



Measurement of RF Interference from an ESARM Evolution Stand Alone Radio Module Transceiver

For	The Chamberlain Group, Inc. 300 Windsor Dr Oak Brook, IL 60523
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Test Personnel	Mark Longinotti
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Frequency Hopping Spread Spectrum Intentional Radiators within the band 902-928MHz Industry Canada RSS-247 Industry Canada RSS-GEN

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THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF ELITE ELECTRONIC ENGINEERING INCORPORATED.

REVISION HISTORY

Revision	Date	Description
—	28 APR 2020	Initial release

Measurement of RF Emissions from an Evolution Stand Alone Radio Module, Part No. ESARM Transceiver

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on The Chamberlain Group, Inc. Evolution Stand Alone Radio Module, Part No. ESARM, transceiver (hereinafter referred to as the EUT). The EUT is a frequency hopping spread spectrum transceiver. The transceiver was designed to transmit in the 902-928MHz band using a 23cm long removable monopole antenna, with a minimum coaxial cable length of 43cm. The EUT was manufactured and submitted for testing by The Chamberlain Group, Inc. located in Oak Brook, IL.

1.2 Purpose

The test series was performed to determine if the EUT (FCC ID: HBW9526 Limited Modular Approval), when placed in the following hosts: MC11 and MC12, meets the Class 2 Permissive Change requirements for FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators Operating within the 902-928MHz band when placed inside a .

The test series was also performed to determine if the EUT (IC ID: 2666A-95269 Limited Modular Approval), when placed in the following hosts: MC11 and MC12, meets the Class 2 Permissive Change requirements for Industry Canada Radio Standards Specification RSS-247 for Transmitters.

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

1.3 Deviations, Additions and Exclusions

The following exclusion from this test series is listed below:

- Unintentional Radiator testing (Radiated Emissions and Conducted Emissions): These tests were performed by Elite Electronic Engineering and test results can be found in reports ETR1902696-02 (for units rated 120VAC and 240VAC) and ETR1902696-03 (for units rated 480VAC and 600VAC).

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the American Association for Laboratory Accreditation (A2LA), A2LA Lab Code: 1786-01.

1.5 Laboratory Conditions

The temperature at the time of the test was 24°C and the relative humidity was 37%.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, 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 9 kHz to 40 GHz"
- 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 Performing Compliance Measurements On Digital Transmissions System, Frequency

Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules,
April 2, 2019

- Industry Canada RSS-247, Issue 2, February 2017, "Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices"

3. EUT SETUP AND OPERATION

3.1 General Description

The EUT is an Evolution Stand Alone Radio Module, Part No. ESARM. The EUT was tested separately with it placed inside a model MC11 Variable Frequency Drive Front of Hood Mount Operator and with it placed inside a model MC21 Variable Frequency Drive Front of Hood Mount Operator. A block diagram of the EUT setup is shown as Figure 1 and a photograph of the EUT is shown as Figure 2.

3.1.1 Power Input

The MC11 Variable Frequency Drive Front of Hood Mount Operator, in which the EUT was placed, obtained 120VAC 60Hz power via a 3 wire, 6.5 foot long, unshielded power cord.

The MC21 Variable Frequency Drive Front of Hood Mount Operator, in which the EUT was placed, obtained 240VAC 60Hz power via a 3-wire, 6.5 ft, unshielded power cord.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Powerhead	Includes the motor, gearbox, and brake.
Control Box	Main control box for equipment.
Photo eyes	Two (2) used during testing.

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the EUT:

Item	Description
VFD Cable	41ft
Encoder Cable	41ft
Photo eye Cable	Approximately 3ft
Photo eye Cable	Approximately 3ft

3.1.4 Grounding

The EUT was grounded only through the third wire of its input power cord.

3.2 Software

For all tests, the EUT had Firmware Version 4.1 loaded onto the device to provide correct load characteristics.

3.3 Operational Mode

The EUT was energized. The unit was programmed to operate in one of the following modes:

- Transmit at 902.25MHz
- Transmit at 914.75MHz
- Transmit at 926.75MHz

3.4 EUT Modifications

No modifications were required for compliance.

4. TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

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

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission tests were performed with an EMI receiver which utilizes the bandwidths and detectors specified by the FCC.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence) are presented below:

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

5. TEST PROCEDURES

5.1 Transmitter

5.1.1 Peak Output Power

5.1.1.1 Requirements

Per section FCC 15.247(b)(2) and RSS-247 Section 5.4, for frequency hopping systems operating in the 902-928MHz band and employing at least 50 hopping channels, the maximum peak output conducted power shall not be greater than 1W (30dBm). Per section 15.247(b)(4) and RSS-247 Section 5.4, this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).

If transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below 30dBm by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.1.1.2 Procedures

The EUT was placed on the non-conductive stand and set to transmit. A bilog 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 20dB bandwidth. The span was set to approximately 5 times the 20 dB 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 hopping frequencies.

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 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 as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.1.1.3 Results

The results are presented on pages 16 and 17. The maximum EIRP measured from the transmitter was 0.0069W (8.4dBm), which is below the 4 Watt limit. Photographs of the test configuration are shown in Figure 3.

5.1.2 Duty Cycle Factor Measurements

5.1.2.1 Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

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 200usec/div. The amplitude settings are adjusted so that the on/off transitions clear the 5th division from the bottom of the display. The markers are set at the beginning and end of the "on-time". The trace is recorded.

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 that exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.1.2.2 Results

See Elite Electronic Engineering Test Report No. 1902696-01 Rev. A for plots and calculations. The duty cycle correction factor was calculated to be -37.6dB.

5.1.3 Radiated Spurious Emissions Measurements

5.1.3.1 Requirements

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.1.3.2 Procedures

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 10.0GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 10.0GHz

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 bilog 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 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 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 1 GHz 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 1 GHz 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 1 MHz 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 1 GHz, 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 1 GHz, 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 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

5.1.3.3 Results

Final radiated emissions data is presented on data pages 18 through 29. As can be seen from the data, all emissions measured from the EUT were within the specification limits. Photographs of the test configuration which yielded the highest radiated emission levels are shown in Figure 4.

6. CONCLUSIONS

It was determined that The Chamberlain Group, Inc. Evolution Stand Alone Radio Module, Part No. ESARM, frequency hopping spread spectrum transceiver, FCC ID: HBW9526, when placed inside either an MC11 or MC21 Variable Frequency Drive Front of Hood Mount Operator, did fully meet the Class 2 Permissive Change requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators Operating within the 902-928MHz band, when tested per ANSI C63.10-2013.

It was also determined that The Chamberlain Group, Inc. Evolution Stand Alone Radio Module, Part No. ESARM frequency hopping spread spectrum transceiver, IC ID: 2666A-6526, when placed inside either an MC11 or MC21 Variable Frequency Drive Front of Hood Mount Operator did fully meet the Class 2 Permissive Change requirements of the Industry Canada Radio Standards Specification RSS-247 for transmitters, when tested per ANSI C63.4-2014.

7. 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 test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

8. ENDORSEMENT DISCLAIMER

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST or any agency of the Federal Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW14	PREAMPLIFIER	PLANAR	PE2-35-120-5R0-10-12-SFF	PL22671	1-20GHz	9/25/2019	9/25/2020
CDY0	WORKSTATION	ELITE	WORKSTATION		WINDOWS 7	N/A	
GRE1	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	2/22/2019	2/22/2020
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	6/28/2018	6/28/2020
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	12/20/2018	12/20/2019
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/31/2018	5/31/2020
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	2/20/2019	2/20/2020
SHA0	DC POWER SUPPLY	HEWLETT PACKARD	6642A	MY40000116	0-20V/0-10A	NOTE 1	
SHC2	Power Supplies	HENGFU	HF60W-SL-24	A11372702	24V	NOTE 1	
T2SB	20DB 25W ATTENUATOR	WEINSCHEL	46-20-34	DC5014	DC-18GHZ	4/23/2018	4/23/2020
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	
XPQ3	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	4	1.8GHZ-10GHZ	9/6/2019	9/6/2021

I/O: Initial Only

N/A: Not Applicable

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.

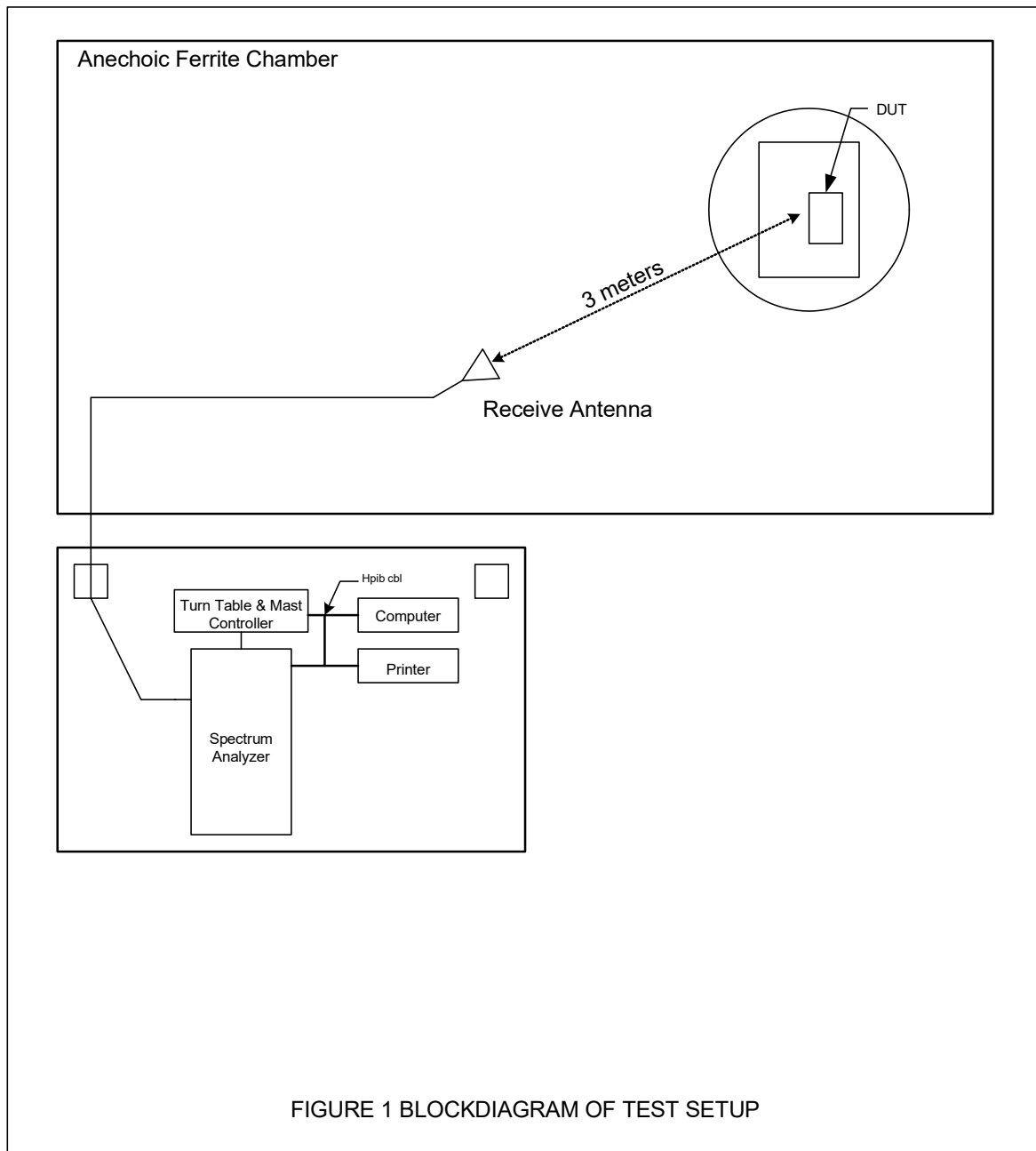
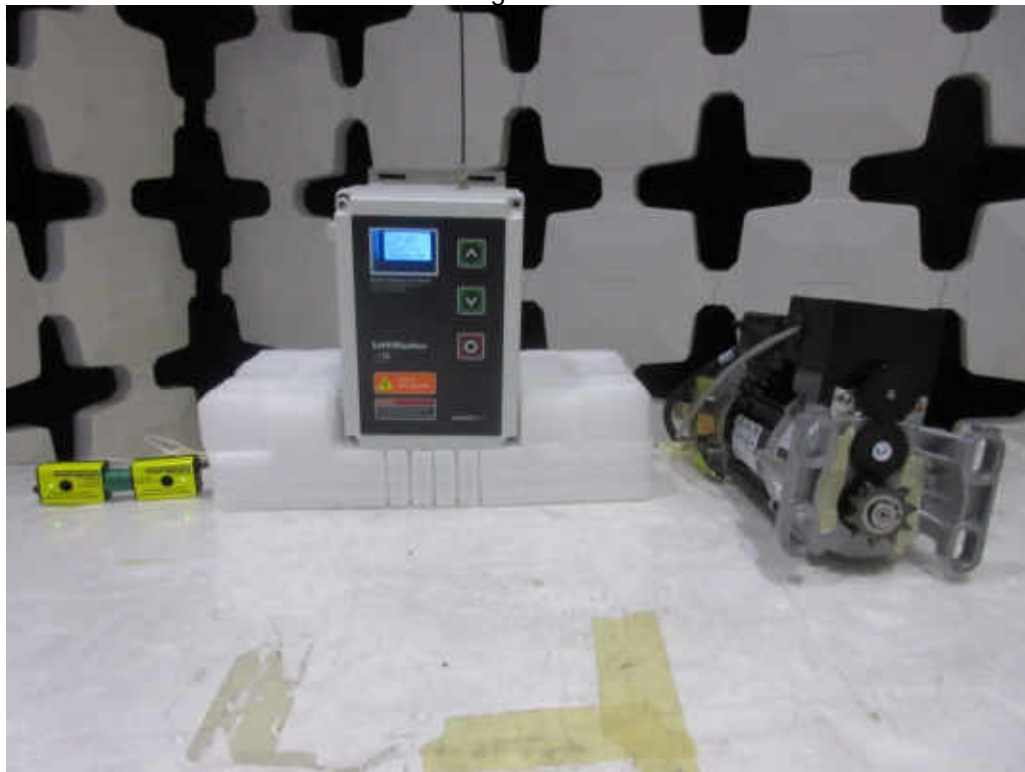


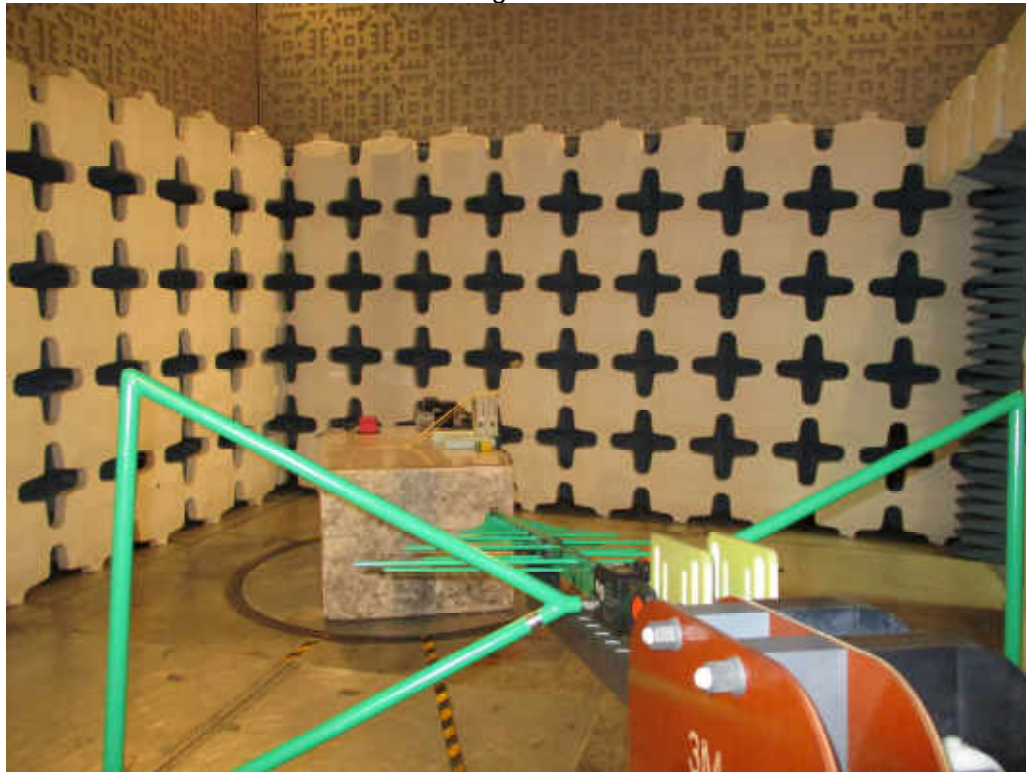
Figure 2



Test Setup



Figure 3



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



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

Figure 4



Test Setup for Radiated Emissions – 1GHz to 10GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 1GHz to 10GHz, Vertical Polarization



Manufacturer : The Chamberlain Group, Inc.
Test Item : Evolution Stand Alone Radio Module
Model No. : ESARM
Mode : Transmit
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : September 19 - 23, 2019
Test Distance : 3 meters
Notes : 120VAC 60Hz, tested inside an MC11 Variable Frequency Drive Front of Hood Mount
: Operator

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
902.25	H	73.2	3.3	2.2	1.6	3.8	36.0	-32.2
902.25	V	75.7	6.0	2.2	1.6	6.6	36.0	-29.4
914.75	H	73.1	3.3	2.2	1.6	3.8	36.0	-32.2
914.75	V	73.8	4.3	2.2	1.6	4.8	36.0	-31.2
926.75	H	71.9	2.2	2.2	1.7	2.7	36.0	-33.3
926.75	V	71.4	2.1	2.2	1.7	2.6	36.0	-33.4



Manufacturer : The Chamberlain Group, Inc.
Test Item : Evolution Stand Alone Radio Module
Model No. : ESARM
Mode : Transmit
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : September 19 - 23, 2019
Test Distance : 3 meters
Notes : 240VAC 60Hz, tested inside an MC21 Variable Frequency Drive Front of Hood Mount
: Operator

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
902.25	H	73.3	3.4	2.2	1.6	3.9	36.0	-32.1
902.25	V	75.0	5.3	2.2	1.6	5.9	36.0	-30.1
914.75	H	72.6	2.8	2.2	1.6	3.3	36.0	-32.7
914.75	V	72.3	2.8	2.2	1.6	3.3	36.0	-32.7
926.75	H	72.7	3.0	2.2	1.7	3.5	36.0	-32.5
926.75	V	77.2	7.9	2.2	1.7	8.4	36.0	-27.6

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 902.25MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version, tested inside an MC11 Variable Frequency Drive Front of
 : Hood Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2706.75	H	48.4	Ambient	3.7	33.5	-40.2	45.4	186.0	5000.0	-28.6
2706.75	V	47.2	Ambient	3.7	33.5	-40.2	44.2	162.0	5000.0	-29.8
3609.00	H	50.8	Ambient	4.3	34.2	-39.5	49.7	306.5	5000.0	-24.3
3609.00	V	51.2	Ambient	4.3	34.2	-39.5	50.1	320.9	5000.0	-23.9
4511.25	H	50.7	Ambient	4.7	36.0	-39.6	51.8	388.0	5000.0	-22.2
4511.25	V	50.7	Ambient	4.7	36.0	-39.6	51.8	388.0	5000.0	-22.2
5413.50	H	50.5	Ambient	5.1	36.8	-39.5	53.0	445.9	5000.0	-21.0
5413.50	V	50.5	Ambient	5.1	36.8	-39.5	53.0	445.9	5000.0	-21.0

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 902.25MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version, tested inside an MC11 Variable Frequency Drive Front of Hood Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2706.75	H	48.40	Ambient	3.7	33.5	-40.2	-37.6	7.8	2.5	500.0	-46.2
2706.75	V	47.2	Ambient	3.7	33.5	-40.2	-37.6	6.6	2.1	500.0	-47.4
3609.00	H	50.8	Ambient	4.3	34.2	-39.5	-37.6	12.1	4.0	500.0	-41.9
3609.00	V	51.2	Ambient	4.3	34.2	-39.5	-37.6	12.5	4.2	500.0	-41.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 914.75MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version, tested inside an MC11 Variable Frequency Drive Front of
 : Hood Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2744.25	H	48.8	Ambient	3.7	33.7	-40.2	46.1	201.2	5000.0	-27.9
2744.25	V	47.9	Ambient	3.7	33.7	-40.2	45.2	181.4	5000.0	-28.8
3659.00	H	50.7	Ambient	4.3	34.6	-39.5	50.0	317.0	5000.0	-24.0
3659.00	V	51.0	Ambient	4.3	34.6	-39.5	50.3	328.1	5000.0	-23.7
4573.75	H	49.9	Ambient	4.7	36.2	-39.7	51.1	359.0	5000.0	-22.9
4573.75	V	49.5	Ambient	4.7	36.2	-39.7	50.7	342.9	5000.0	-23.3

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 914.75MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version tested inside an MC11 Variable Frequency Drive Front of Hood
 : Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2744.25	H	48.80	Ambient	3.7	33.7	-40.2	0.0	46.1	201.2	500.0	-7.9
2744.25	V	47.9	Ambient	3.7	33.7	-40.2	0.0	45.2	181.4	500.0	-8.8
3659.00	H	50.7	Ambient	4.3	34.6	-39.5	0.0	50.0	317.0	500.0	-4.0
3659.00	V	51.0	Ambient	4.3	34.6	-39.5	0.0	50.3	328.1	500.0	-3.7
4573.75	H	49.9	Ambient	4.7	36.2	-39.7	0.0	51.1	359.0	500.0	-2.9
4573.75	V	49.5	Ambient	4.7	36.2	-39.7	0.0	50.7	342.9	500.0	-3.3

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 926.75MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version tested inside an MC11 Variable Frequency Drive Front of Hood
 : Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2780.25	H	49.3	Ambient	3.7	33.4	-40.1	46.3	205.9	5000.0	-27.7
2780.25	V	49.3	Ambient	3.7	33.4	-40.1	46.3	205.9	5000.0	-27.7
3707.00	H	50.5	Ambient	4.3	34.5	-39.5	49.8	309.7	5000.0	-24.2
3707.00	V	50.2	Ambient	4.3	34.5	-39.5	49.5	299.2	5000.0	-24.5
4633.75	H	48.6	Ambient	4.8	36.4	-39.6	50.1	321.5	5000.0	-23.8
4633.75	V	47.5	Ambient	4.8	36.4	-39.6	49.0	283.3	5000.0	-24.9

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 926.75MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 120VAC 60Hz version, tested inside an MC11 Variable Frequency Drive Front of Hood Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2780.25	H	49.30	Ambient	3.7	33.4	-40.1	0.0	46.3	205.9	500.0	-7.7
2780.25	V	49.3	Ambient	3.7	33.4	-40.1	0.0	46.3	205.9	500.0	-7.7
3707.00	H	50.5	Ambient	4.3	34.5	-39.5	0.0	49.8	309.7	500.0	-4.2
3707.00	V	50.2	Ambient	4.3	34.5	-39.5	0.0	49.5	299.2	500.0	-4.5
4633.75	H	48.6	Ambient	4.8	36.4	-39.6	0.0	50.1	321.5	500.0	-3.8
4633.75	V	47.5	Ambient	4.8	36.4	-39.6	0.0	49.0	283.3	500.0	-4.9

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 902.25MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version; tested inside an MC21 Variable Frequency Drive Front of
 : Hood Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2706.75	H	47.3		3.7	33.5	-40.2	44.3	163.9	5000.0	-29.7
2706.75	V	47.3		3.7	33.5	-40.2	44.3	163.9	5000.0	-29.7
3609.00	H	51.1	Ambient	4.3	34.2	-39.5	50.0	317.3	5000.0	-24.0
3609.00	V	51.3	Ambient	4.3	34.2	-39.5	50.2	324.7	5000.0	-23.8
4511.25	H	50.4	Ambient	4.7	36.0	-39.6	51.5	374.9	5000.0	-22.5
4511.25	V	50.4	Ambient	4.7	36.0	-39.6	51.5	374.9	5000.0	-22.5
5413.50	H	51.2	Ambient	5.1	36.8	-39.5	53.7	483.3	5000.0	-20.3
5413.50	V	50.7	Ambient	5.1	36.8	-39.5	53.2	456.3	5000.0	-20.8

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 902.25MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version tested inside an MC21 Variable Frequency Drive Front of Hood
 : Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2706.75	H	47.30		3.7	33.5	-40.2	-37.6	6.7	2.2	500.0	-47.3
2706.75	V	47.3		3.7	33.5	-40.2	-37.6	6.7	2.2	500.0	-47.3
3609.00	H	51.1	Ambient	4.3	34.2	-39.5	-37.6	12.4	4.2	500.0	-41.6
3609.00	V	51.3	Ambient	4.3	34.2	-39.5	-37.6	12.6	4.3	500.0	-41.4
4511.25	H	50.4	Ambient	4.7	36.0	-39.6	-37.6	13.9	4.9	500.0	-40.1
4511.25	V	50.4	Ambient	4.7	36.0	-39.6	-37.6	13.9	4.9	500.0	-40.1
5413.50	H	51.2	Ambient	5.1	36.8	-39.5	-37.6	16.1	6.4	500.0	-37.9
5413.50	V	50.7	Ambient	5.1	36.8	-39.5	-37.6	15.6	6.0	500.0	-38.4

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 914.75MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version, tested inside an MC21 Variable Frequency Drive Front of
 : Hood Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2744.25	H	48.2	Ambient	3.7	33.7	-40.2	45.5	187.8	5000.0	-28.5
2744.25	V	48.5	Ambient	3.7	33.7	-40.2	45.8	194.4	5000.0	-28.2
3659.00	H	51.2	Ambient	4.3	34.6	-39.5	50.5	335.7	5000.0	-23.5
3659.00	V	50.8	Ambient	4.3	34.6	-39.5	50.1	320.6	5000.0	-23.9
4573.75	H	49.5	Ambient	4.7	36.2	-39.7	50.7	342.9	5000.0	-23.3
4573.75	V	49.9	Ambient	4.7	36.2	-39.7	51.1	359.0	5000.0	-22.9

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 914.75MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version, tested inside an MC21 Variable Frequency Drive Front of Hood Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2744.25	H	48.20	Ambient	3.7	33.7	-40.2	-37.6	7.9	2.5	500.0	-46.1
2744.25	V	48.5	Ambient	3.7	33.7	-40.2	-37.6	8.2	2.6	500.0	-45.8
3659.00	H	51.2	Ambient	4.3	34.6	-39.5	-37.6	12.9	4.4	500.0	-41.1
3659.00	V	50.8	Ambient	4.3	34.6	-39.5	-37.6	12.5	4.2	500.0	-41.5
4573.75	H	49.5	Ambient	4.7	36.2	-39.7	-37.6	13.1	4.5	500.0	-40.9
4573.75	V	49.9	Ambient	4.7	36.2	-39.7	-37.6	13.5	4.7	500.0	-40.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 926.75MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version, tested inside an MC21 Variable Frequency Drive Front of
 : Hood Mount Operator
 : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2780.25	H	48.9	Ambient	3.7	33.4	-40.1	45.9	196.6	5000.0	-28.1
2780.25	V	48.6	Ambient	3.7	33.4	-40.1	45.6	189.9	5000.0	-28.4
3707.00	H	50.8	Ambient	4.3	34.5	-39.5	50.1	320.6	5000.0	-23.9
3707.00	V	50.8	Ambient	4.3	34.5	-39.5	50.1	320.6	5000.0	-23.9
4633.75	H	48.2	Ambient	4.8	36.4	-39.6	49.7	307.1	5000.0	-24.2
4633.75	V	48.7	Ambient	4.8	36.4	-39.6	50.2	325.3	5000.0	-23.7

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Manufacturer : The Chamberlain Group, Inc.
 Test Item : Evolution Stand Alone Radio Module
 Model No. : ESARM
 Mode : Transmit at 926.75MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : September 19 - 23, 2019
 Test Distance : 3 meters
 Notes : 240VAC 60Hz version, tested inside an MC21 Variable Frequency Drive Front of Hood Mount Operator

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2780.25	H	48.90	Ambient	3.7	33.4	-40.1	-37.6	8.3	2.6	500.0	-45.7
2780.25	V	48.6	Ambient	3.7	33.4	-40.1	-37.6	8.0	2.5	500.0	-46.0
3707.00	H	50.8	Ambient	4.3	34.5	-39.5	-37.6	12.5	4.2	500.0	-41.5
3707.00	V	50.8	Ambient	4.3	34.5	-39.5	-37.6	12.5	4.2	500.0	-41.5
4633.75	H	48.2	Ambient	4.8	36.4	-39.6	-37.6	12.1	4.0	500.0	-41.8
4633.75	V	48.7	Ambient	4.8	36.4	-39.6	-37.6	12.6	4.3	500.0	-41.3

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle