NVLAP Lab Code 200087-0

ROGERS LABS, INC.

4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Engineering Test Report for Grant of Certification of Application

47CFR Part 90 and Industry Canada RSS-137

Location and Monitoring Service Transmitter

HVIN: 051136

915 MHz

FCC ID: FIH051136

IC: 1584A-051136

Transcore

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

FCC Designation: US5305
ISED Registration: 3041A-1

Test Report Number: 220715

Test Date: July 20, 2022

Authorized Signatory: Scot D Rogers
Scot D. Rogers

Table of Contents

TABLE OF CONTENTS 2

REVISION HISTORY 4

EXECUTIVE SUMMARY 5

SUMMARY 5

ATTESTATIONS 5

APPLICABLE STANDARDS AND TEST PROCEDURES 6

OPINION / INTERPRETATION OF RESULTS 6

EQUIPMENT UNDER TEST 7

Equipment Function and Configuration 7

Equipment Configuration 7

APPLICATION FOR CERTIFICATION 8

UNITS OF MEASUREMENTS 10

TEST SITE LOCATIONS 10

ENVIRONMENTAL CONDITIONS 10

TRANSMITTER POWER OUTPUT 11

Measurements Required 11

Test Arrangement 11

Table 1 Transmitter Power Results 12

Figure 1 Transmitter Output Across Frequency Band 13

MODULATION CHARACTERISTICS 14

Measurements Required 14

Test Arrangement 14

OCCUPIED BANDWIDTH 15

Measurements Required 15

Test Arrangement 15

Table 2 Occupied Bandwidth Results 15

Figure 2 Occupied Bandwidth 16

SPURIOUS EMISSIONS 17

Measurements Required 17

Test Arrangement 17

Table 3 Spurious Emissions Results (ASTM) 18

EMISSION MASK 19

Measurements Required 19

Test Arrangement 20

Results Emission Mask 20

Figure 3 Emissions Mask 21

FIELD STRENGTH OF SPURIOUS RADIATION 22

Measurements Required 22

Test Arrangement 22

Table 4 General Radiated Emission Results (worst-case) 23

FREQUENCY STABILITY 24

Measurements Required 24

Test Arrangement 24

Table 5 Frequency Stability vs. Temperature Results 25

Table 6 Frequency Stability vs. Input Power Supply Voltage Results 25

ANNEX 26

Annex A Measurement Uncertainty Calculations 27

Annex B Additional Test Equipment List 28

Annex C Rogers Qualifications 30

Annex D Laboratory Certificate of Accreditation 31

Revision History

Revision 1 Issued August 3, 2022

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

HVIN: 051136

FCC ID: FIH051136 IC: 1584A-051136

Frequency of Operation: 915 MHz

0.005 watts, occupied bandwidth 6,557 kHz

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 are calibrated and remain in a calibrated state in accordance with ISO 17025:2017 requirements. Further, I attest that all necessary measurements were completed at Rogers Labs, Inc.

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053

Scot D Rogers

Scot D. Rogers
Date: July 20, 2022

Applicable Standards and Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, 47CFR dated July 20, 2022, 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	051136	ENG1

Test results in this report relate only to the items tested

Firmware Version: FCC_FC05

The design utilizes a monopole antenna with unity gain integrated on the Printed Circuit Board.

The software does not provide ability to change power as it is hardcoded in the firmware. The device provides power level in the design is 0.005 watts.

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 internal replaceable button cell battery and provides no provision for alternative power source. The design utilizes internal fixed antenna systems and offers no provision for antenna replacement or modification. 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 switch used to enable the transmitter for testing purposes. The test sample transmits bursts of OOK (On/Off Keyed) modulated signal resembling actual packet data while 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

EUT

Application for Certification

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

2. Identification: **HVIN**: 051136 **FCC ID**: FIH051136 **IC**: 1584A-051136

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	6M56L1D

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. Designed 0.006 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 3.00 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, Inc., 4405 West 259th Terrace, Louisburg, KS

Radiated EMI The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS

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

NVLAP Accreditation Lab code 200087-0

Environmental Conditions

Ambient Temperature 25.0° C

Relative Humidity 43%

Atmospheric Pressure 1015.8 mb

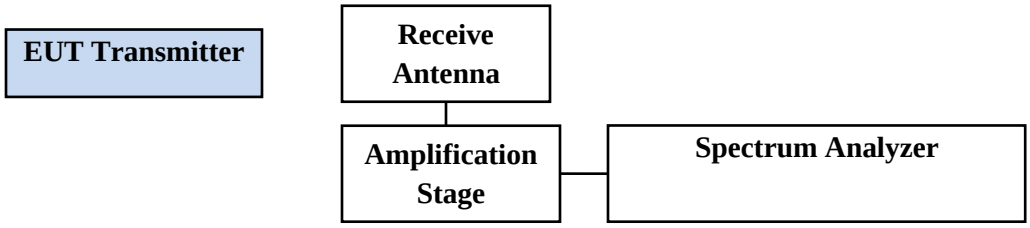
Transmitter Power Output

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 on the Open Area Test Site (OATS). The design offers no provision for connection to antenna port. The substitution method was used to predict the transmitter output power level. 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 = $10^{(6.77/10)}$

= 4.75 mW

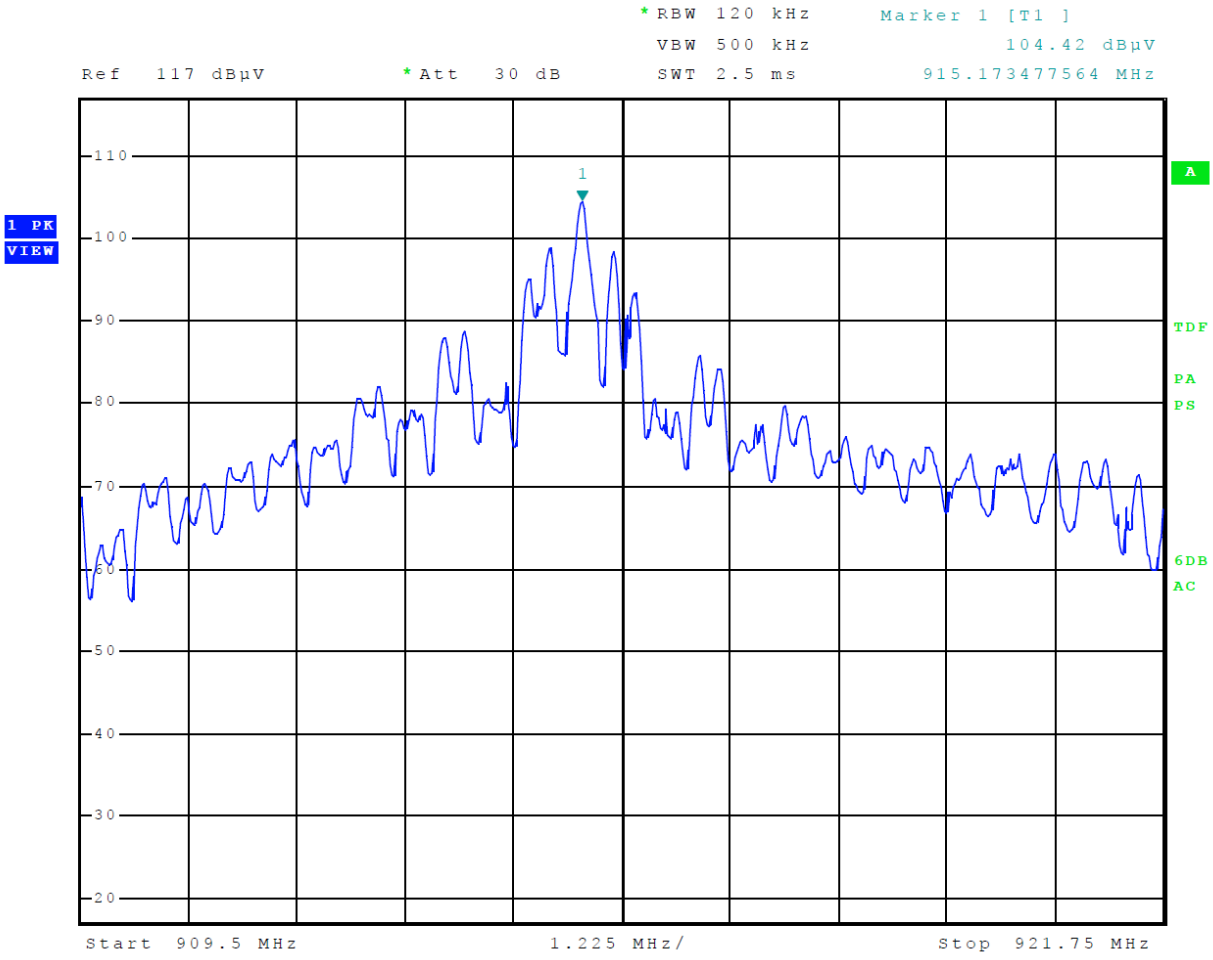
= 0.005 Watts power

Table 1 Transmitter Power Results

Frequency (MHz)	P_{dBm}	P_{mw}	P_w
915	6.77	4.75	0.005

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

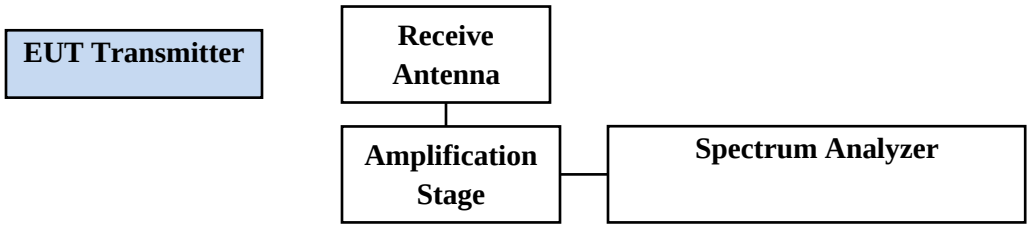


Modulation Characteristics

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, which 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

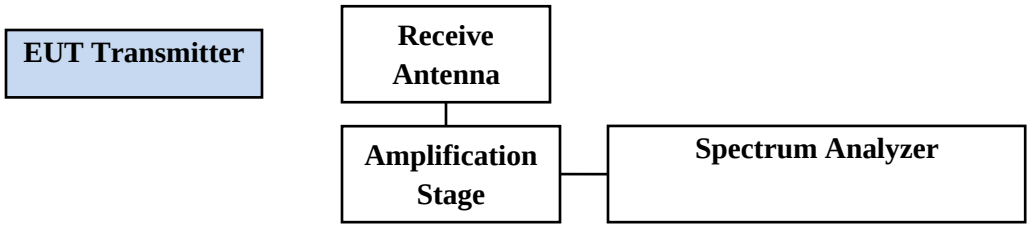
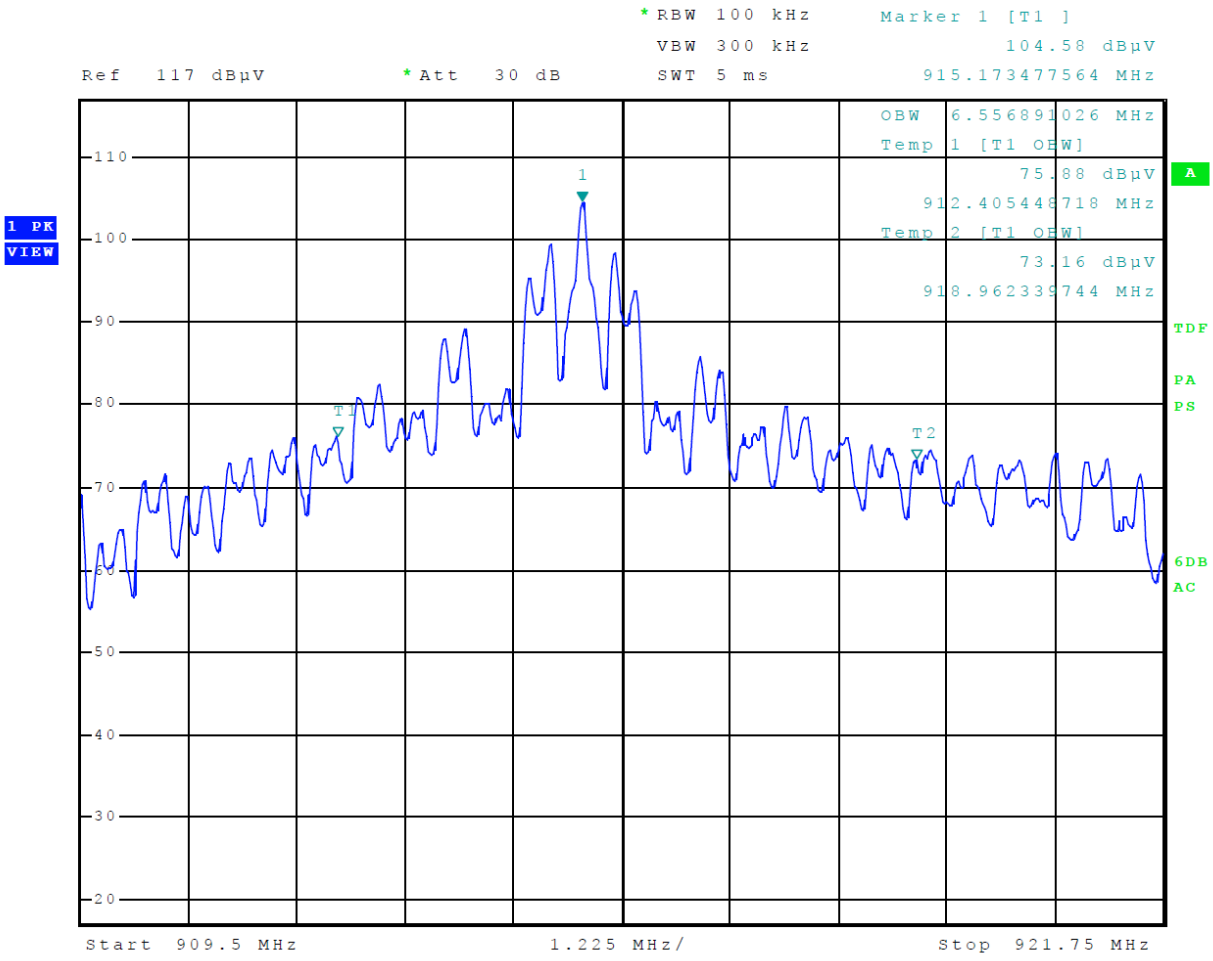


Table 2 Occupied Bandwidth Results

Occupied Bandwidth (kHz)
6,557

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

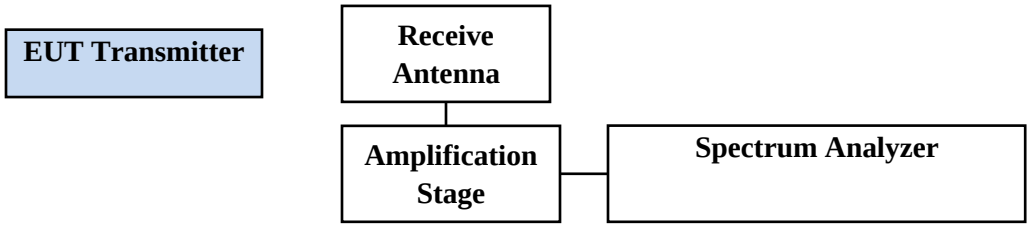


Spurious Emissions

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 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 the at least 55 + 10 Log (P_o) dB.

0.005-watt transmitter limit requires the out of band emissions must be suppressed by at least 32.0 dBc

Attenuation = $55 + 10 \text{ Log}_{10}(P_w)$

= $55 + 10 \text{ Log}_{10} (0.005)$

= 32.0 dBc

Table 3 Spurious Emissions Results (ASTM)

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
915.00	1830.0	-62.5	69.3
	2745.0	-62.5	69.3
	3660.0	-59.2	66.0
	4575.0	-57.6	64.4
	5490.0	-55.7	62.5

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:

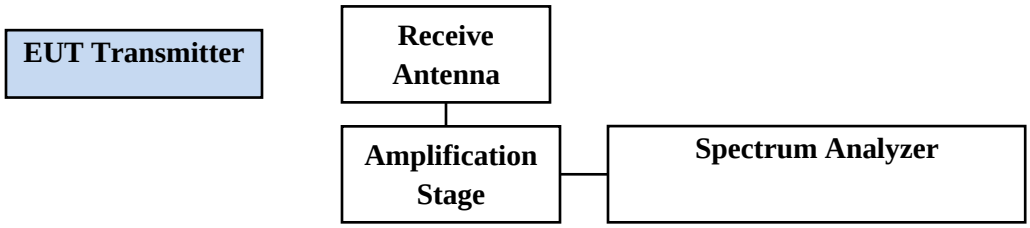
(i) On any frequency within the authorized bandwidth: Zero dB.
(ii) On any frequency outside the licensee's sub-band edges: 55 + 10 log(P) dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

(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 (.006) which equates to 32.8 dBc.

Test Arrangement



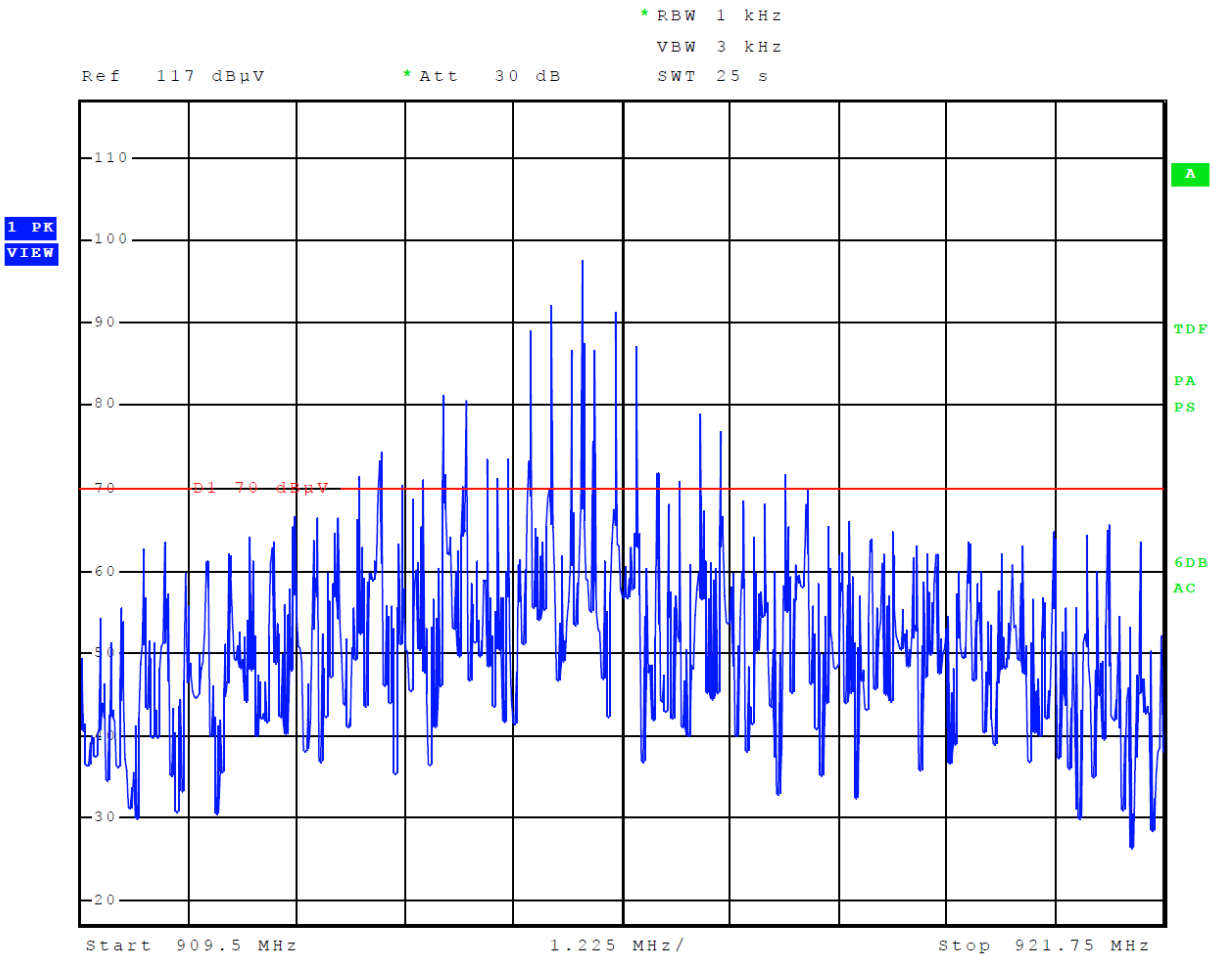
The radio frequency output was passively coupled to a Rohde &Schwarz ESU40 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating through normal modes with maximum output power. The frequency spectrum at the band edges were observed and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

Refer to figures five and six for plots 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

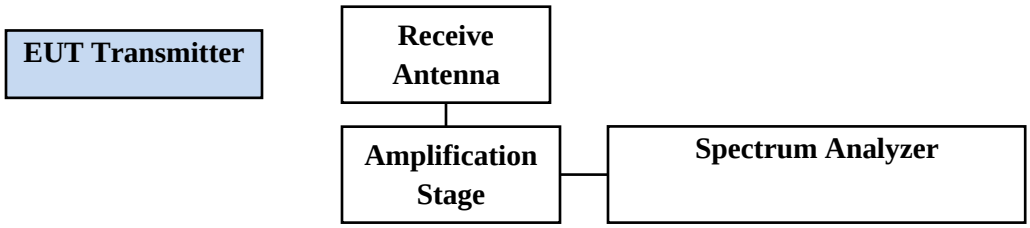


Field Strength of Spurious Radiation

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 on the Open Area Test Site (OATS). The transmitter spurious emissions were measured on the OATS. 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 0.005-watt transmitter power requires spurious emissions be attenuated at least 32.0 dBc below the carrier.
>
> Attenuation = $55 + 10 \text{ Log}_{10}(P_w)$
> $= 55 + 10 \text{ Log}_{10} (0.005)$
> $= 32.0$ 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	
36.1	23.8	29.9	-71.4	-65.3	78.2	72.1	32.0
43.5	21.1	29.6	-74.1	-65.6	80.9	72.4	32.0
50.8	23.0	27.5	-72.2	-67.7	79.0	74.5	32.0
57.9	21.9	28.8	-73.3	-66.4	80.1	73.2	32.0
65.3	20.4	26.9	-74.8	-68.3	81.6	75.1	32.0
166.9	14.0	13.1	-81.2	-82.1	88.0	88.9	32.0

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

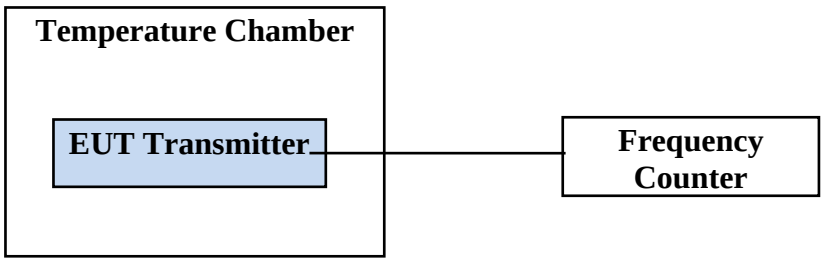
Measurements Required

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 915.135833 (MHz)	Frequency Stability Vs. Temperature Ambient Frequency (915.135833)								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	-11,146	-6,309	-5,103	-3,651	-407	348	468	-7,106	-11,050
PPM	-12.179	-6.894	-5.576	-3.989	-0.445	0.380	0.511	-7.764	-12.074
%	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000	-0.001	-0.001
Limit (PPM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 6 Frequency Stability vs. Input Power Supply Voltage Results

Frequency (915.135833 MHz)	Frequency Stability Vs. Voltage Variation 3.0 volts nominal; Results in Hz change		
Voltage V_{dc}	2.55	3.0	3.45
Change (Hz)	0	0	0
Limit (PPM)	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. Result 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	5.14
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%

NVLAP Lab Code 200087-0

Annex B Additional 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	3/29/2022	3/29/2023
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/29/2022	3/29/2023
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)9kHz-40 GHz		10/14/2021	10/14/2022
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)9kHz-40 GHz		10/14/2021	10/14/2022
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)9kHz-40 GHz		10/14/2021	10/14/2022
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/14/2021	10/14/2022
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/14/2021	10/14/2022
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/14/2021	10/14/2022
☐ Antenna:	EMCO	6509	.001-30 MHz	10/14/2020	10/14/2022
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/14/2021	10/14/2022
☐ Antenna:	Schwarzbeck Model	VHBB 9124 (1468)	30-200MHz	10/14/2020	10/14/2022
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/14/2021	10/14/2022
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	10/14/2020	10/14/2022
☐ Antenna:	Schwarzbeck Model:	VULP 9118 (A-534)	200-1000MHz	10/14/2020	10/14/2022
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/29/2022	3/29/2024
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/14/2020	10/14/2022
☐ Antenna	Com Power	AH-840 (101046)	18-40 GHz	4/6/2021	4/6/2023
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	3/9/2022	3/9/2023
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/18/2022	1/18/2023
☐ 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	10/14/2021	10/14/2022
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/14/2021	10/14/2022
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/14/2021	10/14/2022
☐ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/14/2021	10/14/2022
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/29/2022	3/29/2023
☒ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/29/2022	3/29/2023
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/29/2022	3/29/2023
☒ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	4/6/2021	4/6/2023
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/29/2022	3/29/2023
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/29/2022	3/29/2023
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/29/2022	3/29/2023
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/29/2022	3/29/2023
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/29/2022	3/29/2023
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/29/2022	3/29/2023
☒ Weather station	Davis	6312 (A81120N075)		11/4/2021	11/4/2022

List of Test Equipment			Calibration Date (m/d/y)	Due
☐ Antenna:	Schwarzbeck Model VHBB 9124 (01468)		10/14/2020	10/14/2022
☐ Antenna:	Schwarzbeck Model: VULP 9118 A (VULP 9118 A-856)		10/14/2020	10/14/2022
☐ Frequency Counter:	Leader LDC-825 (8060153		3/29/2022	4/6/2023
☐ ISN:	Com-Power Model ISN T-8		3/29/2022	3/29/2023
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126) .15-30MHz	10/14/2021	10/14/2022
☐ LISN:	Com-Power Model LI-220A		10/14/2020	10/14/2022
☐ LISN:	Com-Power Model LI-550C		10/14/2020	10/14/2022
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072) 9kHz-40 GHz	10/14/2021	10/14/2022
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183) 9kHz-40 GHz	10/14/2021	10/14/2022
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184) 9kHz-40 GHz	10/14/2021	10/14/2022
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)9kHz-40 GHz	10/14/2021	10/14/2022
☐ Cable	Time Microwave	4M-750HF290-750 (4M) 9kHz-24 GHz	10/14/2021	10/14/2022
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch 30-1800 MHz	4/6/2021	4/6/2023
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch 30-1800 MHz	10/14/2021	10/14/2023
☐ Analyzer	HP	8562A (3051A05950) 9kHz-125GHz	3/29/2022	3/29/2023
☐ Wave Form Generator	Keysight	33512B (MY57400128)	3/29/2022	3/29/2023
☐ Antenna:	Solar 9229-1 & 9230-1		2/22/2022	2/22/2023
☐ CDN:	Com-Power Model CDN325E		10/14/2021	10/14/2022
☐ Injection Clamp	Luthi Model EM101		10/14/2021	10/14/2022
☐ Oscilloscope Scope:	Tektronix MDO 4104		2/22/2022	2/22/2023
☐ EMC Transient Generator	HVT TR 3000		2/22/2022	2/22/2023
☐ AC Power Source	(Ametech, California Instruments)		2/22/2022	2/22/2023
☐ Field Intensity Meter:	EFM-018		2/22/2022	2/22/2023
☐ ESD Simulator:	MZ-15		2/22/2022	2/22/2023
☐ 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 Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 36 years' experience in the field of electronics. Work experience includes six years working in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held:

Systems Engineer: A/C Controls Mfg. Co., Inc.

Electrical Engineer: Rogers Consulting Labs, Inc.

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

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, Inc.
Louisburg, 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).

2022-03-22 through 2023-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program