Amber Helm Development L.C.
92723 Michigan Hwy-152
Sister Lakes, Michigan 49047 USA
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LRFOBC-WR2235TXB
Issued: **April 18, 2023**

EMC Test Report

regarding

USA: CFR Title 47, Part 15.519 (Emissions)
Canada: ISED RSS-220 i1+A1 (Emissions)

for

FOBU3

Category: UWB Transceiver

Judgments:
Part 15.519, ISED RSS-220 Compliant
Testing Completed: April 17, 2023

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

Lear Corporation

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Date of Issue: April 18, 2023

Revision History

Rev. No.	Date	Details	Revised By
r0	April 18, 2023	Initial Release.	J. Brunett
r1	May 28, 2023	Typo corrections.	J. Brunett
r2	September 14, 2023	Added Spur Plots	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 May 2033.

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

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	RSFSV3001	RS / Apr-2024
EMI Receiver	R & S / ESW26	101313	RSESW2601	RS / October-2023
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2025
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2025
BNC-BNC Coax	WRTL / RG58/U	001	CAB001-BLACK	AHD / Sept-2023
3.5-3.5MM Coax	PhaseFlex / PhaseFlex	001	CAB015-PURP	AHD / Sept-2023
Harmonic Mixer	Hewlett Packard / 11970A	MY3003A1226	MIX26TO4001	AHD / Mar-2025
K-Band Horn	JEF / NRL Std.	001	HRNK01	AHD / Jul-2024
Ka-Band Horn	JEF / NRL Std.	001	HRNKA001	AHD / Jul-2024
Quad Ridge Horn	Singer / A6100	C35200	HQR1TO18S01	Keysight / Aug-2024

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Lear Corporation 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 Lear Corporation FOBU3 for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
United States	Code of Federal Regulations	CFR Title 47, Part 15.519
Canada	ISED Canada	ISED RSS-220 i1+A1

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.

ANSI C63.4:2014	"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"
TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"
ICES-003; Issue 7 (2020)	"Information Technology Equipment (ITE) - Limits and methods of measurement"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The equipment under test is an Automotive UWB Transceiver. The EUT is approximately 7 x 4 x 1.5 cm in dimension, and is depicted in Figure 1. It is powered by 3 VDC Lithium cell battery. In use, this device is hand held Table 3 outlines provider declared EUT specifications.

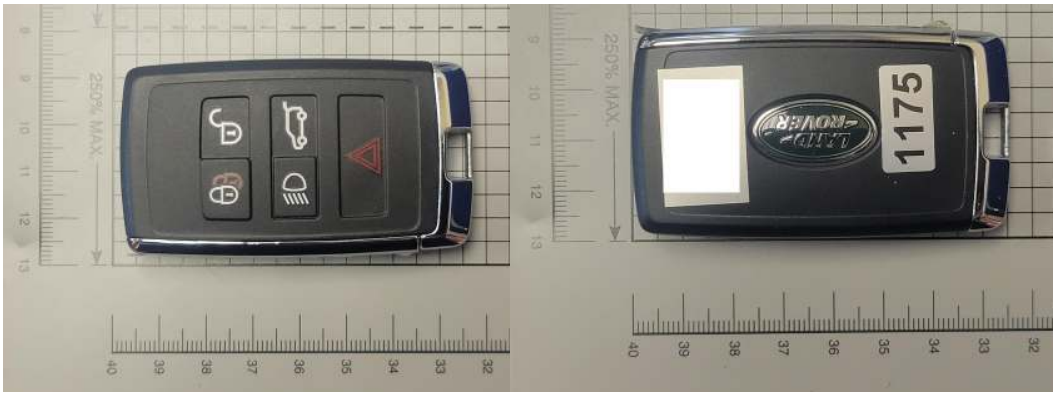


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	UWB Transceiver
Country of Origin:	China
Nominal Supply:	3 VDC
Oper. Temp Range:	-30^{o}C to $+60^{o}$C
Frequency Range:	$3615 - 4337$ MHz
Antenna Dimension:	3 cm
Antenna Type:	Integral
Antenna Gain:	Not Declared
Number of Channels:	1
Channel Spacing:	Not Applicable
Alignment Range:	Not Declared
Type of Modulation:	PPM
United States	
FCC ID Number:	KOBJXF23A
Classification:	15F
Canada	
IC Number:	3521A-JXF23A
Classification:	Hand Held Ultra-Wideband (UWB) Device

3.1.1 EUT Configuration

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

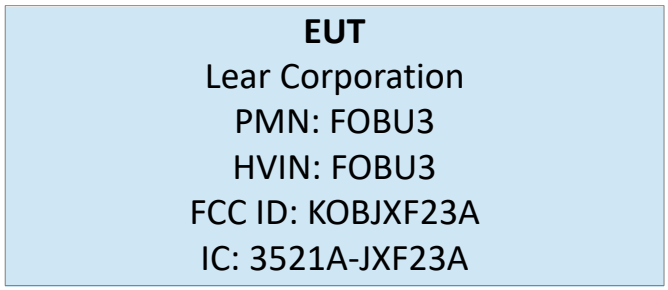


Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

There are two principle modes of operation for this device. The first mode (UWB-MODE) is that of a UWB transceiver used to estimate distance from a paired Vehicular mounted satellite device (SAT). In normal operation the EUT, when triggered by an LF command from the vehicle, sends two PPM UWB frames spaced approximately 10 ms apart to a SAT in the vehicle. The SAT on the vehicle in turn responds with an acknowledgement (ACK). Once the ACK is received, the EUT transmits 3 more UWB messages to the SAT which may result in another ACK from the SAT. This message exchange allows for distance estimation calculations. The second mode (UHF-MODE) is that of a manually or automatically actuated UHF RKE transmitter which is addressed in a second test report (AHD Rpt No.: LRFOBC-WR2235TXA).

3.1.3 Variants

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

3.1.4 Test Samples

Two samples of the EUT were provided for testing, including a normal operating sample (paired with a corresponding UWB Satellite) (SN: 1265) and a sample (SN: 1174) with modified SW that transmits repeatedly at a higher than normal rate (once every 10 ms) when power is applied.

3.1.5 Functional Exerciser

EUT normal operating functionality was verified by toggling the door handle switch on the auxiliary switch box provided with the system. Upon switch toggle the RFA LF would trigger UHF and UWB transmissions from the paired EUT (SK CTO) keyfob which in turn would cause the UWB Satellite to transmit UWB frames in response. Upon proper authentication the LED on the switch box would illuminate demonstrating proper system functionality for all radio components.

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

None.

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.

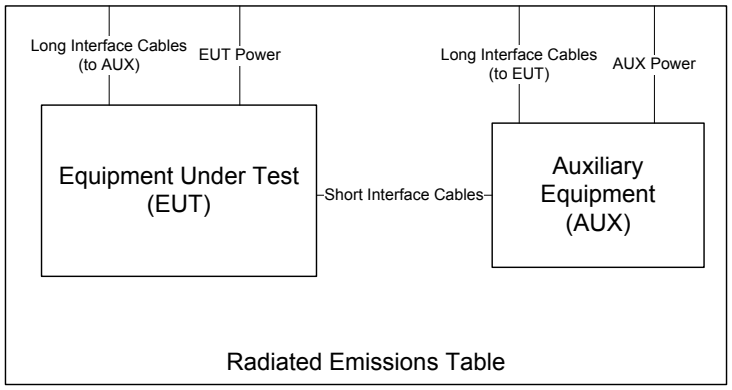


Figure 3: Radiated Emissions Diagram of the EUT.

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.

When microwave measurements are made at a range different than the regulatory distance or made at close-range to improve receiver sensitivity, the reading is corrected back to the regulatory distance. This is done using a 20 dB/decade field behavior as dictated by the test procedures. When measurements are made in the near-field, the near-field/far-field boundary (N/F) is reported. It is computed as

$$N/F = 2D^2/\lambda$$

where D is the maximum dimension of the transmitter or receive antenna, and λ is the wavelength at the measurement frequency. Typically for high frequency measurements the receive antenna is connected to test receiver / analyzer through an external mixer. In this case, cable loss, IF amplifier gain, and mixer conversion losses are corrected for in the data table, or directly in the analyzer.

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

4.1.2 Conducted Emissions Test Setup and Procedures

The EUT is not subject to measurement of power line conducted emissions as it is powered solely by its internal battery.

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.

In the case the EUT is designed for operation from a battery power source, the extreme test voltages are evaluated over the range specified in the test standard; no less than ±10% of the nominal battery voltage declared by the manufacturer. For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

4.2 Intentional Emissions

4.2.1 Fundamental Emission Pulsed Operation

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Duty cycle is reported for all relevant modes of operation. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 4. Plots showing the measurements made to obtain these values are provided in Figure 5.

Table 4: Fundamental Emission Pulsed Operation.

Frequency Range	Det	IFBW	VBW		
f > 1 000 MHz	Pk	10 MHz	10 MHz	**Test Date:**	10-Apr-23
				Test Engineer:	J. Nantz
				EUT	Normal Operating
				Meas. Distance:	60 cm

R0	Pulsed Operation / Duty Cycle									
	Transmit Mode	Voltage (V)	Oper. Freq (MHz)	Min. Cycle Time (ms)	Total Off-Time/s (ms)	EN 302-065 Total Off-Time/s Limit (ms)	Mean Off-Time Limit (ms)	On-Time (ms)	EN 302-065 On-Time LDC Limit (ms)	Exposure Duty Correction (dB)
R1	PPM (Normal)	3.0	3996.0	31.50	998.46	950.00	38.00	1.54	5.00	13.1
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10

(ROW)	(COLUMN)	NOTE:
R0	C5	Total Off-time/sec is equal to 1000ms – duration of the five frames observed due to a single manual activation per second (maximum possible repetition rate of system unlock response time observed by test laboratory > 1 sec).
R0	C8	Maximum five-frame on-time measured.
R0	C10	Worst-case Exposure duty cycle correction (due to burst-modulated carrier) computed as 10*Log(On-Time/ Min Cycle-Time). Overestimate due to finite transmission length of only five frames in the actual paired use system.

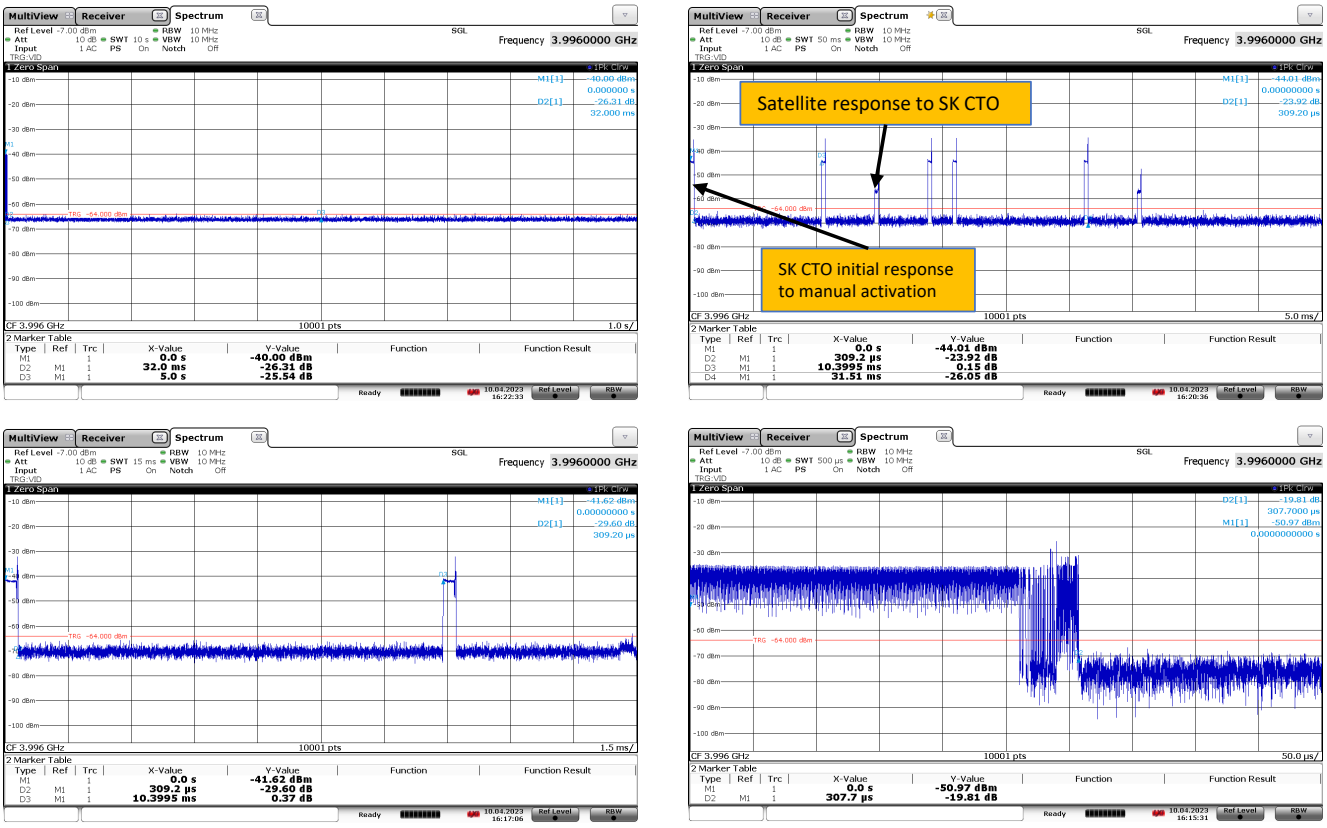


Figure 5: Fundamental Emission Pulsed Operation.

4.2.2 Fundamental Emission Bandwidth

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available frame length and minimum frame spacing. The 20 dB EBW is measured as the max-held peak-detected signal when the IF bandwidth is greater than or equal to 1% of the receiver span. For complex modulations other than ASK and FSK, the 99% emission bandwidth per IC test procedures has a different result, and is also reported. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 5. Plots showing the measurements made to obtain these values are provided in Figure 6.

Table 5: Fundamental Emission Bandwidth.

Frequency Range	Det	IFBW	VBW	Span		
f > 1 000 MHz	Pk	1 MHz	1 MHz	1 GHz		

Test Date:	21-Feb-23
Test Engineer:	Joseph Brunett
EUT	Normal Operating
Meas. Distance:	60 cm

R0	Occupied Bandwidth													
	Transmit Mode	Symbol Rate (Msym/s)	Data Rate (Mbps)	Voltage (V)	Oper. Freq (MHz)	99% OBW (MHz)	10 dB OBW (MHz)	OBW Minimum Limit (MHz)	fL (MHz)	fL Limit (MHz)	fH (MHz)	fH Limit (MHz)	fmax (MHz)	Pass/Fail
R1	Normal PPM	-	-	3.0	3994.0	751.2	614.4	500.0	3723.6	3100.0	4338.0	4800.0	3994.0	Pass
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW) (COLUMN) NOTE:
R0 C7 Measured according to ANSI C63.10-2013, section 10.1

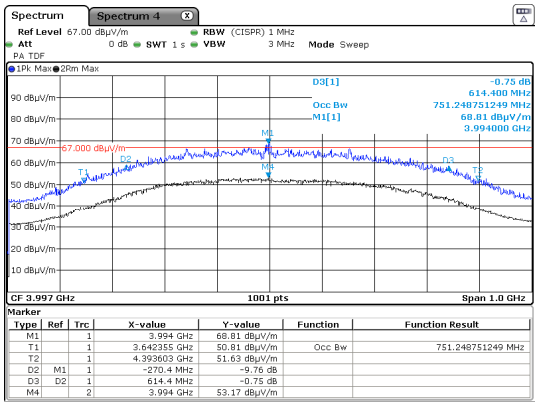


Figure 6: Fundamental Emission Bandwidth.

4.2.3 Fundamental Emission Field Strength

Test Setup & Procedure The test equipment and facilities were setup in accordance with the standards and procedures listed in Section 2.1. Environmental conditions were set at the appropriate temperature and thermal balance was checked with a thermocouple based probe. Fundamental emissions are measured at the regulatory distance on our OATS. The test equipment employed includes RSFSV30001, HQR1TO18S01.

Measurement Results The details and results of testing the EUT are summarized in Table 6.

Table 6(a): Fundamental Emission Field Strength.

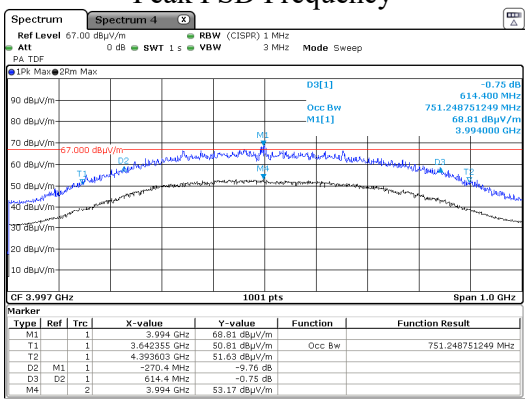
EUT Modes: a1 UWB continuously modulated at higher than normal periodic rate, max frame width.
a2 UWB Normal Operating Mode – Actuated by detection of LF interrogation.
Test Date: 02/27/23 a3
Test Engineer: Joseph Brunett a4

	Frequency		Site					EUT			Test Antenna			Cable	Receiver				Field Strength @ DR						EUT EIRP				Details
	Start	Stop	Temp.	MR	DR	N/F	CF	Mode	Volt.	Dim	Pol.	Dim.	Ka	Kg	Rx Power		Bandwidth		Pk		RMS				Pk		RMS		
R0								see							Pk	RMS	RBW	VBW	Meas.	Limit		Meas.	Limit		Meas.	Limit	Meas.	Limit	
																				USA	CAN		USA	CAN					Pass/Fail
	MHz	MHz	(C)	m			dB	table	(V)	cm	H/V	cm	dB/m	dB	dBuV/m		MHz		dBuV/m						dBm				dB
R1	SETUP:		OATSA					LEAR SK CTO			HRNQR316401				RSFSV30001				NOTES: Max all orientations of EUT and both Test Antenna Polarizations										
R2	**Peak Power - No Key**																												
R3	3994.0	3994.0	-2.0	3.0	3.0	1.3	0.0	a1	3.0	1.5	H/V	22.0	33.6	-0.4			28.00	28.00	89.9										
R4	3994.0	3994.0	-2.0	3.0	3.0	1.3	0.0	a1	3.0	1.5	H/V	22.0	33.6	-0.4			50.00	50.00	94.9						-.3	.0			**0.3**
R5	**Peak Power - With Key**																												
R6	3997.0	3997.0	-2.0	3.0	3.0	1.3	0.0	a1	3.0	1.5	H/V	22.0	33.6	-0.4			28.00	28.00	88.4										
R7	3997.0	3997.0	-2.0	3.0	3.0	1.3	0.0	a1	3.0	1.5	H/V	22.0	33.6	-0.4			50.00	50.00	93.4						-1.8	.0			1.8
R8																													
R10	**PSD - No Key**																												
R11	3994.0	3994.0	-2.0	3.0	3.0	1.3	0.0	a1	2.1	1.5	H/V	22.0	33.6	-0.4			1.00	3.00	68.7				53.2				-42.0	-41.3	**0.7**
R12	3994.0	3994.0	-2.0	3.0	3.0	1.3	0.0	a1	3.0	1.5	H/V	22.0	33.6	-0.4			1.00	3.00	68.8				53.2				-42.0	-41.3	0.7
R13	3994.0	3994.0	-2.0	3.0	3.0	1.3	0.0	a1	3.3	1.5	H/V	22.0	33.6	-0.4			1.00	3.00	68.8				53.2				-42.0	-41.3	0.7
R14																													
R15																													
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C28	C29	C31

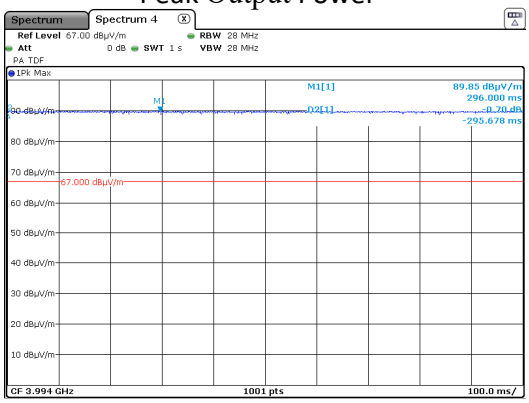
(ROW)	(COLUMN)	NOTE:
R0	C4	MR is Measurement Range, which is reduced from DR to achieve necessary SNR.
R0	C5	DR is the regulatory Desired Range measurement distance.
R0	C6	N/F is Near-Field / Far-Field distance computed for max of EUT Antenna Dimension (C10) and Test Antenna dimension (C12), where applicable.
R0	C7	CF is computed using a 20 dB/decade Decay Rate.
R0	C19	When E-field or EIRP is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings and Pr is not reported.
R0	C19,C22	PEAK and RMS Power measured with 1 GHz Span, 1001 Freq Samples, 1 sec sweep, Max-Held. Peak then measured in zero span using 28MHz RBW/VBW
R4/R7	C25	Peak in 50 MHz BW computed from (R2;C19) using 20*log10(50MHz / 28MHz)
R0	C29	ISED Correspondence regarding this product was granted use at proposed avg power rating under RSS-220 Hand-Held Regulations. See correspondence included in this application.
R0	C29	RMS Limits of -41.3 dBm/MHz are applicable as EUT employs LDC mitigation according to EN 302 065-3 v2.1.1, section 4.5.3 . Exterior limits do not apply to trigger before transmit vehicular systems in alignment with Decision (EU) 2019/785 of 14 May 2019, Annex 3

Table 6(b): Fundamental Emission Field Strength.

Peak PSD Frequency



Peak Output Power



4.3 Unintentional Emissions

4.3.1 Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 7.

Table 7(a): Transmit Chain Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
F < 960 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	27-Mar-23
F > 960 MHz	RMS Detector: 1 GHz Span / 1001 Freq Samples; 1 sec sweep/GHz Span (i.e. 1ms RMS integration time per bin); Max Held			**Test Engineer:**	Joseph Brunett
	Pk Detector: 1 GHz Span / 1001 Freq Samples; 1 sec sweep/GHz Span (i.e. 1ms RMS integration time per bin); Max Held			**EUT:**	LEAR SK CTO
				Mode:	10ms Rep Pulses
GNSS Restricted	Pk Detector start/stop frequencies per statndard, 1kHz RBW / 3 kHzVBW. Max Held			**Meas. Distance:**	As Noted

FCC/IC

R0	Env. Temp. (C)	Env. Volt. (V)	Frequency Band Start MHz	Frequency Band Stop MHz	Antenna + Cable Quality Number	Pol. H/V	Dim. cm	Ka dB/m	Kg dB	Rx. Power Pk dBuV/m	Rx. Power RMS dBuV/m	Range Correction MR m	DR m	N/F m	CF dB	E-Field @ DR Pk dBuV/m	E-Field @ DR Qpk dBuV/m				E-Field Limit Pk dBuV/m	E-Field Limit Qpk dBuV/m	Pass dB	Comments
R1	20	3.0	30.0	88.0	BICEMCO01	H/V	22.0	16.9	35.0			3.0	3.0	0.0	0.0	30.9						40.0	9.1	background
R2	20	3.0	88.0	216.0	BICEMCO01	H/V	22.0	16.9	35.0			3.0	3.0	0.1	0.0	34.7						43.5	8.8	background
R3	20	3.0	216.0	960.0	LOGEMCO01	H/V	22.0	20.1	29.9			3.0	3.0	0.3	0.0	38.1						46.0	7.9	background
R4	Env. Temp. (C)	Env. Volt. (V)	Frequency Band Start MHz	Frequency Band Stop MHz	Antenna + Cable Quality Number	Pol. H/V	Dim. cm	Ka dB/m	Kg dB	Rx. Power Pk dBuV/m	Rx. Power RMS dBuV/m	Range Correction MR m	DR m	N/F m	CF dB	E-Field @ DR Pk dBuV/m	E-Field @ DR Qpk dBuV/m	EIRP Pk dBm	EIRP RMS dBm	EIRP 1MHz Pk Lim dBm	EIRP FCC RMS Lim. dBm	EIRP ISED RMS Lim. dBm	Pass dB	Comments
R5	GPS Restricted Band Emissions																							
R6	20	3.0	1164.0	1240.0	HQR1TO18S01	H/V	22.0	25.2	-0.4			0.6	3.0	0.4	14.0	-11.8		-107.0			-85.3	-85.3	21.7	max all
R7	20	3.0	1559.0	1610.0	HQR1TO18S01	H/V	22.0	21.9	-0.4			0.6	3.0	0.5	14.0	2.3		-92.9			-85.3	-85.3	7.6	max all
R8																								
R9	Harmonic / Spurious UWB Emissions																							
R10	20	3.0	960.0	1610.0	HQR1TO18S01	H/V	22.0	27.6	19.3			0.6	3.0	0.5	14.0	10.4	2.8	-84.8	-92.4	-34.0	-75.3	-75.3	17.1	max all
R11	20	3.0	1610.0	1990.0	HQR1TO18S01	H/V	22.0	21.7	19.1			0.6	3.0	0.6	14.0	16.5	9.2	-78.7	-86.0	-34.0	-63.3	-70.0	16.0	max all
R12	20	3.0	1990.0	3100.0	HQR1TO18S01	H/V	22.0	20.6	18.2			0.6	3.0	1.0	14.0	19.4	12.9	-75.8	-82.3	-34.0	-61.3	-70.0	12.3	max all
R13	20	3.0	3100.0	3615.0	HQR1TO18S01	H/V	22.0	27.4	18.0			0.6	3.0	1.2	14.0	29.2	15.3	-66.0	-79.9	-34.0	-41.3	-41.3	32.0	max all
R14	20	3.0	4337.0	4750.0	HQR1TO18S01	H/V	22.0	52.5	17.3			0.6	3.0	1.5	14.0	41.0	26.8	-54.2	-68.4	-34.0	-41.3	-41.3	20.2	max all
R15	20	3.0	4750.0	10600.0	HQR1TO18S01	H/V	15.0	35.3	29.1			0.6	3.0	1.6	14.0	25.7	14.0	-69.5	-81.2	-34.0	-41.3	-41.3	35.5	max all, noise
R16	20	3.0	10600.0	18000.0	HQR1TO18S01	H/V	15.0	34.3	23.5			0.2	3.0	2.7	26.0	10.7	-1.2	-84.5	-96.4	-34.0	-61.3	-61.3	35.1	max all, noise
R17	20	3.0	18000.0	26500.0	HRNK001	H/V	10.2	33.7	36.5			0.1	3.0	1.8	32.0	12.5	0.5	-82.7	-94.7	-34.0	-61.3	-61.3	33.4	max all, noise
R18	20	3.0	26500.0	40000.0	HRNKA001	H/V	9.2	36.1	0.0	-101	-102	0.1	3.0	2.3	35.6	6.5	5.5	-88.7	-89.7	-34.0	-61.3	-61.3	**28.4**	max all, noise
R19																								
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24

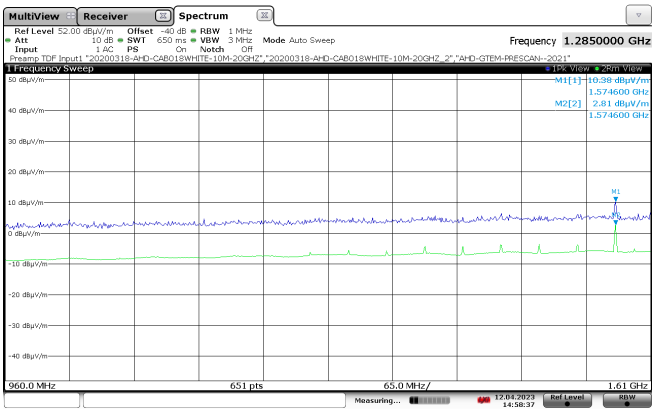
(ROW)	(COLUMN)	NOTE:
R0/R4	C15	CF is computed assuming a 20 dB/decade Decay Rate. DR is the regulatory Desired Range measurement distance. MR is Measurement Range, which is reduced from DR to achieve necessary SNR.
R4	C18/C19	EIRP is computed from field strength at 3 meter distance.
R0/R4	C7	Dimension of antenna is taken to be larger of the test antenna and the EUT antenna; EUT antenna is 1.5cm in dimension.
R13/R14	C22	ISED Correspondence regarding this particular product permitted use at proposed power rating under RSS-220 Hand-Held Regulations. See correspondence included in this application.
R1-R17	C10/C11	When E-field or EIRP is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings and Pr is not reported.
R0/R4	C23	Values reported are the maximum over all orientations and polarizations. Reported values are the maximum radiated power or background noise, whichever is higher.

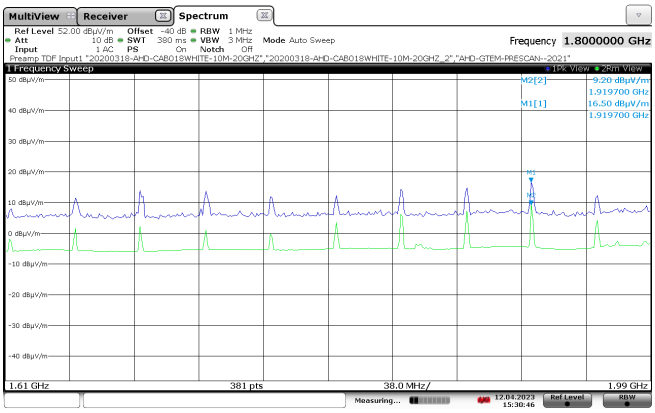
4.3.2 Radiated Digital Spurious

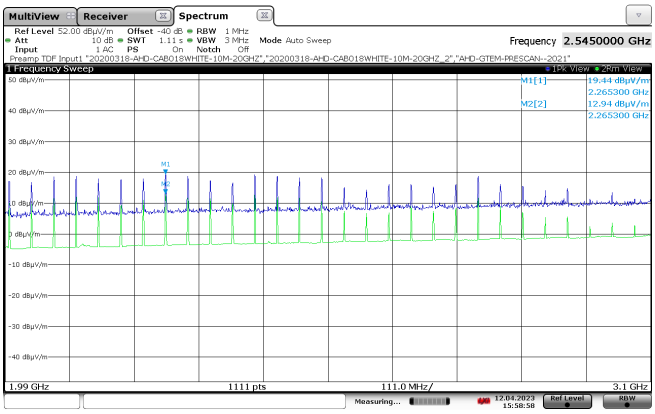
The results for the measurement of digital spurious emissions are not reported herein as all digital emissions were greater than 20 dB below the regulatory limit. Radiation from digital components was measured to 1 GHz, or to five times the maximum digital component operating frequency, whichever is greater.

Table 7(b): Transmit Chain Spurious Emissions.

TX Spurious







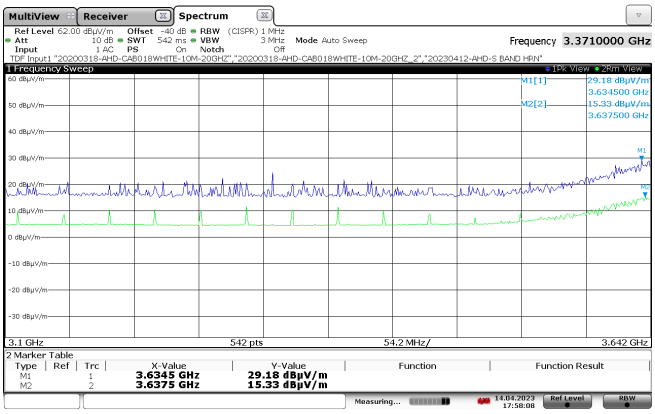
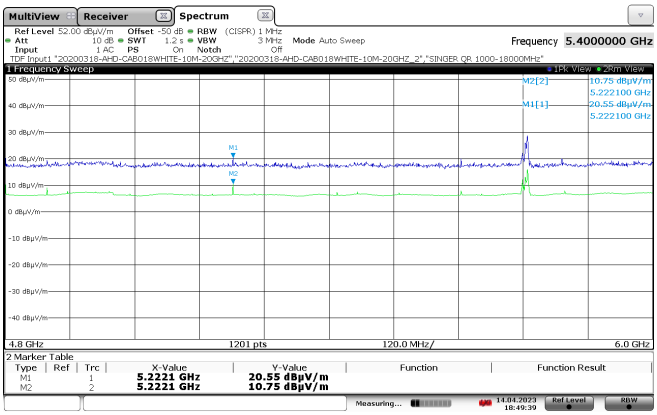
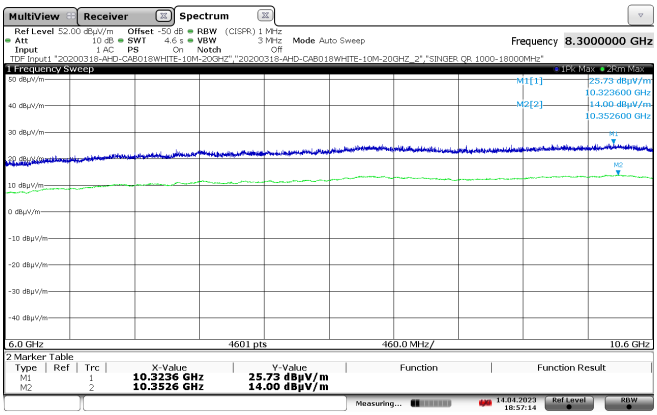
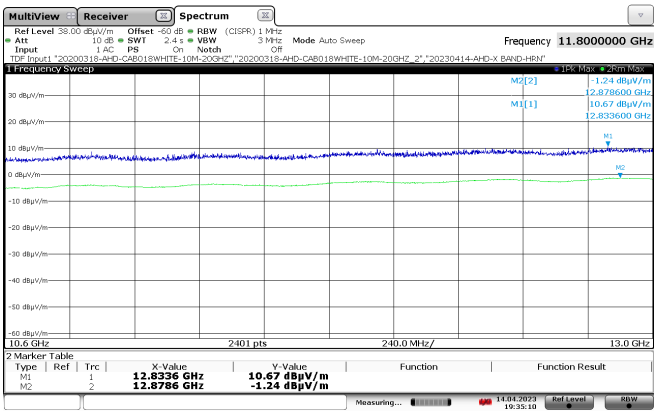


Table 7(c): Transmit Chain Spurious Emissions.

TX Spurious (Continued)







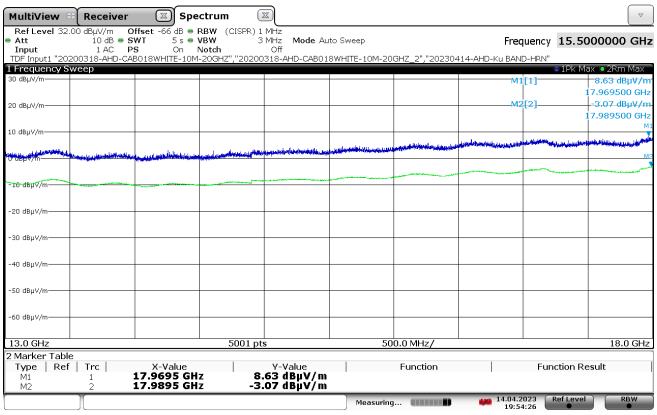
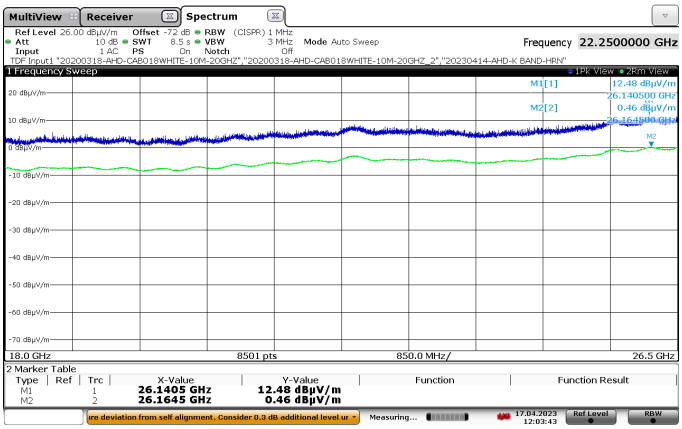
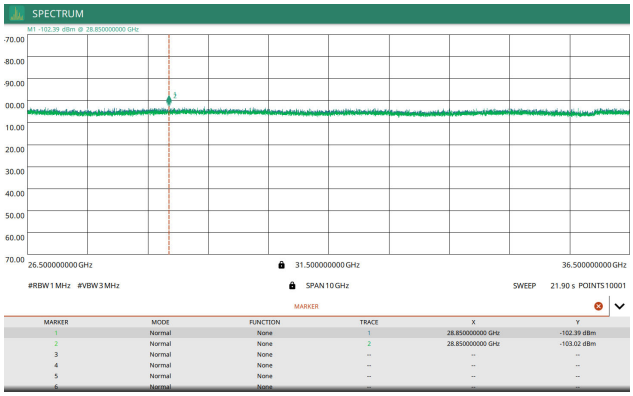


Table 7(d): Transmit Chain Spurious Emissions.

TX Spurious (Continued)





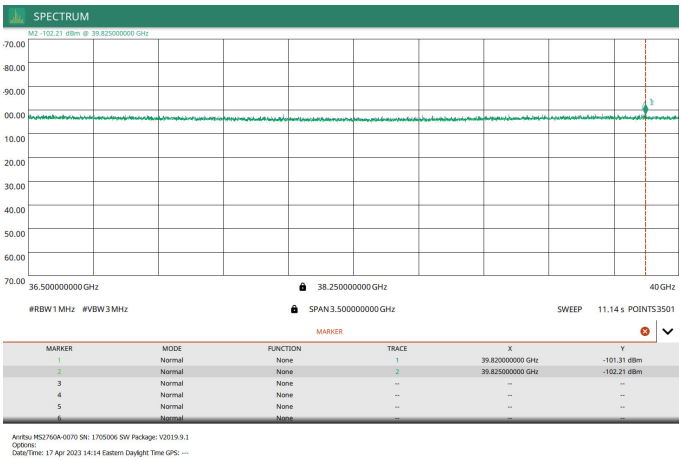
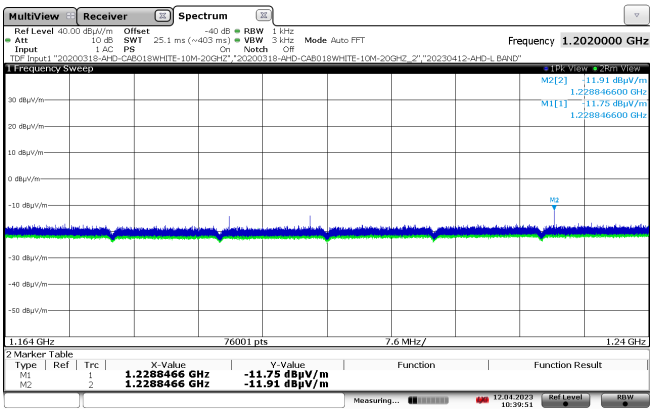
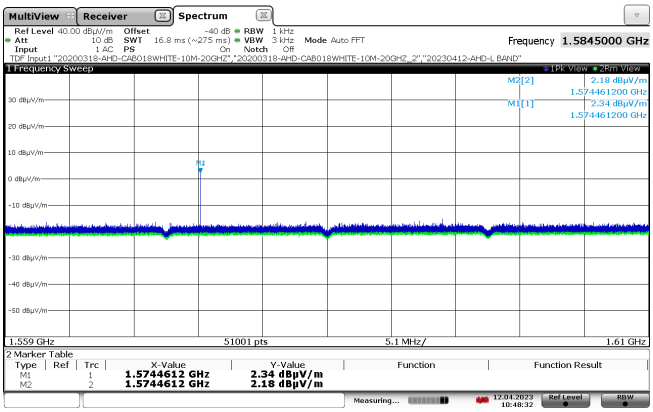


Table 7(e): Transmit Chain Spurious Emissions.

TX Spurious (GNSS)





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 8: 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).

2023-06-20 through 2024-06-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Figure 7: Accreditation Documents