Amber Helm Development L.C.
92723 Michigan Hwy-152
Sister Lakes, Michigan 49047 USA
Tel: 888-847-8027

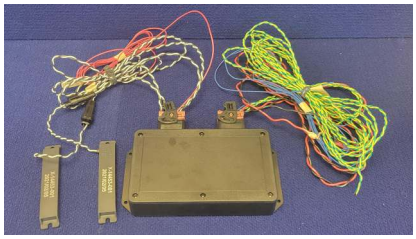
MOL566-WR2221NS
Issued: **July 28, 2022**

Nerve Stimulation Report

regarding

Canada: ISED RSS-102 + SPR-002 (Exposure)

for



49013566

Category: LF Transmitter

Judgments:
RSS-102v5/SPR-002v1 Compliant Transmitter
Testing Completed: July 14, 2022

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

Morgan Olson, LLC

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Data Rec./Rev. by: Dr. Joseph Brunett, EMC-002790-NE

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Rpt. Prep./Rev. by: John Nantz

Date of Issue: July 28, 2022

Revision History

Rev. No.	Date	Details	Revised By
r0	July 28, 2022	Initial Release.	J. Brunett

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1 Test Report Scope and Limitations

1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: US5348 and US5356) and with ISED Canada, Ottawa, ON (File Ref. No: 3161A and 24249). Amber Helm Development L.C. holds accreditation under NVLAP Lab Code 200129-0.

1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until August 2032.

1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

1.4 Test Data

This test report contains data included within the laboratory's scope of accreditation. Any data in this report that is not covered under the laboratory's scope is clearly identified.

1.5 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

1.6 Copyright

This report shall not be reproduced, except in full, without the written approval of Amber Helm Development L.C.

1.7 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

1.8 Test Location

The EUT was fully tested by **Amber Helm Development L.C.**, headquartered at 92723 Michigan Hwy-152, Sister Lakes, Michigan 49047 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1: Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	3615 E Grand River Rd., Williamston, Michigan 48895	OATSC

1.9 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Amber Helm Development L.C. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Cal/Ver By / Date Due
Spectrum Analyzer	R & S / FSV30	101660	RSFSV30001	RS / Apr-2023
10cm E-field Probe	GalaxEMC / EM-E	022	EFPGALX101	Keysight / Aug-2024
10cm H-field Probe	GalaxEMC / EM-H	018	HFPGALX101	Keysight / Aug-2024
BNC-BNC Coax	WRTL / RG58/U	001	CAB001-BLACK	AHD / Sept-2022

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Morgan Olson, LLC is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Morgan Olson, LLC 49013566 for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
Canada	ISED Canada	ISED RSS-102 + SPR-002

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"
ISED Canada	"The Measurement of Occupied Bandwidth"
ISED Canada RSS-102	"Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)"
ISED Canada SPR-002	"Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits."

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The equipment under test is a control module containing an LF transmitter for automotive use. The EUT is approximately 15 x 24 x 4 cm in dimension, and is depicted in Figure 1. It is powered by 13.4 VDC automotive power system. In use, this device is permanently installed in a motor vehicle. Table 3 outlines provider declared EUT specifications.

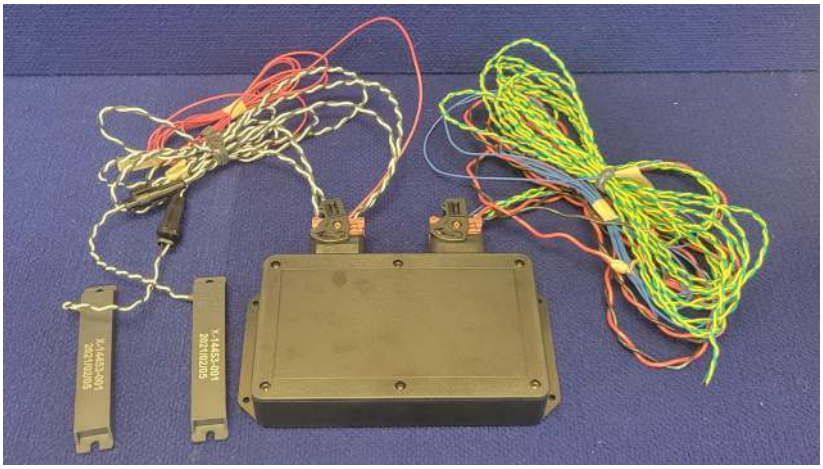

Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	LF Transmitter
Country of Origin:	Not Declared
Nominal Supply:	13.4 VDC
Oper. Temp Range:	Not Declared
Frequency Range:	134.5 kHz
Antenna Dimension:	Not Declared
Antenna Type:	Ferrite Coil
Antenna Gain:	Not Declared
Number of Channels:	1
Channel Spacing:	Not Applicable
Alignment Range:	Not Declared
Type of Modulation:	ASK

Canada	
IC Number:	28701-23001MCM20
Classification:	Remote Control Device

3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

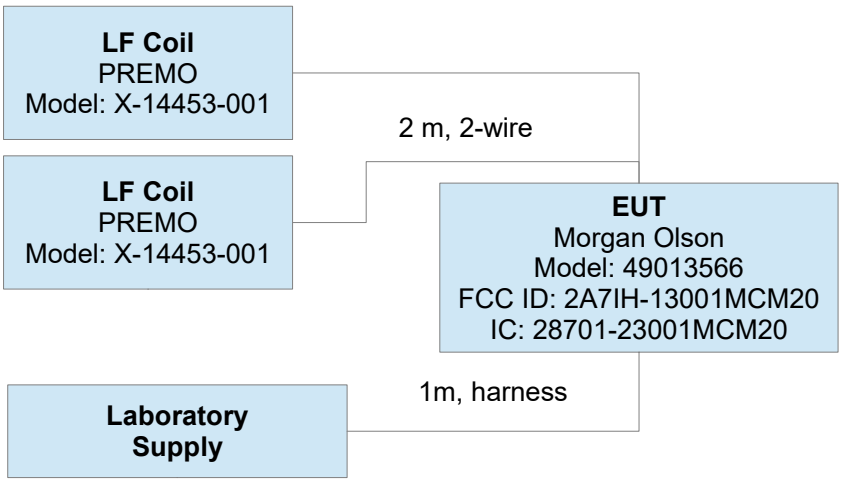

Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

This device is capable of a PE manually activated transmission where both coils are fired sequentially to determine FOB location, and a PS manually activated transmission where only a single coil is fired to determine fob presence. Both modes are fully tested herein.

3.1.3 Variants

There is only a single variant of the EUT, as tested.

3.1.4 Test Samples

One sample in total was for testing.

3.1.5 Functional Exerciser

EUT functionality was verified by observation of transmitted signal.

3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003). The integrated UHF 433.92 MHz receiver employed in this product had been tested following SDoC procedures, and is not addressed in this report.

4 Emissions

4.1 General Test Procedures

4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our screen room. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.8 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded. If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied.

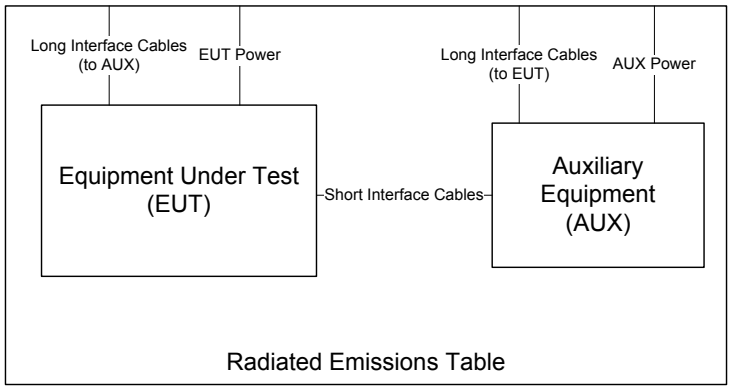

Figure 3: Radiated Emissions Diagram of the EUT.

For devices with intentional emissions below 30 MHz, a shielded loop antenna and/or E-field and H-Field broadband probes are used depending on the regulation. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, 10cm diameter single-axis broadband probes meeting the requirements of ISED SPR-002 section 5.2 are employed. Measurements are repeated and summed over three axes, and the entire frequency range is measured with and without the EUT transmitting.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain or broadband ridge-horn antennas on our OATS with a 4×5 m rectangle of ECCOSORB absorber covering the OATS ground screen and a 1.5m table height. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

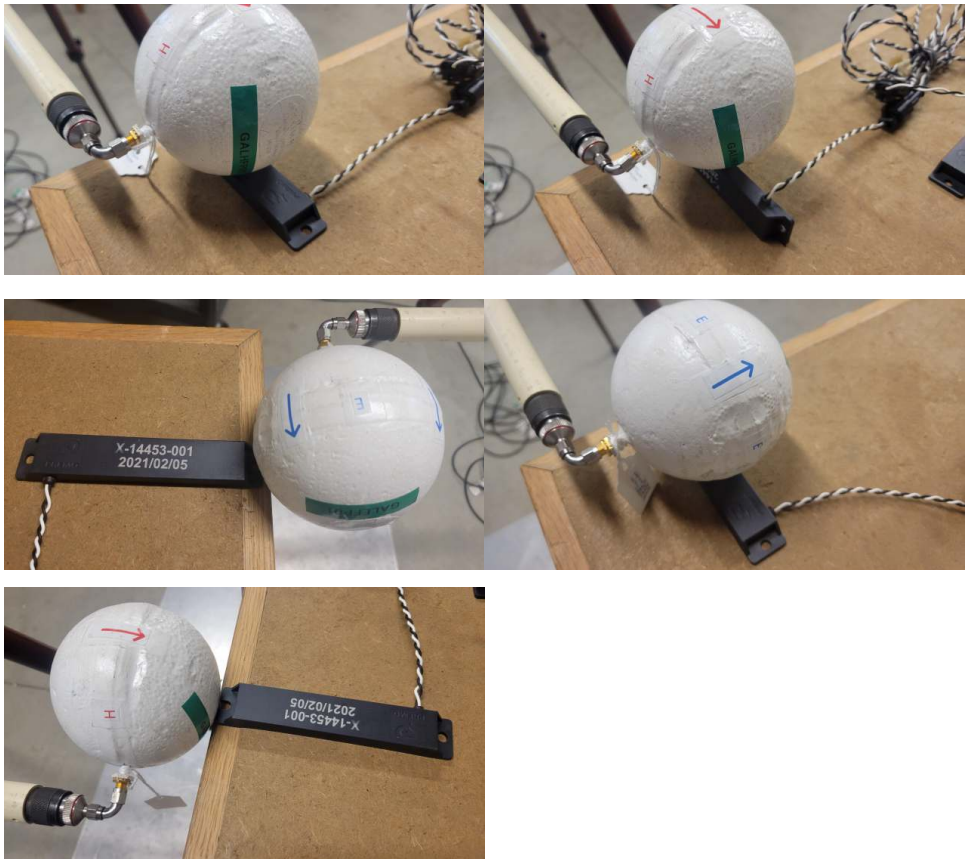

Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

4.2 RF Exposure

4.2.1 Exposure and Potential Health Hazard

To demonstrate compliance with regulations that place limitations on human electromagnetic field exposure for both the general public and for workers, we compute field strengths from measured emission data. These levels are compared with limits placed by the directives and recommendations detailed in Section 2.1. Table 4 details the results of these computations.

Table 4(a): Electromagnetic Field Exposure.

USA REF: 1.1310, 2.1091/1093, 447498 D01 General RF Exposure Guidance v06
IC REF: RSS-102 Issue 5, Safety Code 6 (AVERAGE FIELD LIMITS)
Application: Mobile

Test Date: 14-Jul-22
Test Engineer: Joseph D. Brunett
EUT: MO MCM
EUT Mode: PE
Meas. Distance: 3 meters

					Canada ISED RSS-102 MPE			USA FCC 1.1310 MPE		
Mode	Freq. MHz	Worst Case E3(Pk)* dBuV/m	E20cm(Avg) dBuV/m	H20cm(Avg) dBuA/m	SC6 Limit (E20cm) dBuV/m	SC6 Limit (H20cm) dBuA/m	MPE Ratio worst case	E20cm Limit*** dBuV/m	H20cm Limit*** dBuA/m	MPE Ratio worst case
PE	0.13450	104.4	151.4	100.1		134.7	0.019	175.8	124.2	0.062
						MPE Total	**.019**			**MPE Total**	**.062**
						Complies?	**Yes**			Complies?	**Yes**

*As Measured / Computed from highest fundamental emission, see fundamental emission section of RF Test report. Peak data applied to average limit – no averaging applied.
**EIRP, as computed from Modular Device RF Exposure Exhibits.
*** For FCC MPE, use of 300 kHz limit at 125 kHz as recommended by FCC.
**** EIRP (mW) = S (mW/cm^2) x 4 x PI x 20cm^2

Table 4(b): Electromagnetic Field Exposure.

Frequency Range	**Det**	**IF Bandwidth**	30 kHz	**Test Date:**	07/14/22
3 kHz ≤ f ≤ 10 MHz	Pk	**Video Bandwidth**	100 kHz	**Test Engineer:**	Joseph D Brunett
Min. Separation Distance: 0 mm (touching antennas)				**Meas. Distance:**	0 mm
Loop Antenna Classification: Small				**EUT Tested:**	MO MCM
Application: Mobile (installed in vehicle chassis)					

#	Mode	EUT Side	Sensor Field Axis	Sensor Used	E-field (Pk) dBuV/m	Total E-field (Pk) Hands/Legs/Core V/m	ISED NS E-Field Limit Hands V/m	Legs V/m	Core V/m	Pass By (dB)
1	PE & PS	Front	x	EFPGALX101	147.3	62.9	415.0	124.5	83.0	**26.1**
2			y		154.9					
3			z		145.2					
4		Back	x		144.9	51.3	415.0	124.5	83.0	30.0
5			y		153.4					
6			z		141.2					
7		Right	x		147.2	32.6	415.0	124.5	83.0	34.0
8			y		147.0					
9			z		136.0					
10		Left	x		145.6	33.0	415.0	124.5	83.0	34.0
11			y		148.0					
12			z		139.9					
13		Top	x		147.2	30.0	415.0	124.5	83.0	34.5
14			y		144.3					
15			z		140.2					
16		Bottom	x		144.5	26.9	415.0	124.5	83.0	35.0
17			y		145.6					
18			z		139.0					

#	Mode	EUT Side	Sensor Orientation	Ant. Used	H-field (Pk) dBuA/m	Total H-field (Pk) Hands/Legs/Core A/m	ISED NS H-Field Limit Hands A/m	Legs A/m	Core A/m	Pass By (dB)
19	PE & PS	Front	x	HFPGALX101	139.4	24.8	450.0	135.0	90.0	36.3
20			y		146.2					
21			z		140.5					
22		Back	x		139.4	23.1	450.0	135.0	90.0	36.5
23			y		146.3					
24			z		132.5					
25		Right	x		137.7	35.9	450.0	135.0	90.0	34.7
26			y		150.4					
27			z		141.2					
28		Left	x		135.2	39.9	450.0	135.0	90.0	34.0
29			y		151.3					
30			z		143.2					
31		Top	x		134.9	44.8	450.0	135.0	90.0	**33.1**
32			y		152.8					
33			z		138.7					
34		Bottom	x		144.2	43.2	450.0	135.0	90.0	33.4
35			y		151.3					
36			z		144.1					

*Worst case field strength data is reported over the entire band. It is noted that harmonics / spurious measured were more than 20 dBc.

5 Measurement Uncertainty and Accreditation Documents

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 5: Measurement Uncertainty.

Measured Parameter	Measurement Uncertainty†
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\text{Hz})$
Conducted Emm. Amplitude	$\pm 1.9\,\text{dB}$
Radiated Emm. Amplitude ($f < 30\,\text{MHz}$)	$\pm 3.1\,\text{dB}$
Radiated Emm. Amplitude ($30 - 200\,\text{MHz}$)	$\pm 4.0\,\text{dB}$
Radiated Emm. Amplitude ($200 - 1000\,\text{MHz}$)	$\pm 5.2\,\text{dB}$
Radiated Emm. Amplitude ($f > 1000\,\text{MHz}$)	$\pm 3.7\,\text{dB}$

†Ref: CISPR 16-4-2:2011+A1:2014


United States Department of Commerce
National Institute of Standards and Technology

NVLAP® ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200129-0

AHD (Amber Helm Development, L.C.)
Sister Lakes, MI

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2022-06-28 through 2023-06-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Figure 5: Accreditation Documents