Amber Helm Development L.C.
92723 Michigan Hwy-152
Sister Lakes, Michigan 49047 USA
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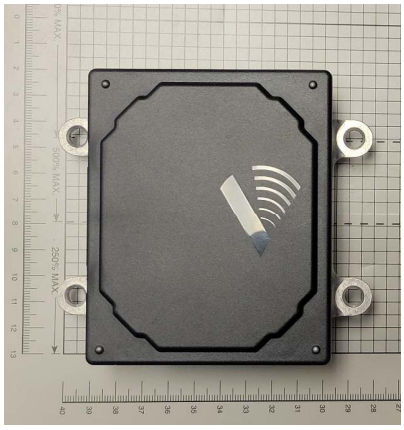
PRST79-WR2308TX
Issued: **April 22, 2023**

EMC Test Report

regarding

USA: **CFR Title 47, Part 95 Subpart M** (Emissions)
Canada: **ISED RSS-251 version 2** (Emissions)

for



Sentry 79

Category: FMCW Radar

Judgments:
FCC Part 95M and ISED RSS-251v2 Compliant
Testing Completed: March 30, 2023

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

Preco Electronics

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Revision History

Rev. No.	Date	Details	Revised By
r0	April 22, 2023	Initial Release.	J. Brunett
r1	May 5, 2023	Minor typo corrections.	J. Brunett
r2	May 12, 2023	Add ppm stability detail.	J. Brunett

Contents

Revision History **2**

Table of Contents **2**

1 Test Report Scope and Limitations **4**
1.1 Laboratory Authorization . . . 4
1.2 Report Retention . . . 4
1.3 Subcontracted Testing . . . 4
1.4 Test Data . . . 4
1.5 Limitation of Results . . . 4
1.6 Copyright . . . 4
1.7 Endorsements . . . 4
1.8 Test Location . . . 5
1.9 Traceability and Equipment Used . . . 5

2 Test Specifications and Procedures **6**
2.1 Test Specification and General Procedures . . . 6

3 Configuration and Identification of the Equipment Under Test **7**
3.1 Description and Declarations . . . 7
3.1.1 EUT Configuration . . . 8
3.1.2 Modes of Operation . . . 8
3.1.3 Variants . . . 8
3.1.4 Test Samples . . . 8
3.1.5 Functional Exerciser . . . 8
3.1.6 Modifications Made . . . 8
3.1.7 Production Intent . . . 9
3.1.8 Declared Exemptions and Additional Product Notes . . . 9

4 Emissions **10**
4.1 General Test Procedures . . . 10
4.1.1 Radiated Test Setup and Procedures . . . 10
4.1.2 Conducted Emissions Test Setup and Procedures . . . 13
4.1.3 Power Supply Variation . . . 13
4.2 Intentional Emissions . . . 14
4.2.1 Fundamental Emission Pulsed Operation . . . 14
4.2.2 Fundamental Emission Bandwidth . . . 16
4.2.3 Fundamental Emission . . . 18
4.3 Unintentional Emissions . . . 19
4.3.1 Transmit Chain Spurious Emissions . . . 19

5 Measurement Uncertainty and Accreditation Documents **21**

List of Tables

1 Test Site List. 5
2 Equipment List. 5
3 EUT Declarations. 7
4 Pulsed Emission Characteristics (Duty Cycle). 14
5 Intentional Emission Bandwidth. 16
6 Fundamental Radiated Emissions. 18
7 Transmit Chain Spurious Emissions. 19
7 Transmit Chain Spurious Emissions. 20
8 Measurement Uncertainty. 21

List of Figures

1 Photos of EUT. 7
2 EUT Test Configuration Diagram. 8
3 Radiated Emissions Diagram of the EUT. 10
4 Radiated Emissions Test Setup Photograph(s). 12
5 Example Pulsed Emission Characteristics (Duty Cycle). 15
6 Example Intentional Emission Bandwidth. 17
7 Accreditation Documents 21

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	RSFSV30001	RS / Apr-2023
Spectrum Analyzer	Rohde & Schwarz / FSV3	101131	RSFSV301	RS / Nov-2023
Harmonic Mixer	Hewlett Packard / 11970A	MY3003A1226	MIX26TO4001	AHD / Mar-2025
Harmonic Mixer	Hewlett Packard / 11970U	2332A01153	MIX40TO7001	AHD / CNR
Harmonic Mixer	VDI / SAX 108	A30316	MIX60TO9001	AHD / On-use
Harmonic Mixer	Hewlett Packard / 11970W	2521A00179	MIX70TO11001	AHD / On-use
Harmonic Mixer	Pacific mmWave / GMA	26	MIX110TO23001	PMP / On-use
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2023
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2023
Quad Ridge Horn	Singer / A6100	C35200	HQR1TO18S01	Keysight / Aug-2024
K-Band Horn	JEF / NRL Std.	001	HRNK01	AHD / Jul-2023
Ka-Band Horn	JEF / NRL Std.	001	HRNKA001	AHD / Jul-2023
U-Band Horn	Cust. Micro. / HO19R	-	HRNU01	Cust.M. / On-Use
E-Band Horn	Flann / 26240-25-1030B	250901	HRNE01	Flann / On-Use
W-Band Horn	Cust. Micro. / HO10R	-	HRNW01	Cust.M. / On-Use
D/G-Band Horn	Cust. Micro. / HO5R	-	HRNG01	Cust.M. / On-Use

2 Test Specifications and Procedures

2.1 Test Specification and General Procedures

The goal of Preco Electronics 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 Preco Electronics Sentry 79 for compliance to:

Country/Region	**Rules or Directive**	**Referenced Section(s)**
United States	Code of Federal Regulations	CFR Title 47, Part 95 Subpart M
Canada	ISED Canada	ISED RSS-251 version 2

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"
ANSI C63.26:2015	"American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services"
KDB 653005 D01 v01r02	"Equipment Authorization Guidance for 76-81 GHz Radar Devices "
TP0102RA	"AHD Internal Document TP0102 - Radiated Emissions Test Procedure"

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is an vehicular radar. The EUT is approximately 9 x 11 x 4 cm in dimension, and is depicted in Figure 1. It is powered by 9 or 30 VDC vehicle power system. In use, this device is permanently affixed in a motor vehicle. Table 3 outlines provider declared EUT specifications.

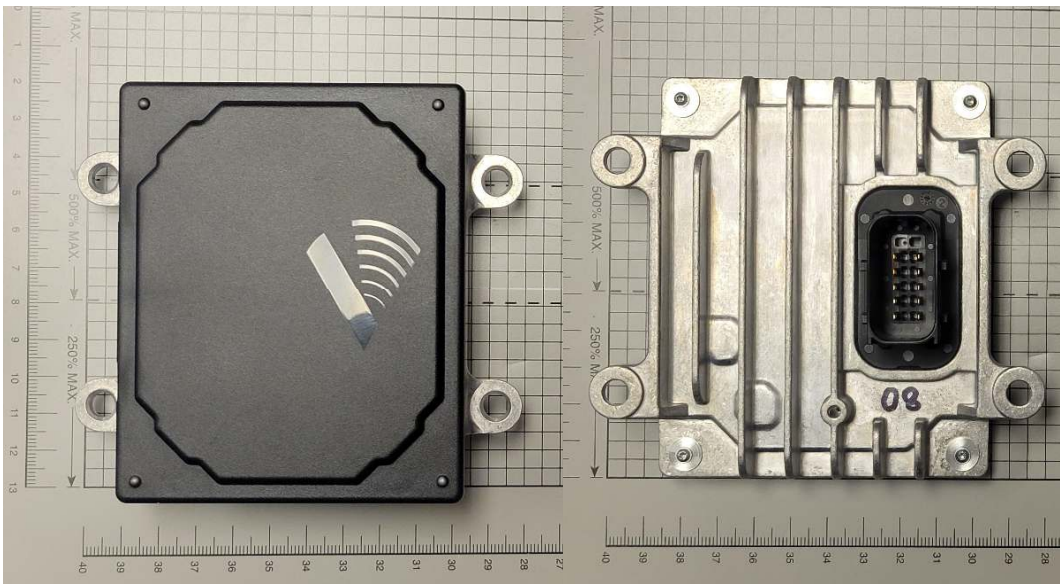

Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations	
Equipment Type:	FMCW Radar
Country of Origin:	Not Declared
Nominal Supply:	9 or 30 VDC
Oper. Temp Range:	-40^{o}C to $+85^{o}$C
Frequency Range:	78.5 to 79.5 GHz
Antenna Dimension:	6cm
Antenna Type:	integral patch arrays
Antenna Gain:	TX1:9.5 dBi, TX23:12.5 dBi
Number of Channels:	1
Channel Spacing:	Not Applicable
Alignment Range:	Not Declared
Type of Modulation:	FMCW
United States	
FCC ID Number:	OXZSENTRY79
Classification:	VRD
Canada	
IC Number:	20379-PREVIEW79
Classification:	Other

3.1.1 EUT Configuration

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

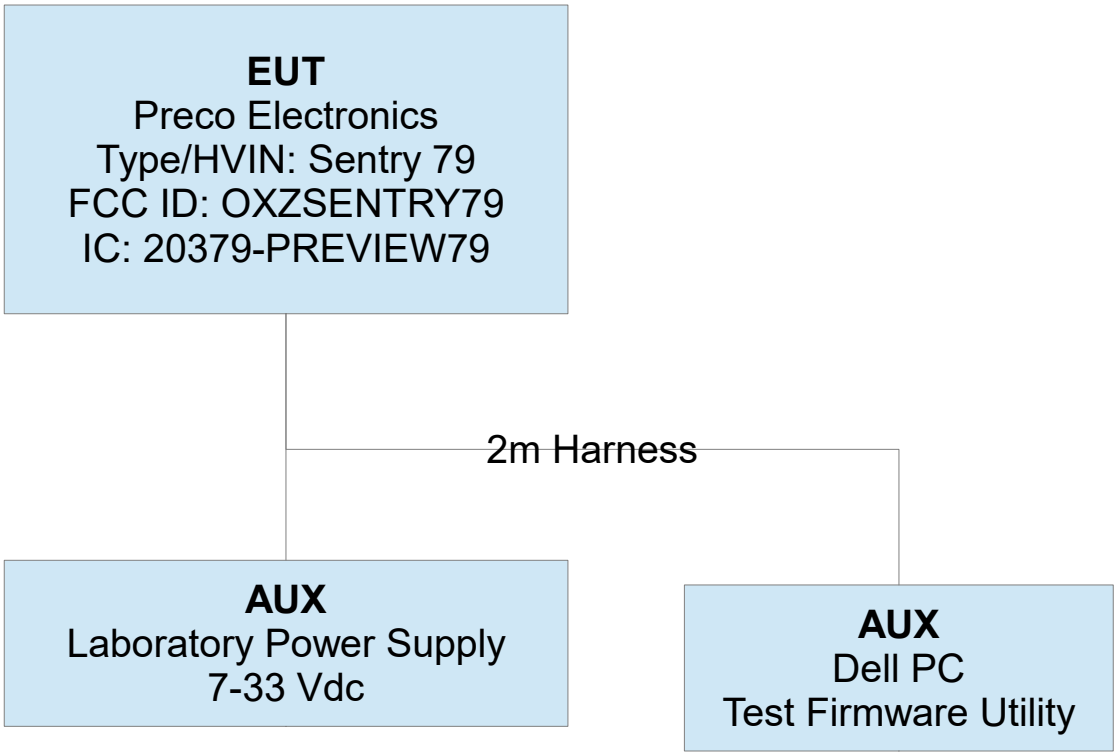

Figure 2: EUT Test Configuration Diagram.

3.1.2 Modes of Operation

The EUT employs two modes, TX1 where it transmits chirps on either its TX1 antenna array and TX23 where it transmits on its TX23 antenna array. Both modes employ the same FMCW chrip modulation and are fully tested herein.

3.1.3 Variants

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

3.1.4 Test Samples

Two samples were provided for testing along with a PC and CAN interface to enable test modes. Sample SN:A was fully tested, sample SN:B was taken apart for photos. For testing the product was measured in both normal and CW mode (set to lowest, middle, and highest frequencies of the chirp).

3.1.5 Functional Exerciser

Normal operating EUT functionality was verified prior to testing by observation of the emissions spectrum.

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). In the mm-wave band, narrow pulses arise as the FMCW signal chirps past the receiver tuned frequency. To avoid amplitude measurement error due to Pulse Desensitization, we measure peak emissions only when the radar is either placed into CW mode or when the signal "Dwells" at a single frequency for an extended period of time.

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.

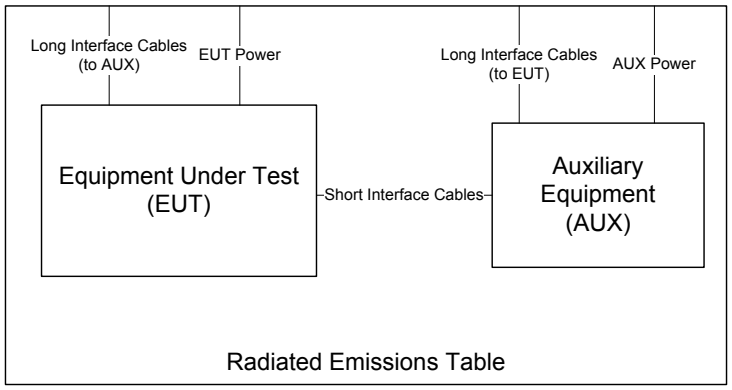

Figure 3: Radiated Emissions Diagram of the EUT.

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.

Where regulations call for substitution method measurements, the EUT is replaced by a substitution antenna if field strength measurements indicate the emission is close to the regulatory limit. This antenna is co-polarized with the test antenna and tuned (when necessary) to the emission frequency, after which the test antenna height is again optimized. The substitution antenna's signal level is adjusted such that its emission is equal to the level measured from the EUT. The signal level applied to the substitution antenna is then recorded. Effective isotropic radiated power (EIRP) and effective radiated power (ERP) in dBm are formulated from

$$EIRP = P_T - G_A = ERP + 2.16, \tag{1}$$

where P_T is the power applied to substitution antenna in dBm, including correction for cable loss, and G_A is the substitution antenna gain, in dBi.

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.

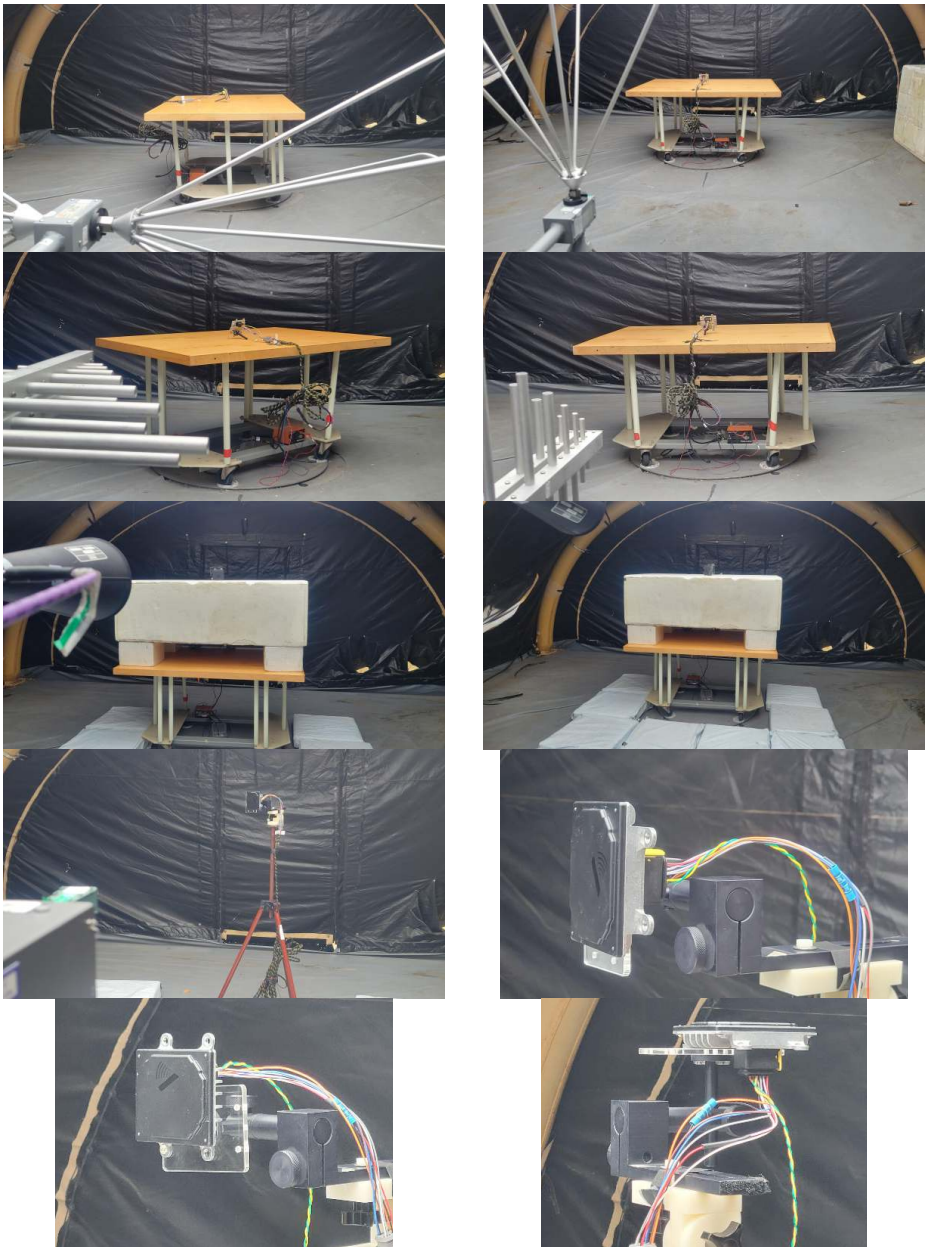

Figure 4: Radiated Emissions Test Setup Photograph(s).

4.1.2 Conducted Emissions Test Setup and Procedures

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 Intentional Emissions

4.2.1 Fundamental Emission Pulsed Operation

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

Table 4: Pulsed Emission Characteristics (Duty Cycle).

EUT: PRECO Sentry 79
Test Date(s): 03/21/23
Test Engineer: J. Brunett
Meas. Distance: 3 m

EUT Modes:
a1 Tx1
a2 Tx23
a3 CW, Tx1
a4 CW, Tx23

FMCW Details – Duty Cycle

R0	Transmit Mode	Voltage	Freq	Receiver Bandwidth RBW	VBW	Total Cycle Time	FMCW On-Time	BPSK Ant Duty	Exposure Duty Factor	FMCW Period	CHIRP BW	Dwell/MHz/Chirp	Chirps / On-Time	Max On-Time per Chirp-MHz
		Voltage	GHz	MHz		ms	ms	dB	dB	ms	MHz	ms	#	ms
R1	**a1, a2**	24.0	78.508	10.000	28.000	50.0	4.57	0.0	**-10.4**	0.036	970.0	0.00004	128	0.005
R2														
R3														
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW)	(COLUMN)	NOTES
R0	C3	Worst-case frequency selected at center of operating band.
R0	C6	BPSK Duty Cycle applies for array interleaving (where applicable)
R0	C7	Exposure Duty Correction = 10*Log(Total On-Time/Total Cycle-Time) + BPSK Antenna Duty
R0	C10	Dwell / MHz / Chirp is the CW time spent in any given 1MHz window within the channel during a single chirp = FMCW Period / CHIRP BW,
R0	C11	Chirps / On-Time = FMCW On-Time / FMCW Period
R0	C12	Max On-Time / Cycle = Chirps / On-Time x Dwell / MHz / Chirp, Total on time in a 1 MHz band per Chirp Cycle
R1	all	Chirp modulation for Tx1 and Tx23 modes is identical, only the transmit antenna array is changed.

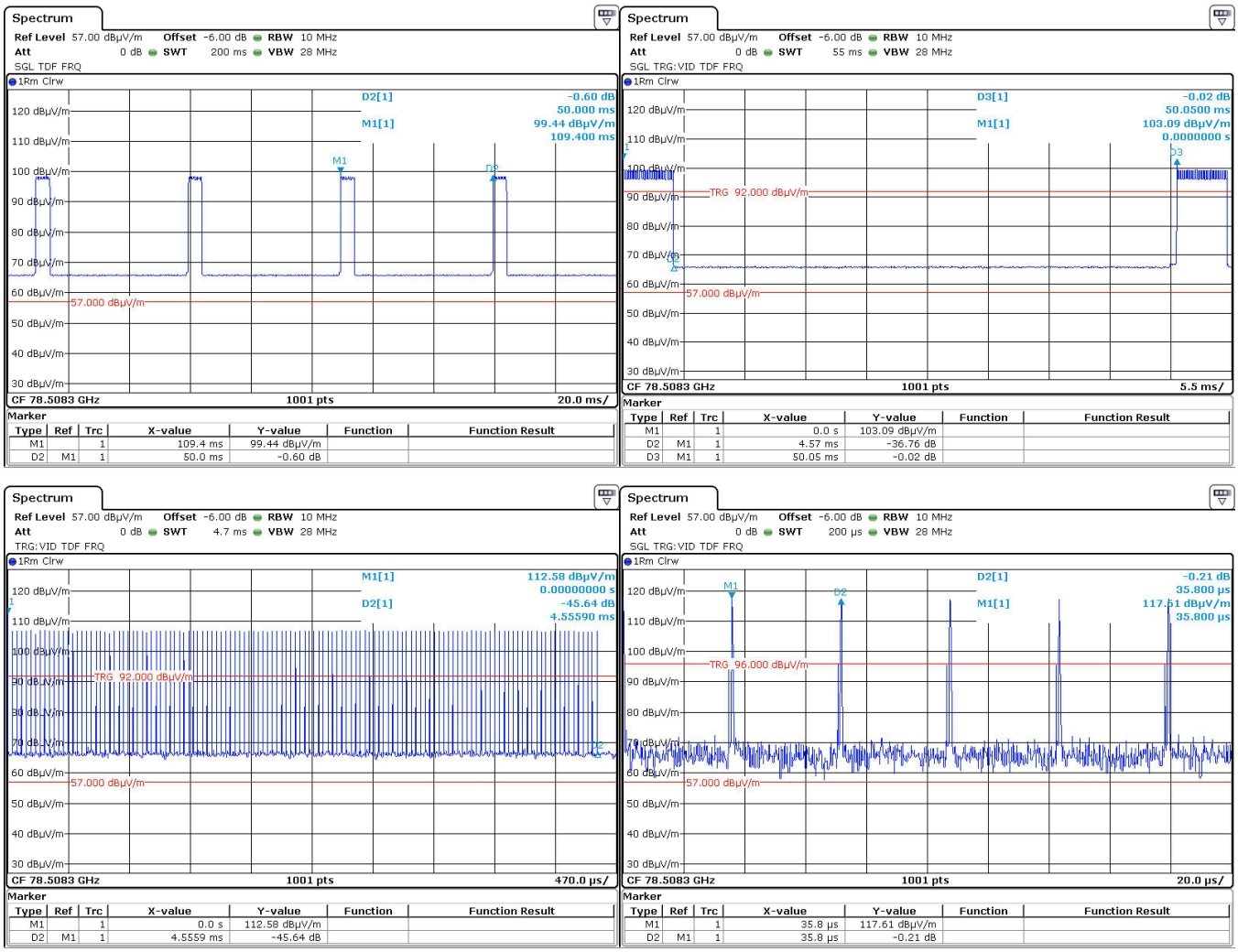

Figure 5: Example Pulsed Emission Characteristics (Duty Cycle).

4.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the worst case test mode. Radiated emissions are recorded following the test procedures listed in Section 2.1. The 99% 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. The results of EBW testing are summarized in Table 5. Plots showing measurements employed to obtain the emission bandwidth reported are provided in Figure 6.

Table 5: Intentional Emission Bandwidth.

Det	IF Bandwidth	Video Bandwidth	EUT:	PRECO Sentry 79
Pk	10 MHz	28 MHz	Test Date(s):	3/21/23, 5/1/23
			Test Engineer:	J. Brunett

EUT Modes

a1	Tx1
a2	Tx23
a3	CW, Tx1
a4	CW, Tx23

Occupied Bandwidth

R0	Transmit Mode	Temperature (C)	Voltage (V)	fL (MHz)	fL Limit (MHz)	fH (MHz)	fH Limit (MHz)	99% OBW (MHz)	Stability (ppm)	Notes/Pass/Fail
R1		85.0	33.0	78469.9	76000.0	79440.3	81000.0	970.4		
R2		85.0	7.6	78469.8	76000.0	79440.2	81000.0	970.4	19.0	
R3		80.0	24.0	78469.9	76000.0	79440.2	81000.0	970.4	19.6	
R4		70.0	24.0	78469.7	76000.0	79440.1	81000.0	970.4	17.1	
R5		60.0	24.0	78469.5	76000.0	79439.9	81000.0	970.4	14.6	
R6		50.0	24.0	78469.3	76000.0	79439.7	81000.0	970.4	12.1	
R7		40.0	24.0	78469.1	76000.0	79439.5	81000.0	970.4	9.7	
R8	**a1**	30.0	24.0	78468.9	76000.0	79439.3	81000.0	970.4	7.2	
R9		20.0	24.0	78468.4	76000.0	79438.7	81000.0	970.4	0.0	
R10		10.0	24.0	78468.2	76000.0	79438.5	81000.0	970.4	-2.5	
R11		0.0	24.0	78468.0	76000.0	79438.3	81000.0	970.4	-5.0	
R12		-10.0	24.0	78467.8	76000.0	79438.1	81000.0	970.4	-7.5	
R13		-20.0	24.0	78467.6	76000.0	79437.9	81000.0	970.4	-9.9	
R14		-30.0	24.0	78467.9	76000.0	79438.3	81000.0	970.4	-5.3	
R15		-40.0	33.0	78468.1	76000.0	79438.4	81000.0	970.4	-3.5	
R16		-40.0	7.6	78467.9	76000.0	79438.2	81000.0	970.4		
R17		85.0	33.0	78469.9	76000.0	79440.3	81000.0	970.4		
R18		85.0	7.6	78469.8	76000.0	79440.2	81000.0	970.4	19.0	
R19		80.0	24.0	78469.9	76000.0	79440.2	81000.0	970.4	19.6	
R20		70.0	24.0	78469.7	76000.0	79440.1	81000.0	970.4	17.1	
R21		60.0	24.0	78469.5	76000.0	79439.9	81000.0	970.4	14.6	
R22		50.0	24.0	78469.3	76000.0	79439.7	81000.0	970.4	12.1	
R23		40.0	24.0	78469.1	76000.0	79439.5	81000.0	970.4	9.7	
R24	**a2**	30.0	24.0	78468.9	76000.0	79439.3	81000.0	970.4	7.2	
R25		20.0	24.0	78468.4	76000.0	79438.7	81000.0	970.4	0.0	
R26		10.0	24.0	78468.2	76000.0	79438.5	81000.0	970.4	-2.5	
R27		0.0	24.0	78468.0	76000.0	79438.3	81000.0	970.4	-5.0	
R28		-10.0	24.0	78467.8	76000.0	79438.1	81000.0	970.4	-7.5	
R29		-20.0	24.0	78467.6	76000.0	79437.9	81000.0	970.4	-9.9	
R30		-30.0	24.0	78467.9	76000.0	79438.3	81000.0	970.4	-5.3	
R31		-40.0	33.0	78468.1	76000.0	79438.4	81000.0	970.4	-3.5	
R32		-40.0	7.6	78467.9	76000.0	79438.2	81000.0	970.4		
R33			**fL_{MIN}**	**78467.6**	**fH_{MAX}**	**79440.3**	**OBW_{MAX}**	**970.4**		Pass
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10

(ROW)	(COLUMN)	NOTES
R0	C4, C6	Computed via CW mode frequency shift and nominal OBW measurements.

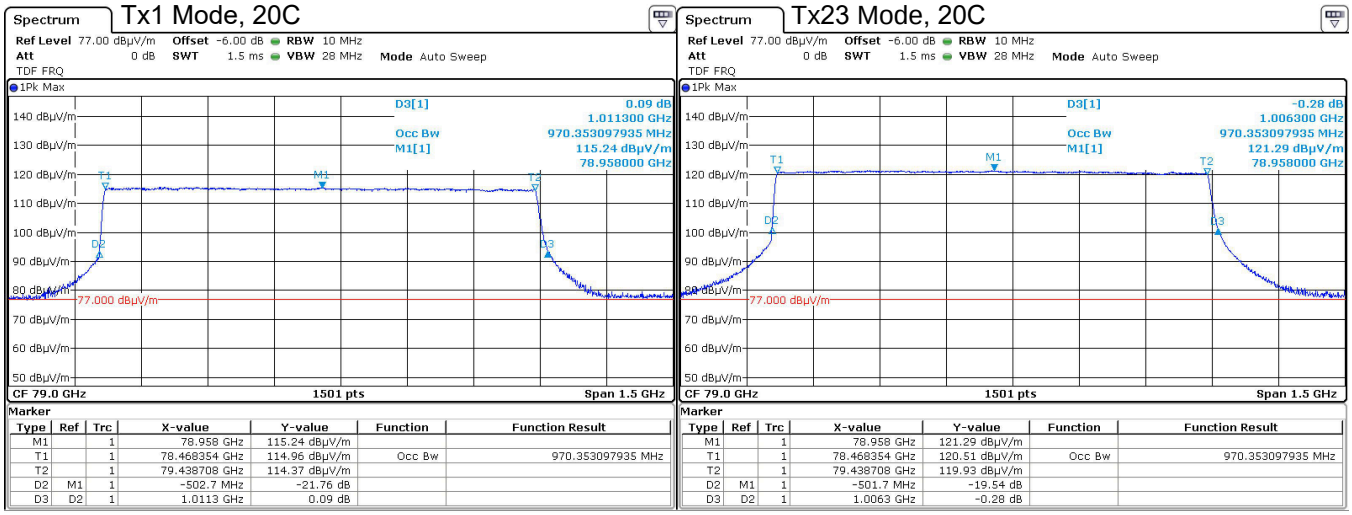

Figure 6: Example Intentional Emission Bandwidth.

4.2.3 Fundamental Emission

Following the test procedures listed in Section 2.1, radiated emissions measurements are made on the EUT for both Horizontal and Vertical polarized fields. Table 6 details the results of these measurements.

Table 6: Fundamental Radiated Emissions.

EUT Modes: **a1** Tx1 **a5**
EUT: PRECO Sentry 79 **a2** Tx23 **a6**
Test Date(s): 03/22/23 **a3** CW, Tx1 **a7**
Test Engineer: J. Brunett **a4** CW, Tx23 **a8**

R0	Frequency		Site						EUT			Test Antenna				Cable/Mixer	Receiver		Field Strength @ DR				EIRP				Regulation	Details	Comments
	Start	Stop	Temp. Hum	Table Angle	MR	DR	N/F	CF	Mode	Volt.	Dim	Pol.	Ant. Height	Dim.	Ka	CL/Kg	Bandwidth RBW	VBW	Pk Meas.	Pk Limit	Avg Meas.	Avg Limit	Pk Calc.	Pk Limit	Avg Calc.	Avg Limit	USA/CAN 95M/251	Pass/Fail	
	MHz	MHz	C, %	deg	m			dB		(V)	cm	H/V	m	cm	dB/m	dB	MHz		dBuV/m				dBm				§	dB	
R1	SETUP		OATSC						SAMPLE A			HRNE01				VDIE01	FSV3		NOTES: EUT Copolarized along long axis of radome.										
R2	78473.0	78473.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a3**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	115.2				20.0	55.0			95M/251	35.0	Peak Meas, CW mode
R3	79000.0	79000.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a3**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	116.2				21.0	55.0			95M/251	34.0	Peak Meas, CW mode
R4	79432.0	79432.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a3**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	116.9				21.7	55.0			95M/251	33.3	Peak Meas, CW mode
R5	78473.0	78473.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a4**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	120.7				25.5	55.0			95M/251	29.5	Peak Meas, CW mode
R6	79432.0	79432.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a4**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	121.0				25.8	55.0			95M/251	**29.2**	Peak Meas, CW mode
R7	78473.0	78473.0	20, 38	0.0	3.0	3.0	1.3	0.0	**a4**	24.0	5.0	V	1.5	2.0		-6.0	1.00	28.00	120.4				25.2	55.0			95M/251	29.8	Peak Meas, CW mode
R8																													
R9																													
R10	76000.0	81000.0	20, 38	0.0	3.0	3.0	1.4	0.0	**a1**	24.0	5.0	H	1.5	2.0		-6.0	1.00	28.00			104.0				8.8	50.0	95M/251	41.2	FCC RMS Meas, chirp
R11	76000.0	81000.0	20, 38	0.0	3.0	3.0	1.4	0.0	**a2**	24.0	5.0	H	1.5	2.0		-6.0	1.00	28.00			109.2				14.0	50.0	95M/251	36.0	FCC RMS Meas, chirp
R12																													
R13																													
#	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	C27	C28	C29

(ROW)	(COLUMN)	NOTE:
R0	C5	MR is Measurement Range, which may be reduced from DR to achieve necessary SNR.
R0	C6	DR is the regulatory Desired Range measurement distance.
R0	C7	N/F is Near-Field / Far-Field distance computed for max of Antenna Dimension (C10 or C14) computed above 1 GHz.
R0	C8	CF is computed using a 20 dB/decade Decay Rate.
R2-R7	C19	Measurement settings for peak power according to KDB 653005 D01 76-81 GHz Radars v01r01, 4 (c) but with radar in CW mode negating concerns for pulse desensitization.
R10, R11	C19	Measurement settings for RMS power integrated over the OBW according to KDB 653005 D01 76-81 GHz Radars v01r01, 4(b)

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.

EUT Modes: **a1** Tx1 **a5** max all modes (a1 - a4)
EUT: PRECO Sentry 79 **a2** Tx23 **a6**
Test Date(s): 03/23/23 **a3** CW, Tx1 **a7**
Test Engineer: J. Brunett **a4** CW, Tx23 **a8**

R0	Frequency		Site						EUT			Test Antenna				Cable	Receiver		Field Strength @ DR				EIRP				Regulation		Comments
	Start	Stop	Temp.	Table	MR	DR	N/F	CF				Pol.	Ant.	Dim.	Ka	Mixer	Bandwidth		Pk		Qpk/Avg		Pk		Qpk/Avg		USA/CAN		
			Hum	Angle					Mode	Volt.	Dim		Height			CL/Kg	RBW	VBW	Meas.	Lim.	Meas.	Lim.	Calc.	Lim.	Calc.	Lim.	95M/GEN	Pass/Fail	
	MHz	MHz	C, %	deg	m			dB		(V)	cm	H/V	m	cm	dB/m	dB	MHz		dBuV/m				dBm				§	dB	
R1	SETUP		OATSC						SAMPLE A			BICEMCO01				CBL01	FSV3												
R2	30.0	88.0	20 38	0.0	3.0	3.0	0.0	0.0	**a5**	24.0	5.0	H/V	1-4				0.12	0.30	30.2		25.4	40.0	-65.0		-69.8		15.209 / GEN	14.6	
R3	88.0	216.0	20 38	0.0	3.0	3.0	0.0	0.0	**a5**	24.0	5.0	H/V	1-4				0.12	0.30	23.9		21.4	43.5	-71.3		-73.8		15.209 / GEN	22.1	
R4	SETUP		OATSC						SAMPLE A			LOGEMCO01				CBL01	FSV3												
R5	216.0	1000.0	20 38	0.0	3.0	3.0	0.0	0.0	**a5**	24.0	5.0	H/V	1-4				0.12	0.30	40.2		38.8	46.0	-55.0		-56.4		15.209 / GEN	7.2	
R6	380.0	875.0	20 38	0.0	3.0	3.0	0.0	0.0	**a5**	24.0	5.0	H	1-4				0.12	0.30	40.2		38.8	46.0	-55.0		-56.4		15.209 / GEN	**7.2**	
R7	380.0	875.0	20 38	0.0	3.0	3.0	0.0	0.0	**a5**	24.0	5.0	V	1-4				0.12	0.30	36.3		33.9	46.0	-58.9		-61.3		15.209 / GEN	12.1	
R8	SETUP		OATSC						SAMPLE A			HQR1TO18S01				CBL04	FSV30												
R9	1000.0	6000.0	20 38	0.0	3.0	3.0	0.9	0.0	**a5**	24.0	5.0	H/V	1.5	15.0			1.00	3.00	45.2	74.0	43.8	54.0	-50.0		-51.4		15.209 / GEN	10.2	
R10	1375.0	1375.0	20 38	0.0	3.0	3.0	0.2	0.0	**a5**	24.0	5.0	H	1.5	15.0			1.00	3.00	45.2	74.0	43.8	54.0	-50.0		-51.4		15.209 / GEN	10.2	
R11	1625.0	1625.0	20 38	0.0	3.0	3.0	0.2	0.0	**a5**	24.0	5.0	V	1.5	15.0			1.00	3.00	42.5	74.0	40.9	54.0	-52.7		-54.3		15.209 / GEN	13.1	
R12	6000.0	18000.0	20 38	0.0	3.0	3.0	2.7	0.0	**a5**	24.0	5.0	H/V	1.5	15.0			1.00	3.00	49.0	74.0	36.9	54.0	-46.3		-58.3		15.209 / GEN	17.1	
R13	SETUP		OATSC						SAMPLE A			HRNK01				BL04 + PN40AM	FSV30												
R14	18000.0	26500.0	20 38	0.0	3.0	3.0	1.8	0.0	**a5**	24.0	5.0	H/V	1.5	10.2		40.0	1.00	3.00	29.8	74.0		54.0	-65.4		-95.2		15.209 / GEN	44.2	
R15	26300.0	26300.0	20 38	0.0	3.0	3.0	1.8	0.0	**a5**	24.0	5.0	H/V	1.5	10.2		40.0	1.00	3.00	29.8	74.0		54.0	-65.4		-95.2		15.209 / GEN	44.2	
R16	SETUP		OATSC						SAMPLE A			HRNKA01				PN40AMP	FSV3												
R17	26500.0	40000.0	20 38	0.0	3.0	3.0	2.3	0.0	**a5**	24.0	5.0	H/V	1.5	9.2		40.0	1.00	3.00	40.1	74.0		54.0	-55.1		-95.2		15.209 / GEN	33.9	
R18	26974.0	26974.0	20 38	0.0	3.0	3.0	1.5	0.0	**a5**	24.0	5.0	H/V	1.5	9.2		40.0	1.00	3.00	40.1	74.0		54.0	-55.1		-95.2		15.209 / GEN	33.9	CW / LO
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	C25	C26	C27	C28	C29

(ROW)	(COLUMN)	NOTE:
R0	C5	MR is Measurement Range, which may be reduced from DR to achieve necessary SNR.
R0	C6	DR is the regulatory Desired Range measurement distance.
R0	C7	N/F is Near-Field / Far-Field distance computed for max of Antenna Dimension (C10 or C14) computed above 1 GHz.
R0	C8	CF is computed using a 20 dB/decade Decay Rate.
R7,R11	C28	For a vehicular mounted radio device, only spurious arrising from the RF chain are subject to the spurious emissions limits. If these emissions are from digital circuitry, they may not be subject.

Table 7(b): Transmit Chain Spurious Emissions.

EUT Modes: **a1** Tx1 **a5** max all modes (a1 - a4)
EUT: Sensata PRECO SAW33 **a2** Tx23 **a6**
Test Date(s): 10/19/2022-10/21/2022 **a3** CW, Tx1 **a7**
Test Engineer: J. Brunett **a4** CW, Tx23 **a8**

R0	Frequency		Site						EUT			Test Antenna				Cable	Receiver		Field Strength @ DR				EIRP/MHz				Regulation		Comments
	Start	Stop	Temp.	Table	MR	DR	N/F	CF	Mode	Volt.	Dim	Pol.	Ant.	Dim.	Ka	Mixer	Bandwidth		Pk		QPk/RMS		Pk		Avg / RMS		Canada		
			Hum	Angle									Height			CL/Kg	RBW	VBW	Meas.	Lim.	Meas.	Lim.	Calc.	Lim.	Calc.	Lim.	RSS-251	Pass/Fail	
	GHz	GHz	C, %	deg	m			dB		(V)	cm	H/V	m	cm	dB/m	dB	MHz		dBuV/m				dBm/MHz				§	dB	
R1	SETUP		FARMHILLS						SAMPLE A			HRNU01				MIX40TO7001	FSV3												
R2	40.0	70.0	20 38	0.0	0.3	3.0	1.9	20.0	**a5**	24.0	5.0	H/V	1.5	6.3			1.00	3.00	57.6		48.2		-37.6		-47.0	-30.0	10.2	17.0	noise floor
R3	SETUP		FARMHILLS						SAMPLE A			HRNE01				MIX60TO9001	FSV3												
R4	70.0	73.5	20 38	0.0	3.0	3.0	1.2	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	61.3		50.7		-33.9		-44.5	-30.0	10.2	14.5	noise floor
R5	73.5	76.0	20 38	0.0	3.0	3.0	1.3	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	65.1		56.2		-30.1		-39.0	-30.0	10.2	9.0	noise floor
R6	81.0	90.0	20 38	0.0	3.0	3.0	1.5	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	70.2		59.1		-25.0		-36.1	-30.0	10.2	6.1	noise floor
R7	SETUP		FARMHILLS						SAMPLE A			HRNF01				MIX90TO14001	FSV3												
R8	90.0	140.0	20 38	0.0	3.0	3.0	2.3	0.0	**a5**	24.0	5.0	H/V	1.5	1.8			1.00	3.00	70.1		61.1		-25.1		-34.1	-30.0	10.2	**4.1**	noise floor
R9	SETUP		FARMHILLS						SAMPLE A			HRNG01				MIX140TO22001	FSV3												
R10	140.0	162.0	20 38	0.0	0.3	3.0	2.7	20.0	**a5**	24.0	5.0	H/V	1.5	1.0			1.00	3.00	65.2		55.1		-30.0		-40.1	-30.0	10.2	10.1	noise floor
R11																													
R12																													

R13	Frequency		Site						EUT			Test Antenna				Cable	Receiver		Field Strength @ DR				S @ DR				Regulation		Comments
	Start	Stop	Temp.	Table	MR	DR	N/F	CF	Mode	Volt.	Dim	Pol.	Ant.	Dim.	Ka	Mixer	Bandwidth		Pk		QPk/Avg		Pk		Avg		USA		
			Hum	Angle									Height			CL/Kg	RBW	VBW	Meas.	Lim.	Meas.	Lim.	Calc.	Lim.	Calc.	Lim.	Part 95M	Pass/Fail	
	GHz	GHz	C, %	deg	m			dB		(V)	cm	H/V	m	cm	dB/m	dB	MHz		dBuV/m				dBm/cm2				§	dB	
R14	SETUP		FARMHILLS						SAMPLE A			HRNU01				MIX40TO7001	FSV3												
R15	40.0	70.0	20 38	0.0	0.3	3.0	1.9	20.0	**a5**	24.0	5.0	H/V	1.5	6.3			1.00	3.00	57.6		44.8		-98.1		-110.9	-62.2	95.3379	48.7	noise floor
R16	SETUP		FARMHILLS						SAMPLE A			HRNE01				MIX60TO9001	FSV3												
R17	70.0	73.5	20 38	0.0	3.0	3.0	1.2	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	61.3		50.7		-94.4		-105.0	-62.2	95.3379	42.8	noise floor
R18	73.5	76.0	20 38	0.0	3.0	3.0	1.3	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	65.1		56.2		-90.6		-99.5	-62.2	95.3379	37.3	noise floor
R19	81.0	90.0	20 38	0.0	3.0	3.0	1.5	0.0	**a5**	24.0	5.0	H/V	1.5	2.0			1.00	3.00	70.2		59.1		-85.5		-96.6	-62.2	95.3379	34.4	noise floor
R20	SETUP		FARMHILLS						SAMPLE A			HRNF01				MIX90TO14001	FSV3												
R21	90.0	140.0	20 38	0.0	3.0	3.0	2.3	0.0	**a5**	24.0	5.0	H/V	1.5	1.8			1.00	3.00	70.1		61.1		-85.6		-94.6	-62.2	95.3379	32.4	noise floor
R22	SETUP		FARMHILLS						SAMPLE A			HRNG01				MIX140TO22001	FSV3												
R23	140.0	200.0	20 38	0.0	1.0	3.0	3.3	9.5	**a5**	24.0	5.0	H/V	1.5	1.0			1.00	3.00	65.2		55.1		-90.5		-100.6	-62.2	95.3379	38.4	noise floor
R23	200.0	220.0	20 38	0.0	1.0	3.0	3.7	9.5	**a5**	24.0	5.0	H/V	1.5	1.0			1.00	3.00	65.2		55.1		-90.5		-100.6	-60.0	95.3379	40.6	noise floor
R24	SETUP		FARMHILLS						SAMPLE A			HRNG01				MIX220TO33001	FSV3												
R25	220.0	243.0	20 38	0.0	0.1	3.0	4.1	29.5	**a5**	24.0	5.0	H/V	1.5	1.0			1.00	3.00	68.0		59.2		-87.7		-96.5	-60.0	95.3379	36.5	noise floor
R27																													

#	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	C27	C28	C29

(ROW)	(COLUMN)	NOTE:
R0	C5	MR is Measurement Range, which may be reduced from DR to achieve necessary SNR.
R0	C6	DR is the regulatory Desired Range measurement distance.
R0	C7	N/F is Near-Field / Far-Field distance computed for max of Antenna Dimension (C11 or C14) computed above 1 GHz.
R0	C8	CF is computed using a 20 dB/decade Decay Rate.
R0	C23	EIRP is computed from field strength at 3 meter distance in a 1 MHz RBW / 3 MHz VBW.
R15	C23	Spatial Power Density S @ 3m (dBm/cm^2) = EIRP (dBm) – 10*log10(4*pi*((300cm)^2)) = EIRP (dBm) – 60.5 dB, E-Field (dBuV/m) @ 3m - 155.7 dB
R15	C23	S @ DR: 600 pW/cm2 = -62.2 dBm/cm2, 1000 pW/cm2 = -60 dBm/cm2, FCC Regulatory Limit; ISED Regulatory Limit EIRP / MHz

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
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AHD (Amber Helm Development, L.C.)
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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 7: Accreditation Documents