NVLAP Lab Code 200087-0

Rogers Labs, a division of The Compatibility Center LLC
7915 Nieman Rd.
Lenexa, KS 66214
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Engineering Test Report
Application for Grant of Certification
47CFR Part 90 and Industry Canada RSS-137
Location and Monitoring Service Transmitter

HVIN: 051153

915 MHz
FCC ID: FIH051153
IC: 1584A-051153

Transcore

Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113

FCC Designation: US5305
ISED Registration: 3041A-1

Test Report Number: 240930

Test Date: September 30, 2024

Authorized Signatory:

Patrick Powell
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Revision History

Revision 1 – Issued November 2, 2024

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Executive Summary

The following information is submitted for consideration in obtaining Equipment Grant of Certification for Licensed Intelligent Transportation Systems Radio Service, Location and Monitoring Services (LMS) governed under 47CFR Paragraph 90 (M) and Innovation, Science and Economic Development (ISED) RSS-137 issue 2.

Summary

☒ The device fulfills the general approval requirements of the referenced standards identified in this test report and requested by the customer.

Name of Applicant: Transcore
Amtech Technology Center 8600 Jefferson Street, NE
Albuquerque, NM 87113
Phone: (505) 856-8000

Product Marketing Name (PMN:) 051153 HVIN: 051153

FCC ID: FIH051153 IC: 1584A-051153

Frequency of Operation: 915 MHz

0.0008 watts, occupied bandwidth 4,936

Attestations

This equipment has been tested in accordance with the standards identified in this report and determined in compliance with the referenced requirements and regulations. To the best of my knowledge all testing was performed using the measurement procedures identified in this report. All instrumentation used during compliance testing is calibrated and remains in a calibrated state in accordance with ISO 17025:2017 requirements. Further, I attest that all necessary measurements were completed at Rogers Labs, a division of The Compatibility Center LLC

Rogers Labs, a division of The Compatibility Center LLC
7915 Nieman Rd
Lenexa, KS 66214

Patrick Powell
Date: October 25, 2024

Applicable Standards and Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, 47CFR dated May 11, 2023, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057; 90.201 through 90.217, 90.350 through 90.363 and RSS-137 Issue 2 the following information is submitted. Test procedures used were the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.26-2015 and ANSI 63.4-2014.

Opinion / Interpretation of Results

Test Number	Measurement	FCC Rule	Pass/Fail
#1	Power Measurement	47CFR paragraphs 2.1046 90.205, RSS-137, Issue 2	Pass
#2	Modulation Characteristics	47CFR paragraphs 2.1047, 90.207, RSS-137	Pass
#3	Occupied Bandwidth	47CFR paragraphs 2.1049, 90.209, RSS-137	Pass
#4	Spurious Emissions	47CFR 2.1051, 90.219, RSS-137	Pass
#5	Emission Mask	47CFR 2.1051, 90.210, RSS-137	Pass
#6	Field Strength of Spurious Radiation	47CFR 2.1051,2.1057, 90.210, RSS-137	Pass
#7	Frequency Stability	47CFR 2.1055, 90.213, RSS-137	Pass

Equipment Under Test

Equipment	Model / PN	Serial Number
EUT	051153	ENG1

Test results in this report relate only to the items tested

Firmware Version: 201

The design utilizes a dipole antenna with 0-dB gain integrated on the Printed Circuit Board.

The software does not provide the ability to change power as it is hardcoded in the firmware. The device design provides 0.0008 watts of radiated power.

Equipment Function and Configuration

The EUT is a mobile non-Multilateral transponder Tag Operating as location and monitoring Radio Frequency Identification (RFID) transmitter. The EUT documented in this report is an active mobile transponder operating at 915 MHz frequency band transmitting information to compatible Location and Monitoring Service equipment. The unit operates from direct current power provided from replaceable button cell battery and provides no provision for alternative power source. The design utilizes an internal fixed antenna system and offers no provision for antenna replacement or modification. The operation of the design utilizes standardized RFID modulation schemes offering the ability to interface and respond with Industry Standard Radio Frequency Identification (RFID) interrogation systems. The test sample was modified from production equipment for testing purposes. The modifications involved the addition of slide switches used to enable the transmitter for testing purposes. The test sample transmits bursts of OOK (On/Off Keyed) modulated signal resembling actual packet data in the test mode. Activation of the switch placed the EUT in a test mode operating the transmitter at a 100% duty cycle. The testing mode of operation exceeds typical duty cycle operation of production equipment. Test results in this report relate only to the products described in this report.

Equipment Configuration

Application for Certification

1. Manufacturer: Transcore
   Amtech Technology Center
   8600 Jefferson Street, NE
   Albuquerque, NM 87113

2. Identification: **HVIN**: 051153 **FCC ID**: FIH051153 **IC**: 1584A-051153

3. A copy of the installation and operating instructions furnished to the end user. Refer to the instruction manual furnished with this application for details.

4. Emission Types: Modulated in width/duration/data – L1D

Frequency (MHz)	Emission Designator
915	4M94L1D

5. Frequency Range: 915 MHz

6. Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power. 0.0008 watts.

7. Maximum power rating as defined in the applicable part(s) of the rules. As stated in 47CFR, 90.205(l) the maximum permissible output power allowed is 30 watts.

8. The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range. The maximum operating mode runs at 3.0 volts consuming 0.018 amps.

9. Provide the tune-up procedure over the power range, or at specific operating power levels. Refer to the tune-up procedure furnished with this application for details.

10. A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power. Refer to the schematics and technical exhibits furnished with this application for details.

11. A photograph or drawing of the equipment identification plate, or label showing the information to be placed thereon shall be provided. Refer to the identification label exhibit and information furnished with this application for details.

12. Photographs (8" x 10") of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals supplied with the certification request, additional photographs are necessary only to complete the required showing. Refer to the exhibits of this report and or additional information furnished with the application for details.

13. For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase, and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated. Information about modulation is contained in Operational description exhibit.

14. The data required by Sections 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in Section 2.1041.

15. The application for certification of an external radio frequency power amplifier under Part 97 of this chapter need not be accompanied by the data required by Paragraph (b)(14) of this section. In lieu thereof, measurements shall be submitted to show compliance with the technical specifications in Subpart C of Part 97 of this chapter and such information as required by Section 2.1060 of this part. This paragraph does not apply to this equipment.

16. An application for certification of an AM broadcast stereophonic exciter generator intended for interfacing with existing certified, or formerly type accepted or notified transmitters must include measurements made on a complete stereophonic transmitter. The instruction book must include complete specifications and circuit requirements for interconnecting with existing transmitters. The instruction book must also provide a full description of the equipment and measurement procedures to monitor modulation and to verify that the combination of stereo exciter generator and transmitter meets the emission limitations of section 73.44. This paragraph does not apply to this equipment.

17. A single application may be filed for a composite system that incorporates devices subject to certification under multiple rule parts; however, the appropriate fee must be included for each device. Separate applications must be filed if different FCC Identifiers will be used for each device.

18. The device is not a software-defined radio and requirements of 2.944 do not apply to this application.

19. Applications for certification of equipment operating under part 27 of this chapter, that a manufacturer is seeking to certify for operation in the:

    (i) 1755-1780 MHz, 2155-2180 MHz, or both bands shall include a statement indicating compliance with the pairing of 1710-1780 and 2110-2180 MHz specified in §§27.5(h) and 27.75 of this chapter.
    (ii) 1695-1710 MHz, 1755-1780 MHz, or both bands shall include a statement indicating compliance with §27.77 of this chapter.
    (iii) 600 MHz band shall include a statement indicating compliance with §27.75 of this chapter.

20. Applications for certification of equipment operating under part 90 of this chapter and capable of operating on the 700 MHz interoperability channels (See §90.531(b)(1) of this chapter) shall include a Compliance Assessment Program Supplier's Declaration of Conformity and Summary Test Report or, alternatively, shall include a document detailing how the applicant determined that its equipment complies with §90.548 of this chapter and that the equipment is interoperable across vendors.

21. Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used.

Units of Measurements

Conducted EMI Data presented in dBµV; dB referenced to one microvolt

Antenna port Conducted Data is in dBm; dB referenced to one milliwatt

Radiated EMI Data presented in dBµV/m; dB referenced to one microvolt per meter

Note: Radiated limit may be expressed for measurement in dBµV/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for Open Area Test Site using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Test Site Locations

Conducted EMI AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).

Radiated EMI The radiated emissions tests were performed at the 3 meters Semi-Anechoic Chamber (SAC) located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS or at the 3 meters Outdoor Area Test Site (OATS) in the satellite location.

Registered Site information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

Environmental Conditions

Ambient Temperature 22.8° C

Relative Humidity 46%

Atmospheric Pressure 1017.3mb

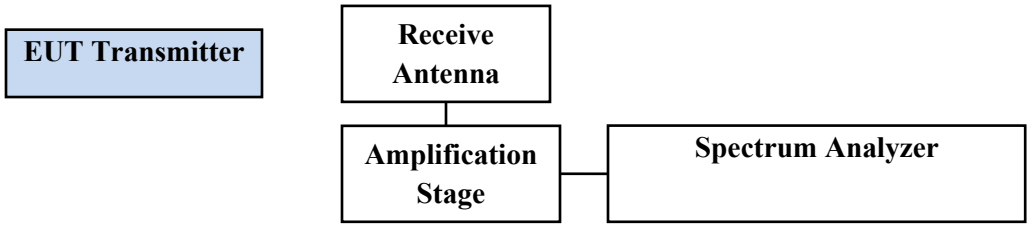
Transmitter Power Output

Measurements Required

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded, and no adjustment shall be made to the transmitter after the test has begun, except as noted below:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

Test Arrangement



The radio frequency power output was measured in the semi anechoic chamber (SAC). The design offers no provision for connection to antenna port. The substitution method was used to predict the transmitter output power level. The receiver peak detector was used to record the highest emission levels. The EUT was placed on a rotatable platform elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. The platform was rotated though 360 degrees to locate the position registering the highest amplitude emission. The frequency spectrum was searched for maximum emission generated. Emission level was measured and recorded for the maximum amplitude. The EUT transmitter was then removed and replaced with a substitution antenna, which was powered from a signal generator. The output signal from the generator was then adjusted such that the amplitude received was the same as that previously recorded for each frequency. This step was repeated for both horizontal and vertical polarizations. The power in dBm required to produce the desired signal level was then recorded from the signal generator. The power in dBm was then calculated by reducing the previous readings by the gain in the substitution antenna. The testing procedures used conform to the procedures stated in the ANSI C63.26-2015

document. Data was taken per 47CFR Paragraph 2.1046(a) and applicable paragraphs of Part 90 and RSS-137.

Refer to figure one displaying plot of radiated spectral emissions taken in screen room (for reference only).

P_{dBm} = power in dB above 1 milliwatt

Milliwatts $= 10^{(PdBm/10)}$

Watts = (Milliwatts) (0.001) (W/mW)

Milliwatts $= 10^{(3.2/10)}$

= .8 mW

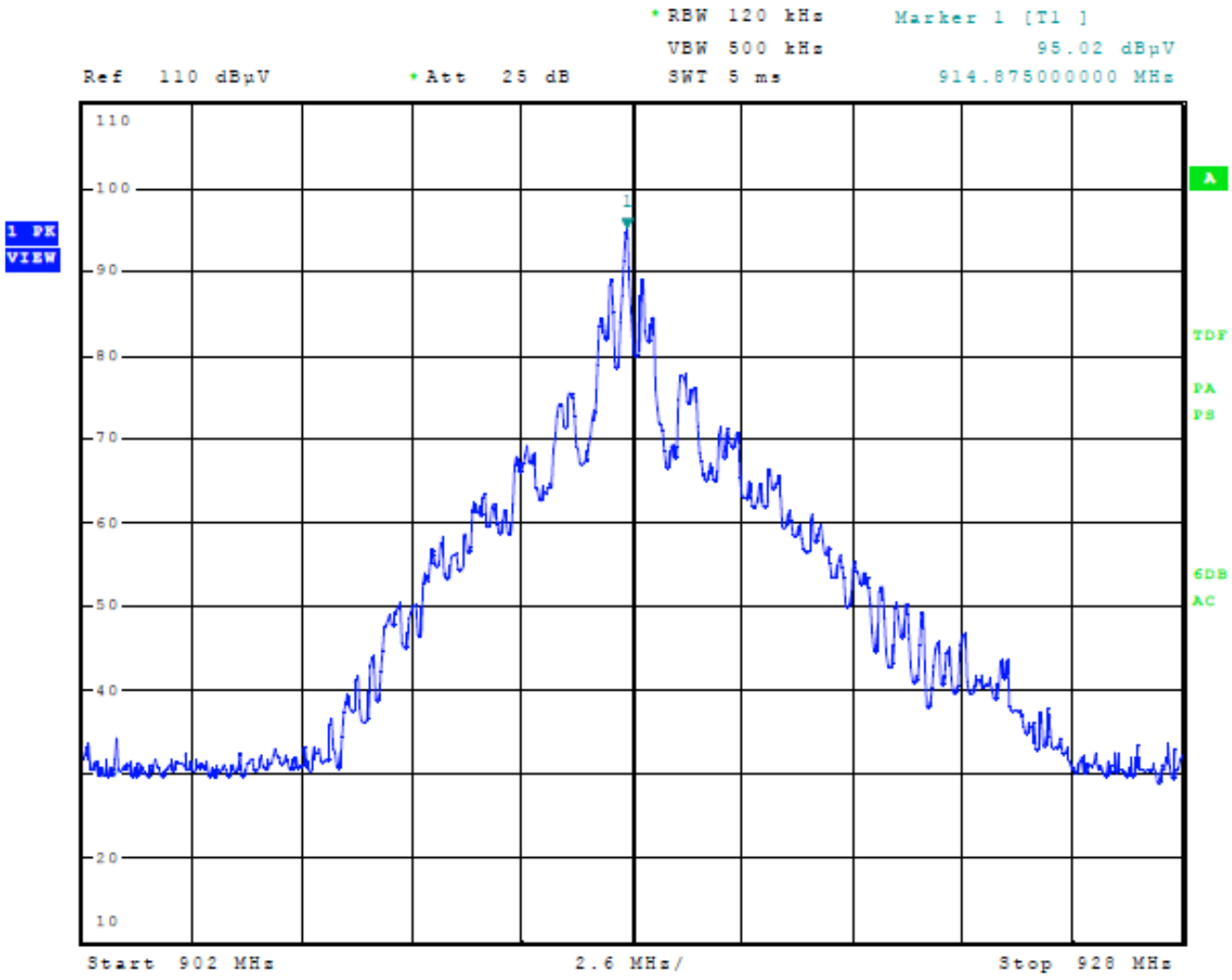
= 0.0008 Watts power

Table 1 Transmitter Power Results

Frequency (MHz)	P_{dBm}	P_{mw}	P_w
915	-0.93	.81	0.0008

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 2 and 90.205 and RSS-137. There are no deviations to the specifications.

Figure 1 Transmitter Output Across Frequency Band

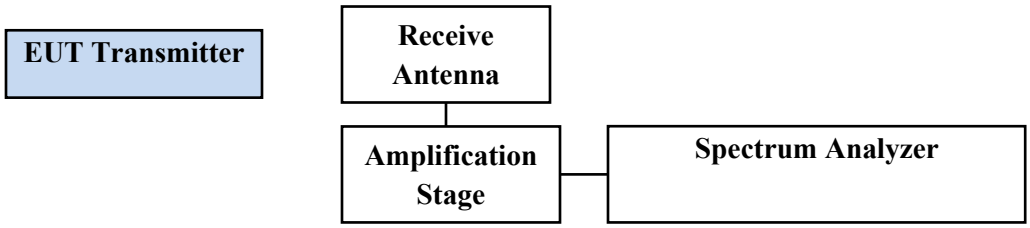


Modulation Characteristics

Measurements Required

A curve or equivalent data that shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed shall be submitted.

Test Arrangement



The radio frequency output was coupled to a Rohde &Schwarz ESU40 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its normal mode.

The transmitter operates providing digital data, transmitted signals modulated in amplitude/width/duration. The EUT demonstrated compliance with the specifications of Paragraphs 2.1047(d), 90.207 and RSS-137, paragraph 6.2. There are no deviations to the specifications.

Occupied Bandwidth

Measurements Required

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Refer to figure two displaying plot of the occupied bandwidth measurement.

Test Arrangement

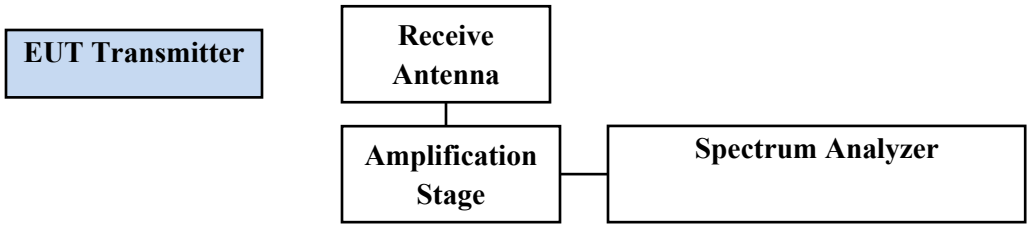
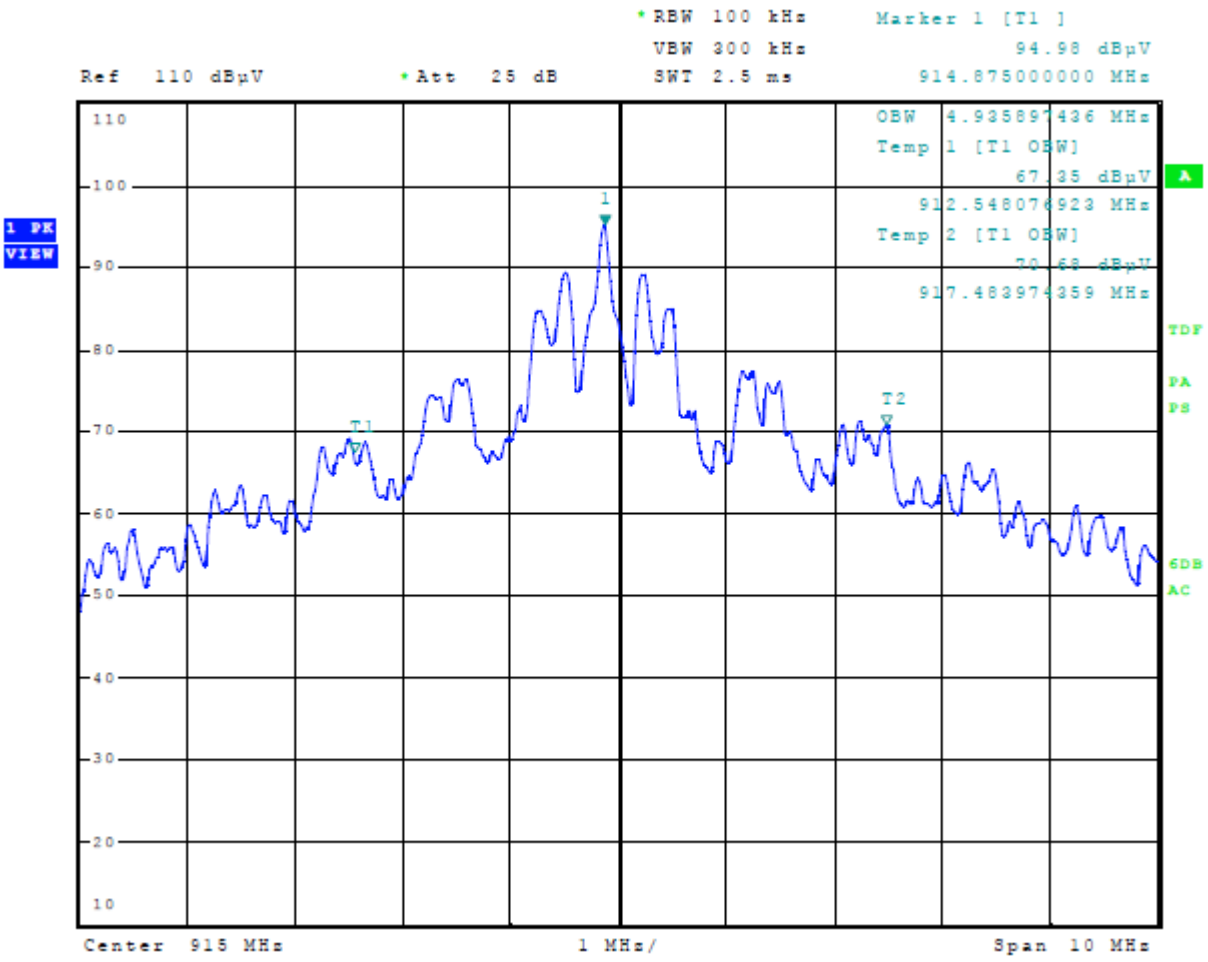


Table 2 Occupied Bandwidth Results

Operation mode	Occupied Bandwidth (kHz)
OOK	4,936

The EUT demonstrated compliance with the requirements of Paragraphs 2.1049, 90.209 and RSS-137 paragraph 6.1.2. There are no deviations to the specifications.

Figure 2 Occupied Bandwidth

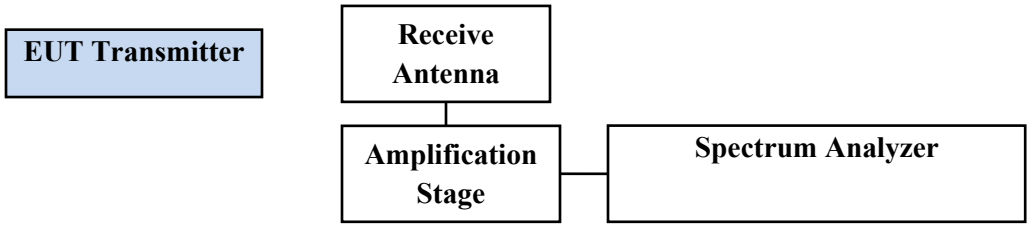


Spurious Emissions

Measurements Required

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. To gain dynamic range in the test equipment, a high pass filter attenuated the fundamental frequency of operation was used to observe the harmonic emissions.

Test Arrangement



The radio frequency output was passively coupled to a Rohde &Schwarz ESU40 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its normal mode. The receiver peak detector was used to record the highest emission levels. The frequency spectrum from 9 kHz to 10 GHz was observed. Data was taken per 47CFR 2.1051 and applicable paragraphs of Part 90 and RSS-137.

Limit: Spurious emissions must be attenuated below the peak output power by at least 55 + 10 Log (P_o) dB.

0.0008-watt transmitter limit requires the out of band emissions must be suppressed by at least 24.0 dBc

Attenuation = $55 + 10 \log_{10}(P_w)$

= $55 + 10 \log_{10} (0.0008)$

= 24.0 dBc

Table 3 Spurious Emissions Results

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
915.00	1830.0	-65.5	65.10
	2745.0	-55.6	55.20
	3660.0	-66.5	66.10
	4575.0	-65.9	65.50
	5490.0	-63.4	63.00

Data was taken per 2.1051 and applicable parts of 47CFR 90.210 and RSS-137. The EUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057 and 90.210(k)(3) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

Emission Mask

Measurements Required

Transmitters used in the radio services governed by this part must comply with the emissions masks outlined in this section. Paragraph 90.210(K)(3) specifies the out of band emission limitations for this equipment. The spurious emissions for the device were measured at the maximum output power condition.

90.210 (k)
(3) *Other transmitters*. For all other transmitters authorized under subpart M that operate in the 902-928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

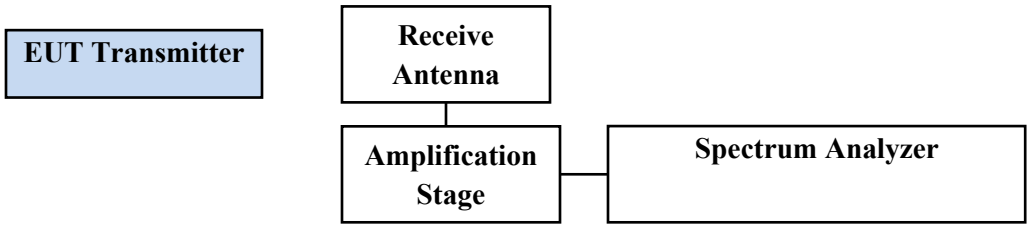
(i) On any frequency within the authorized bandwidth: Zero dB.
(ii) On any frequency outside the licensee's sub-band edges: 55 + 10 log(P) dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

(4) In the 902-928 MHz band, the resolution bandwidth of the instrumentation used to measure the emission power shall be 100 kHz, except that, in regard to paragraph (2) of this section, a minimum spectrum analyzer resolution bandwidth of 300 Hz shall be used for measurement center frequencies with 1 MHz of the edge of the authorized subband.

RSS-137
6.5.3 Emission Mask C – Other Transmitters
Except as provided in sections 6.5.1, 6.5.2 and 6.5.4, the unwanted emission of all other transmitters operating in the band 902-928 MHz shall comply with the following:
The power of any emission outside the equipment operating sub-band edge shall be attenuated below the maximum permitted output power P_{max} by at least $55 + 10 \log_{10} P_{max}$ dB

Emission Mask Calculation for this equipment: Limit=55+10Log (.0008) which equates to 24.0 dBc.

Test Arrangement



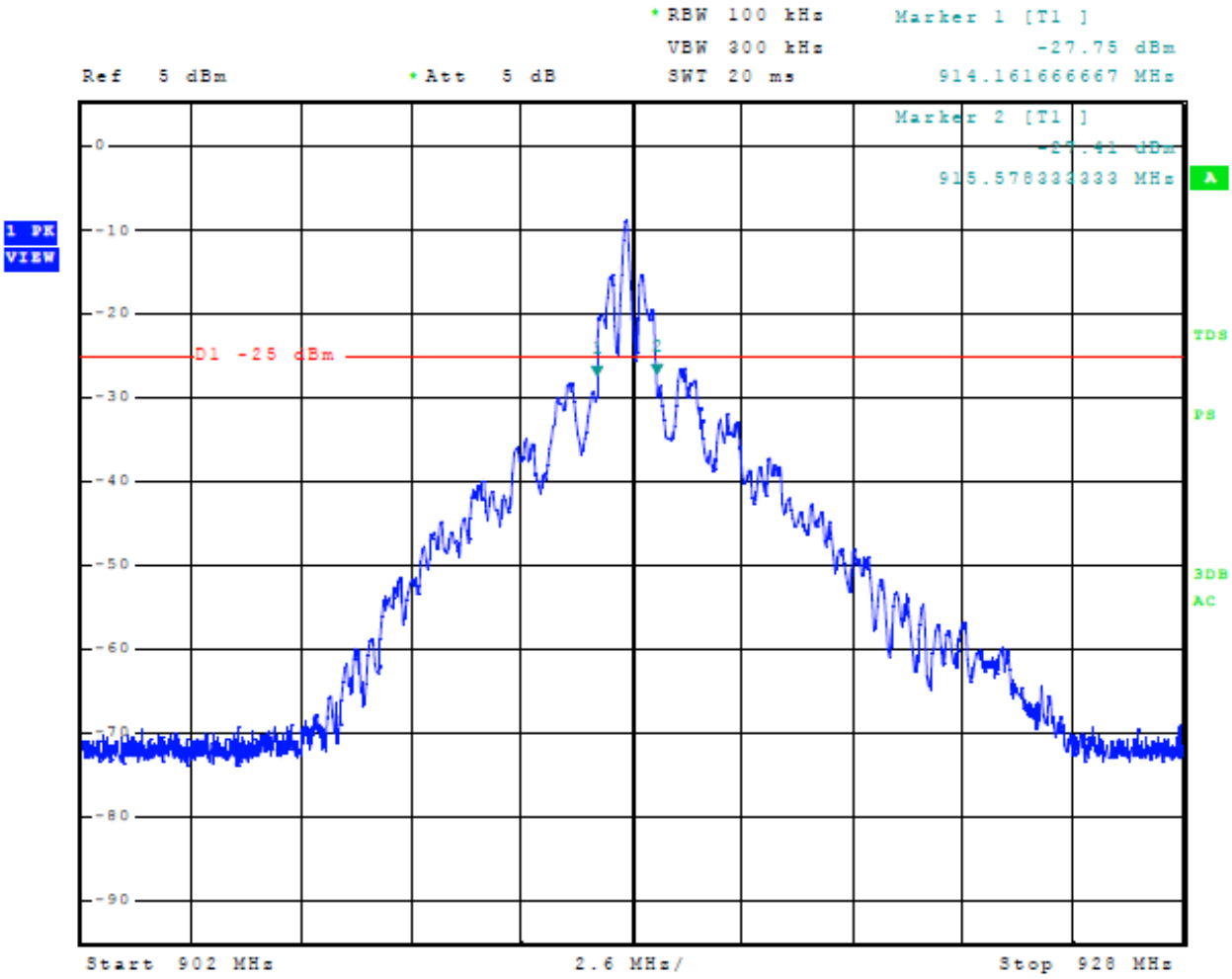
The radio frequency output was passively coupled to a Rohde &Schwarz ESU40 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating through normal modes with maximum output power. The frequency spectrum at the band edges were observed and plots produced. Data was taken per 47CFR 2.1051 and applicable parts of Part 90.210 (k) and RSS-137.

Refer to figure three for plot presenting compliance with emission mask requirements at the band edges.

Results Emission Mask

The EUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

Figure 3 Emissions Mask

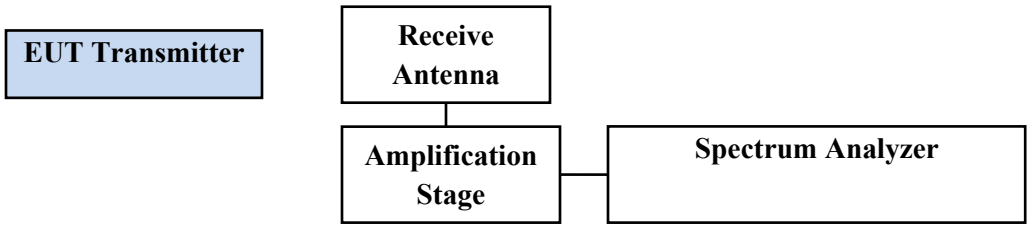


Field Strength of Spurious Radiation

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Test Arrangement



Preliminary radiated emissions investigation was made in a screen room to determine frequencies of emissions for investigation in the semi anechoic chamber (SAC). The transmitter spurious emissions were measured in the SAC. The EUT was placed on a turntable elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. Raising and lowering the FSM antenna and rotating the turntable to maximize the emission. Data was measured and recorded for the maximum amplitude of each spurious emission. A Loop antenna was used for measuring emissions from 0.009 to 30 MHz, Biconilog Antenna for 30 to 1000 MHz, Double-Ridge, and/or Pyramidal Horn Antennas above 1 GHz. Emissions were measured in dBµV/m @ 3 meters. The substitution method was used to measure harmonic emissions. Harmonic emission levels from the EUT were measured and amplitude levels were recorded. The EUT transmitter was then removed and replaced with a substitution antenna, which was powered from a signal generator. The output signal from the generator was then adjusted such that the amplitude received was the same as that previously recorded for each frequency. This step was repeated for both horizontal and vertical polarizations. The power in

dBm required to produce the desired signal level was then recorded from the signal generator. The power in dBm was then calculated by reducing the previous readings by the gain in the substitution antenna.

The limits for the spurious radiated emissions are defined by the following equation.

> Limit = Amplitude of the spurious emission must be attenuated by this amount below the level of the fundamental. On any frequency removed from the assigned frequency outside the assigned sub-band edges: at least 55 + 10 Log (P_o) dB.
>
> Emission requirement for 0.0008-watt transmitter power requires spurious emissions be attenuated at least 24.5 dBc below the carrier.
>
> Attenuation = 55 + 10 Log_{10}(P_w)
> = 55 + 10 Log_{10} (0.0008)
> = 24.0 dBc

Data was taken per 2.1051 and applicable parts of 47CFR 90. The EUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

Table 4 General Radiated Emission Results (worst-case)

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBc)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
34.58	24.76		-70.5		70.0		24.0
530.3	32.38		-62.8		62.4		24.0
537.74	28.61		-66.6		66.2		24.0
30.59		20.37		-74.9		74.4	24.0
530.3		32.56		-62.7		62.2	24.0
605.15		25.12		-70.1		69.7	24.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Frequency Stability

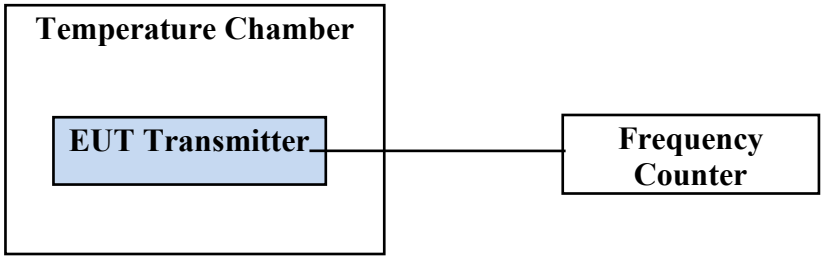
Measurements Required

The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability, the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value.

(2) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement



The measurement procedure outlined below shall be followed for frequency stability testing.

Step 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.

Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.

Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated at full radio frequency power output at the duty cycle, for which it is rated, for duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored, and measurements shall be recorded.

Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to +50°C in 10-degree increments.

Table 5 Frequency Stability vs. Temperature Results

Frequency 914.872797 (MHz)	Frequency Stability Vs. Temperature Ambient Frequency (914.872797)								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	-8,265	-8,442	-380	976	785	584	-8,179	-8,372	-6,705
PPM	-9.0	-9.2	-0.4	1.1	0.9	0.6	-8.9	-9.2	-7.3
%	-0.001	-0.001	0.000	0.000	0.000	0.000	-0.001	-0.001	-0.001
Limit (PPM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Frequency stability is not required for this mobile transponder device per 47CFR 90.213 and RSS-137 paragraph 6.3. Frequency stability testing was performed for completeness.

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1055 and applicable Parts of 90.213 and RSS-137 paragraph 6.3. There are no deviations or exceptions to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Additional Test Equipment List
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. The results of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.46
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6˚C
Humidity	3%

Annex B Test Equipment List

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/25/2024	3/25/2025
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/25/2024	3/25/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/25/2024	3/25/2026
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/8/2024	7/8/2025
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/26/2024	1/26/2025
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Power meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/25/2024	3/25/2025

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Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☐ Frequency Counter: Leader		LDC-825 (8060153)		3/28/2023	3/28/2025
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/25/2024	3/25/2025
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	9/16/2024	9/16/2025
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch	30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch	30-1800 MHz	3/28/2023	3/28/2025
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/25/2024	3/25/2025
☐ Wave Form Generator Keysight		33500B (MY57400128)		3/25/2024	3/25/2025
☐ Antenna:	Solar	9229-1 & 9230-1		2/10/2024	2/10/2025
☐ CDN:	Com-Power	Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope: Tektronix		MDO 4104		2/10/2024	2/10/2025
☐ EMC Transient Generator HVT		TR 3000		2/10/2024	2/10/2025
☐ AC Power Source (Ametech, California Instruments)				2/10/2024	2/10/2025
☒ Field Intensity Meter: EFM-018				2/10/2024	2/10/2025
☒ ESD Simulator: MZ-15				2/10/2024	2/10/2025
☒ Weather station Davis		6152 (A70927D44N)		7/11/2024	7/11/2025
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Rogers Labs Qualifications

Patrick Powell, Engineer

Rogers Labs, a division of The Compatibility Center LLC

Mr. Powell has approximately 40 years' experience in the field of electronics. Working experience includes automated test engineering in Military electronics; design & development in medical electronics; and application engineering / small business ownership in the semiconductor and display technology spaces.

Positions Held:

Test Engineer:	McDonnell Douglas (now Boeing)
	Allied Signal Aerospace (now Honeywell)
Electrical Engineer:	PPG Biomedical Systems
	Nellcor, Inc.
Applications Engineer / small business owner:	
	Sharp Electronics
	Lattice Semiconductor
EMC Test Engineering:	The Compatibility Center LLC (current)

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Annex D Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, KS

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).

2024-03-18 through 2025-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program