



41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

Application for FCC Grant of Equipment Authorization

FCC Part 15 Subpart C

Model: 71100-701

FCC ID: 2AVRC-71100-701

APPLICANT: Rugged Nature, LLC
88360 Diamondhead Drive E
Diamondhead, MS 39525

TEST SITE(S): National Technical Systems
41039 Boyce Road.
Fremont, CA. 94538-2435

PROJECT NUMBER: PR104153

REPORT DATE: March 10, 2020

RE-ISSUED DATE: September 18, 2020

FINAL TEST DATES: January 15, 27 and February 5 and September
14, 2020

TOTAL NUMBER OF PAGES: 31



This report and the information contained herein represent the results of testing of only those articles / products identified in this document and selected by the client. The tests were performed to specifications and/or procedures selected by the client. National Technical Systems (NTS) makes no representations expressed or implied that such testing fully demonstrates efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it present any statement whatsoever as to its merchantability or fitness of the test article or similar products, for a particular purpose. This report shall not be reproduced except in full without written approval from NTS.



VALIDATING SIGNATORIES

PROGRAM MGR

David W. Bare
Chief Engineer

TECHNICAL REVIEWER:

David W. Bare
Chief Engineer

FINAL REPORT PREPARER:

David Guidotti
Senior Technical Writer

QUALITY ASSURANCE DELEGATE

Jesse Reel
Technical Writer



REVISION HISTORY

Rev#	Date	Comments	Modified By
-	March 10, 2020	First release	
1	September 14, 2020	Added results below 30 MHz	DWB
2	September 18, 2020	Added results to cover 30 kHz to 10 MHz emissions	DMG

TABLE OF CONTENTS

COVER PAGE.....	1
VALIDATING SIGNATORIES	2
REVISION HISTORY	3
TABLE OF CONTENTS	4
SCOPE.....	5
OBJECTIVE	6
STATEMENT OF COMPLIANCE.....	6
DEVIATIONS FROM THE STANDARDS.....	6
TEST RESULTS SUMMARY	7
MEASUREMENT UNCERTAINTIES.....	7
EQUIPMENT UNDER TEST (EUT) DETAILS.....	8
GENERAL.....	8
ANTENNA SYSTEM	8
ENCLOSURE.....	8
MODIFICATIONS.....	8
SUPPORT EQUIPMENT.....	8
EUT INTERFACE PORTS	8
EUT OPERATION	8
TEST SITE.....	9
GENERAL INFORMATION.....	9
RADIATED EMISSIONS CONSIDERATIONS	9
MEASUREMENT INSTRUMENTATION	10
RECEIVER SYSTEM	10
INSTRUMENT CONTROL COMPUTER	10
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	10
FILTERS/ATTENUATORS	11
ANTENNAS.....	11
ANTENNA MAST AND EQUIPMENT TURNTABLE.....	11
INSTRUMENT CALIBRATION.....	11
TEST PROCEDURES	12
EUT AND CABLE PLACEMENT	12
RADIATED EMISSIONS	12
BANDWIDTH MEASUREMENTS	15
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS.....	16
GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS	16
SAMPLE CALCULATIONS - RADIATED EMISSIONS.....	17
APPENDIX A TEST EQUIPMENT CALIBRATION DATA	18
APPENDIX B TEST DATA	19
END OF REPORT	31

SCOPE

An electromagnetic emissions test has been performed on the Rugged Nature, LLC model 71100-701, pursuant to the following rules:

FCC Part 15 Subpart C, §15.249

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems test procedures:

ANSI C63.10-2013

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Rugged Nature, LLC model 71100-701 complied with the requirements of the following regulations:

FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Rugged Nature, LLC model 71100-701 and therefore apply only to the tested sample. The sample was selected and prepared by Daniel Francis of Rugged Nature, LLC.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

OPERATION IN 902-928 MHZ BAND

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203		RF Connector	Integral antenna	Unique or integral antenna required	Complies
15.207		AC Conducted Emissions	Testing was not performed as the EUT is battery powered.		
15.209		Spurious Emissions	47.3 dB μ V/m @ 7247.5 MHz	54 dB μ V/m	Complies
15.249		Fundamental Field Strength	85.1 dB μ V/m	94.0 dB μ V/m	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Radiated emission (field strength)	dB μ V/m	10 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Rugged Nature, LLC model 71100-701 is a Hunter Beacon Keyfob handheld transceiver and indicator that is designed to trigger the illumination of the puck and to indicate motion at the puck by LED. Since the EUT would normally be handheld during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 3 Volts DC, supplied by a replaceable battery.

The sample was received on January 15, 2020 and tested on January 15, 27 and February 5 and September 14, 2020. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Rugged Nature, LLC	71100-701	Hunter Beacon Keyfob handheld transceiver and indicator	EDU002	2AVRC-71100-701

ANTENNA SYSTEM

The antenna system consists of an integral chip antenna.

ENCLOSURE

The EUT enclosure is primarily constructed of uncoated plastic. It measures approximately 3.5 x 1.5 x 7.0 cm.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	-	-	-	-

EUT OPERATION

During testing of the intentional transmitter, the EUT was continuously transmitting a FSK modulated signal.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 6.2 of RSS-GEN, NTS has been recognized as an accredited test laboratory by the Commission and Innovation, Science and Economic Development Canada. A description of the facilities employed for testing is maintained by NTS.

Site	Company / Registration Numbers		Location
	FCC	Canada	
Chamber 3	US1031	2845B	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4		(Wireless Test	
Chamber 5		Lab #US0027)	

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Results from testing performed in this chamber have been correlated with results from an open area test site. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

Software is used to view and convert receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers. The software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10 specifies that the test height above ground for table mounted devices shall be 80 centimeters for testing below 1 GHz and 1.5m for testing above 1 GHz. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor as specified in ANSI C63.4. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

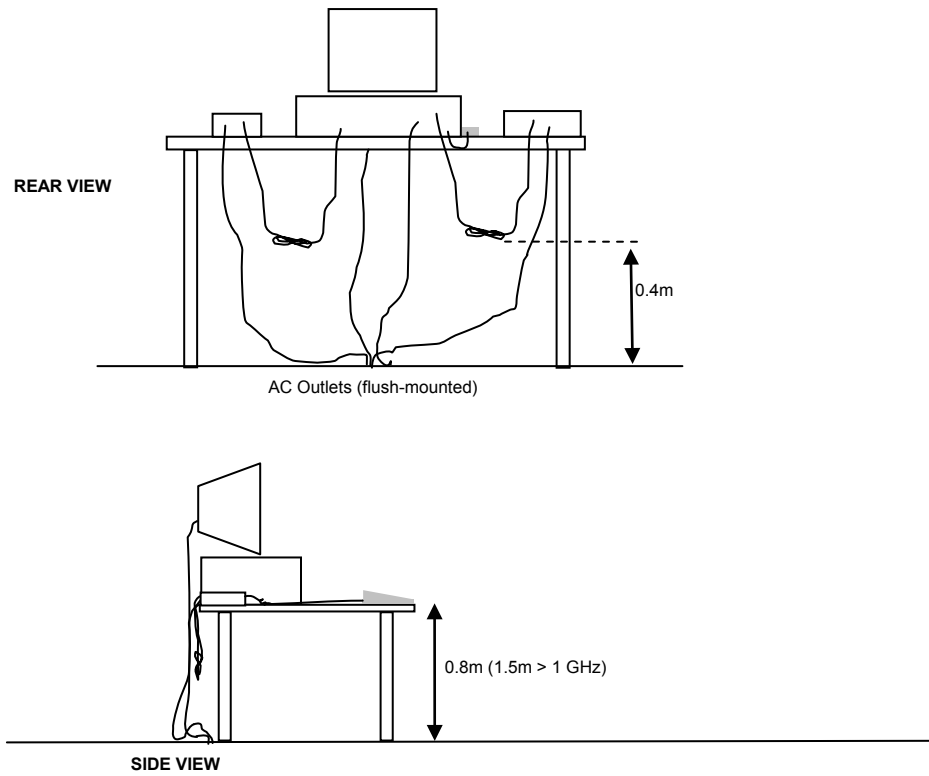
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

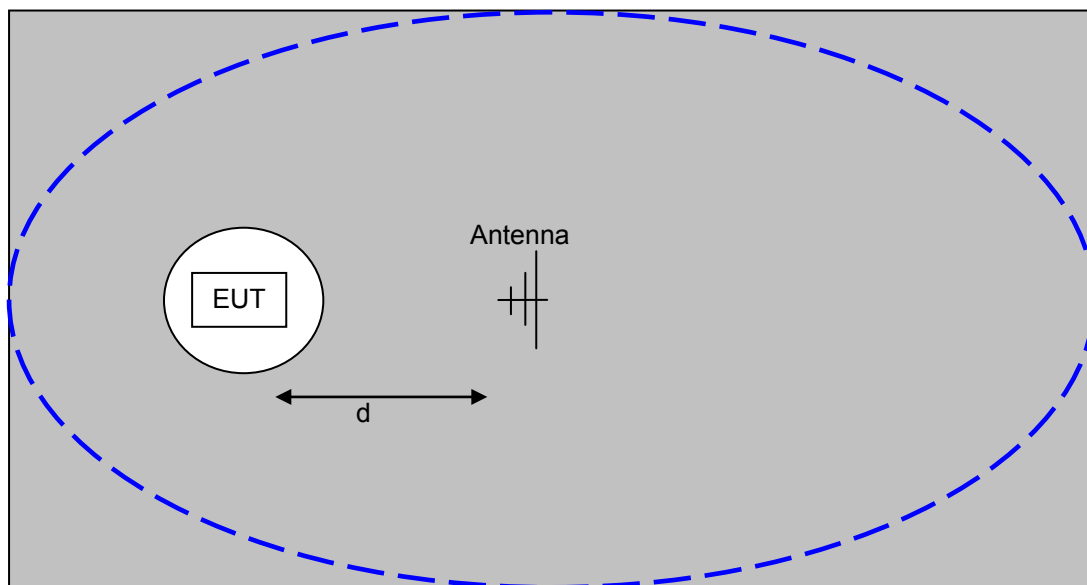
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

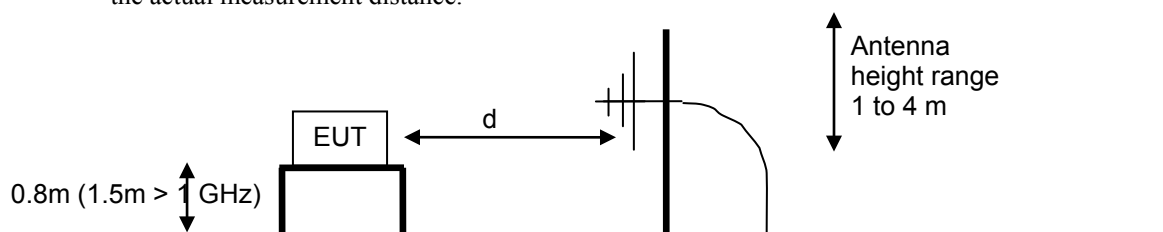
When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.



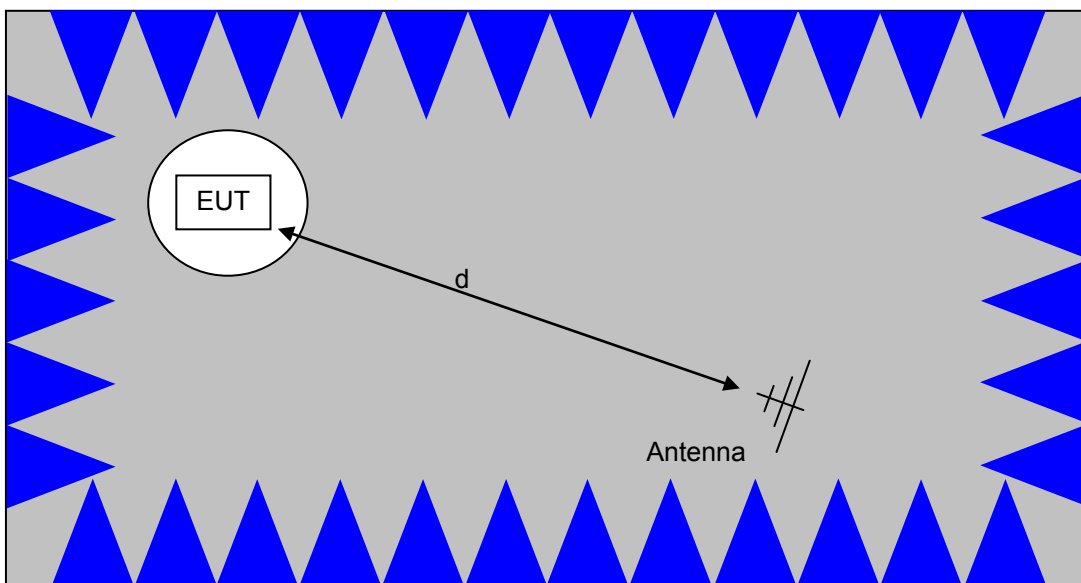
Typical Test Configuration for Radiated Field Strength Measurements



The ground plane extends beyond the ellipse defined in CISPR 16 / CISPR 22 / ANSI C63.4 and is large enough to accommodate test distances (d) of 3m and 10m. Refer to the test data tables for the actual measurement distance.

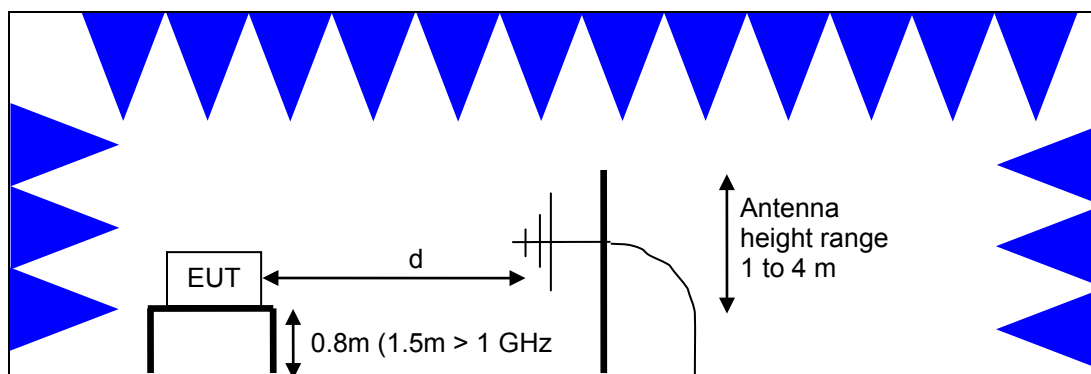


Test Configuration for Radiated Field Strength Measurements OATS- Plan and Side Views



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	2400/F _{KHz} @ 300m	67.6-20*log ₁₀ (F _{KHz}) @ 300m
0.490-1.705	24000/F _{KHz} @ 30m	87.6-20*log ₁₀ (F _{KHz}) @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

¹ The restricted bands are detailed in FCC 15.205 and RSS-Gen Table 7

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20 * \log_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40 * \log_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Radiated Emissions, 1,000 - 9,300 MHz, 15-Jan-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Hewlett Packard	Spectrum Analyzer (Purple)	8564E	WC055660	7/24/2019	7/24/2020
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	WC064432	9/18/2018	9/18/2020
Hewlett Packard	High Pass filter, 1.5 GHz	84300-80037	WC064494	7/15/2019	7/15/2020
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064574	7/19/2019	7/19/2020
Radiated Emissions, 30 - 1,000 MHz, 27-Jan-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
National Technical Systems	NTS Capture Analyzer Software (rev 4.0)	N/A	WC022706	N/A	
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064536	10/24/2018	1/9/2021
Rhode & Schwarz	EMI Test Receiver 20Hz-26.5GHz	ESI	WC071498	4/9/2019	4/9/2020
Com-Power	RF Preamplifier	PAM-103	WC072429	10/25/2019	10/25/2020
Radiated Emissions, 10 - 30 MHz, 14-Sep-20					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Rhode & Schwarz	Loop Antenna	HFH2-Z2	WC062457	1/23/2020	1/23/2022
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	WC064989	11/4/2019	11/4/2020

Appendix B Test Data

TL104153-RA Key fob Pages 20 – 31



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Product	71100-701	T-Log Number:	TL104153-RA
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Daniel Francis	Project Engineer:	David Bare
Emissions Standard(s):	FCC part 15.249, RSS-210	Class:	-
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

Rugged Nature, LLC

Product

71100-701

Date of Last Test: 9/18/2020



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	-

Radiated Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/14 & 18/2020
Test Engineer: David Bare
Test Location: Fremont Chamber #5

Config. Used: 1
Config Change: None
EUT Voltage: Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.

The test distance and extrapolation factor (if used) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:
Temperature: 25 °C
Rel. Humidity: 44 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	30 kHz - 30 MHz	FCC 15.209	Pass	No emissions observed with 30 dB of the limit (Noise floor)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.



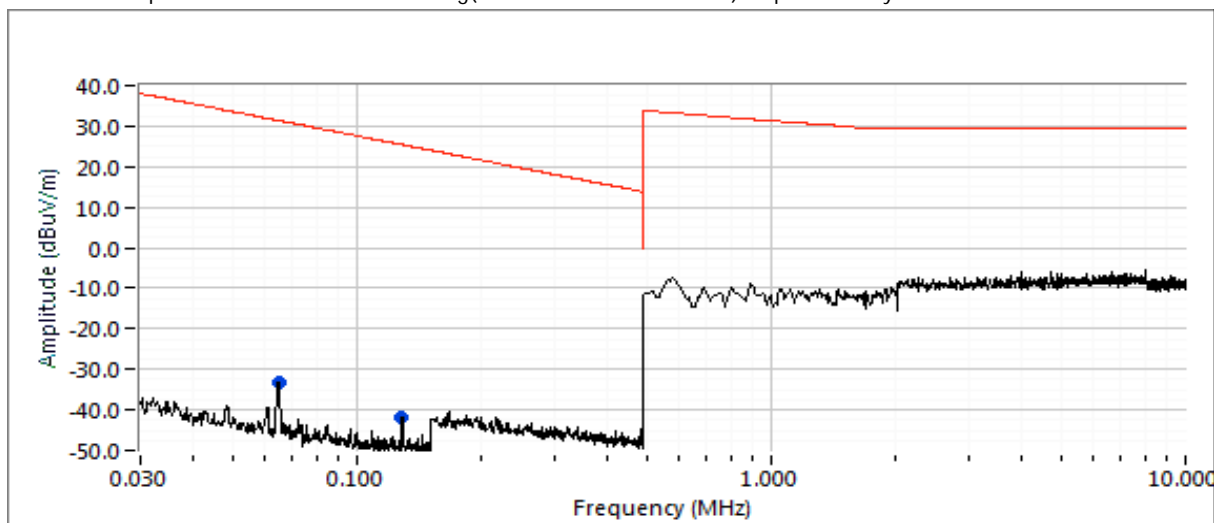
EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	-

Run #1: Radiated Emissions, 10 - 30 MHz, FCC 15.209

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.03 - 0.49 MHz	3	300	-80.0
0.49 - 30.0 MHz	3	30	-40.0

Note - the extrapolation factor is based on $40\log(\text{test distance}/\text{limit distance})$ as permitted by FCC 15.31



Preliminary readings

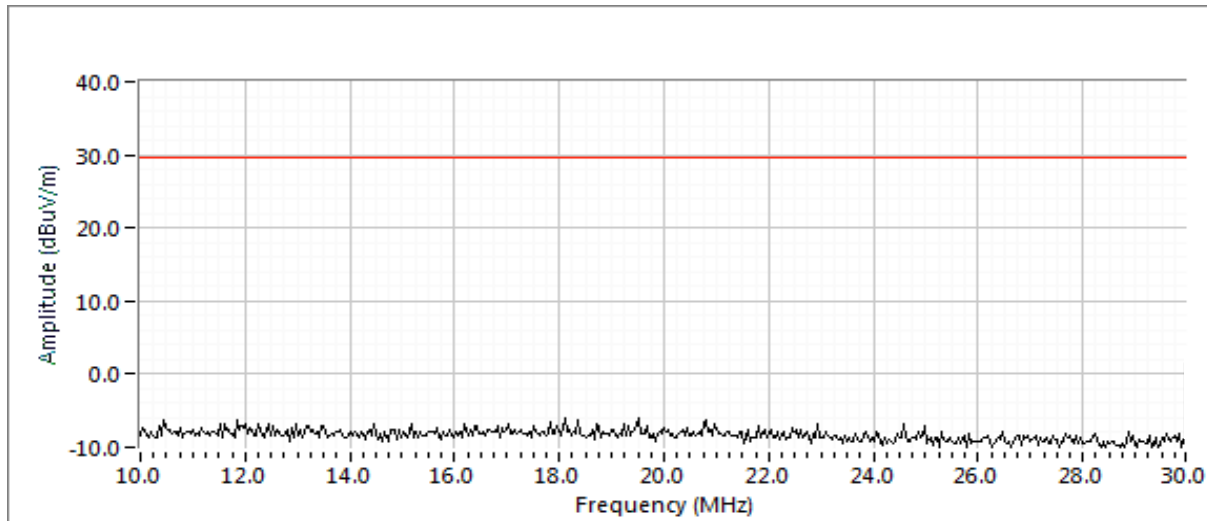
Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
0.064	-33.1	V	31.4	-64.5	Peak	298	1.5	
0.128	-41.8	V	25.4	-67.2	Peak	98	1.5	

All emissions observed more than 60 dB below the limit or not above the noise floor of the test equipment



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	-



Preliminary readings

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
No emissions observed above the noise floor of the test equipment								



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

RSS-210 and FCC 15.249 Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions: Temperature: 19 °C
 Rel. Humidity: 38 %

Summary of Results - Device Operating in the 900 MHz Band

Run #	Test Performed	Limit	Result	Value / Margin
1	Fundamental Signal Field Strength	FCC 249 RSS 210 Annex B.10	Pass	85.1 dBµV/m @ 905.97 MHz (Margin: -8.9 dB)
1	Transmitter Radiated Spurious Emissions, 30 - 1,000 MHz	FCC 15.209 & 15.249 RSS 210/RSS GEN	Pass	37.0 dBµV/m @ 957.98 MHz (Margin: -9.0 dB)
2	Transmitter Radiated Spurious Emissions, 1,000 - 9,300 MHz	FCC 15.209 & 15.249 RSS 210/RSS GEN	Pass	47.3 dBµV/m @ 7247.5 MHz (Margin: -6.7 dB)
3	Receiver Radiated Spurious Emissions, 30 - 2,800 MHz	FCC 15.109	Pass	31.9 dBµV/m @ 31.03 MHz (Margin: -8.1 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Procedure Comments:

Measurements performed in accordance with ANSI C63.10
Peak measurements above 1 GHz performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, the test samples emission duty cycle is 94%. The average value was calculated by subtracting a duty cycle correction factor of 10 dB as normal operation has a fixed duty cycle of 31.4 %.

Sample Notes

Sample S/N: None



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

Run #1: Preliminary Radiated Emissions, 30-9,200 MHz, Transmitter Spurious Emissions

Date of Test: 1/27/2020

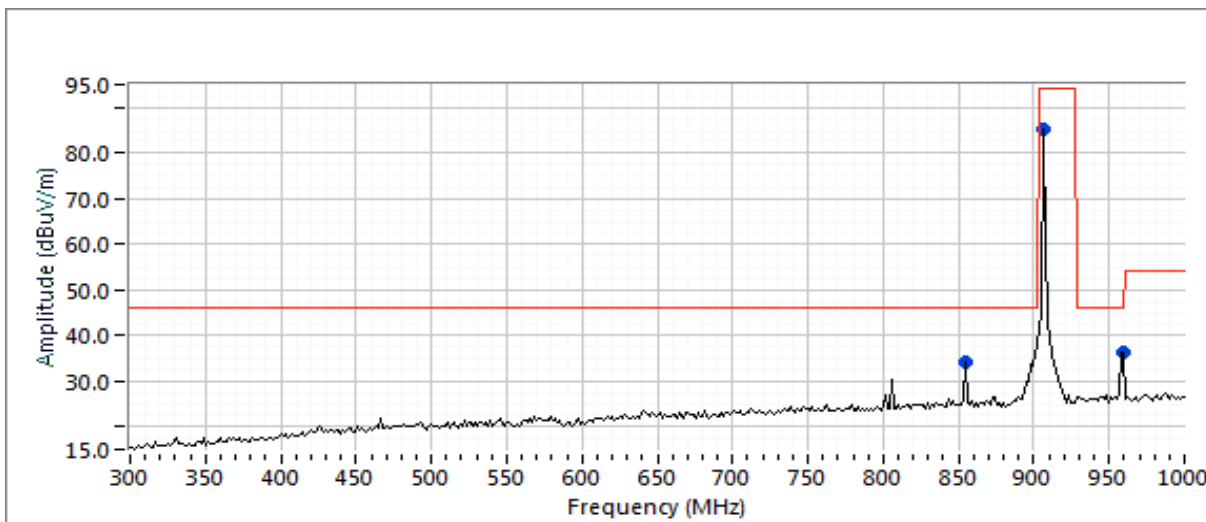
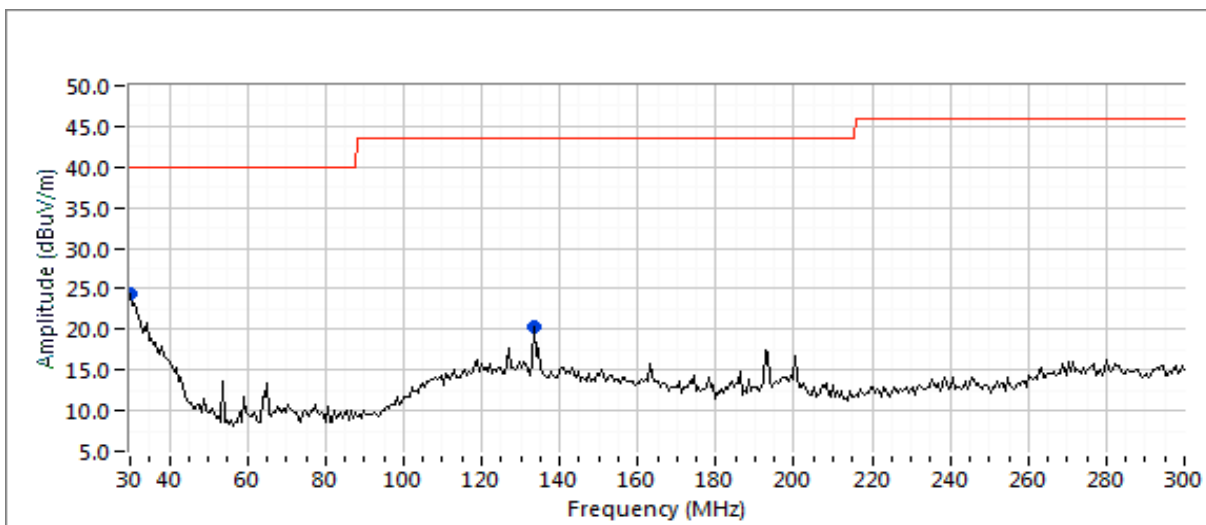
Config. Used: 1

Test Engineer: M. Birgani

Config Change: None

Test Location: FT Chamber #3

EUT Voltage: Battery (3V)





EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

Run #1: Preliminary Radiated Emissions, 30-9,200 MHz, Transmitter Spurious Emissions

Date of Test: 1/27/2020

Config. Used: 1

Test Engineer: M. Birgani

Config Change: None

Test Location: FT Chamber #3

EUT Voltage: Battery (3V)

Fundamental Field Strength

Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments	Orientation
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
905.970	85.1	H	94.0	-8.9	QP	96	1.0	QP (1.00s)	side
905.970	76.4	V	94.0	-17.6	QP	360	1.0	QP (1.00s)	side

Spurious Emissions

Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments	Orientation
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
957.981	37.0	H	46.0	-9.0	QP	278	1.0	QP (1.00s)	side
30.740	18.1	H	40.0	-21.9	QP	195	3.0	QP (1.00s)	side
855.800	21.1	H	46.0	-24.9	QP	271	2.5	QP (1.00s)	side
133.493	12.3	H	43.5	-31.2	QP	360	1.0	QP (1.00s)	side



EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

Run #2: Radiated Spurious Emissions, 1,000 - 9,300 MHz

Date of Test: 1/15/2020 8:10

Test Engineer: David Bare

Test Location: Fremont Chamber #4

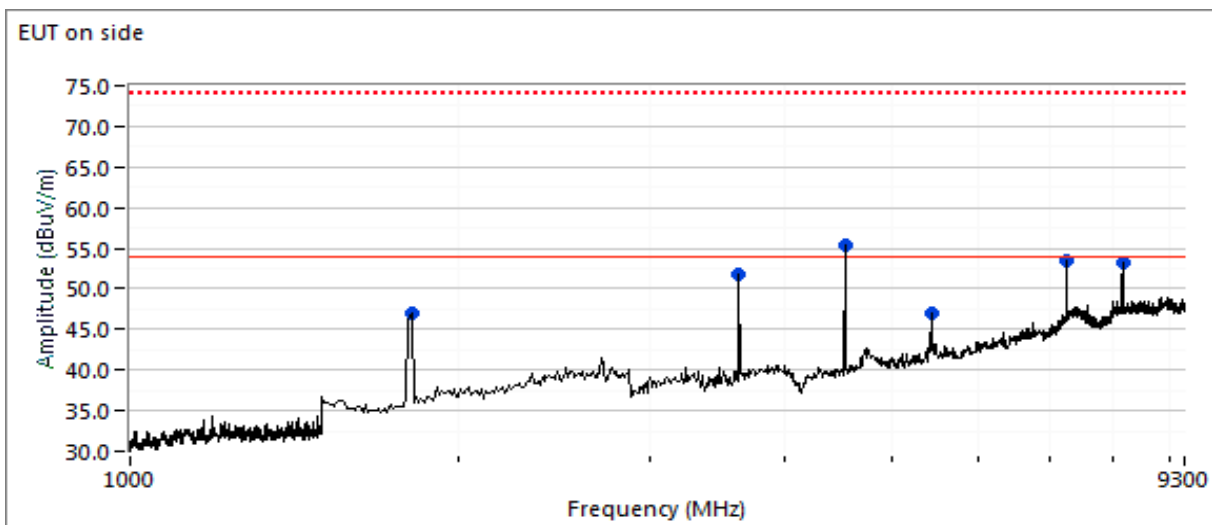
Config. Used: 1

Config Change: None

EUT Voltage: Battery

Spurious Emissions, EUT on side (worst case orientation)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	PK/QP/Avg	degrees	meters	
7247.460	47.3	H	54.0	-6.7	AVG	38	1.0	Peak corrected by duty cycle
7247.550	57.3	H	74.0	-16.7	PK	38	1.0	RB 1 MHz;VB 3 MHz;Peak
8153.580	47.1	V	54.0	-6.9	AVG	41	1.1	Peak corrected by duty cycle
8153.680	57.1	V	74.0	-16.9	PK	41	1.1	RB 1 MHz;VB 3 MHz;Peak
4529.890	46.8	V	54.0	-7.2	AVG	173	1.7	Peak corrected by duty cycle
4528.480	56.8	V	74.0	-17.2	PK	173	1.7	RB 1 MHz;VB 3 MHz;Peak
3624.100	43.5	H	54.0	-10.5	AVG	14	1.4	Peak corrected by duty cycle
3624.370	53.5	H	74.0	-20.5	PK	14	1.4	RB 1 MHz;VB 3 MHz;Peak
5435.680	41.1	V	54.0	-12.9	AVG	40	1.0	Peak corrected by duty cycle
5435.670	51.1	V	74.0	-22.9	PK	40	1.0	RB 1 MHz;VB 3 MHz;Peak
1811.960	39.2	H	54.0	-14.8	AVG	360	1.3	Peak corrected by duty cycle
1812.030	49.2	H	74.0	-24.8	PK	360	1.3	RB 1 MHz;VB 3 MHz;Peak





EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

Run #3: Receiver Spurious Emissions

Date of Test: 8/28/2019

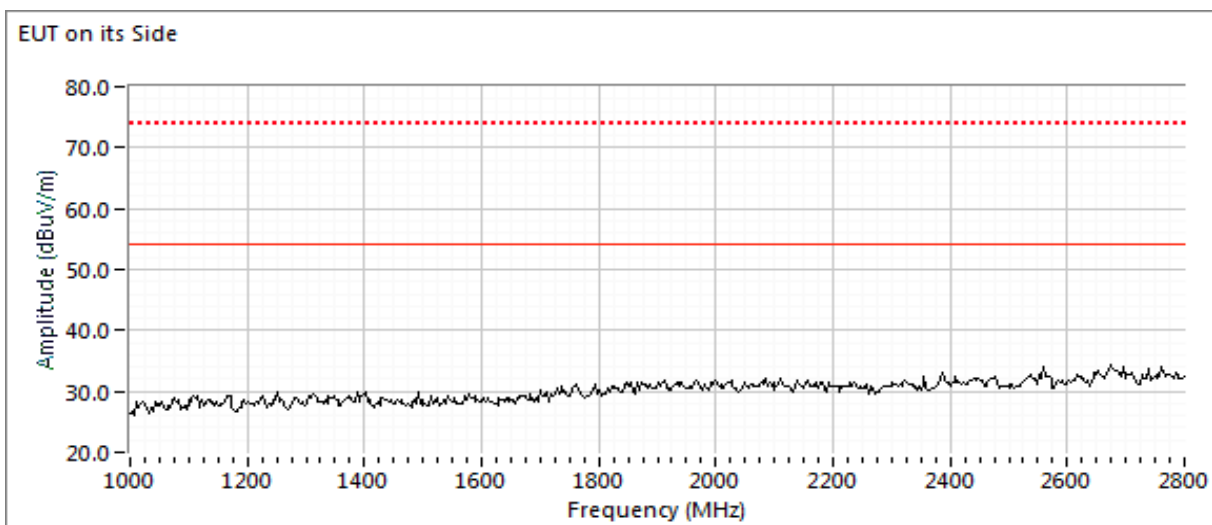
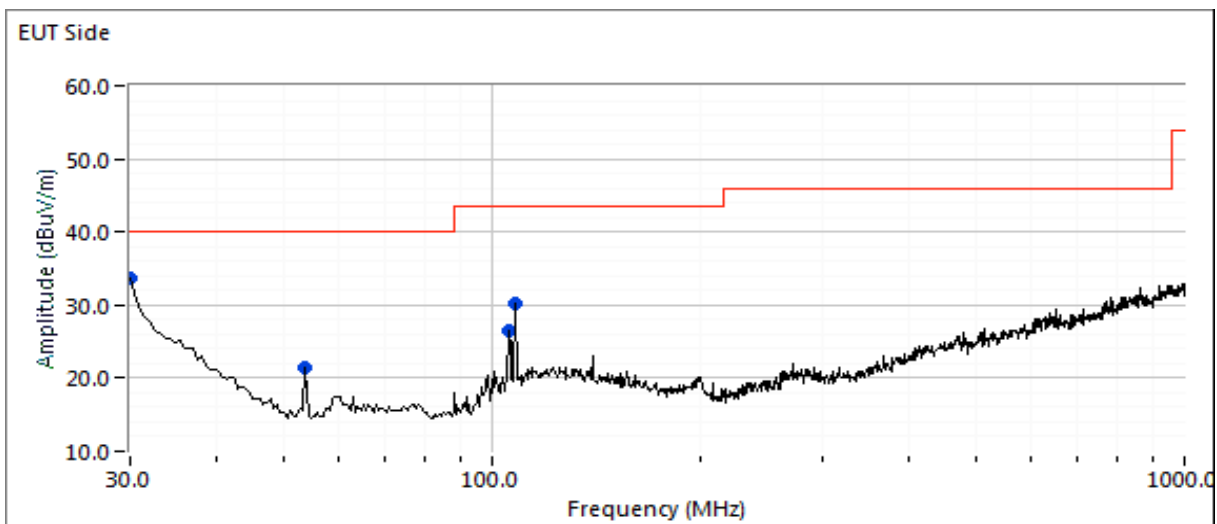
Test Engineer: Rafael Varelas

Test Location: FT Chamber #4

Config. Used: 1

Config Change: None

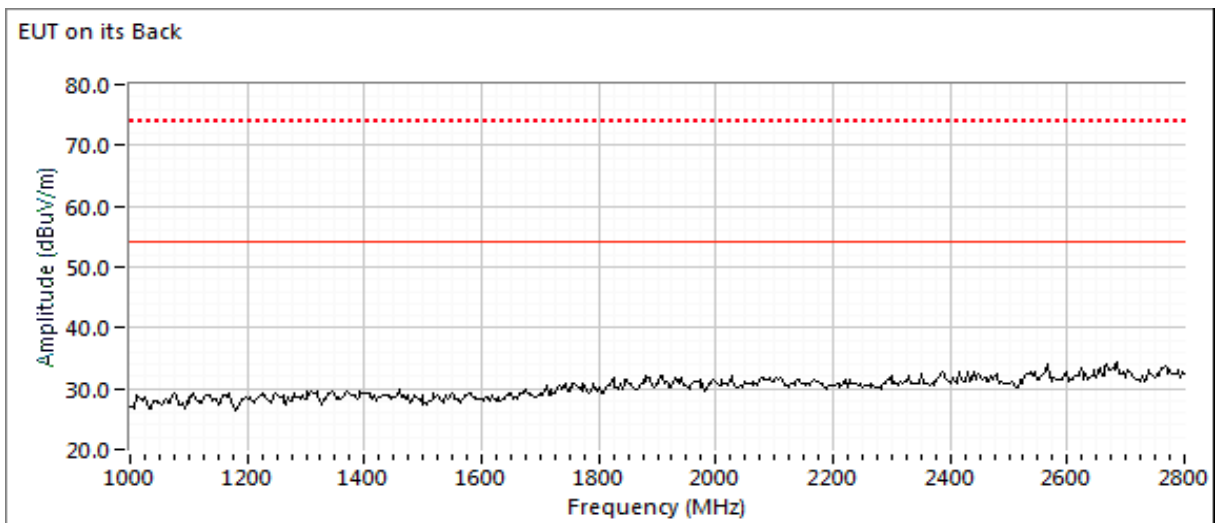
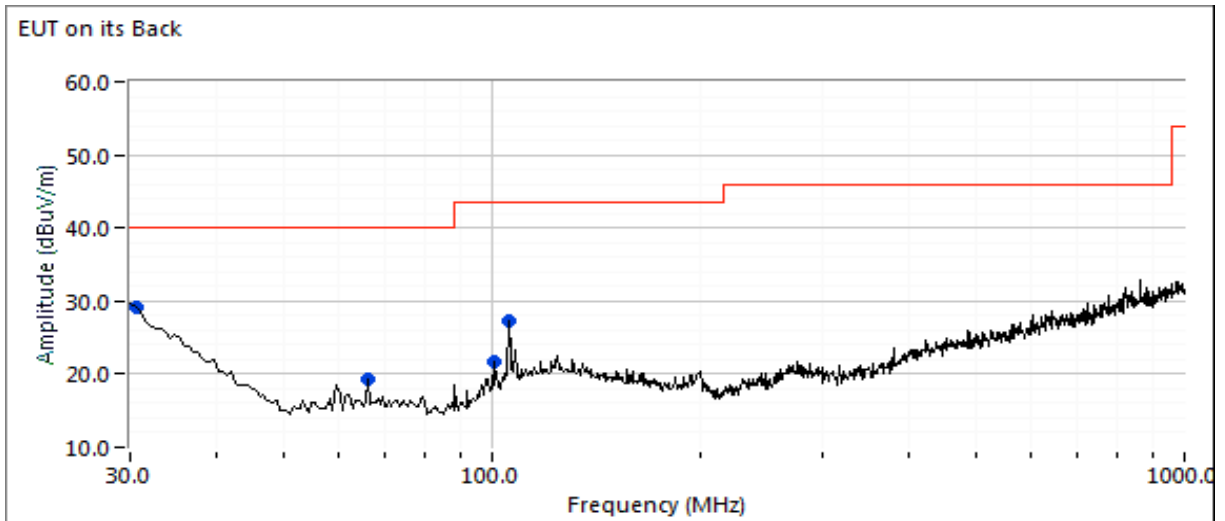
EUT Voltage: Battery (3V)





EMC Test Data

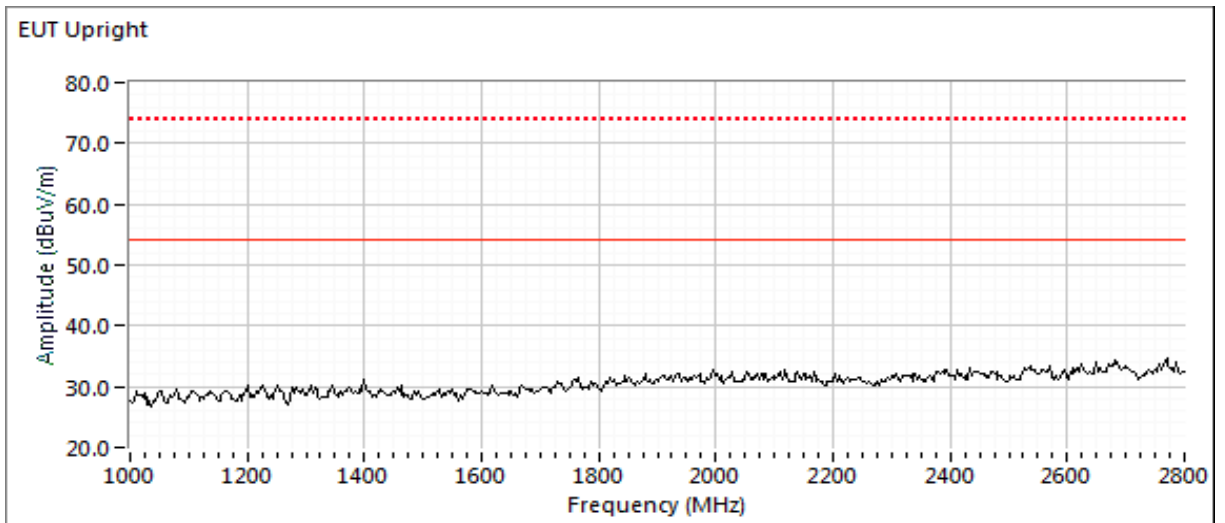
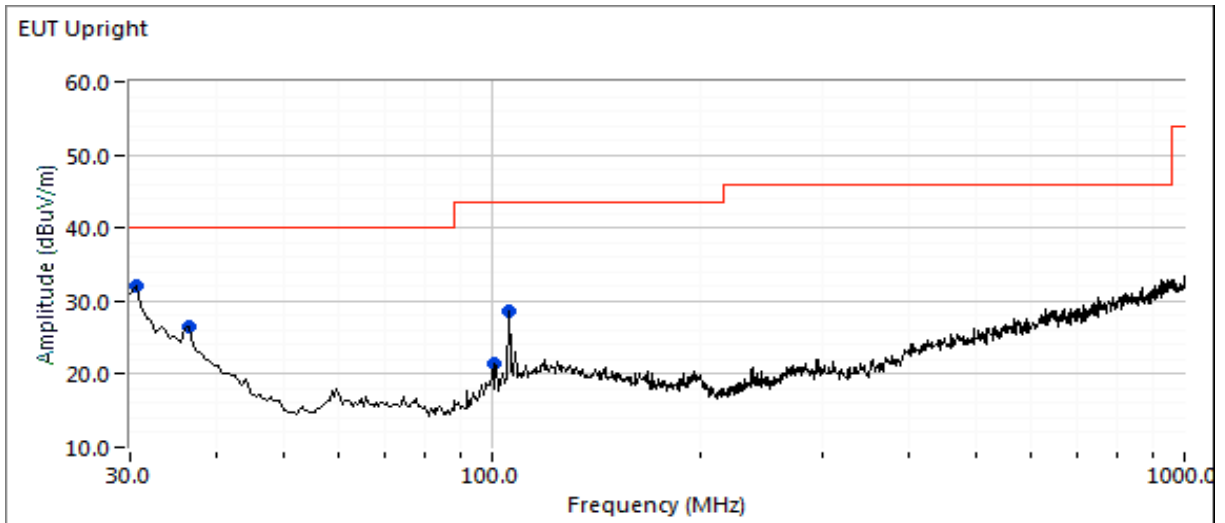
Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A





EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A





EMC Test Data

Client:	Rugged Nature, LLC	PR Number:	PR104153
Model:	71100-701	T-Log Number:	TL104153-RA
Contact:	Daniel Francis	Project Manager:	Deepa Shetty
Standard:	FCC part 15.249, RSS-210	Project Engineer:	David Bare
		Class:	N/A

Run #4: Receiver Spurious Emissions

Preliminary Emissions

Frequency	Level	Pol	FCC 15.109		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
31.033	33.6	V	40.0	-6.4	Peak	260	1.5	EUT on its Side
53.859	21.5	V	40.0	-18.5	Peak	314	1.5	EUT on its Side
105.701	26.5	V	43.5	-17.0	Peak	256	1.0	EUT on its Side
107.708	30.2	V	43.5	-13.3	Peak	34	1.0	EUT on its Side
31.215	29.1	V	40.0	-10.9	Peak	87	3.0	EUT on its Back
66.082	19.2	H	40.0	-20.8	Peak	283	1.5	EUT on its Back
100.248	21.8	H	43.5	-21.7	Peak	126	3.5	EUT on its Back
105.637	27.3	H	43.5	-16.2	Peak	334	4.0	EUT on its Back
31.231	32.2	H	40.0	-7.8	Peak	267	2.0	EUT Upright
36.305	26.5	V	40.0	-13.5	Peak	194	1.5	EUT Upright
100.347	21.5	V	43.5	-22.0	Peak	217	3.5	EUT Upright
105.707	28.5	H	43.5	-15.0	Peak	163	4.0	EUT Upright

Maximized Emissions

Frequency	Level	Pol	FCC 15.109		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
31.033	31.9	V	40.0	-8.1	QP	259	1.0	EUT on its Side
53.859	19.8	V	40.0	-20.2	QP	313	1.0	EUT on its Side
105.701	27.5	V	43.5	-16.0	QP	257	1.3	EUT on its Side
107.708	25.1	V	43.5	-18.4	QP	34	1.9	EUT on its Side
100.248	24.6	H	43.5	-18.9	QP	127	1.0	EUT on its Back
31.215	31.9	V	40.0	-8.1	QP	86	1.5	EUT on its Back
66.082	20.7	H	40.0	-19.3	QP	283	1.0	EUT on its Back
105.637	27.8	H	43.5	-15.7	QP	334	1.0	EUT on its Back
105.707	28.2	H	43.5	-15.3	QP	163	1.0	EUT Upright
36.305	28.5	V	40.0	-11.5	QP	194	1.0	EUT Upright
100.347	24.0	V	43.5	-19.5	QP	217	1.0	EUT Upright
31.231	31.9	H	40.0	-8.1	QP	267	1.1	EUT Upright

End of Report

This page is intentionally blank and marks the last page of this test report.