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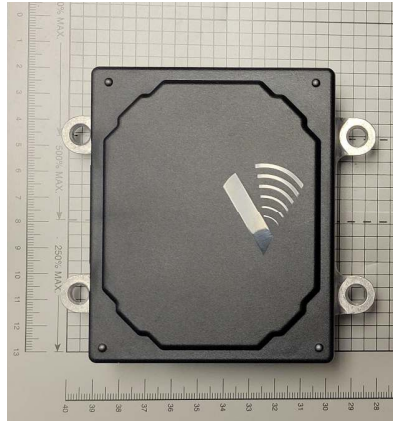
PRST79-WR2308TX
Issued: April 22, 2023

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



Prepared for:

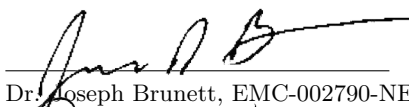
Preco Electronics

10335 W Emerald St, Boise Idaho 83704

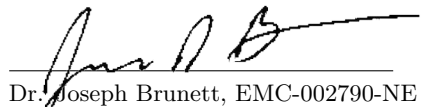
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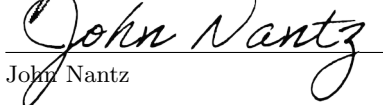
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Date of Issue:

April 22, 2023

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

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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

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
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.

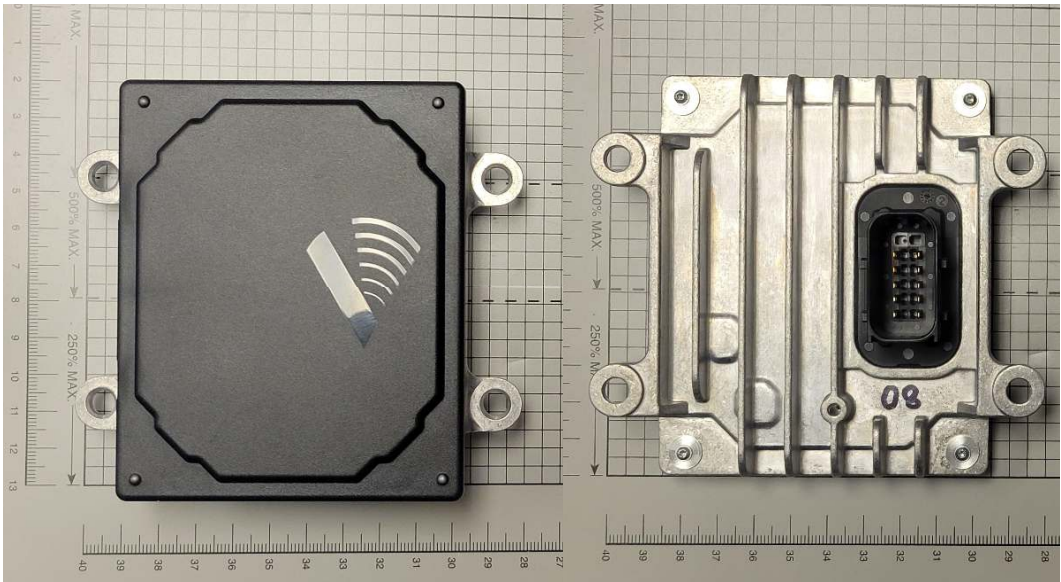


Figure 1: Photos of EUT.

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°C to +85°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:	OXZSEENTRY79
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.

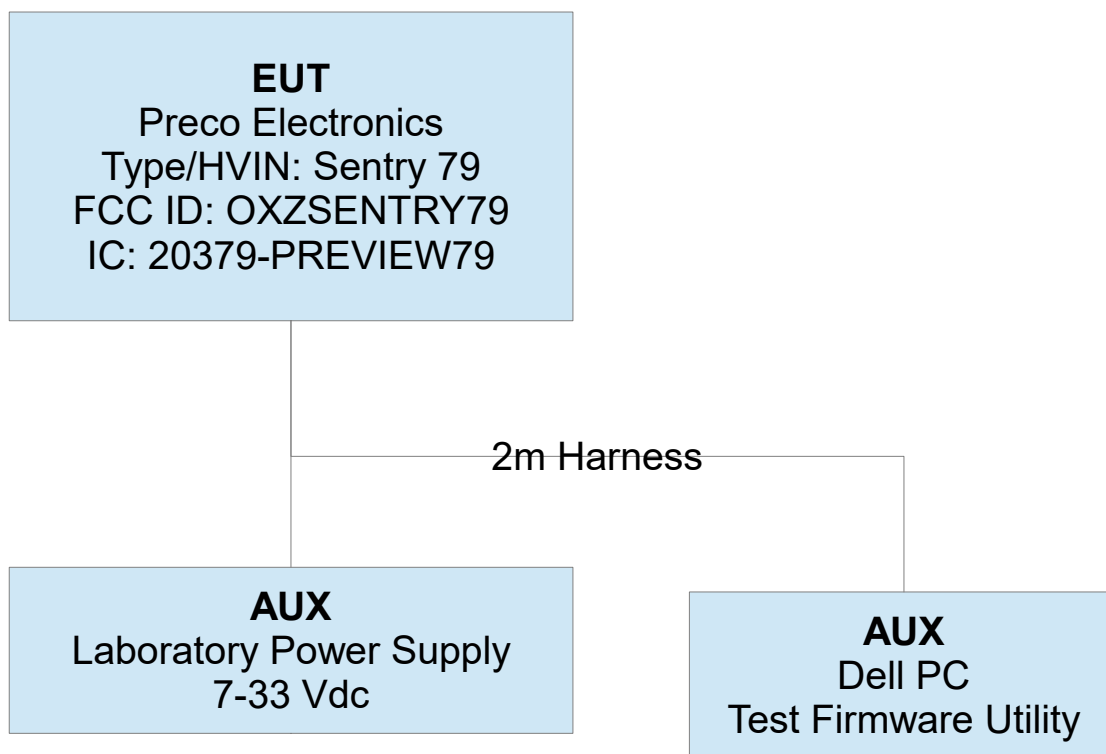


Figure 2: EUT Test Configuration Diagram.

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 chirp 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.

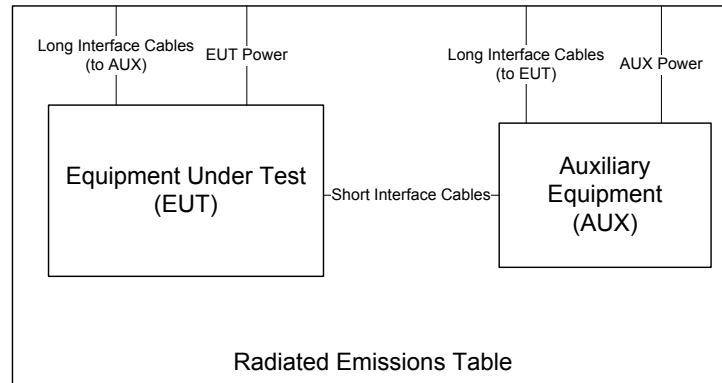


Figure 3: Radiated Emissions Diagram of the EUT.

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 ISSED 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° 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

$$EIRP = P_T - G_A = ERP + 2.16, \quad (1)$$

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.

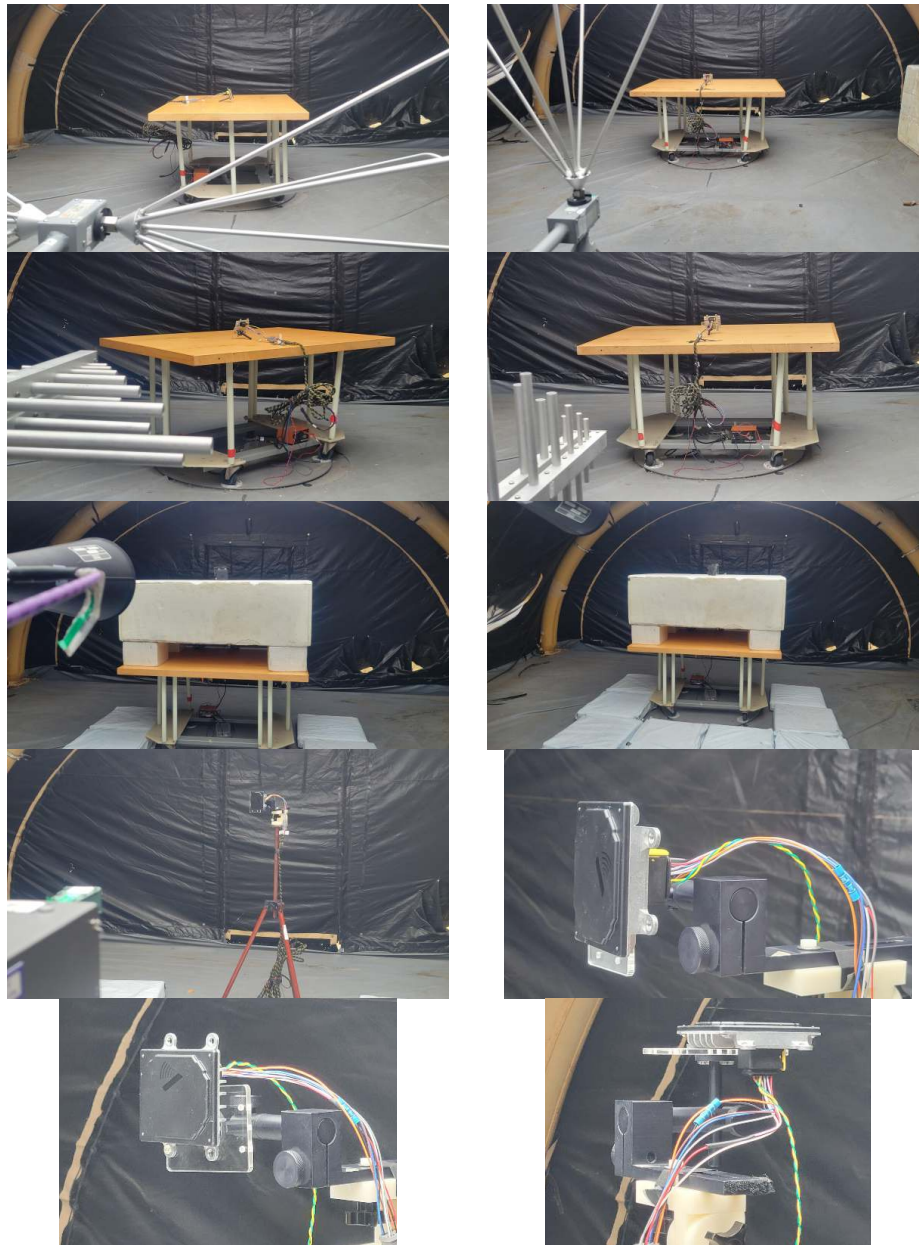


Figure 4: Radiated Emissions Test Setup Photograph(s).

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		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	RBW	VBW	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)													
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.													

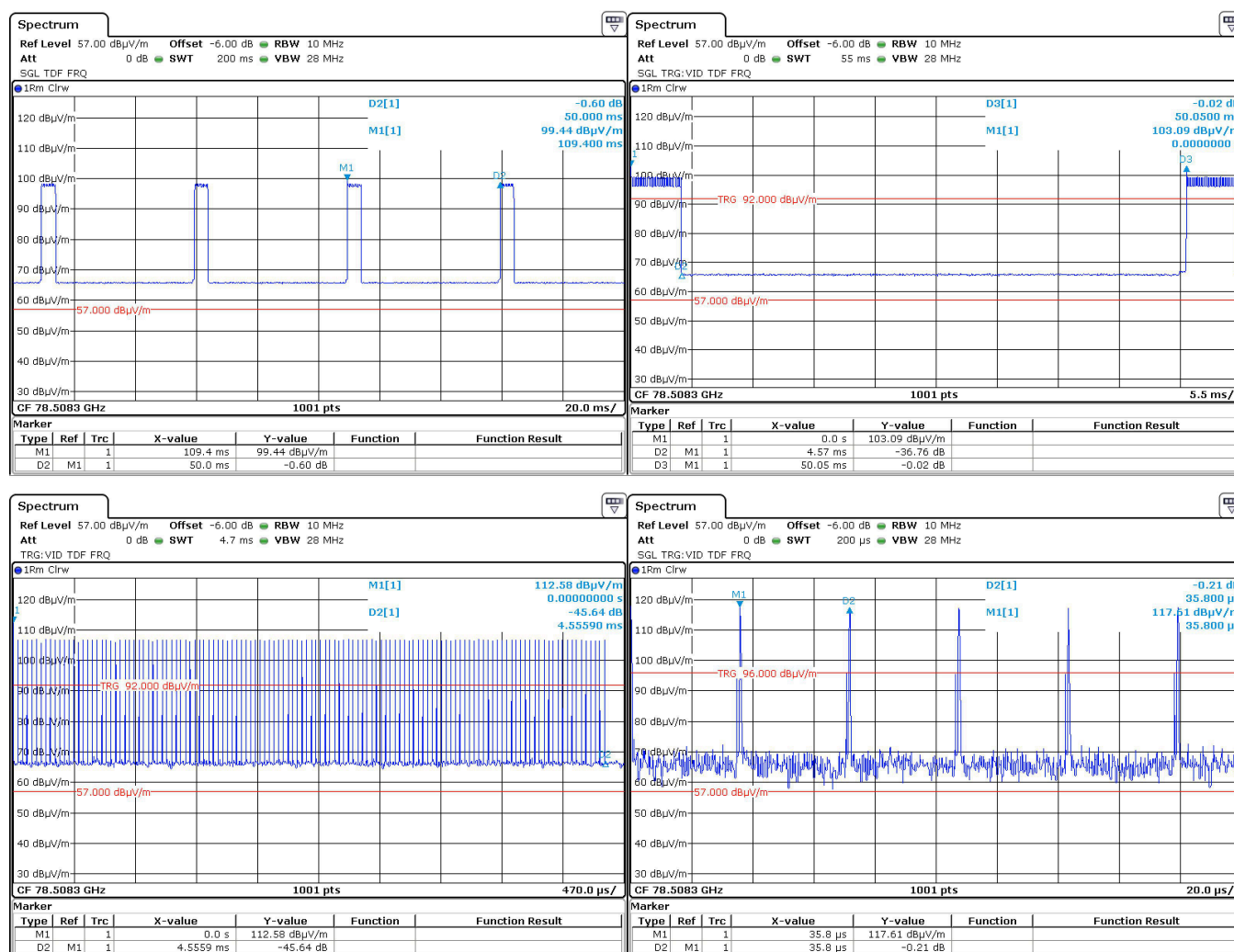


Figure 5: Example Pulsed Emission Characteristics (Duty Cycle).

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 Pk	IF Bandwidth 10 MHz		Video Bandwidth 28 MHz		EUT: Test Date(s): Test Engineer:				PRECO Sentry 79 3/21/23, 5/1/23 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	a1	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		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	a2	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		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.						

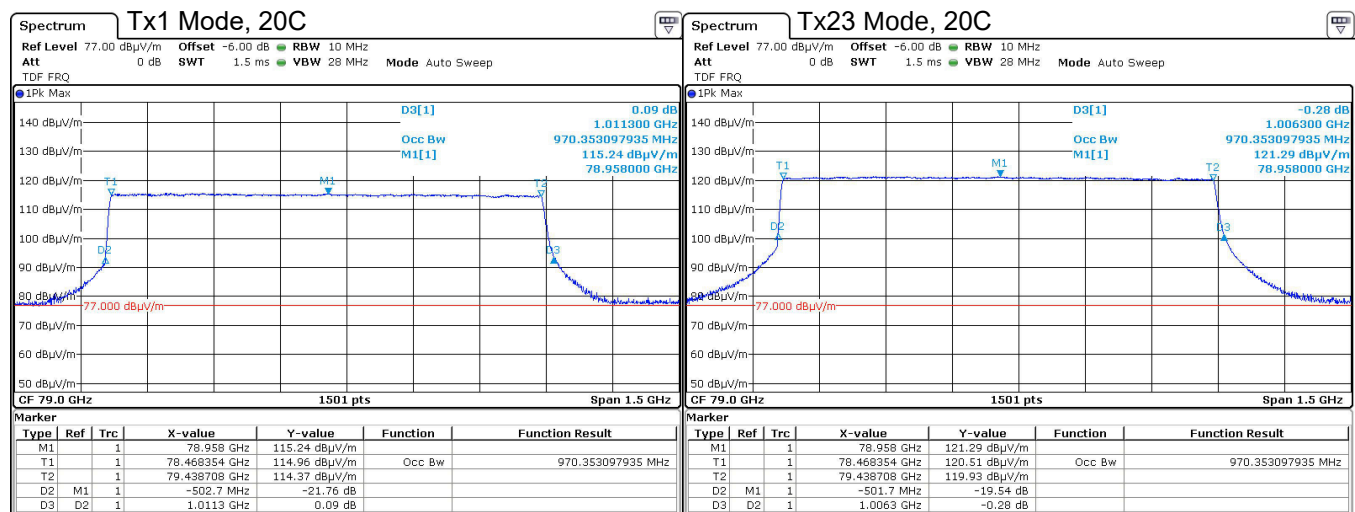


Figure 6: Example Intentional Emission Bandwidth.

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: PRECO Sentry 79
 Test Date(s): 03/22/23
 Test Engineer: J. Brunett

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

a5
 a6
 a7
 a8

R0	Frequency		Site					EUT			Test Antenna				Cable/Mixer	Receiver	Field Strength @ DR				EIRP		Regulation	Details	Comments				
	Start	Stop	Temp.	Table	MR	DR	N/F	CF	Mode	Volt.	Dim	Pol.	Ant.	Dim.	Ka	Bandwidth	Field	Pk	Avg	Pk	Avg	USA/CAN	Pass/Fail						
	MHz	MHz	Hum	Angle			m	dB		(V)	cm	H/V	Height	cm	dB/m	RBW/VBW	Meas.	Limit	Meas.	Limit	Calc.	Limit	95M/251	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
 EUT: PRECO Sentry 79 a2 Tx23
 Test Date(s): 03/23/23 a3 CW, Tx1
 Test Engineer: J. Brunett a4 CW, Tx23
 a5 max all modes (a1 - a4)
 a6
 a7
 a8

R0	Frequency		Temp. Hum C, %	Table Angle deg	Site			N/F CF dB	EUT			Test Antenna			Cable Mixer CL/Kg dB	Receiver Bandwidth RBW/VBW MHz	Field Strength @ DR				EIRP		Regulation USA/CAN 95M/GEN §	Pass/Fail dB	Comments				
	Start	Stop			MR	DR	DR		Mode	Volt. (V)	Dim cm	Pol. H/V	Ant. Height m	Dim. cm			Ka dB/m	Pk Meas.	QPk/Avg Lim.	Meas.	Lim.	Pk Calc.				Qpk/Avg Lim.	Calc.	Lim.	
	MHz	MHz			m																								
R1	SETUP				OATSC				SAMPLE A				BICEMCO01				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				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				HQRITO18S01				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 arising 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
 EUT: Sensata PRECO SAW33 a2 Tx23
 Test Date(s): 10/19/2022-10/21/2022 a3 CW, Tx1
 Test Engineer: J. Brunett a4 CW, Tx23
 a5 max all modes (a1 - a4)
 a6
 a7
 a8

R0	Frequency		Site					EUT			Test Antenna				Cable Mixer CL/Kg dB	Receiver Bandwidth RBW/VBW MHz	Field Strength @ DR		EIRP/MHz		Regulation Canada RSS-251 \$	Pass/Fail dB	Comments						
	Start GHz	Stop GHz	Temp. Hum C, %	Table Angle deg	MR	DR	N/F	CF	Mode	Volt. (V)	Dim cm	Pol. H/V	Ant. Height m	Dim. cm			Ka	Pk Meas. Lim. dBuV/m	QPk/RMS Meas. Lim. dBuV/m	Pk Calc. Lim. dBm/MHz				Avg/ RMS Calc. Lim. dBm/MHz					
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 Mixer CL/Kg dB	Receiver Bandwidth RBW/VBW MHz	Field Strength @ DR		S @ DR		Regulation USA Part 95M \$	Pass/Fail dB	Comments						
	Start GHz	Stop GHz	Temp. Hum C, %	Table Angle deg	MR	DR	N/F	CF	Mode	Volt. (V)	Dim cm	Pol. H/V	Ant. Height m	Dim. cm			Ka	Pk Meas. Lim. dBuV/m	QPk/Avg Meas. Lim. dBuV/m	Pk Calc. Lim. dBm/cm2				Avg Lim. Calc. dBm/cm2					
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/cm²) = 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; ISD 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 MHz)	$\pm 4.0 \text{ dB}$
Radiated Emm. Amplitude (200 – 1000 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



Figure 7: Accreditation Documents