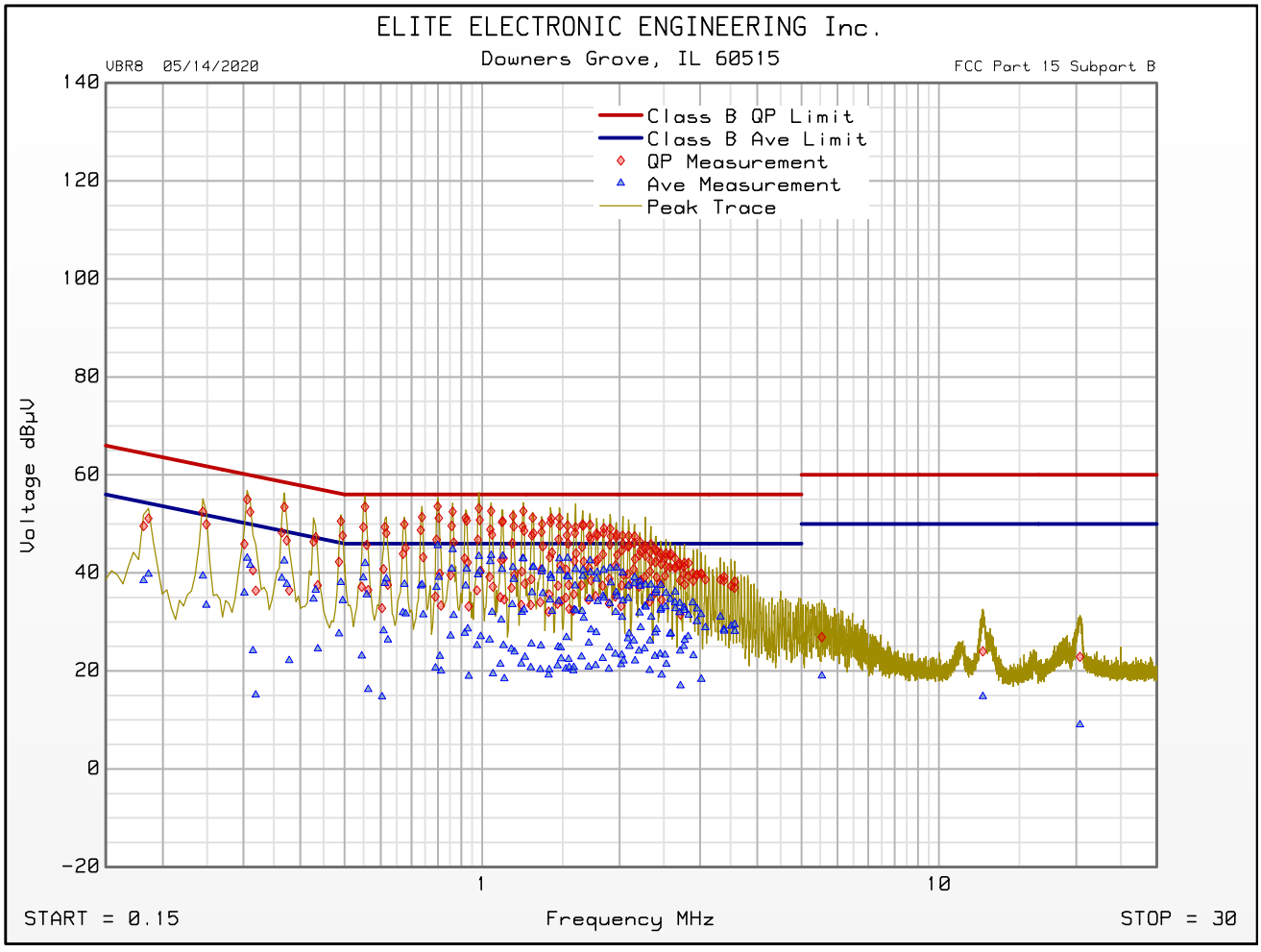
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.245	52.5	61.9		39.4	51.9	
0.369	53.4	58.5		42.4	48.5	
0.554	53.5	56.0		42.0	46.0	
0.799	53.6	56.0		45.6	46.0	
0.862	52.5	56.0		44.8	46.0	
0.984	53.2	56.0		43.4	46.0	
1.047	52.6	56.0		43.6	46.0	
1.110	50.5	56.0		43.4	46.0	
1.227	49.4	56.0		42.9	46.0	
1.231	52.6	56.0		42.9	46.0	
1.475	51.2	56.0		42.9	46.0	
1.538	49.6	56.0		43.0	46.0	
1.723	49.8	56.0		42.5	46.0	
2.030	47.6	56.0		40.0	46.0	
3.388	39.2	56.0		28.2	46.0	
5.540	26.9	60.0		19.0	50.0	
12.483	24.0	60.0		14.8	50.0	
20.368	22.9	60.0		9.0	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	Production Firmware
Serial Number	:	151220510793
DUT Mode	:	MultiTx WiFi, Production Firmware
Line Tested	:	High, PLF4
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-4
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	May 03, 2022 11:07:10 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	Production Firmware
Serial Number	:	151220510793
DUT Mode	:	MultiTx WiFi, Production Firmware
Line Tested	:	Neutral, PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-4
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	May 03, 2022 11:13:31 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 4 dB margin below limit

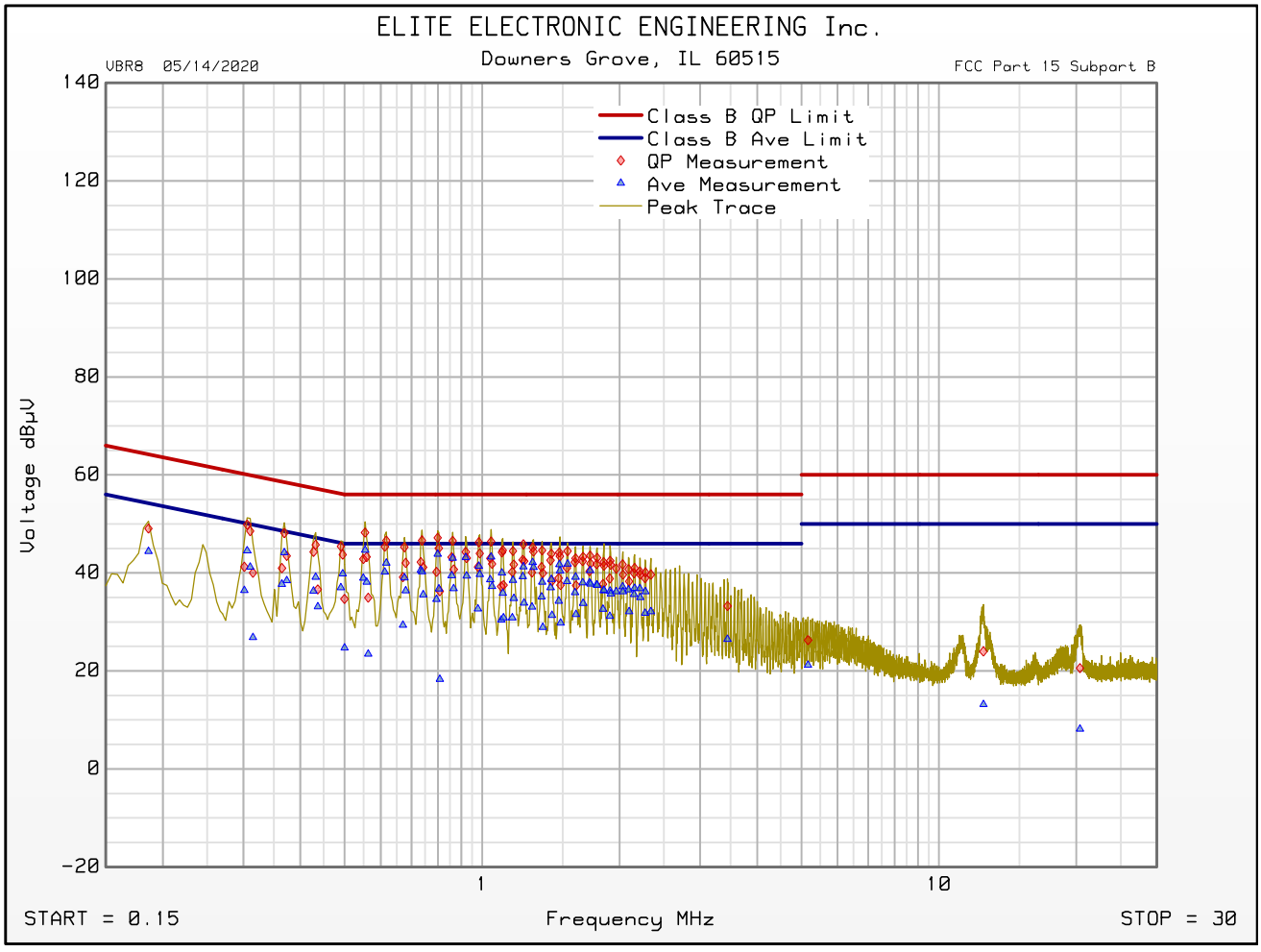
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.186	49.0	64.2		44.4	54.2	
0.306	49.8	60.1		44.5	50.1	
0.554	48.2	56.0		44.7	46.0	
0.617	46.6	56.0		42.0	46.0	
0.799	47.2	56.0		43.8	46.0	
0.862	46.5	56.0		43.0	46.0	
0.921	44.3	56.0		43.2	46.0	
1.047	46.4	56.0		43.3	46.0	
1.291	45.2	56.0		42.2	46.0	
2.030	41.7	56.0		37.2	46.0	
3.446	33.2	56.0		26.4	46.0	
5.171	26.3	60.0		21.2	50.0	
12.510	24.0	60.0		13.2	50.0	
20.359	20.6	60.0		8.2	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 05/14/2020

Manufacturer	:	Chamberlain
Model	:	85780
DUT Revision	:	Production Firmware
Serial Number	:	151220510793
DUT Mode	:	MultiTx WiFi, Production Firmware
Line Tested	:	Neutral, PLF2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-4
Notes	:	
Test Engineer	:	N. Bouchie
Limit	:	Class B
Test Date	:	May 03, 2022 11:13:31 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

21. RF Radiated Emissions

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Phoenix AC GDO Logic Board
Model No.	003-0458-5
Serial No.	151220510865
Mode	All Tx Off

Test Site Information	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	Room 29
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Highest Internal Frequency	2412MHz
Highest Measurement Frequency	13GHz
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

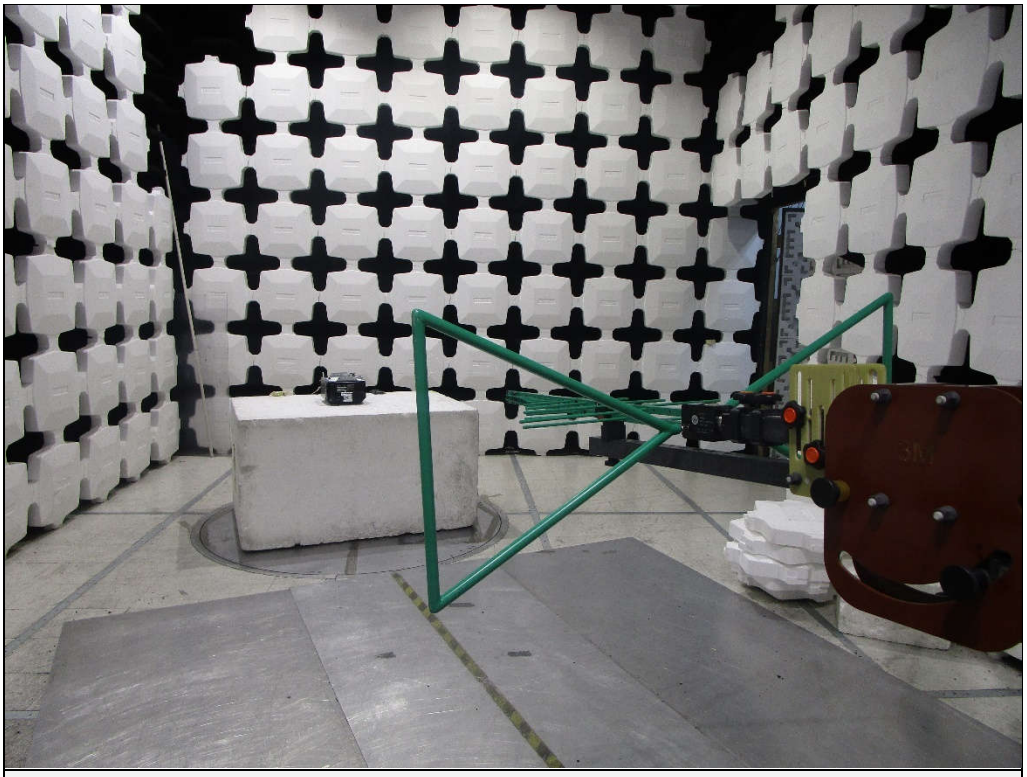
Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz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

Requirements
The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the values in the following tables.

FCC Part 15 Class B Radiated Emissions Limits (30MHz to 1GHz)		
Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	54
FCC Part 15 Class B Radiated Emissions Limits (Above 1GHz)		
Frequency of Emission (MHz)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)
Above 1000	74	54

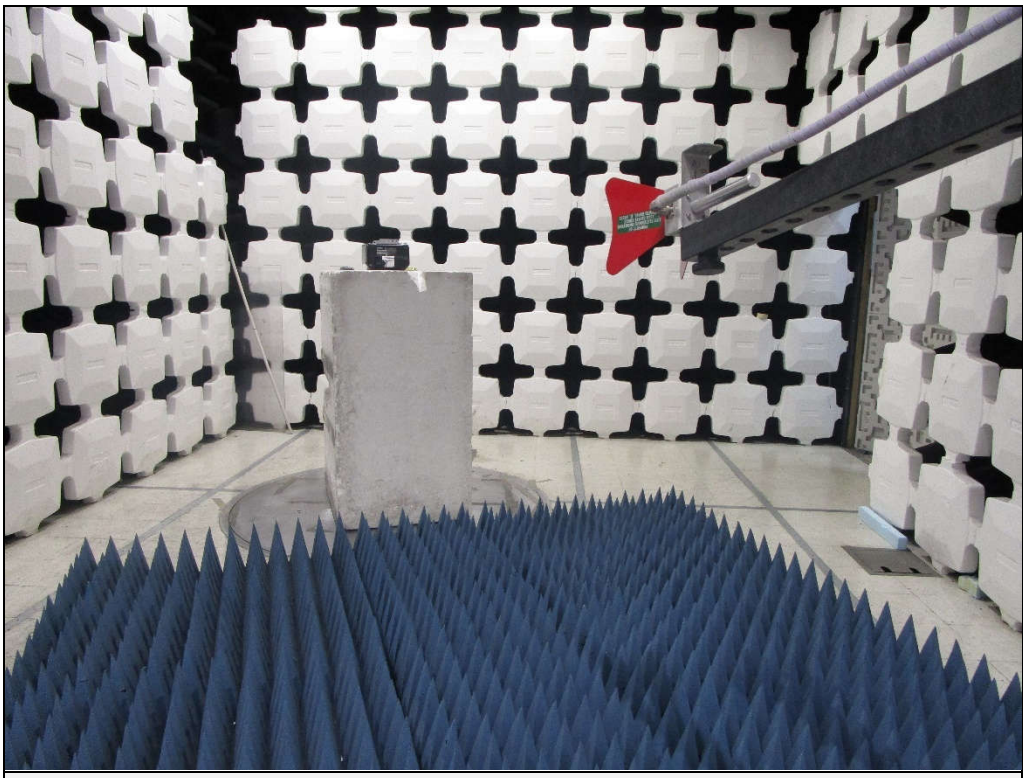
ICES-003 Class B Radiated Emissions Limits (30MHz to 1GHz)		
Frequency Range (MHz)	Field Strength at 3 meters (dBµV/m)	Field Strength at 10 meters (dBµV/m)
30 – 88	40	30
88 – 216	43.5	33.1
216 – 230	46	35.6
230 – 960	47	37
960 – 1000	54	43.5
ICES-003 Class B Radiated Emissions Limits (At and Above 1GHz)		
Frequency Range (GHz)	Average (dBµV/m)	Peak (dBµV/m)
1 – F_M	54	74
F_M = highest measurement frequency		

Procedure
Since a quasi-peak detector and an average detector require long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector. The EUT and all peripheral equipment were placed on an 80cm high non-conductive stand. The broadband measuring antenna was positioned at a 3-meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 13GHz was investigated using a peak detector function with the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. Final radiated emissions were performed on all significant broadband and narrowband emissions found in the exploratory sweeps using the following methods: 1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna. 2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken: a) The EUT was rotated so that all sides were exposed to the receiving antenna. b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured. c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings. d) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

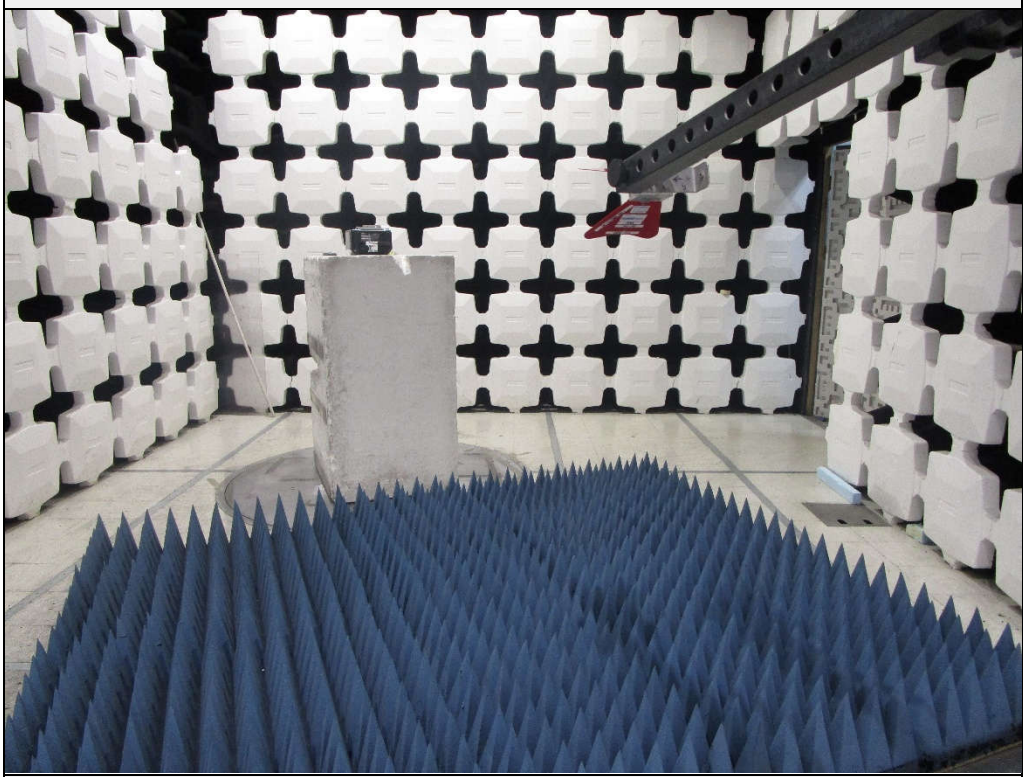


Test Setup for Radiated Emissions: 30MHz to 1GHz, Horizontal Polarization

Test Setup for Radiated Emissions: 30MHz to 1GHz, Vertical Polarization



Test Setup for Radiated Emissions: Above 1GHz, Horizontal Polarization



Test Setup for Radiated Emissions: Above 1GHz, Vertical Polarization

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

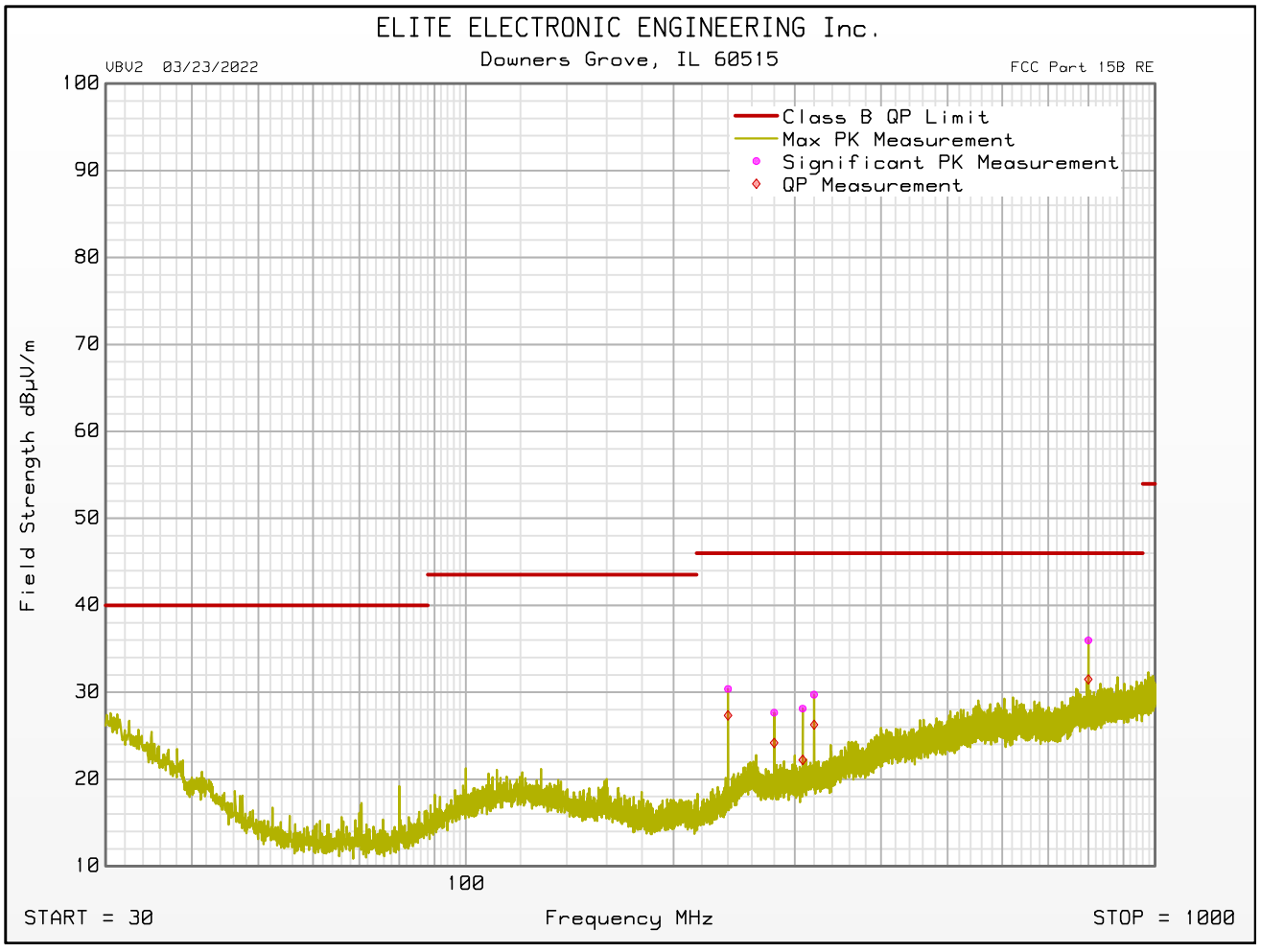
Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 03:37:41 PM

Freq MHz	Peak Mtr Rdg dBuV	QP Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	QP Total dBµV/m	QP Limit dBµV/m	QP Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive QP Level
30.840	4.3	-2.4	24.0	0.0	0.4	0.0	28.6	21.9	40.0	-18.1	Vertical	200	135	
69.840	8.7	-2.6	12.2	0.0	0.4	0.0	21.3	10.0	40.0	-30.0	Vertical	340	270	
79.980	10.8	7.6	12.9	0.0	0.4	0.0	24.1	20.9	40.0	-19.1	Vertical	120	225	
100.000	9.3	6.2	16.9	0.0	0.4	0.0	26.5	23.5	43.5	-20.0	Vertical	120	180	
160.000	7.4	3.7	16.3	0.0	0.6	0.0	24.4	20.6	43.5	-22.9	Vertical	120	225	
240.000	12.2	9.2	17.4	0.0	0.8	0.0	30.4	27.3	46.0	-18.7	Horizontal	120	315	
280.020	8.3	4.8	18.6	0.0	0.8	0.0	27.7	24.2	46.0	-21.8	Horizontal	120	45	
307.980	8.2	2.3	19.1	0.0	0.8	0.0	28.1	22.2	46.0	-23.8	Horizontal	340	0	
319.980	9.5	6.0	19.4	0.0	0.8	0.0	29.7	26.3	46.0	-19.7	Horizontal	120	0	
799.980	8.4	3.9	26.1	0.0	1.5	0.0	36.0	31.5	46.0	-14.5	Horizontal	120	90	

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

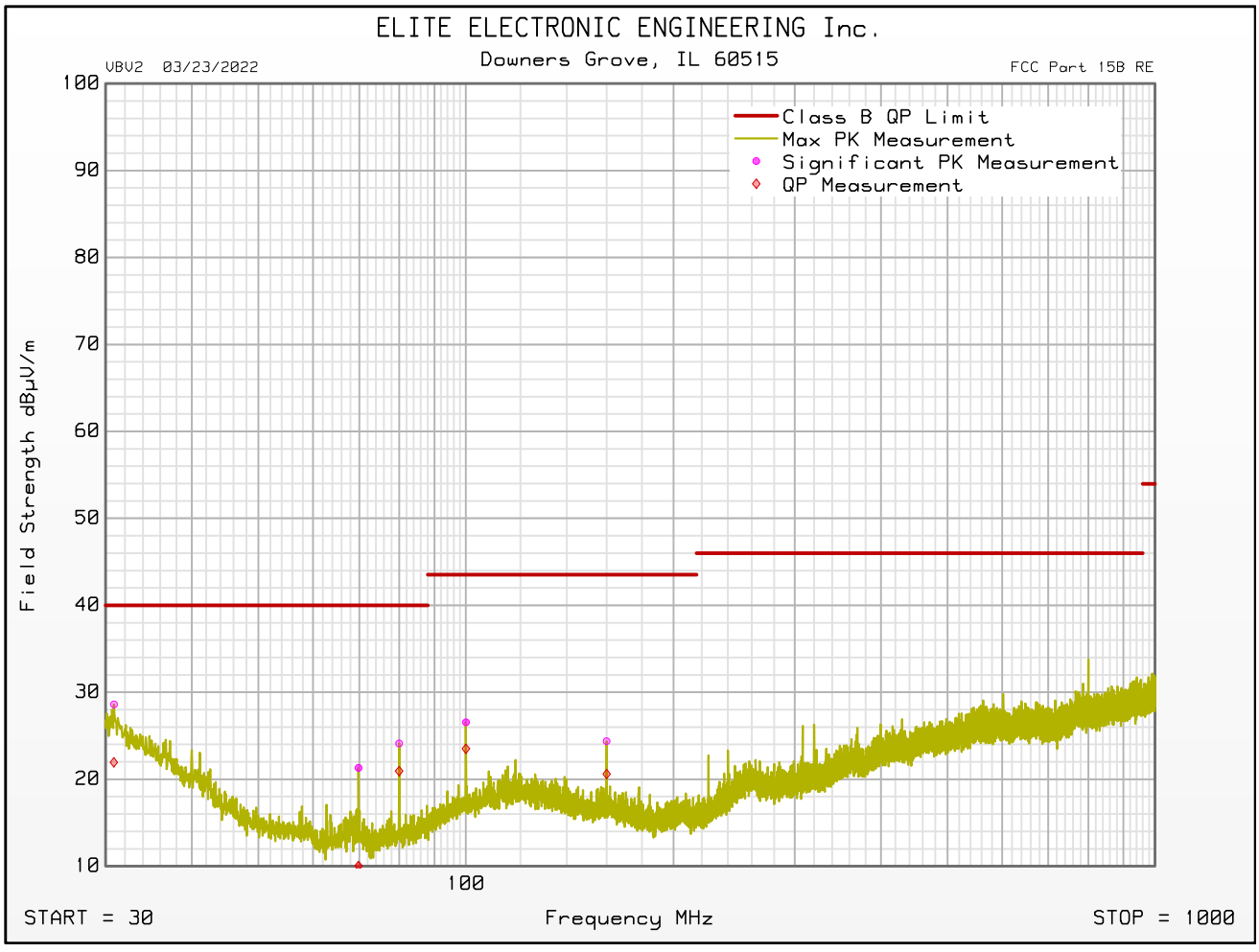
Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 03:37:41 PM



FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	120 kHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 03:37:41 PM



FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 04:13:19 PM

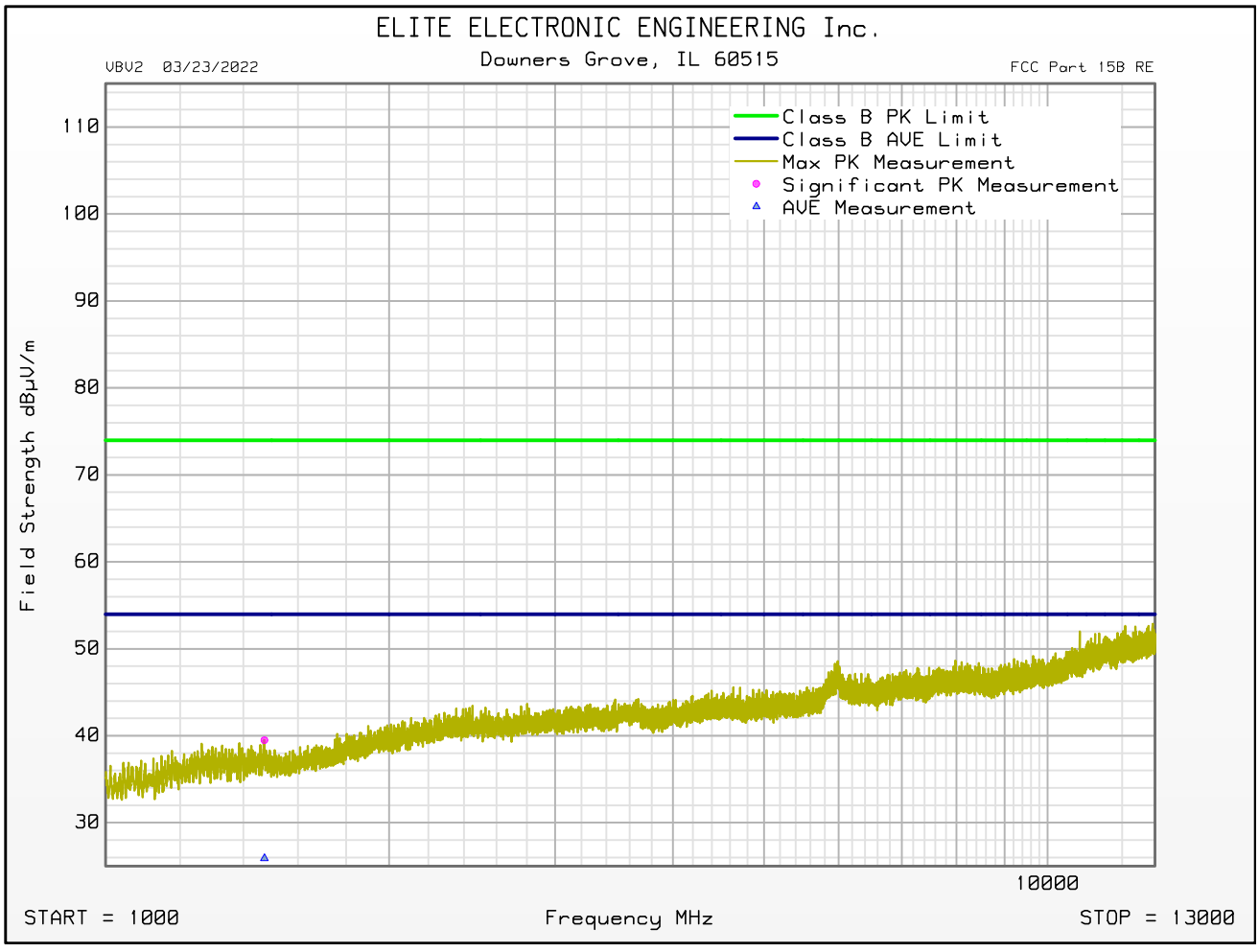
Freq MHz	Peak Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Peak Total dBµV/m	Peak Limit dBµV/m	Peak Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Peak Level
1474.000	49.3	28.5	-40.3	1.9	0.0	39.5	74.0	-34.5	Horizontal	120	0	
2225.000	48.4	32.2	-39.9	2.5	0.0	43.1	74.0	-30.9	Vertical	200	135	
3564.500	47.1	33.6	-39.5	3.2	0.0	44.5	74.0	-29.5	Vertical	120	225	
4577.500	47.8	34.3	-39.7	3.7	0.0	46.0	74.0	-28.0	Vertical	340	135	
5991.500	48.3	36.3	-39.6	4.2	0.0	49.2	74.0	-24.8	Vertical	200	225	
12620.000	46.4	39.1	-38.6	6.1	0.0	52.9	74.0	-21.1	Vertical	120	45	

Freq MHz	Average Mtr Rdg dBuV	Ant Fac dB/m	Amp Fac dB	Cbl Fac dB	Dist Corr dB	Average Total dBµV/m	Average Limit dBµV/m	Average Lim Mrg dB	Ant Pol	Mast Ht cm	Azim °	Excessive Average Level
1474.000	35.7	28.5	-40.3	1.9	0.0	25.9	54.0	-28.1	Horizontal	120	0	
2225.000	35.0	32.2	-39.9	2.5	0.0	29.7	54.0	-24.3	Vertical	200	135	
3564.500	34.2	33.6	-39.5	3.2	0.0	31.5	54.0	-22.4	Vertical	120	225	
4577.500	33.8	34.3	-39.7	3.7	0.0	32.0	54.0	-22.0	Vertical	340	135	
5991.500	33.5	36.3	-39.6	4.2	0.0	34.4	54.0	-19.6	Vertical	200	225	
12620.000	33.2	39.1	-38.6	6.1	0.0	39.7	54.0	-14.2	Vertical	120	45	

FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

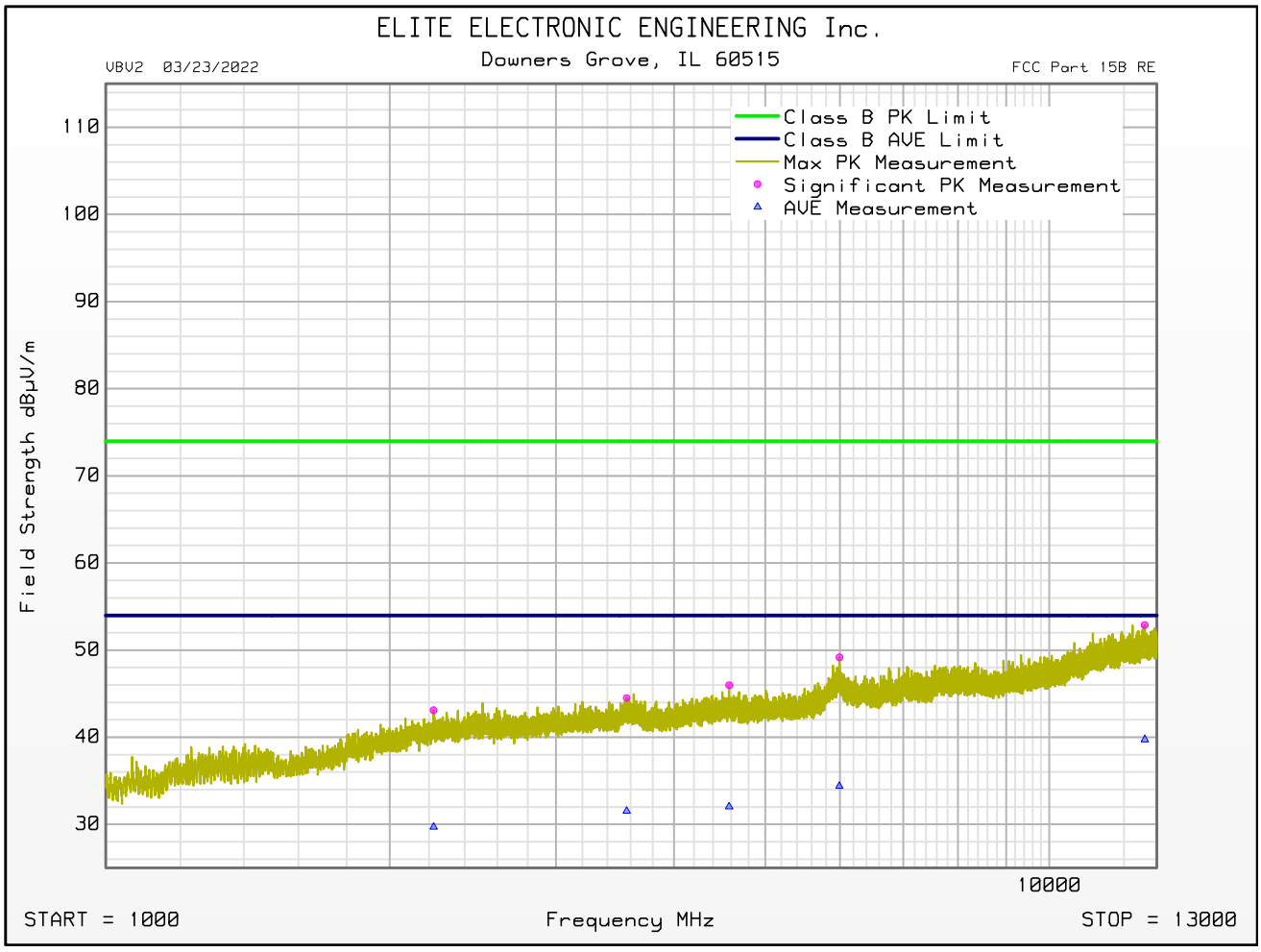
Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Horizontal
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 04:13:19 PM



FCC Part 15B Class B
Radiated RF Emissions Test

SW ID/Rev: VBV2 03/23/2022

Manufacturer	:	Chamberlain
Model	:	003-0458-5
Serial Number	:	151220510865
DUT Mode	:	All Tx Off
Turntable Step Angle (°)	:	45
Mast Positions (cm)	:	120, 200, 340
Antenna Polarization	:	Vertical
Scan Type	:	Stepped Scan
Test RBW	:	1 MHz
Prelim Dwell Time (s)	:	0.0001
Notes	:	
Test Engineer	:	N. Bouchie
Test Date	:	May 23, 2022 04:13:19 PM



22. Multi Tx Emissions

EUT Information	
Manufacturer	Chamberlain Group, Inc.
Product	Phoenix AC GDO Logic Board
Model No.	003-0458-5
Serial No.	151220510865
Mode	MultiTx WiFi MultiTx BLE

Test Site Information	
Setup Format	Tabletop
Height of Support	N/a
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	Room 29
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

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

Requirements
Per 996369 D04 Module Integration Guide v01: Testing of the host product with all the transmitters installed is recommended, to verify that the host product meets all the applicable FCC rules. The radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). The testing shall also check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. No emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles and anechoic absorber material is installed over the ferrite tiles. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

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

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

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

   a) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

   b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz 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 bilog 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 100kHz 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.

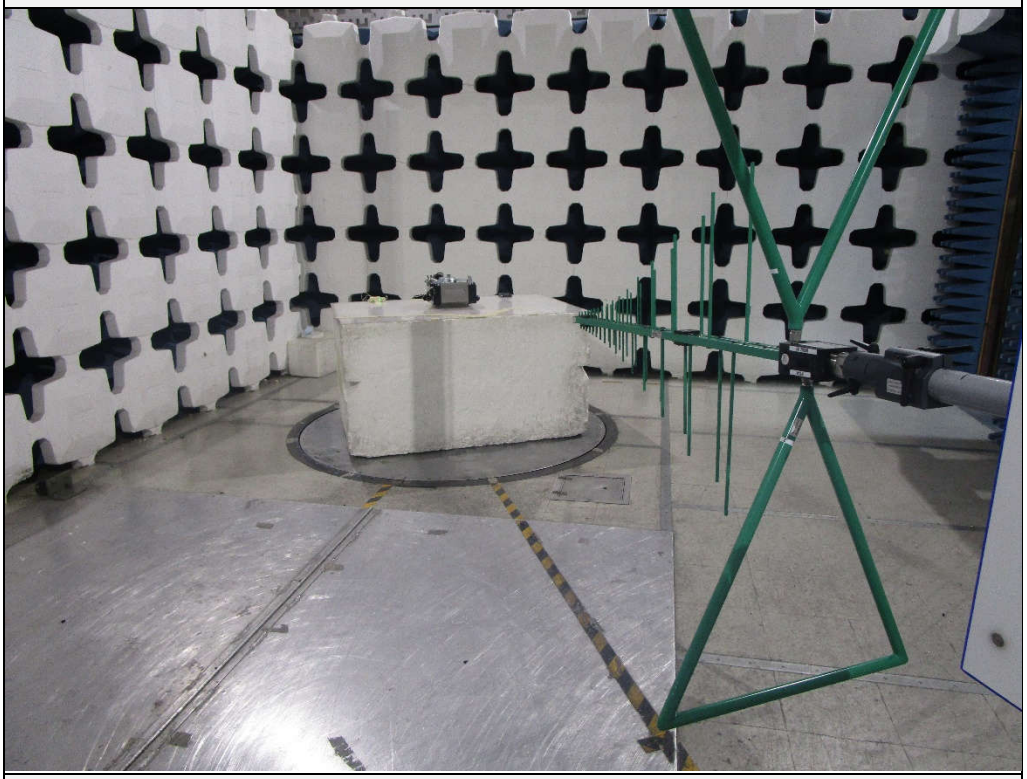
   iv. In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded.

d) For all radiated emissions measurements below 1GHz, if the peak reading is below the limits listed in §15.209(a), no further measurements are required. If, however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

e) For all radiated emissions measurements above 1GHz, the peak readings must comply with the §15.35(b) limits. §15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1GHz must be no greater than 20dB above the limits specified in §15.209(a).

f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector and an average reading was taken.

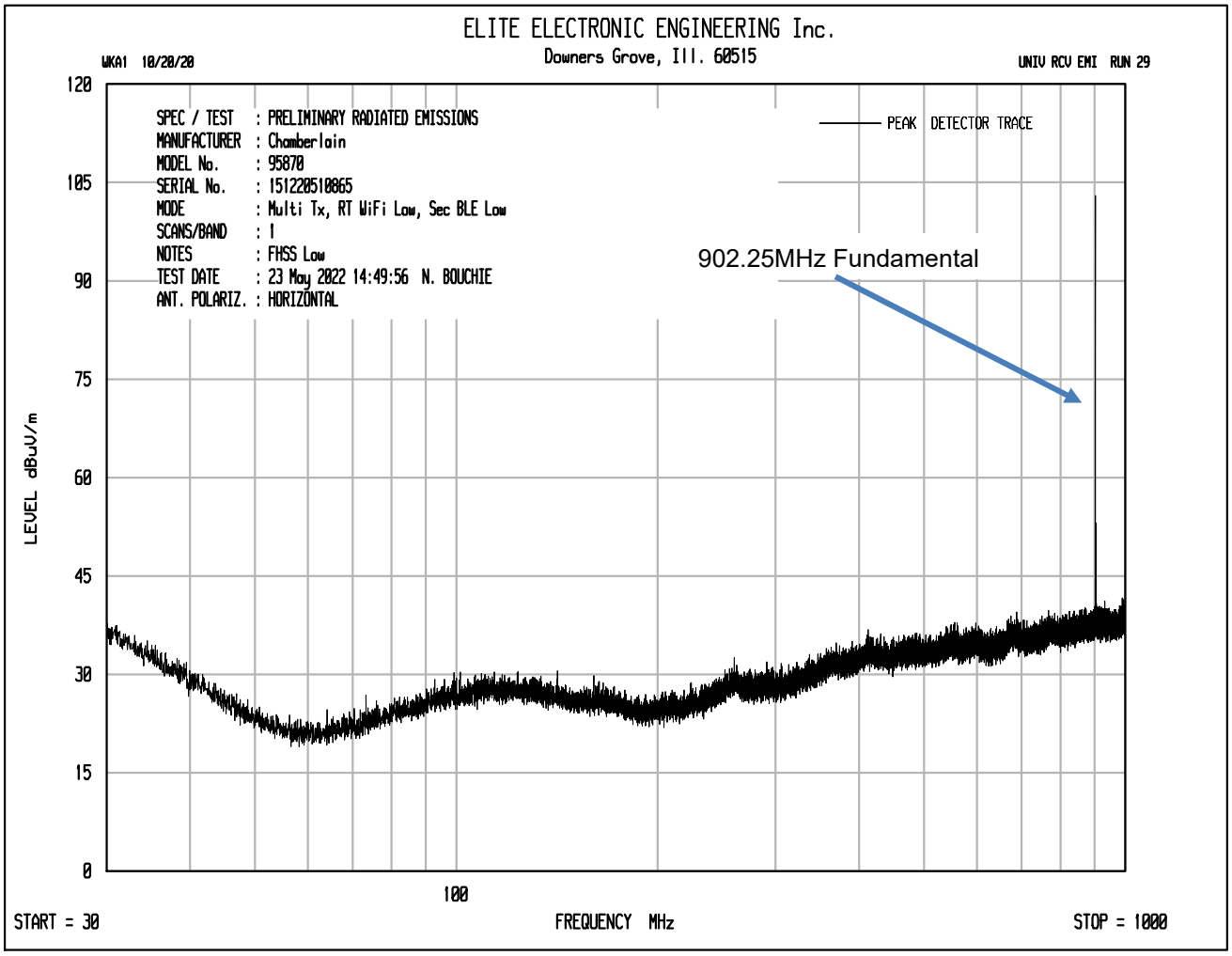
Test Setup for Spurious Emissions: 30MHz to 1GHz, Horizontal Polarization



Test Setup for Spurious Emissions: 30MHz to 1GHz, Vertical Polarization

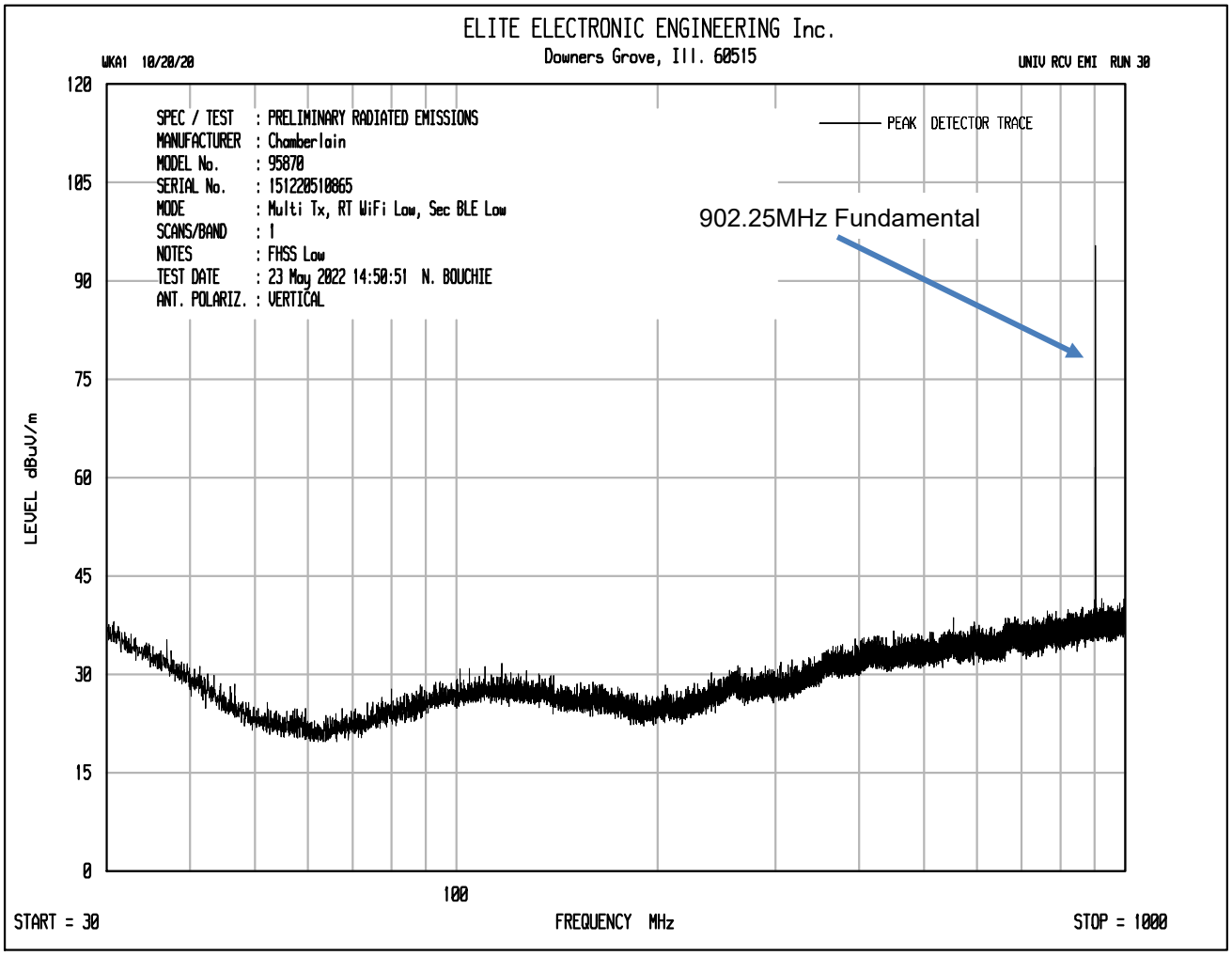
Test Setup for Spurious Emissions: Above 1GHz, Horizontal Polarization

Test Setup for Spurious Emissions: Above 1GHz, Vertical Polarization



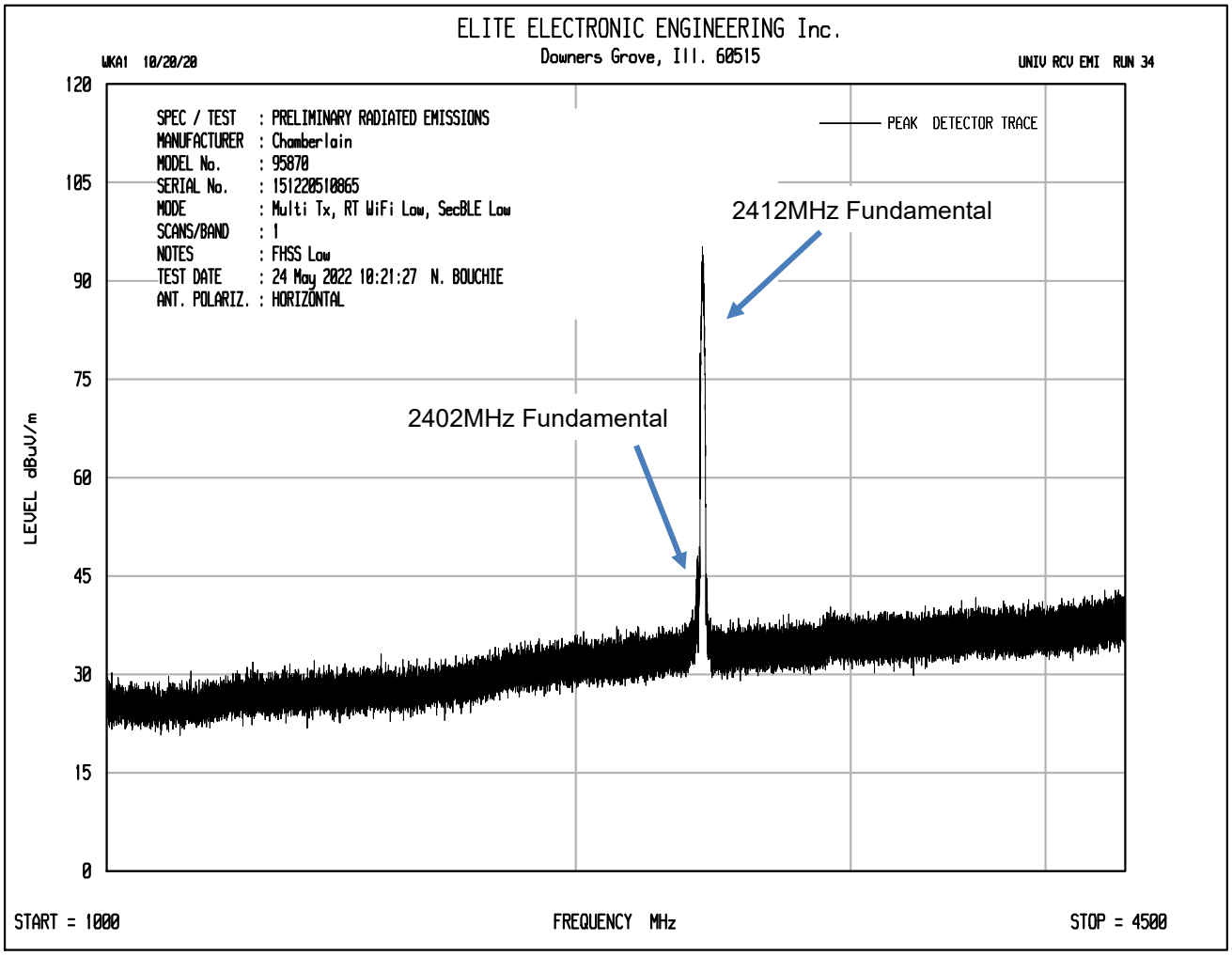
Intermodulation Frequencies:

None Found



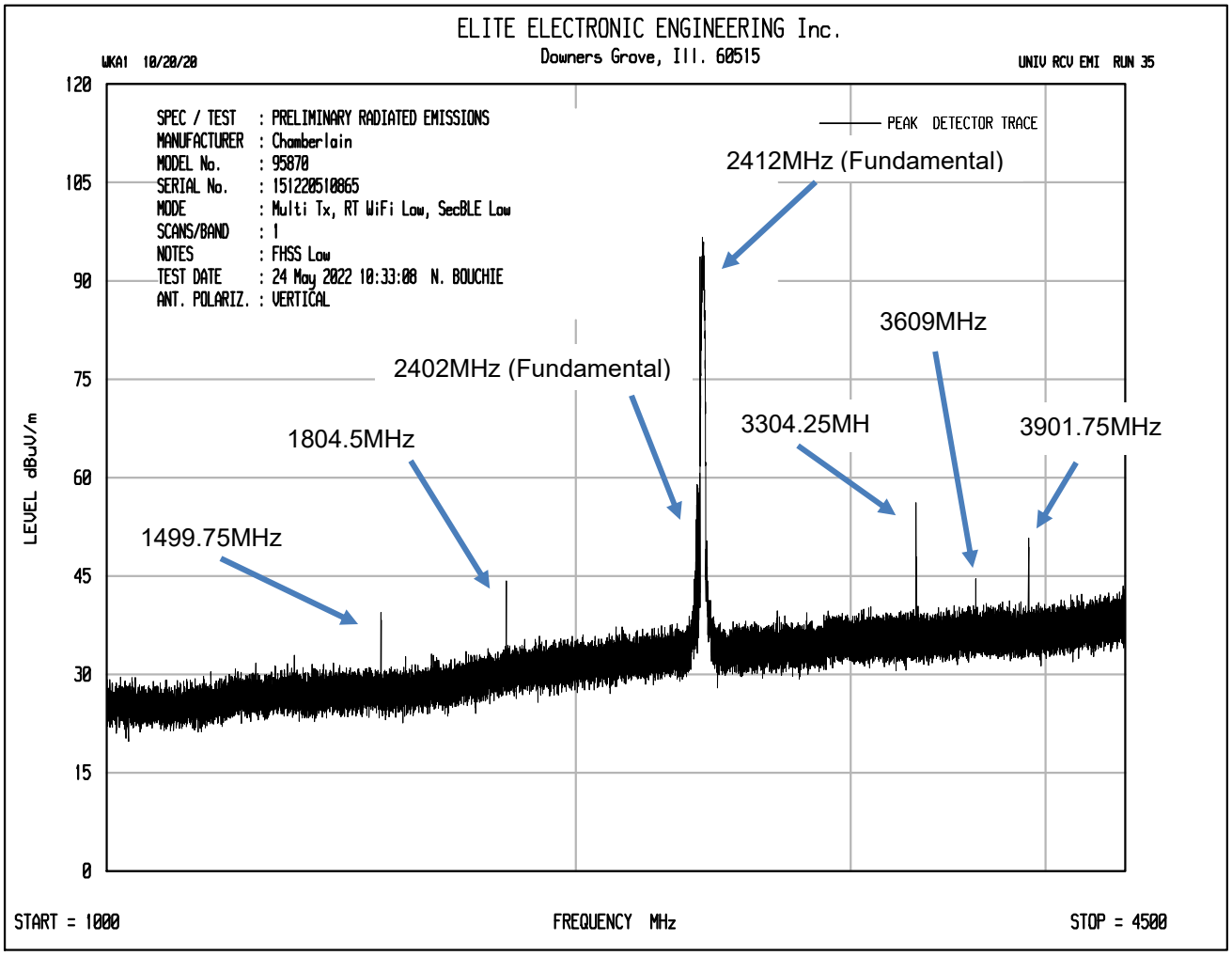
Intermodulation Frequencies:

None Found



Intermodulation Frequencies:

None Found



Intermodulation Frequencies:

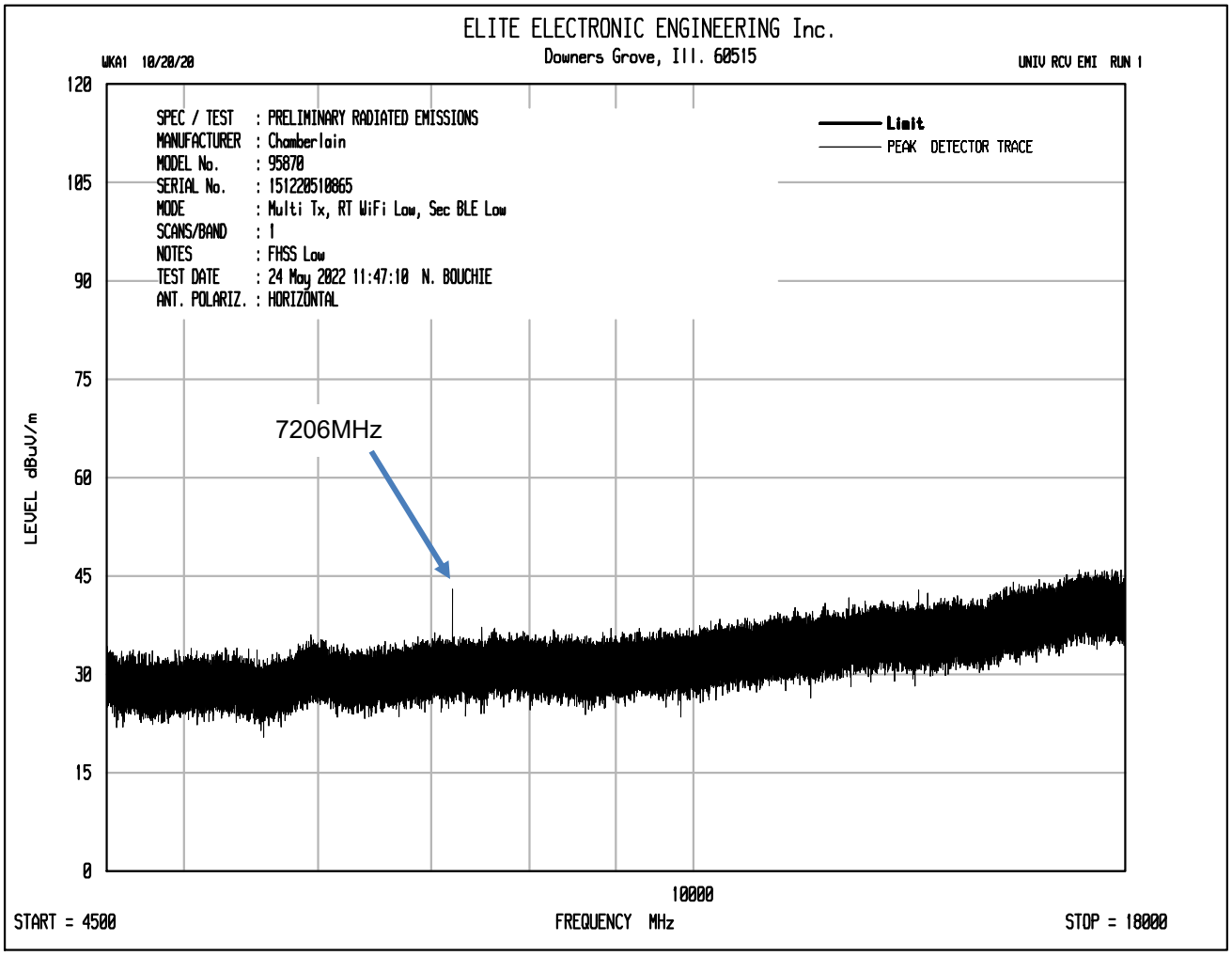
1499.75MHz = 2402MHz - 902.25MHz

1804.5MHz = 2 * 902.25MHz

3304.25MHz = 2402MHz + 902.25MHz

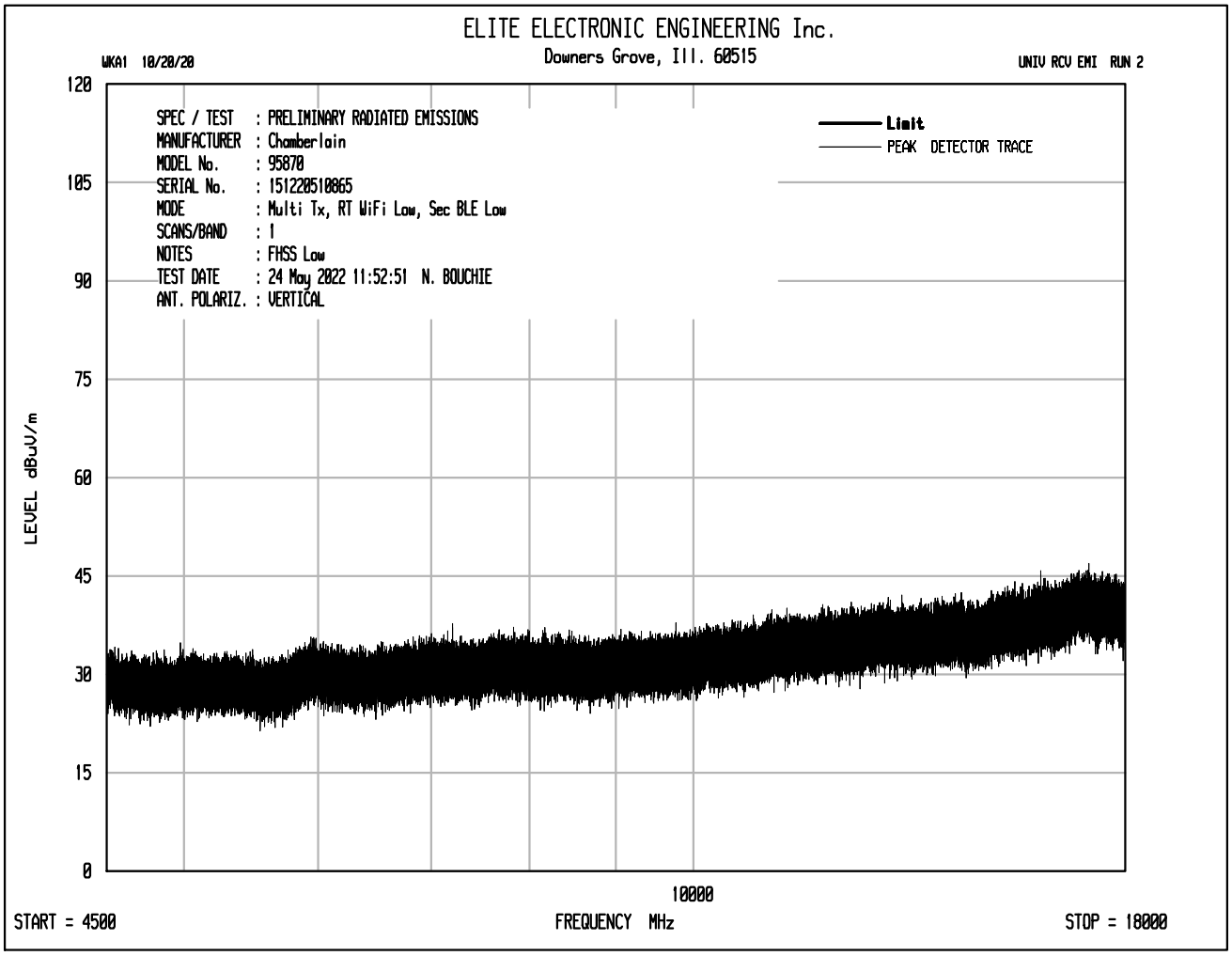
3609MHz = 4 * 902.25MHz

3901.75 = 2 * (2402MHz) - 902.25MHz



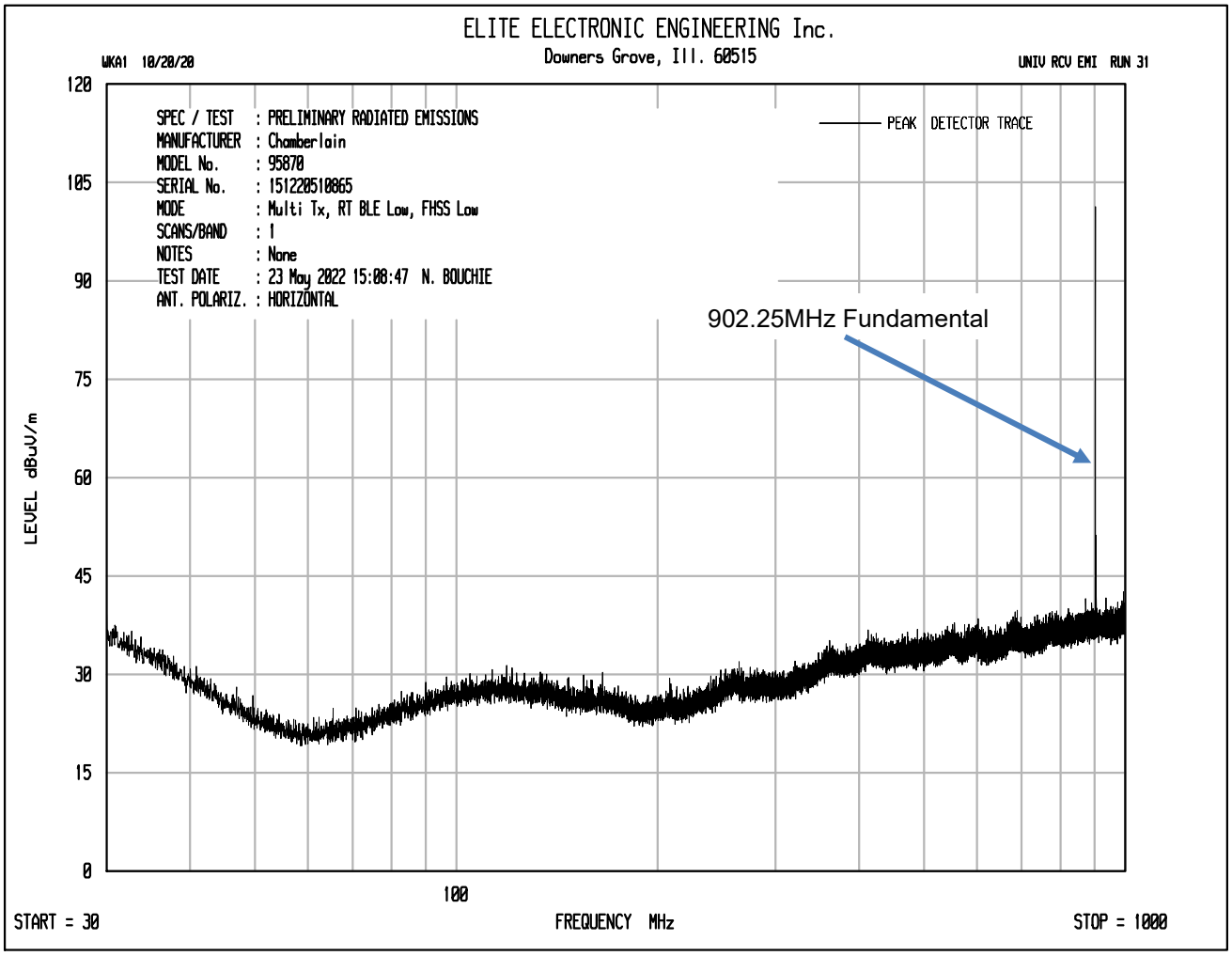
Intermodulation Frequencies:

7206MHz = 3 * (2402MHz)



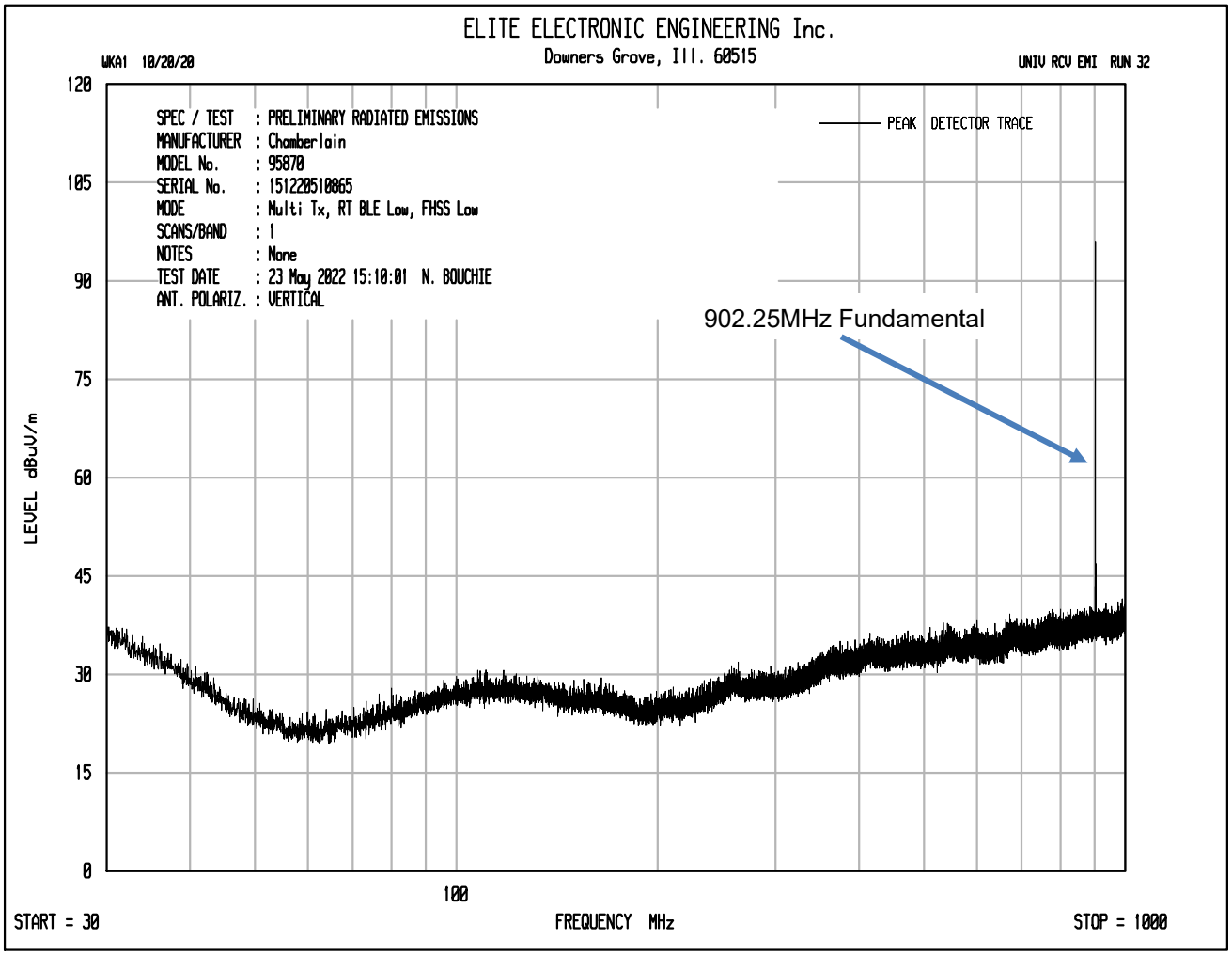
Intermodulation Frequencies:

None Found



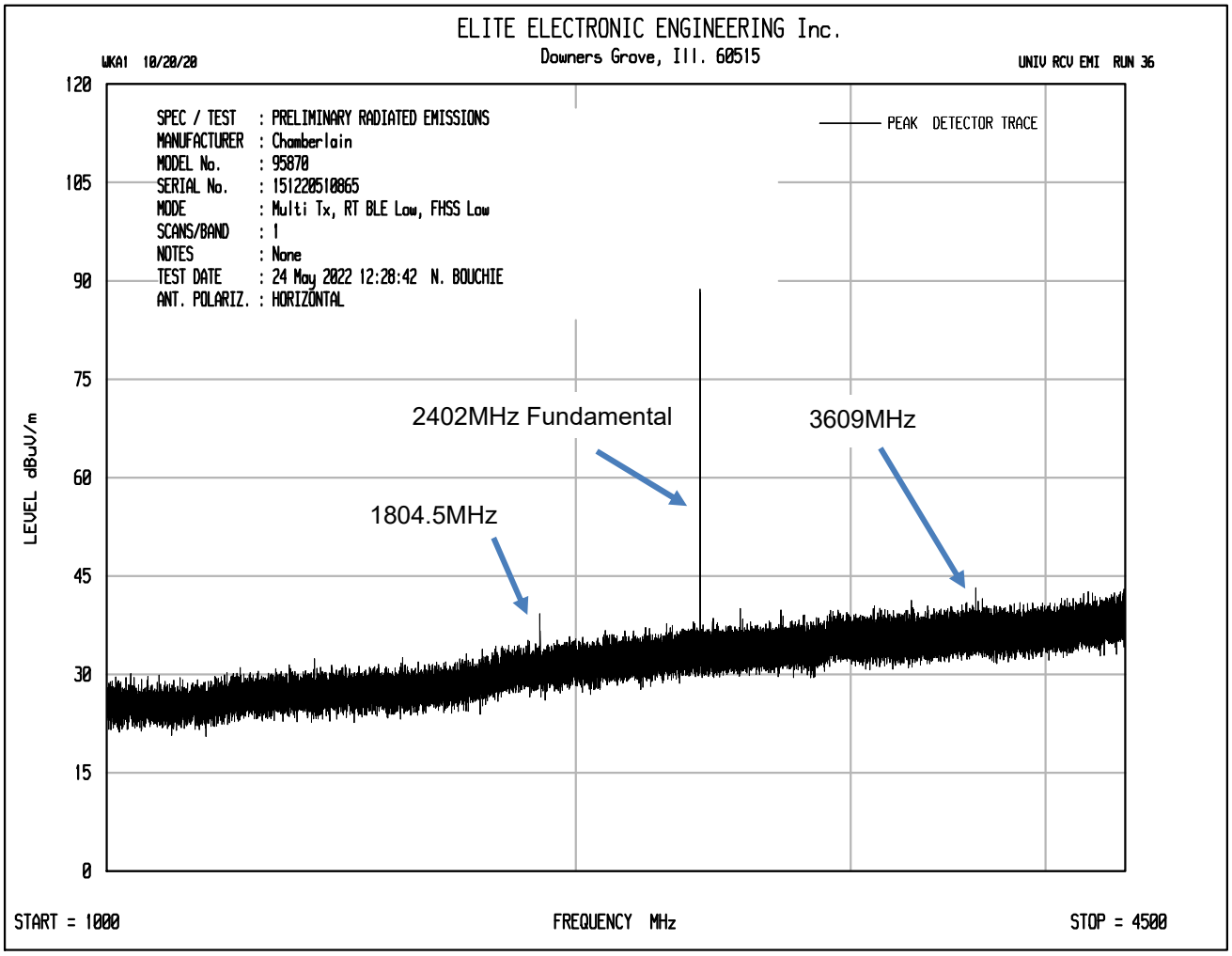
Intermodulation Frequencies:

None Found



Intermodulation Frequencies:

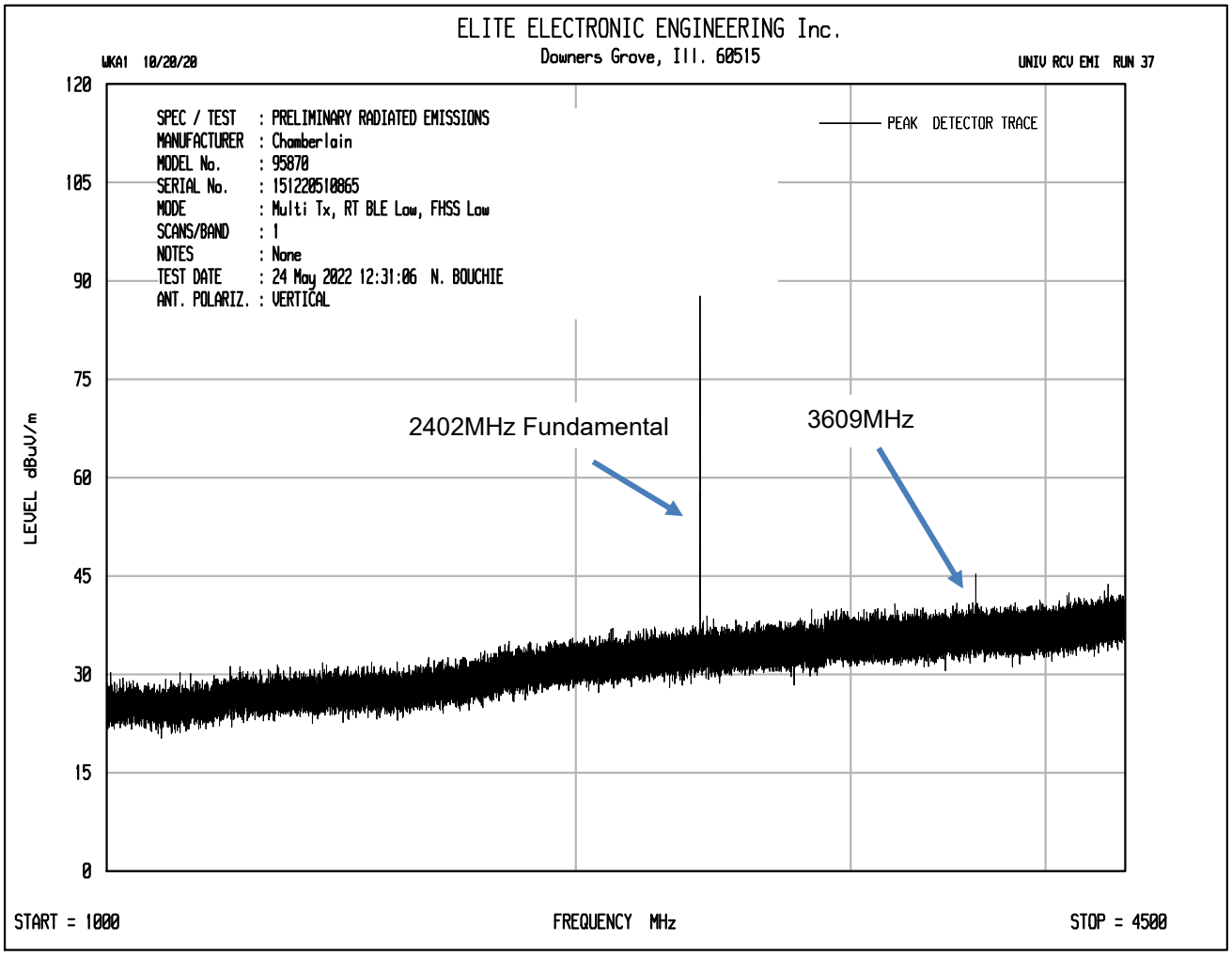
None Found



Intermodulation Frequencies:

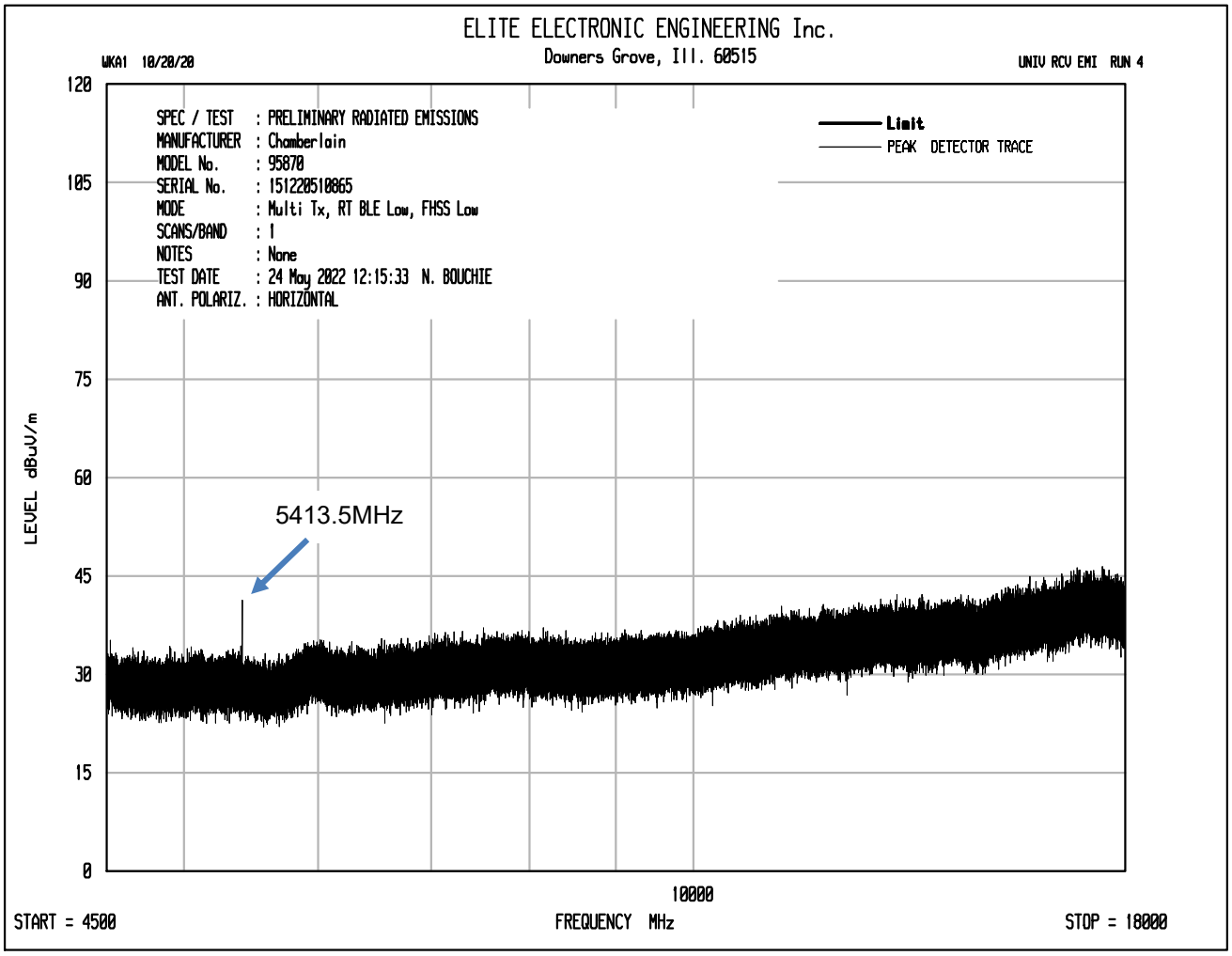
1804.5MHz = 2 * 902.25MHz

3609MHz = 4 * 902.25MHz



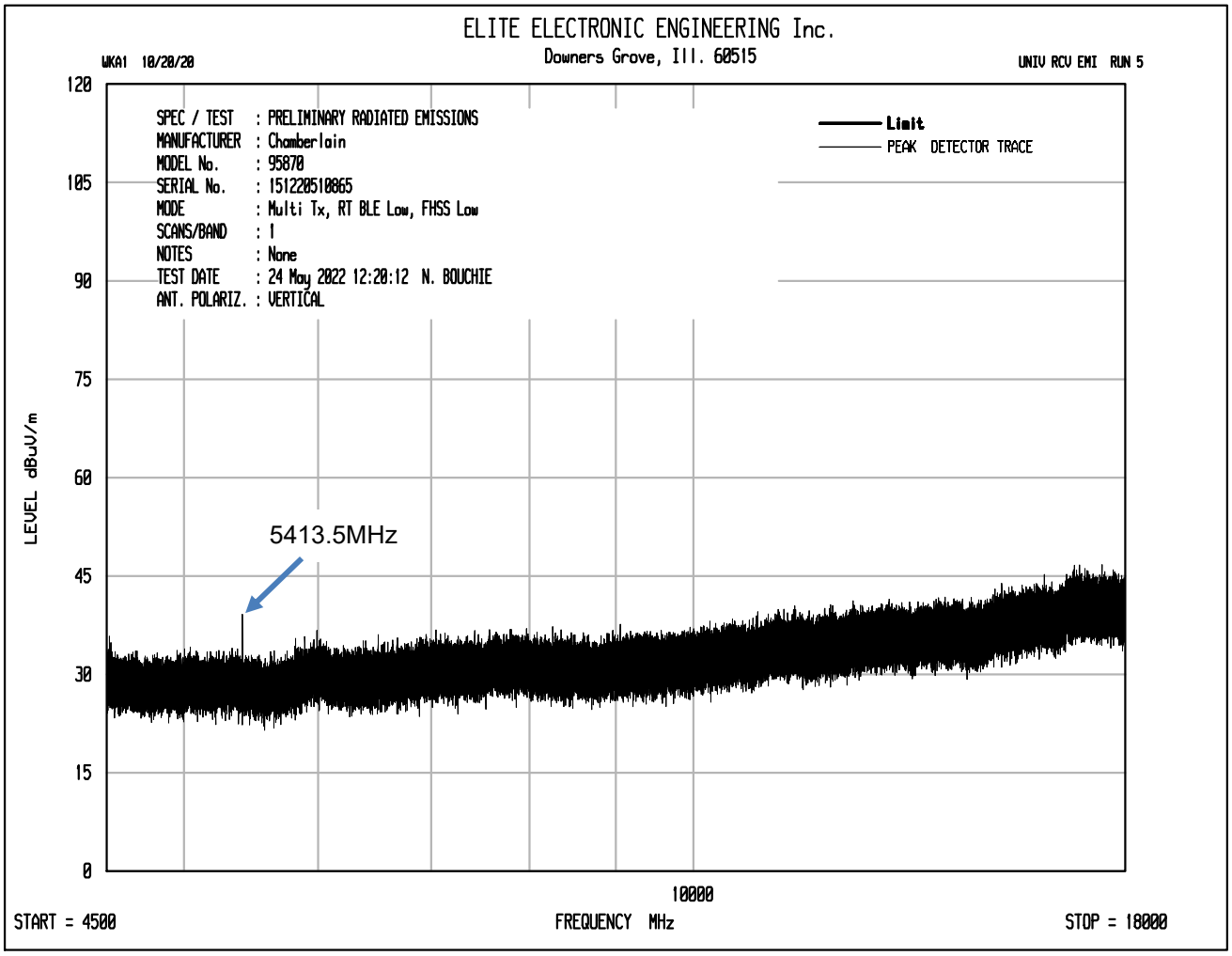
Intermodulation Frequencies:

3609MHz = 4 * 902.25MHz



Intermodulation Frequencies:

5413.5 = 6 * 902.25MHz



Intermodulation Frequencies:

5413.5 = 6 * 902.25MHz

Test Details	
Manufacturer	Chamberlain Group, Inc.
Model No.	003-0458-5
Serial No.	151220510865
Test	Host Product Testing – Intermodulation Case Spurious Emissions
Mode	MultiTx WiFi
Frequencies Tested	Realtek WiFi Low Channel (2412MHz) 900MHz Low Channel (902.25MHz) Security 3.0 BLE Low Channel (2402MHz)
Notes	Fundamental frequencies and their respective harmonics are covered in ETR2201780-02, -03, and -05. Intermodulation frequencies are shown below.

Peak Measurements

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)
1499.75	H	23.6		2.0	29.2	0.0	54.9	557.4	5000.0	-19.1
1499.75	V	25.4		2.0	29.2	0.0	56.6	679.5	5000.0	-17.3
3304.25	H	25.0		3.1	33.4	0.0	61.5	1188.3	79533.2	-36.5
3304.25	V	26.6		3.1	33.4	0.0	63.1	1436.9	79533.2	-34.9
3901.75	H	27.2		3.4	35.1	0.0	65.7	1923.6	5000.0	-8.3
3901.75	V	27.6		3.4	35.1	0.0	66.1	2011.9	5000.0	-7.9

Average Measurements

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)
1499.75	H	9.2		2.0	29.2	0.0	0.0	40.5	105.7	500.0	-13.5
1499.75	V	11.9		2.0	29.2	0.0	0.0	43.2	144.3	500.0	-10.8
3901.75	H	12.6		3.4	35.1	0.0	0.0	51.0	356.5	500.0	-2.9
3901.75	V	12.6		3.4	35.1	0.0	0.0	51.0	356.5	500.0	-2.9

23. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELITE ELECTRONIC ENGINEERING, INC.
1516 Centre Circle
Downers Grove, IL 60515
Robert Bugielski (QA Manager) Phone: 630 495 9770 ext. 168
Email: rbugielski@elitetest.com
Craig Fanning (EMC Lab Manager) Phone: 630 495 9770 ext. 112
Email: cfanning@elitetest.com
Brandon Lugo (Automotive Team Leader) Phone: 630 495 9770 ext. 163
Email: blugo@elitetest.com
Richard King (FCC/Commercial Team Leader) Phone: 630 495 9770 ext. 123
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)

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Test Technology:	Test Method(s) [1]:
Vehicle Radiated Emissions	CISPR 12; CISPR 36; ICES-002; ECE Regulation 10.06 Annex 5
Bulk Current Injection (BCI)	ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1; GMW 3097, Section 3.4.1; SAE J1113-4; EMC-CS-2009.1 (RI112); FMC1278 (RI112); ECE Regulation 10.06 Annex 9
Radiated Immunity Anechoic *(Including Radar Pulse)*	ISO 11452-2; ISO 11452-5; CS-11979, Section 6.2; CS.00054, Section 5.8.2; GMW 3097, Section 3.4.2; EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21; ECE Regulation 10.06 Annex 9
Radiated Immunity Magnetic Field	ISO 11452-8
Radiated Immunity Reverb	ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMC1278 (RI114); ISO 11452-11
Radiated Immunity *(Portable Transmitters)*	ISO 11452-9; EMC-CS-2009.1 (RI115); FMC1278 (RI115)
Vehicle Radiated Immunity (ALSE)	ISO 11451-2; ECE Regulation 10.06 Annex 6
Vehicle Product Specific EMC Standards	EN 14982; EN ISO 13309, ISO 13766; EN 50498; EC Regulation No. 2015/208; EN 55012
Electrical Loads	ISO 16750-2
Emissions Radiated and Conducted (3m Semi-anechoic chamber, up to 40 GHz)	47 CFR, FCC Part 15 B (using ANSI C63.4:2014); 47 CFR, FCC Part 18 (using FCC MP-5:1986); ICES-001; ICES-003; ICES-005; IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004); IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010); KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008); CISPR 11; EN 55011; KS C 9811; CNS 13803 (1997, 2003); CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1; KS C 9814-1; KN 14-1; IEC/CISPR 22 (1997); EN 55022 (1998) + A1(2000); EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006); IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004); AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz); CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz); CISPR 32; EN 55032; KS C 9832; KN 32; ECE Regulation 10.06 Annex 14
Cellular Radiated Spurious Emissions	ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12; ETSI TS 134 124 UMTS; 3GPP TS 34.124; ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124

Test Technology:	Test Method(s) [1]:
Emissions (cont'd)	
Current Harmonics	IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2; KS C 9610-3-2; ECE Regulation 10.06 Annex 11
Flicker and Fluctuations	IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3; KS C 9610-3-3; ECE Regulation 10.06 Annex 12
Immunity	
Electrostatic Discharge	IEC 61000-4-2, Ed. 1.2 (2001); IEC 61000-4-2 (1995) + A1(1998) + A2(2000); EN 61000-4-2 (1995); EN 61000-4-2 (2009-05); KN 61000-4-2 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2; KS C 9610-4-2; IEEE C37.90.3 2001
Radiated Immunity	IEC 61000-4-3 (1995) + A1(1998) + A2(2000); IEC 61000-4-3, Ed. 3.0 (2006-02); IEC 61000-4-3, Ed. 3.2 (2010); KN 61000-4-3 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3; KS C 9610-4-3; IEEE C37.90.2 2004
Electrical Fast Transient/Burst	IEC 61000-4-4, Ed. 2.0 (2004-07); IEC 61000-4-4, Ed. 2.1 (2011); IEC 61000-4-4 (1995) + A1(2000) + A2(2001); KN 61000-4-4 (2008-5); RRL Notice No. 2008-5 (May 20, 2008); IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4; KS C 9610-4-4; ECE Regulation 10.06 Annex 15
Surge	IEC 61000-4-5 (1995) + A1(2000); IEC 61000-4-5, Ed 1.1 (2005-11); EN 61000-4-5 (1995) + A1(2001); KN 61000-4-5 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5; KS C 9610-4-5; IEEE C37.90.1 2012; IEEE STD C62.41.2 2002; ECE Regulation 10.06 Annex 16
Conducted Immunity	IEC 61000-4-6 (1996) + A1(2000); IEC 61000-4-6, Ed 2.0 (2006-05); IEC 61000-4-6 Ed. 3.0 (2008); KN 61000-4-6 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6; EN 61000-4-6; KN 61000-4-6; KS C 9610-4-6

Test Technology:	Test Method(s) [1]:
Immunity (cont'd)	
Power Frequency Magnetic Field Immunity (*Down to 3 A/m*)	IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009); EN 61000-4-8 (1994) + A1(2000); KN 61000-4-8 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8; KS C 9610-4-8
Voltage Dips, Short Interrupts, and Line Voltage Variations	IEC 61000-4-11, Ed. 2 (2004-03); KN 61000-4-11 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11; KS C 9610-4-11
Ring Wave	IEC 61000-4-12, Ed. 2 (2006-09); EN 61000-4-12:2006; IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12; IEEE STD C62.41.2 2002
Generic and Product Specific EMC Standards	IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1; KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2; KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3; AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3; IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4; KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2; EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3; EN 55015; EN 60730-1; EN 60945; IEC 60533; EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2; AS/NZS CISPR 14.2; KN 14-2; KS C 9814-2; IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24; IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35; KS C 9835; IEC 60601-1-2; JIS T0601-1-2
TxRx EMC Requirements	EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17; EN 301 489-19; EN 301 489-20
European Radio Test Standards	ETSI EN 300 086-1; ETSI EN 300 086-2; ETSI EN 300 113-1; ETSI EN 300 113-2; ETSI EN 300 220-1; ETSI EN 300 220-2; ETSI EN 300 220-3-1; ETSI EN 300 220-3-2; ETSI EN 300 330-1; ETSI EN 300 330-2; ETSI EN 300 440-1; ETSI EN 300 440-2; ETSI EN 300 422-1; ETSI EN 300 422-2; ETSI EN 300 328; ETSI EN 301 893; ETSI EN 301 511; ETSI EN 301 908-1; ETSI EN 908-2; ETSI EN 908-13; ETSI EN 303 413; ETSI EN 302 502; EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4

Test Technology:	Test Method(s) [1]:
Canadian Radio Tests	RSS-102 (RF Exposure Evaluation only); RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-247; RSS-248; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN
Mexico Radio Tests	IFT-008-2015; NOM-208-SCFI-2016
Japan Radio Tests	Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18
Taiwan Radio Tests	LP-0002 (July 15, 2020)
Australia/New Zealand Radio Tests	AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)
Hong Kong Radio Tests	HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073
Korean Radio Test Standards	KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52; KS X 3124; KS X 3125; KS X 3130; KS X 3126; KS X 3129
Vietnam Radio Test Standards	QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT; QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT; QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT; QCVN 112:2017/BTTTT; QCVN 117:2020//BTTTT
Vietnam EMC Test Standards	QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT; QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT
Unlicensed Radio Frequency Devices *(3 Meter Semi-Anechoic Room)*	47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))
Licensed Radio Service Equipment	47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101 (using ANSI/TIA-603-E, TIA-102.CAAA-E, ANSI C63.26:2015)

Test Technology:	Test Method(s) [1]:
OTA (Over the Air) Performance	
GSM, GPRS, EGPRS	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
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	
Electrical Measurements and Simulation	
AC Voltage / Current	
(1mV to 5kV) 60 Hz	FAA AC 150/5345-10H
(0.1V to 250V) up to 500 MHz	FAA AC 150/5345-43J
(1µA to 150A) 60 Hz	FAA AC 150/5345-44K
DC Voltage / Current	FAA AC 150/5345-46E
(1mV to 15-kV) / (1µA to 10A)	FAA AC 150/5345-47C
Power Factor / Efficiency / Crest Factor	FAA EB 67D
(Power to 30kW)	
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.1 [2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Unintentional Radiators		
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.1[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	40000
Intentional Radiators Part 15C	ANSI C63.10:2013	40000
Unlicensed Personal Communication Systems Devices Part 15D	ANSI C63.17:2013	40000
U-NII without DFS Intentional Radiators Part 15E	ANSI C63.10:2013	40000
U-NII with DFS Intentional Radiators Part 15E	FCC KDB 905462 D02 (v02)	40000
UWB Intentional Radiators Part 15F	ANSI C63.10:2013	40000
BPL Intentional Radiators Part 15G	ANSI C63.10:2013	40000
White Space Device Intentional Radiators Part 15H	ANSI C63.10:2013	40000
Commercial Mobile Services (FCC Licensed Radio Service Equipment) Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
General Mobile Radio Services (FCC Licensed Radio Service Equipment) 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
Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment) 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[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Maritime and Aviation Radio Services		
Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
Microwave and Millimeter Bands Radio Services		
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
Broadcast Radio Services		
Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Signal Boosters		
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.