RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.231 Test Data

433.92 MHz Siren Strobe

Model: RE636

for

Alula
2340 Energy Park Drive
St. Paul, MN 55108
Contact: Chris Weltzien

Testing Conducted By:

Rhein Tech Laboratories, Inc.
360 Herndon Parkway, Suite 1400
Herndon, VA 20170

RTL Test Engineer: Jon Wilson

RTL Project/Report Number: 2019040

March 12, 2019

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, and ANSI C63.10.

Signature: _____ Date: March 12, 2019

Typed/Printed Name: Desmond A. Fraser Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANAB. Refer to certificate and scope of accreditation AT-1445. ISED test site number: 2956A-1

Radiated Spurious Harmonics Emissions

The data and limits presented in this report are for radiated emissions per 15.231(b)(2) which references 15.35(b), and peak limiting for restricted bands per 15.209(e), which again references 15.35(b)(2), as procured by Alula. No average data is presented in this report. Data (if applicable) is also presented for spurious, non-harmonic radiated emissions per 15.209. The Equipment Under Test (EUT) was the **433.92 MHz Model RE636, RTL Bar Code 23214.**

Test Procedure

Radiated fundamental and spurious emissions were tested at 3 m. The EUT was tested in the three orthogonal planes with the receive antenna in both polarities. The emissions were maximized; that is, the measurement antenna height was varied between 1 and 4 m, and the EUT was rotated through 360° on a rotating turntable until the maximum emissions were found. Both horizontal and vertical measurement antenna polarizations were used. A resolution bandwidth of 120 kHz was used for frequencies less than 1000 MHz, and a resolution bandwidth of 1 MHz was used for frequencies greater than or equal to 1000 MHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth.

EUT Disposition

The EUT was adapted to continuously transmit for testing purposes.

15.231 Radiated Spurious Emissions Test Data:

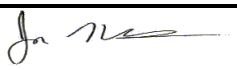
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	Peak	V	82.1	18.1	100.2	100.8	-0.6
867.840	Peak	V	50.0	-2.8	47.2	80.8	-33.6
1301.760	Peak	H	49.6	2.1	51.7	74.0	-22.3
1735.680	Peak	H	48.0	6.4	54.4	80.8	-26.4
2169.600	Peak	V	45.4	-10.9	34.5	80.8	-46.3
2603.520	Peak	V	58.6	-10.1	48.5	80.8	-32.3
3037.440	Peak	V	55.8	-10.0	45.8	80.8	-35.0
3471.360	Peak	V	58.0	-8.6	49.4	80.8	-31.4
3905.280	Peak	V	48.0	-7.4	40.6	74.0	-33.4
4339.200	Peak	V	58.1	-1.9	56.2	74.0	-17.8

Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2. +/- 4.6 dB

Radiated Emissions Test Equipment

RTL Bar Code	Manufacturer	Model	Part	Serial Number	Calibration Due Date
900930	Hewlett Packard	85662A	Spectrum Analyzer Display	3144A20839	4/26/19
900931	Hewlett Packard	8566B	Spectrum Analyzer (100Hz – 22 GHz)	3138A07771	4/26/19
90905	Rhein Tech Labs	PR-1040	Preamplifier (10 – 2000 MHz)	N/A	8/20/19
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 – 26.5 GHz)	3008A00505	10/1/19
900791	Chase	CBL6112	Antenna (30 MHz – 2 GHz)	2099	10/4/20
900772	EMCO	3161-02	Horn Antenna (2 GHz – 4 GHz)	9804-1044	5/17/21
900321	EMCO	3161-03	Horn Antenna (4.0 GHz – 8.2 GHz)	9508-1020	5/17/21

Test Personnel:

Jon Wilson		March 1, 2019
EMC Test Engineer	Signature	Date of Test

FCC/IC Cross Reference

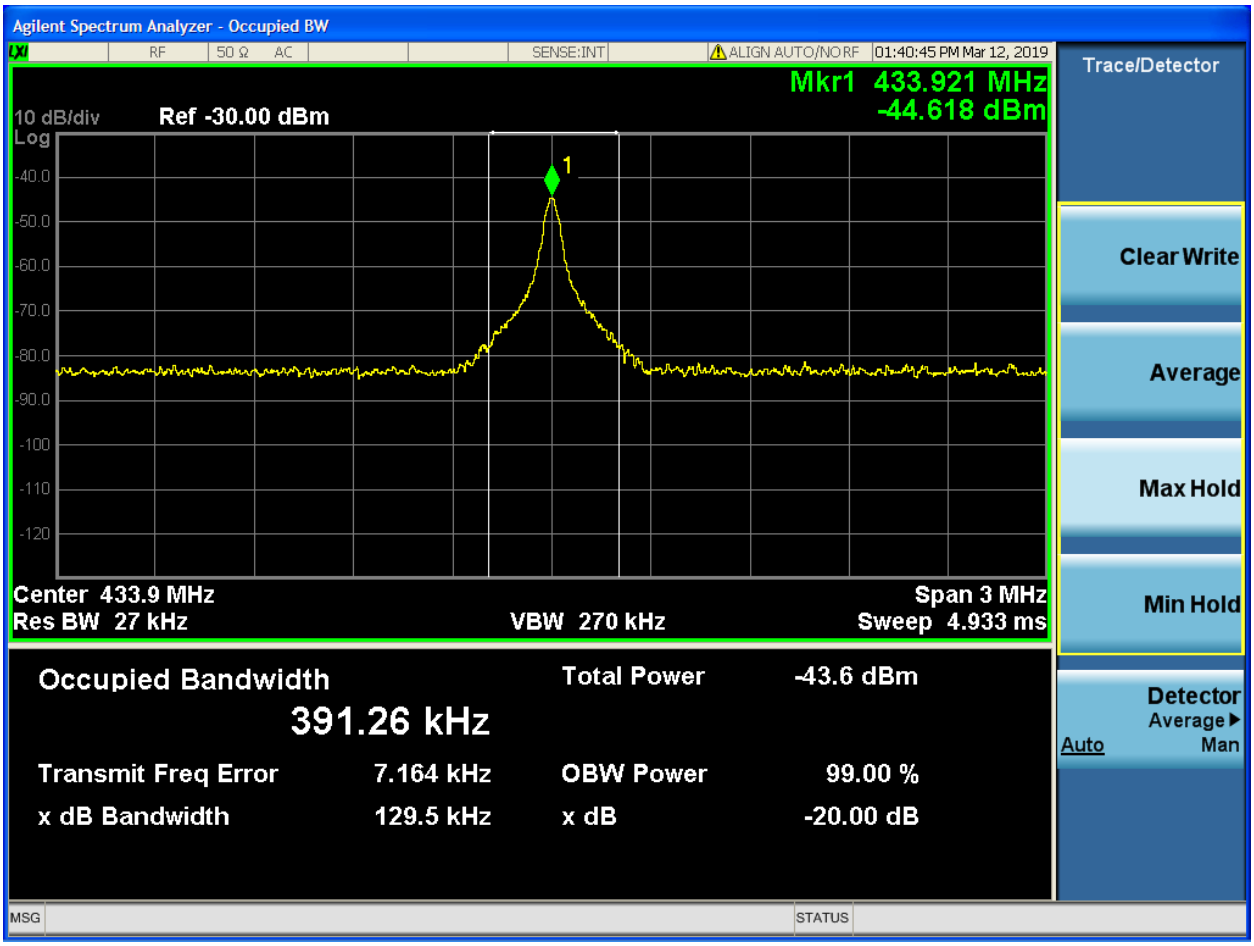
5 second timing	FCC 15.231(a)	RSS-210 Issue 9 A1.1
Field Strength	FCC 15.231(b)(2)	RSS-210 Issue 9 A1.2
Restricted Band	FCC 15.205	RSS-Gen Issue 5 8.10
General Field Strength	FCC 15.209	RSS-Gen Issue 5 8.9
Bandwidth	FCC 15.231(c)	RSS-210 Issue 9 A1.3

Occupied Bandwidth

15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz

RE636:
Limit = 433.92 MHz * 0.25% = 1.0848 MHz = 1085 kHz
OBW 99% = 391.26 kHz
OBW 20 dB = 129.5 kHz

Plot: OBW 99%/ OBW 20 dB

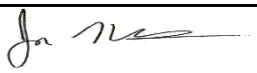


Measurement uncertainty: ±1 x 10^{-6} Hz. This measurement uncertainty is an expanded uncertainty for 95% confidence level received with a coverage factor k=2.

Occupied Bandwidth Test Equipment

RTL Bar Code	Manufacturer	Model	Part	Serial Number	Calibration Due Date
901583	Agilent	EXA N9010A	Spectrum Analyzer	MY51250846	2/6/2020

Test Personnel:

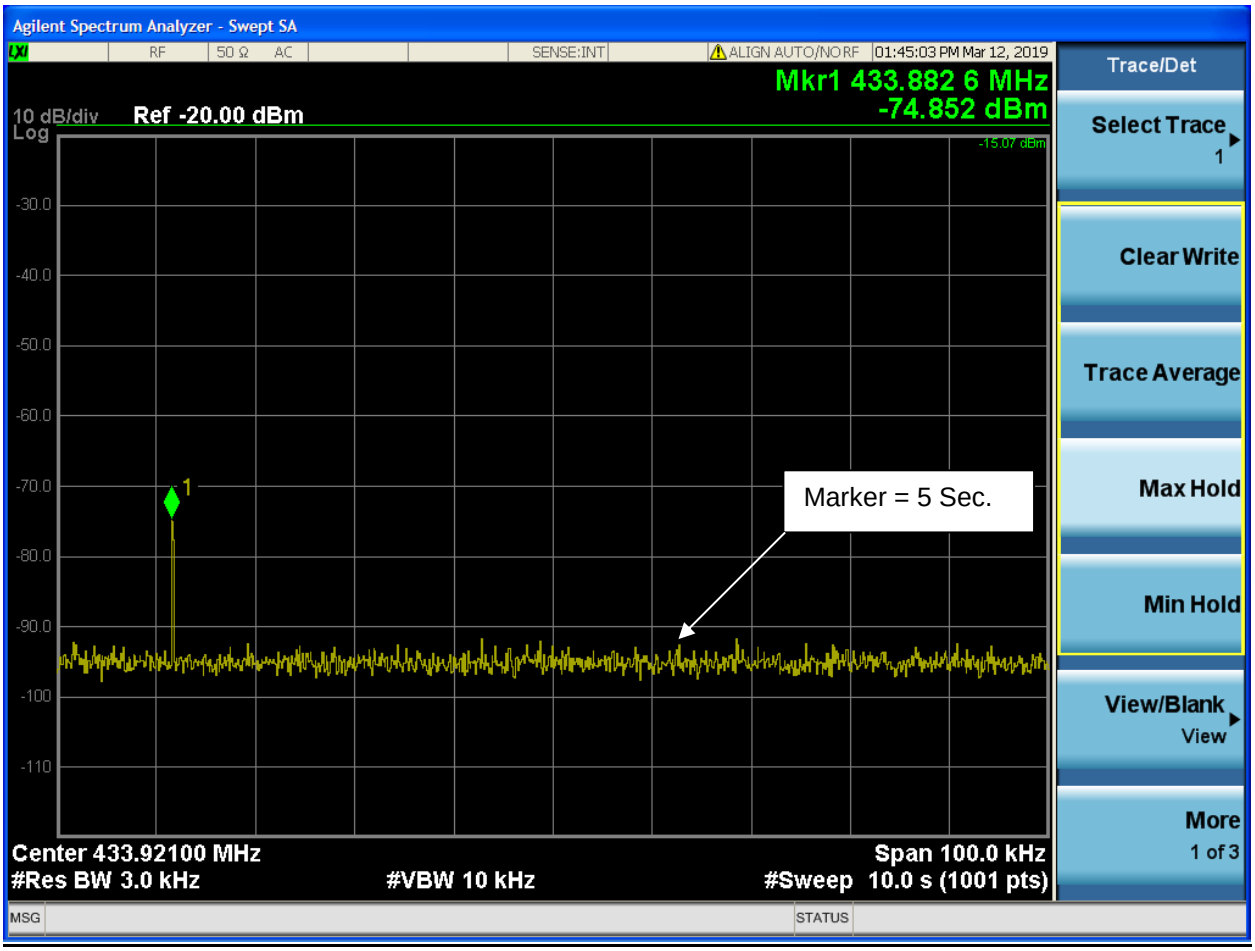
Jon Wilson		March 12, 2019
EMC Test Engineer	Signature	Date of Test

Transmitter Deactivation

15.231(a)
(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

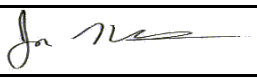
Plot: 5 s Deactivation



5 s Deactivation Test Equipment

RTL Bar Code	Manufacturer	Model	Part	Serial Number	Calibration Due Date
901583	Agilent	EXA N9010A	Spectrum Analyzer	MY51250846	2/6/2020

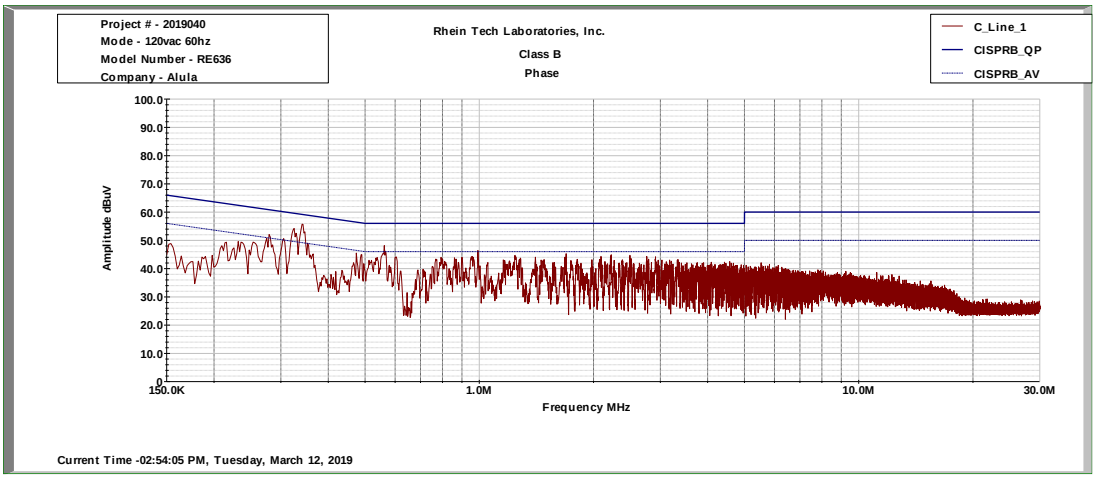
Test Personnel:

Jon Wilson		March 12, 2019
EMC Test Engineer	Signature	Date of Test

15.207
AC Power Line Conducted Emissions

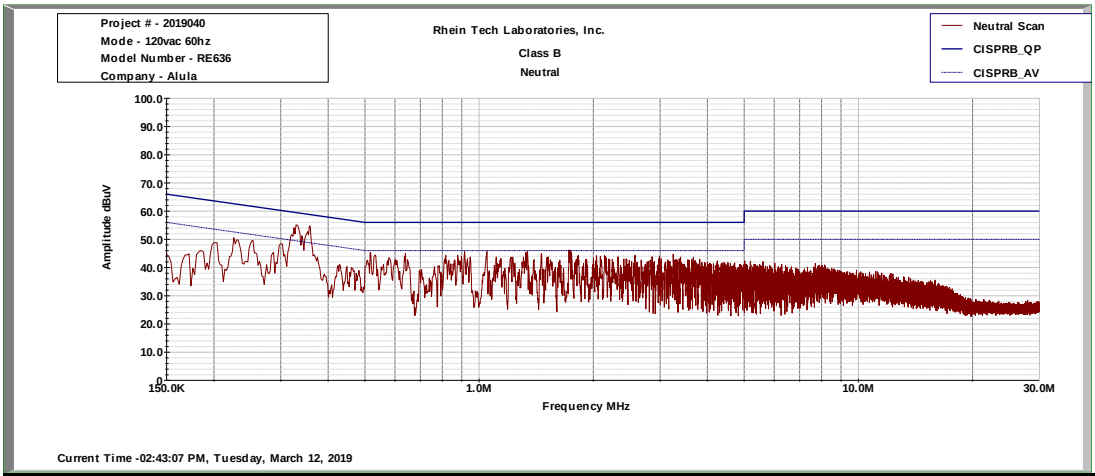
Test Procedure
The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was placed on a wooden table. Power was fed to the EUT through a 50-ohm/50 microhenry LISN. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB resolution bandwidth was set to 9 kHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth. Average measurements are performed in linear mode using a 9 kHz resolution bandwidth and a 1 Hz video bandwidth. The frequency spectrum was scanned from 150 kHz to 30 MHz.

15.207 Conducted Line Emissions Test Data



Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.331	QP	53.7	0.7	54.4	59.4	-5.0	Pass
0.331	Av	41.8	0.7	42.5	49.4	-6.9	Pass
0.562	QP	37.8	0.8	38.6	56.0	-17.4	Pass
0.562*	Av	--	0.8	--	46.0	--	Pass
0.992	QP	40.2	0.9	41.1	56.0	-14.9	Pass
0.992*	Av	--	0.9	--	46.0	--	Pass
1.694	QP	39.7	1.2	40.9	56.0	-15.1	Pass
1.694*	Av	--	1.2	--	46.0	--	Pass

*Note: Average measurements not required if QP is below the Average limit.



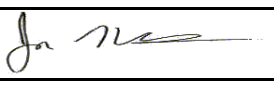
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.331	QP	53.4	0.8	54.2	59.4	-5.2	Pass
0.331	Av	42.4	0.8	43.2	49.4	-6.2	Pass
0.916	QP	40.9	1.0	41.9	56.0	-14.1	Pass
0.916*	Av	--	1.0	--	46.0	--	Pass
1.049	QP	40.3	1.0	41.3	56.0	-14.7	Pass
1.049*	Av	--	1.0	--	46.0	--	Pass
1.340	QP	39.8	1.2	41.0	56.0	-15.0	Pass
1.340*	Av	--	1.2	--	46.0	--	Pass
1.723	QP	39.1	1.4	40.5	56.0	-15.5	Pass
1.723*	Av	--	1.4	--	46.0	--	Pass

*Note: Average measurements not required if QP is below the Average limit.

Conducted Line Emissions Test Equipment

Part	Manufacturer	Model	Serial Number	RTL Bar Code	Calibration Due Date
Quasi-Peak Adapter	Hewlett Packard	85650A	2521A00743	900339	4/26/19
Spectrum Analyzer Display	Hewlett Packard	85662A	3144A20839	900930	4/16/19
Spectrum Analyzer (100 Hz – 22 GHz)	Hewlett Packard	8566B	3138A07771	900931	4/26/19
16A LISN	AFJ International	LS16/110VAC	16010020080	901083	2/13/21
Filter	Solar	Type 8130-7.0	N/A	900728	4/24/20
Test software	ETS-Lindgren	Tile!	7.1.3.20	N/A	N/A

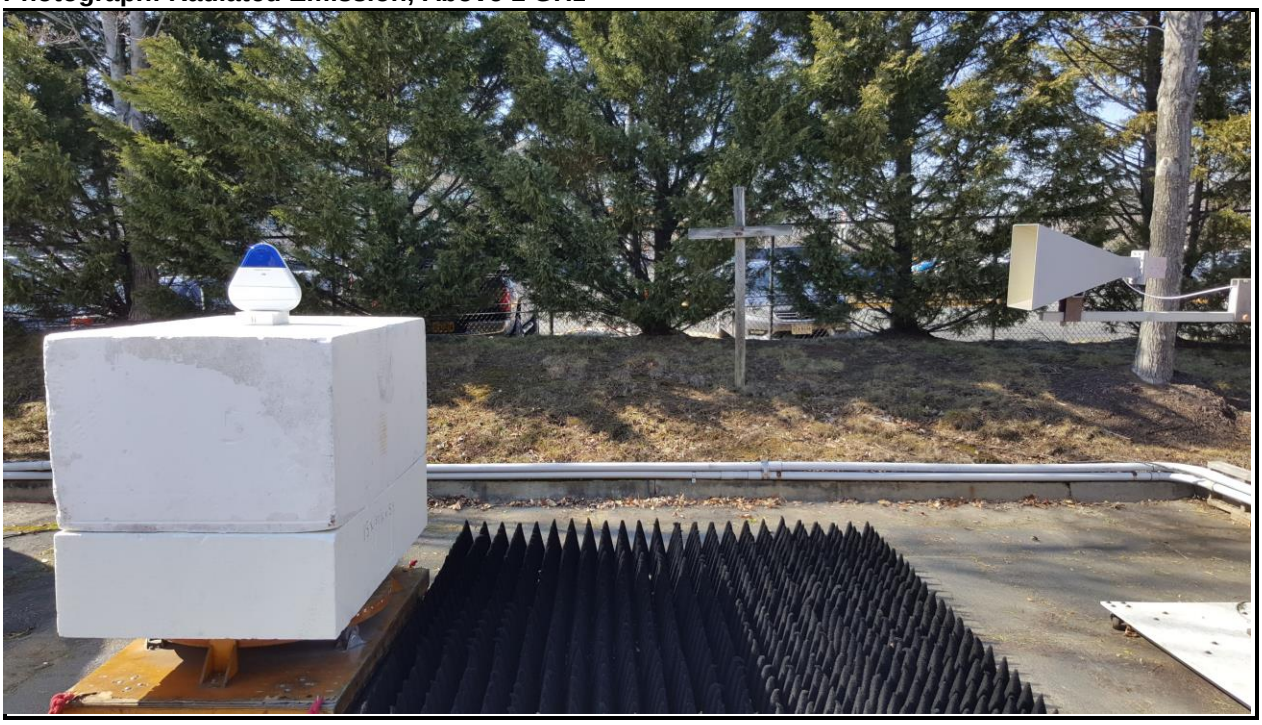
Test Personnel:

Jon Wilson		March 12, 2019
Test Engineer	Signature	Date of Test

Test Configuration Photographs

Photograph: Radiated Emission, 30 MHz – 1 GHz

Photograph: Radiated Emission, Above 1 GHz



Photograph: Conducted Emissions