

ROGERS LABS, INC.

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

Application For Grant of Certification

Model: 051045-GOLD
915 MHz

47CFR Part 90 and Industry Canada RSS-137
Location and Monitoring Service Transmitter

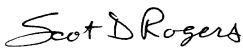
FCC ID: FIH051045
IC: 1584A-FIH051045

Transcore

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

FCC Designation: US5305
ISED Registration: 3041A-1
Test Report Number: 190508

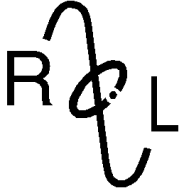
Test Date: May 8, 2019

Authorized Signatory: 
Scot D. Rogers

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

Transcore
Model: 051045-GOLD
Test: 190508
Test to: 47CFR Parts 2, 90 and RSS-137
File: Transcore 051045 TstRpt 190508

SN: ENG1
FCC ID: FIH051045
IC: 1584A-FIH051045
Date: August 6, 2019
Page 1 of 32



ROGERS LABS, INC.

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

Engineering Test Report For Grant of Certification Application

Transcore

Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113
Phone: (505) 856-8101

Model: 051045-GOLD

Location Monitoring Service Transmitter

Frequency: 915 MHz
FCC ID: FIH051045
IC: 1584A-FIH051045

Test Date: May 8, 2019

Certifying Engineer: *Scot D Rogers*

Scot D. Rogers
Rogers Labs, Inc.
4405 W. 259th Terrace
Louisburg, KS 66053
Telephone / Facsimile: (913) 837-3214

This report shall not be reproduced except in full, without the written approval of the laboratory. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

Transcore
Model: 051045-GOLD
Test: 190508
Test to: 47CFR Parts 2, 90 and RSS-137
File: Transcore 051045 TstRpt 190508

SN: ENG1
FCC ID: FIH051045
IC: 1584A-FIH051045
Date: August 6, 2019
Page 2 of 32

Table of Contents

TABLE OF CONTENTS.....	3
REVISION HISTORY	5
EXECUTIVE SUMMARY	6
OPINION / INTERPRETATION OF RESULTS	6
EQUIPMENT UNDER TEST	6
Equipment Function and Configuration	7
Equipment Configuration	7
APPLICATION FOR CERTIFICATION.....	8
APPLICABLE STANDARDS AND TEST PROCEDURES.....	10
UNITS OF MEASUREMENTS	10
TEST SITE LOCATIONS	10
ENVIRONMENTAL CONDITIONS.....	10
LIST OF TEST EQUIPMENT	11
TRANSMITTER POWER OUTPUT	12
Measurements Required	12
Test Arrangement	12
Table 1 Transmitter Power Results.....	13
Figure 1 Transmitter Output Across Frequency Band.....	14
MODULATION CHARACTERISTICS.....	15
Measurements Required	15
Test Arrangement	15
Results Modulation Characteristics	15

OCCUPIED BANDWIDTH 16

Measurements Required16

Test Arrangement16

Table 2 Occupied Bandwidth Results16

 Figure 2 Occupied Bandwidth.....17

SPURIOUS EMISSIONS..... 18

Measurements Required18

Test Arrangement18

Table 3 Spurious Emissions Results19

EMISSION MASK 20

Measurements Required20

Test Arrangement20

Results Emission Mask.....20

 Figure 3 Emissions Mask21

 Figure 4 Emissions Mask22

FIELD STRENGTH OF SPURIOUS RADIATION..... 23

Measurements Required23

Test Arrangement23

Table 4 General Radiated Emission Results (worst-case)24

Table 5 Results Spurious Radiation25

FREQUENCY STABILITY 26

Measurements Required26

Test Arrangement26

Table 6 Frequency Stability Results.....27

ANNEX..... 28

Annex A Measurement Uncertainty Calculations29

Annex B Additional Test Equipment List.....30

Annex C Rogers Qualifications.....31

Annex D Laboratory Certificate of Accreditation32

Revision History

Revision 1 Issued August 6, 2019

Executive Summary

The following information is submitted for consideration in obtaining Grant of Certification of 47CFR Paragraph 90 (M) and Industry Canada RSS-137 Location Monitoring Service (LMS) transmitter equipment.

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

Model: 051045-GOLD

FCC ID: F1H051045 IC: 1584A-F1H051045

Frequency of Operation: 915 MHz

Transmit Power: 0.001 watts, occupied bandwidth 11,009.6 kHz

Opinion / Interpretation of Results

Tests Performed	Results
Requirements per 47CFR paragraphs 2.1031-2.1057 and RSS-137, Issue 2	Complies
Requirements per 47CFR paragraphs 90.205 and RSS-137	Complies
Requirements per 47CFR paragraphs 90.207 and RSS-137	Complies
Requirements per 47CFR paragraphs 90.209 and RSS-137	Complies
Requirements per 47CFR paragraphs 90.210 and RSS-137	Complies
Requirements per 47CFR paragraphs 90.213 and RSS-137	Complies

Equipment Under Test

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT	051045-GOLD	ENG1

Test results in this report relate only to the items tested.

Software Version: 9114_FCC. The software does not provide ability to change power as it is hardcoded in the firmware. The power level in the design is 0.001 watts (902-928 MHz).

Rogers Labs, Inc. 4405 West 259 th Terrace Louisburg, KS 66053 Phone/Fax: (913) 837-3214 Revision 1	Transcore Model: 051045-GOLD Test: 190508 Test to: 47CFR Parts 2, 90 and RSS-137 File: Transcore 051045 TstRpt 190508	SN: ENG1 FCC ID: F1H051045 IC: 1584A-F1H051045 Date: August 6, 2019 Page 6 of 32
--	---	--

Equipment Function and Configuration

The EUT is a mobile low power transmitter functioning as location and monitoring transmitter. The design incorporates two low power transmitters. The transmitter documented in this report provides operation in the 902-928 MHz band. The other transmitter provides operation in the 2400-2483.5 MHz band as Low Power Device Transmitter. The transmitter documented in this report is an active transponder operating at 915 MHz frequency band transmitting information to compatible Location and Monitoring Service equipment. The unit operates from internal direct current power provided from non-removable battery cell 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 industry modulation scheme offering the ability to interface and respond with Industry Standard Radio Frequency Identification Device (RFID) interrogation systems. The transmitter transmits sends bursts of OOK modulated signal resembling actual packet data in the test mode. The test sample was modified from production equipment for testing purposes. The modification involved addition of slide switch used to turn on the transmitter and enabled operation for testing purposes. Activation of the switch placed the EUT in a test mode operating the transmitter at a high 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: **Model:** 051045-GOLD **FCC ID:** FIH051045 **IC:** 1584A-FIH051045
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	11M0L1D
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. Approximately 0.001 watts.
7. Maximum power rating as defined in the applicable part(s) of the rules. As stated in 47CFR, 90.205(k) 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 3.3 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.

Applicable Standards and Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, 47CFR dated May 8, 2019, 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.

Units of Measurements

AC Line Conducted EMI Data is in dB μ V; dB referenced to one microvolt.

Radiated EMI Data is in dB μ V/m; dB/m referenced to one microvolt per meter

Antenna Conducted Data is in dBm, dB referenced to one milliwatt

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 and ISED #: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

Environmental Conditions

Ambient Temperature 20.6° C

Relative Humidity 48%

Atmospheric Pressure 1018.4 mb

List of Test Equipment

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model (SN)</u>	<u>Band</u>	<u>Cal Date(m/d/y)</u>	<u>Due</u>
<input type="checkbox"/> LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	4/18/2019	4/18/2020
<input type="checkbox"/> LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	EMCO	3147 (40582)	200-1000MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
<input type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/16/2018	10/24/2019
<input type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	4/18/2019	4/18/2021
<input checked="" type="checkbox"/> Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	4/18/2019	4/18/2020
<input type="checkbox"/> Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/31/2019	1/31/2020
<input type="checkbox"/> Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	4/18/2019	4/18/2020
<input type="checkbox"/> Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	4/18/2019	4/18/2020
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	4/18/2019	4/18/2020
<input checked="" type="checkbox"/> Weather station	Davis	6312 (A81120N075)		10/26/2018	10/26/2019

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

Transcore
Model: 051045-GOLD
Test: 190508
Test to: 47CFR Parts 2, 90 and RSS-137
File: Transcore 051045 TstRpt 190508

SN: ENG1
FCC ID: FIH051045
IC: 1584A-FIH051045
Date: August 6, 2019
Page 11 of 32

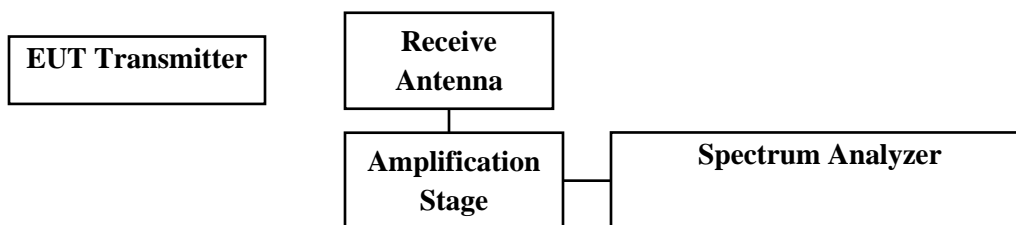
Transmitter Power Output

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 through 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.

P_{dBm} = power in dB above 1 milliwatt
 Milliwatts = $10^{(P_{dBm}/10)}$
 Watts = (Milliwatts)(0.001)(W/mW)
 Milliwatts = $10^{(1/10)}$
 = 2.5 mW
 = 0.001 Watts power

Table 1 Transmitter Power Results

Frequency (MHz)	P_{dBm}	P_{mw}	P_w
915	1	1.2	0.00

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.

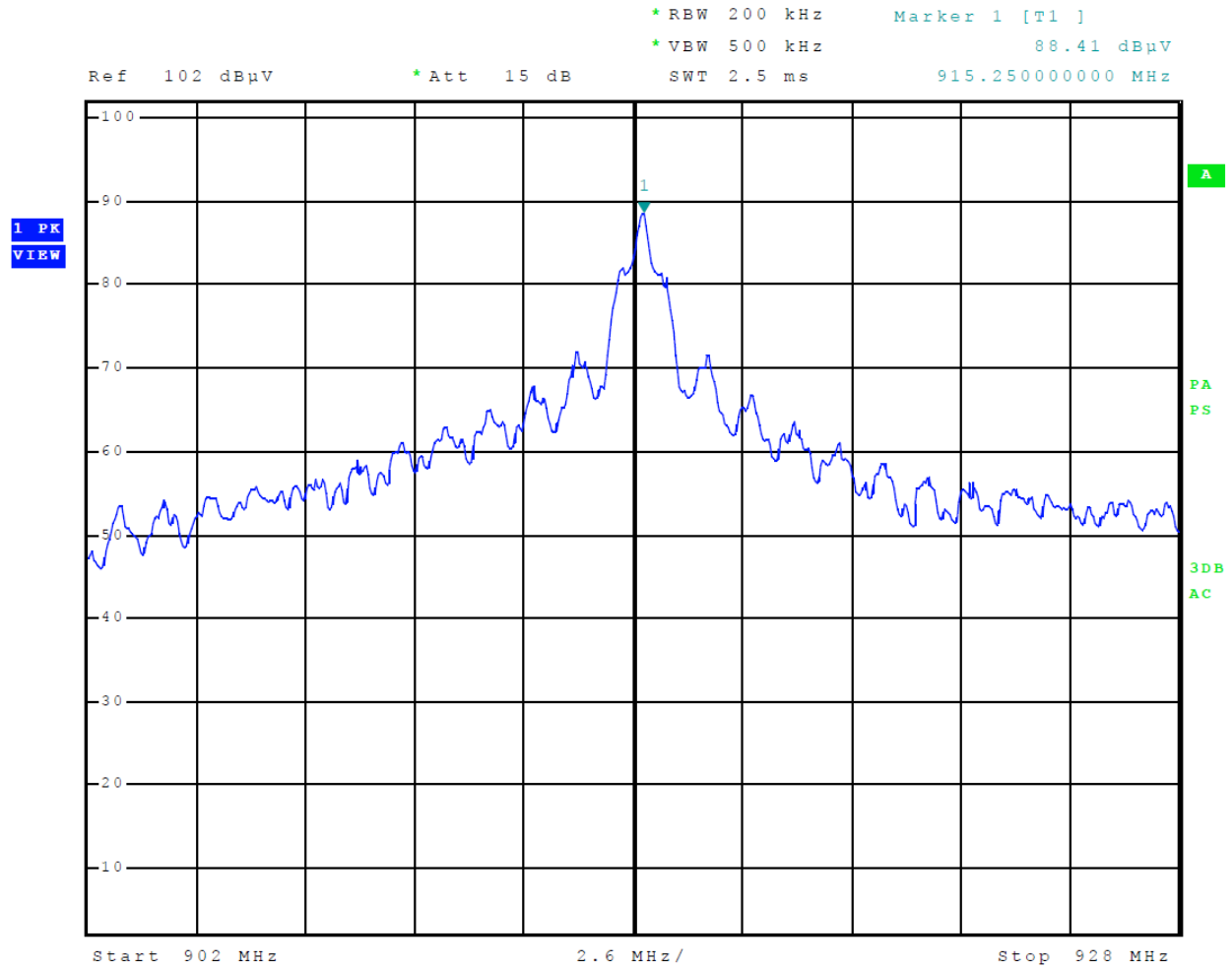


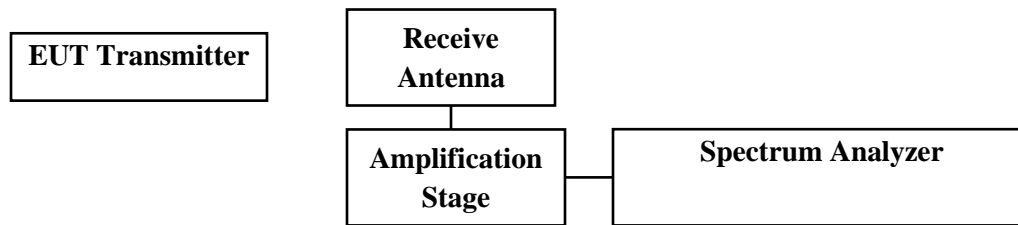
Figure 1 Transmitter Output Across Frequency Band

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.

Results Modulation Characteristics

The transmitter operates providing digital data, transmitted signals modulated in amplitude/width/duration. The EUT demonstrated compliance with the specifications of Paragraphs 2.1046(a), 90.205 and RSS-137. 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

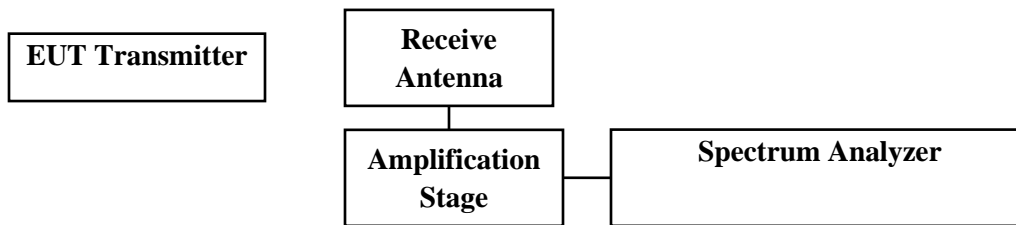


Table 2 Occupied Bandwidth Results

Operational Frequency Band (MHz)	Occupied Bandwidth (kHz)
915.00	11,009.6

The EUT demonstrated compliance with the requirements of Paragraphs 2.1046(a) 90.209 and RSS-137 paragraph 6.1. There are no deviations to the specifications.

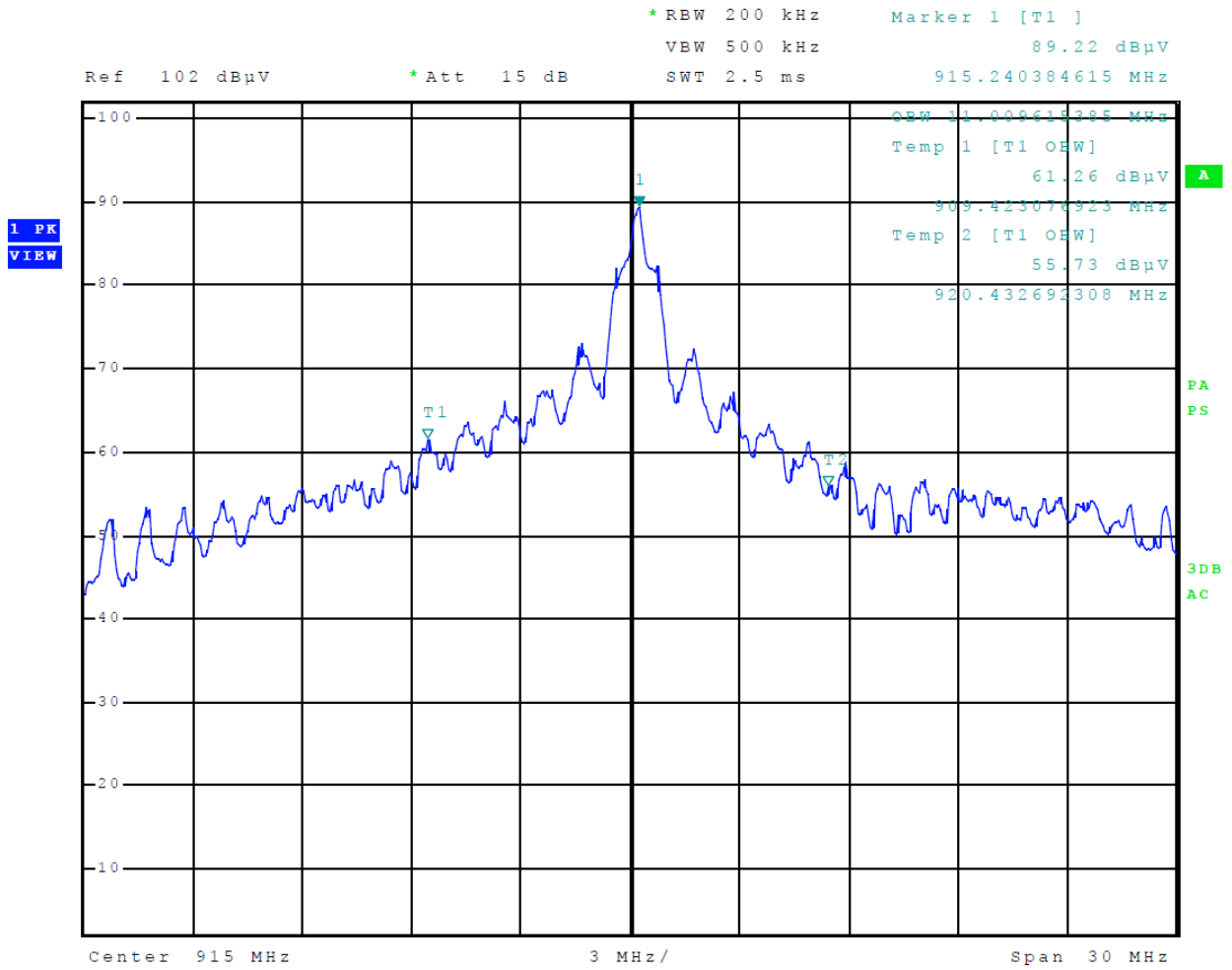


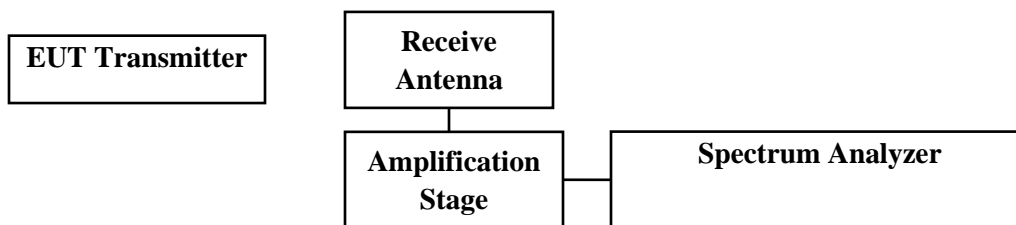
Figure 2 Occupied Bandwidth

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 $55 + 10 \text{ Log}(P_o)$ dB.

0.004-watt transmitter limit requires the out of band emissions must be suppressed by at least 31.0 dBc and for full high power

$$\begin{aligned}
 \text{Attenuation} &= 55 + 10 \text{ Log}_{10}(P_w) \\
 &= 55 + 10 \text{ Log}_{10}(0.001) \\
 &= 25.0 \text{ dBc}
 \end{aligned}$$

Table 3 Spurious Emissions Results

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
915.00	1830.0	-54.03	48.0
	2745.0	-59.03	53.0
	3660.0	-58.23	52.2
	4575.0	-56.23	50.2
	5490.0	-55.53	49.5
	6405.0	-54.33	48.3

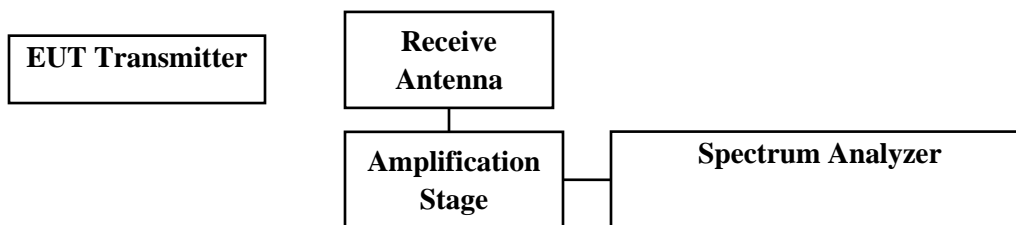
Data was taken per 2.1051 and applicable parts of 47CFR 90.210 and RSS-137. The EUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

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) specifies the out of band emission limitations for this equipment. The spurious emissions for the device were measured at the maximum output power condition.

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. Refer to figures three and four for plots presenting compliance with emission mask requirements at the band edges. Data was taken per 47CFR 2.1051 and applicable parts of Part 90.210 (k) and RSS-137.

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.

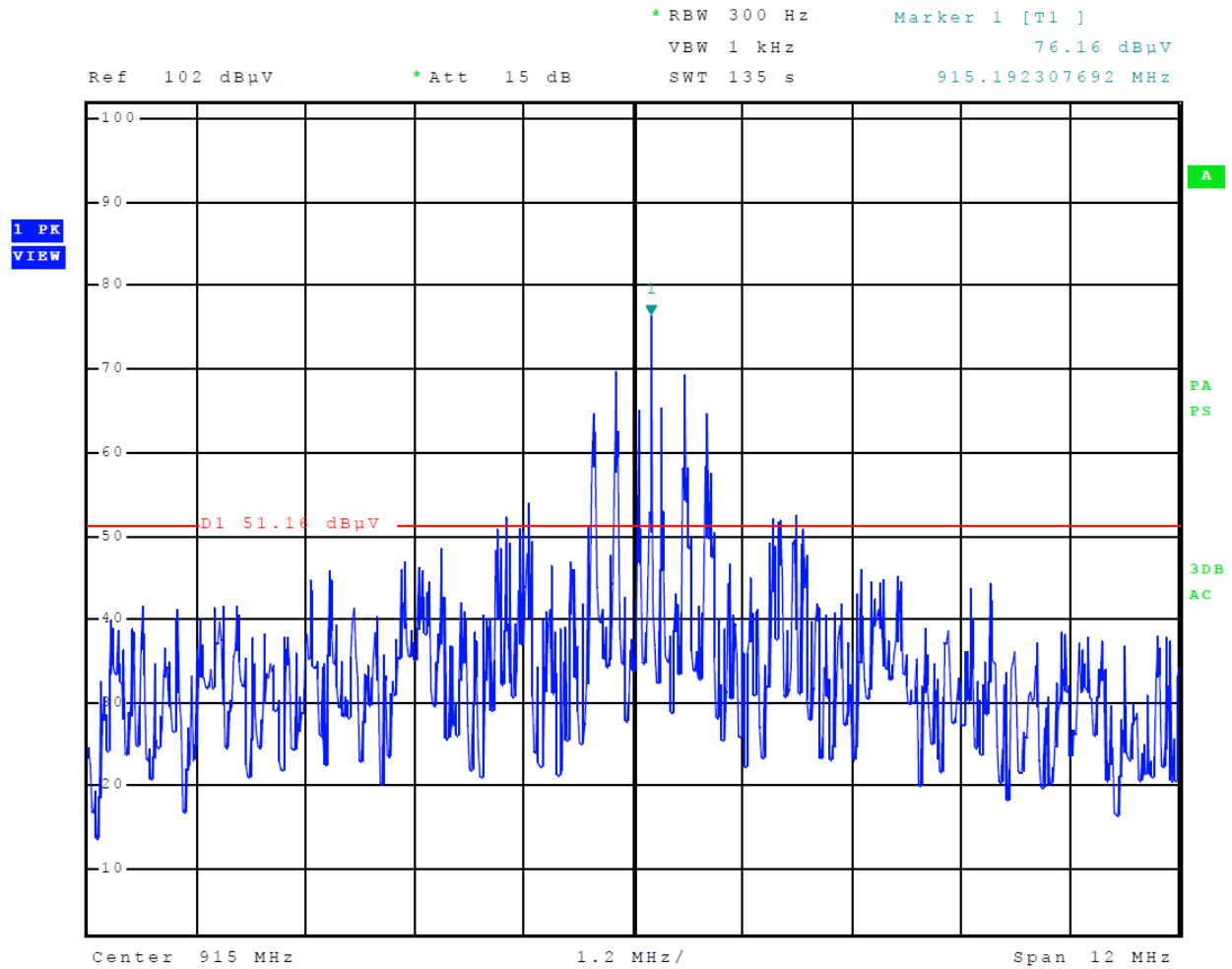


Figure 3 Emissions Mask

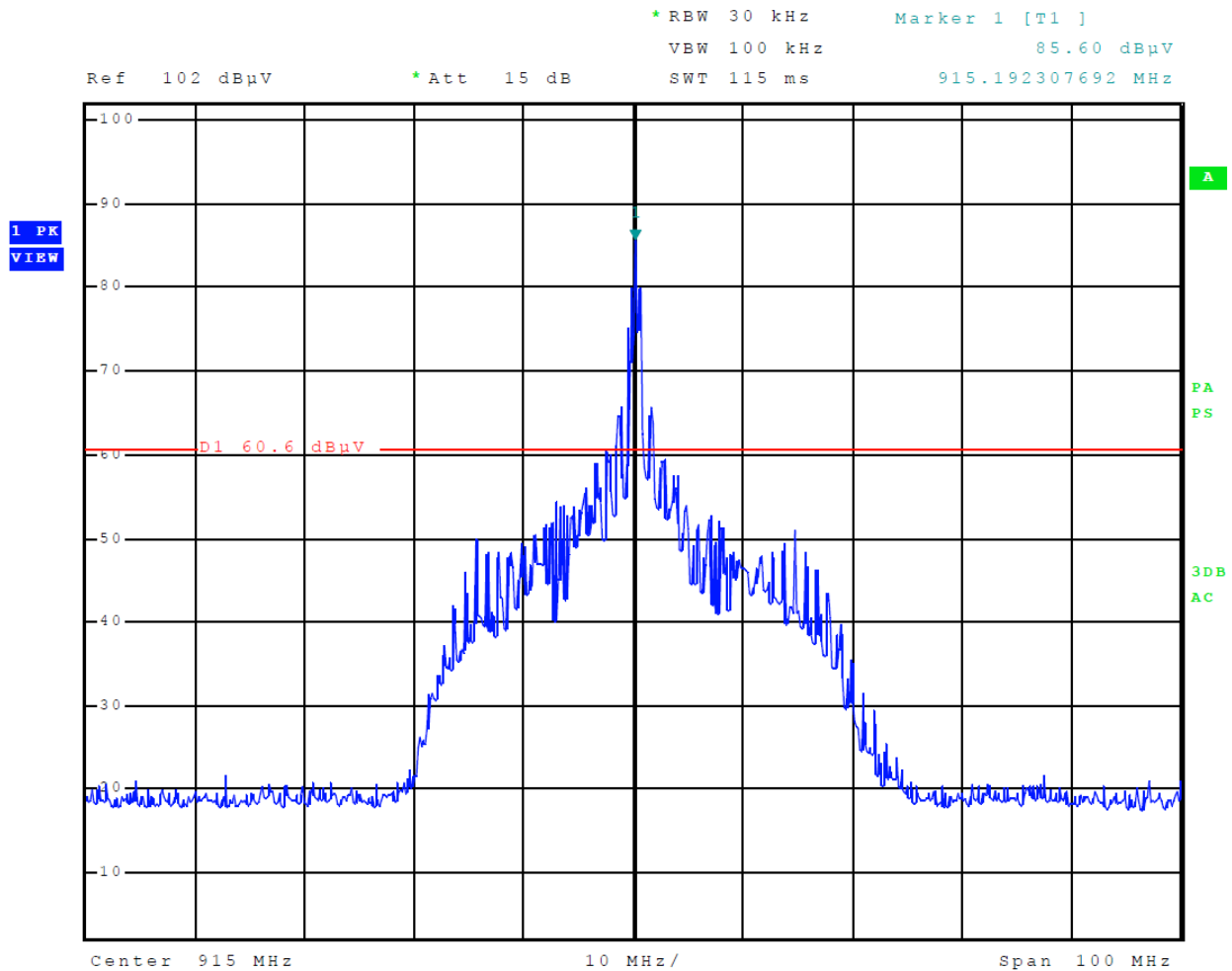


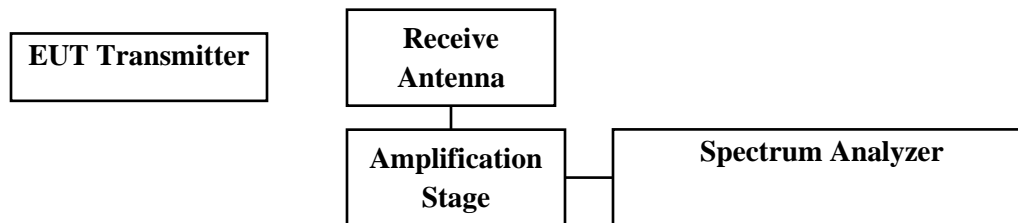
Figure 4 Emissions Mask

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 through 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 dB μ V/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 $55 + 10 \text{ Log } (P_o)$ dB.

0.001-watt transmitter power and requirement specifies emissions be attenuated below the carrier more than 25.0 dB.

$$\begin{aligned} \text{Attenuation} &= 55 + 10 \text{ Log}_{10}(P_w) \\ &= 55 + 10 \text{ Log}_{10}(0.001) \\ &= 25.0 \text{ dBc} \end{aligned}$$

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)
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
50.8	25.1	31.0	-70.1	-64.2	64.1	58.2	25
58.0	25.5	28.2	-69.7	-67.0	63.7	61.0	25
65.3	25.8	28.2	-69.4	-67.0	63.4	61.0	25
79.7	24.3	25.7	-70.9	-69.5	64.9	63.5	25
384.3	14.8	15.3	-80.4	-79.9	74.4	73.9	25
800.0	21.7	22.4	-73.5	-72.8	67.5	66.8	25

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.

Table 5 Results Spurious Radiation

Frequency MHz	Amplitude of Emission (dBμV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBc)
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
1830.0	41.2	33.5	-54.03	-61.73	48.0	55.7	25
2745.0	36.2	35.5	-59.03	-59.73	53.0	53.7	25
3660.0	37.0	36.5	-58.23	-58.73	52.2	52.7	25
4575.0	39.0	38.3	-56.23	-56.93	50.2	50.9	25
5490.0	39.7	39.7	-55.53	-55.53	49.5	49.5	25
6405.0	40.9	40.9	-54.33	-54.33	48.3	48.3	25

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.

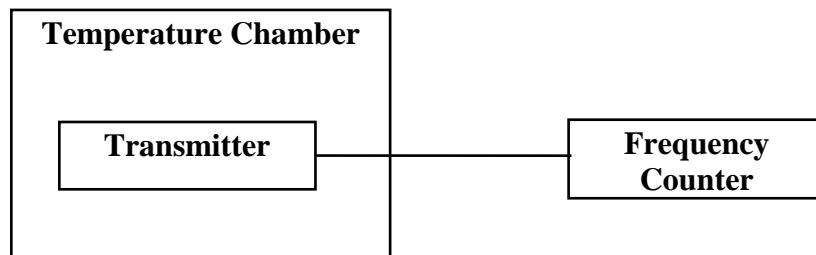
Frequency Stability

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.

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.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. A DC Power Supply was used to vary the DC voltage of the power input nominally (3.00 V_{dc}) from 2.55 V_{dc} to 3.30 V_{dc}. The frequency was measured and the variation in parts per million calculated. Data was taken per 47CFR Paragraphs 2.1055 and applicable paragraphs of part 90.213 and RSS-137.

Table 6 Frequency Stability Results

Frequency 915.190424 MHz	Frequency Stability Vs Temperature								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	-1,708	-1,663	-1,447	-1,289	-1,093	-428	94	161	410
PPM	-1.9	-1.8	-1.6	-1.4	-1.2	-0.5	0.1	0.2	0.4
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Limit (PPM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Frequency 915.190424 MHz	Frequency Stability Vs Voltage Variation 3.0 volts nominal; Results in Hz change		
Voltage V _{dc}	2.55	3.00	3.30
Change (Hz)	0.0	0.0	0.0
PPM	0.0	0.0	0.0

Limit defined in CFR 47 Paragraph 90.213(a) requires not to exceed 2.5 PPM. The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 90.213 and RSS-137. 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%

Annex B Additional Test Equipment List

List of Test Equipment	Calibration	Date (m/d/y)	Due
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)		4/18/2019	4/18/2020
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)		4/18/2019	4/18/2020
Antenna: EMCO 6509		10/16/2018	10/16/2020
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz		4/18/2019	4/18/2020
Antenna: EMCO Dipole Set 3121C		2/22/2019	2/22/2020
Antenna: C.D. B-101		2/22/2019	2/22/2020
Antenna: Solar 9229-1 & 9230-1		2/22/2019	2/22/2020
Cable: Belden 8268 (L3)		10/16/2018	10/16/2019
Cable: Time Microwave: 4M-750HF290-750		10/16/2018	10/16/2019
Frequency Counter: Leader LDC-825 (8060153)		4/18/2019	4/18/2020
Oscilloscope Scope: Tektronix 2230		2/22/2019	2/22/2020
Wattmeter: Bird 43 with Load Bird 8085		2/22/2019	2/22/2020
R.F. Generators: HP 606A, HP 8614A, HP 8640B		2/22/2019	2/22/2020
R.F. Power Amp 65W Model: 470-A-1010		2/22/2019	2/22/2020
R.F. Power Amp 50W M185- 10-501		2/22/2019	2/22/2020
R.F. Power Amp A.R. Model: 10W 1010M7		2/22/2019	2/22/2020
R.F. Power Amp EIN Model: A301		2/22/2019	2/22/2020
LISN: Compliance Eng. Model 240/20		4/18/2019	4/18/2020
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08		4/18/2019	4/18/2020
Audio Oscillator: H.P. 201CD		2/22/2019	2/22/2020
ESD Test Set 2010i		2/22/2019	2/22/2020
Oscilloscope Scope: Tektronix MDO 4104		2/22/2019	2/22/2020
EMC Transient Generator HVT TR 3000		2/22/2019	2/22/2020
AC Power Source (Ametech, California Instruments)		2/22/2019	2/22/2020
Fast Transient Burst Generator Model: EFT/B-101		2/22/2019	2/22/2020
Field Intensity Meter: EFM-018		2/22/2019	2/22/2020
KEYTEK Ecat Surge Generator		2/22/2019	2/22/2020
ESD Simulator: MZ-15		2/22/2019	2/22/2020
Shielded Room not required			

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 31 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. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

- 1) Bachelor of Science Degree in Electrical Engineering from Kansas State University
- 2) Bachelor of Science Degree in Business Administration Kansas State University
- 3) 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 17025:2005

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 17025:2005.
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).*

2019-03-27 through 2020-03-31

Effective Dates



[Signature]
For the National Voluntary Laboratory Accreditation Program

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

Transcore
Model: 051045-GOLD
Test: 190508
Test to: 47CFR Parts 2, 90 and RSS-137
File: Transcore 051045 TstRpt 190508

SN: ENG1
FCC ID: FIH051045
IC: 1584A-FIH051045
Date: August 6, 2019
Page 32 of 32