



Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.231 Test Data

433.92 MHz Sensor

Model: RE660

for

**Alula
1402 Heggen Street
Hudson, WI 54016
Contact: Chris Weltzien**

Testing Conducted By:

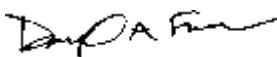
**Rhein Tech Laboratories, Inc.
360 Herndon Parkway, Suite 1400
Herndon, VA 20170**

RTL Test Engineer: Dan Baltzell

RTL Project/Report Number: 2018251

December 27, 2018

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: December 27, 2018

Typed/Printed Name: Desmond A. Fraser

Position: President

This report may not be reproduced, except in full, without the full written approval of Rhein Tech Laboratories, Inc. and Alula. Test results relate only to the item tested.

*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 RE660, RTL Bar Code 23143**.

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 – Peak:

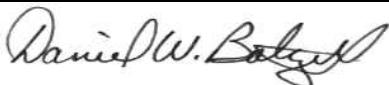
Frequency (MHz)	Antenna Polarity (H / V)	Raw Emission (dB μ V/m)	Site Correction Factor (dB/m)	Corrected Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result (Pass / Fail)
433.92	V	68.5	18.2	86.7	100.8	-14.1	Pass
867.84	V	49.1	23.6	72.7	80.8	-8.1	Pass
1301.76	H	17.9	27.5	45.4	74.0	-28.6	Pass
1735.68	V	17.1	30.9	48.0	80.8	-32.8	Pass
2169.60	H	27.9	25.6	53.5	80.8	-27.3	Pass
2603.52	H	23.3	26.5	49.8	80.8	-31.0	Pass
3037.44	H	20.6	27.0	47.6	80.8	-33.2	Pass
3471.36	H	25.7	27.8	53.5	80.8	-27.3	Pass
3905.28	V	16.2	28.5	44.7	74.0	-29.3	Pass
4339.20	V	8.4	33.7	42.1	74.0	-31.9	Pass

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
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	4/26/21
901729	Insulated Wire Inc.	KPS-1503-3150-KPR	SMK RF Cables 20'	NA	8/21/19
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:

Dan Baltzell		December 7, 2018
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

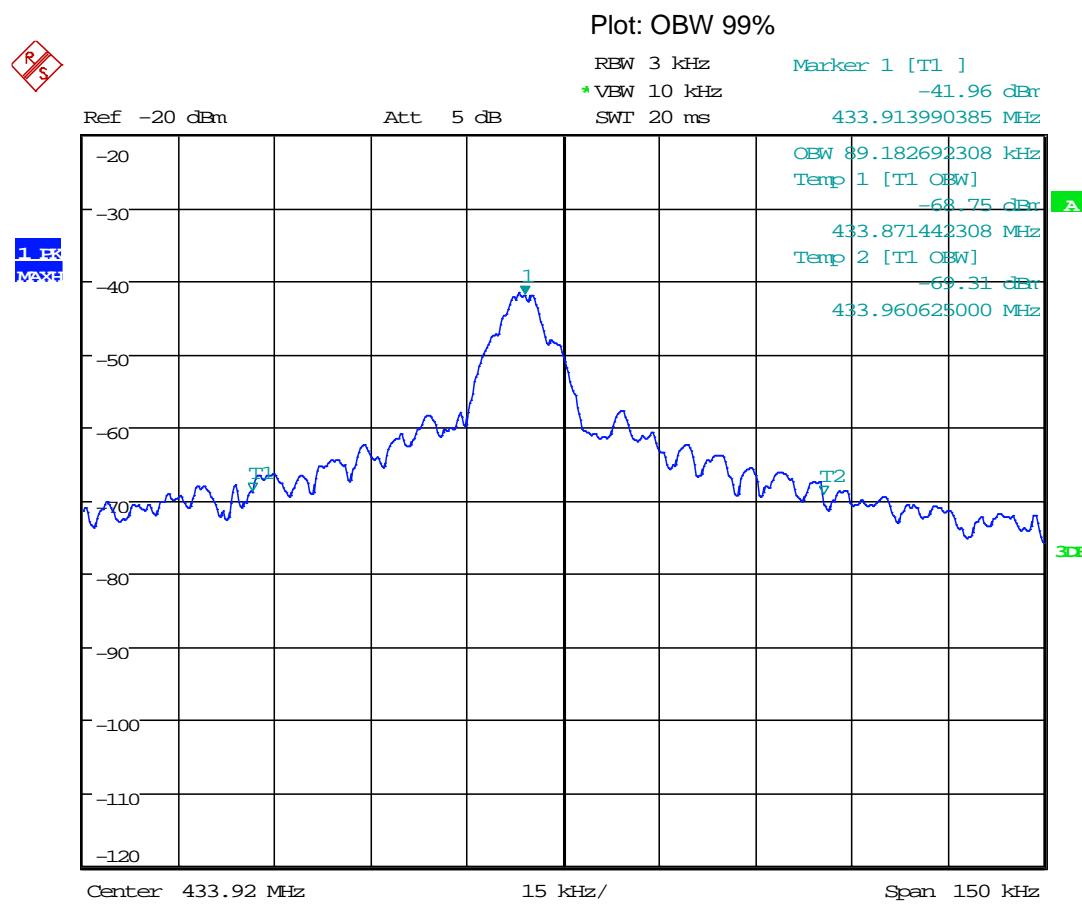
15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz

RE660:

$$\text{Limit} = 433.92 \text{ MHz} * 0.25\% = 1.0848 \text{ MHz} = 1085 \text{ kHz}$$

$$\text{OBW 99\%} = 89.2 \text{ kHz}$$

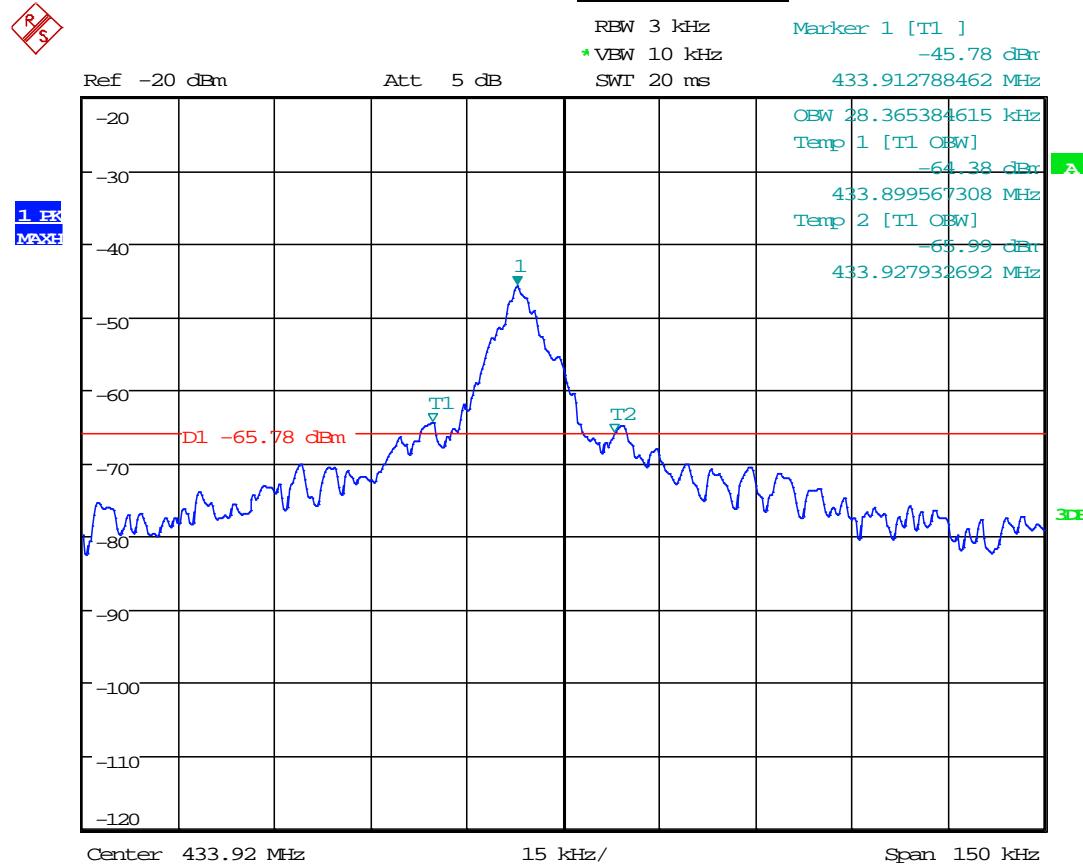
$$\text{OBW 20 dB} = 28.4 \text{ kHz}$$



Date: 7.DEC.2018 10:05:39



Plot: OBW 20 dB



Date: 7.DEC.2018 10:08:18

Measurement uncertainty: $\pm 1 \times 10^{-6}$ 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
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	4/26/21

Test Personnel:

Dan Baltzell		December 7, 2018
EMC Test Engineer	Signature	Date of Test

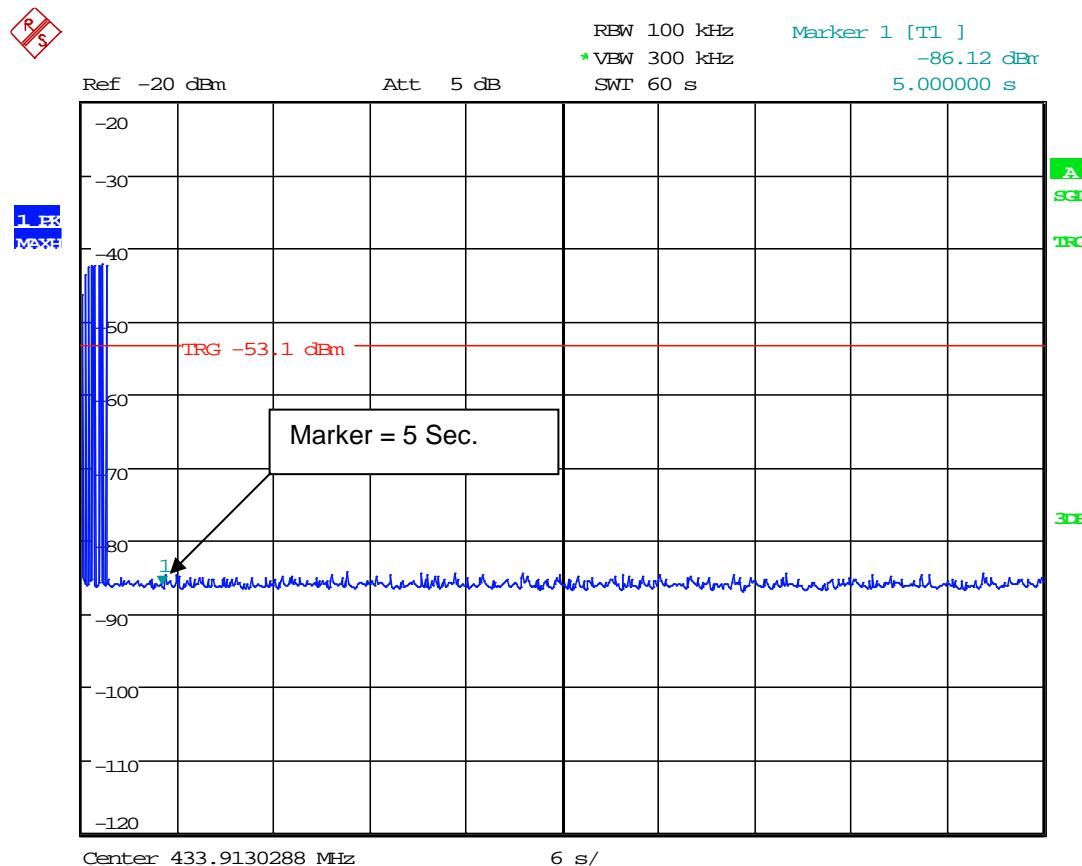
Transmitter Deactivation

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



Date: 7.DEC.2018 10:12:10

5 s Deactivation Test Equipment

RTL Bar Code	Manufacturer	Model	Part	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	4/26/21

Test Personnel:

Dan Baltzell		December 7, 2018
EMC Test Engineer	Signature	Date of Test

Test Configuration Photographs

Photograph: Radiated Emission, 30 MHz – 1 GHz, Front



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Photograph: Radiated Emission, 30 MHz – 1 GHz, Rear



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Photograph: Radiated Emission, Above 1 GHz, Rear



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