



Engineering Solutions & Electromagnetic Compatibility Services

**FCC Part 15.231 Test Data**

**433.92 MHz Sensor**

**Model: DWS-LL**

**for**

**Alula**

**2340 Energy Park Drive, Suite 100**

**St. Paul, MN 55108 (USA)**

**Contact: Josh Gathje**

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**Phone: 888.88.ALULA**

**Testing Conducted By:**

**Rhein Tech Laboratories, Inc.**

**360 Herndon Parkway, Suite 1400**

**Herndon, VA 20170**

**RTL Test Engineer: Jon Wilson**

**RTL Project/Report Number: 2021071**

**July 14, 2021**

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: July 5, 2021

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.*

*This report replaces R0.0.*

*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#:2956A*

**FCC/ISED Cross Reference**

5 second timing	FCC 15.231(a)(1)	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

The Equipment Under Test (EUT) was the **433.92 MHz Model DWS-LL, RTL Bar Code 23887.**

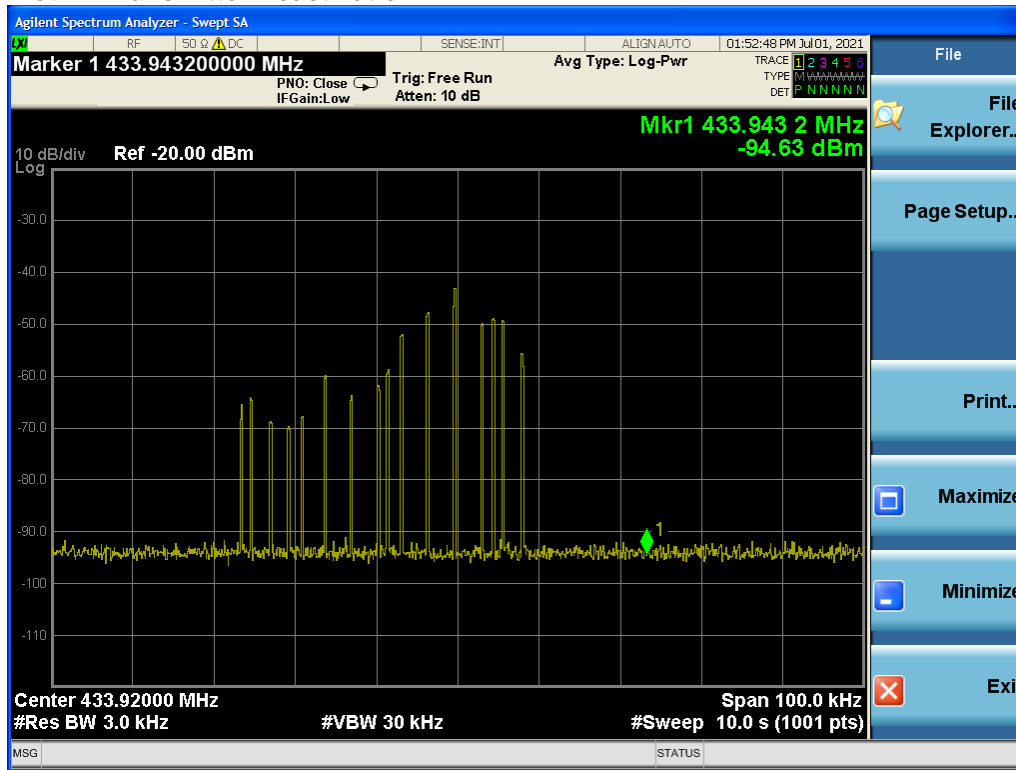
**Transmitter Deactivation**

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

**Deactivation Data, DWS-LL V6**

Frequency (MHz)	Limit (s)	Result (Pass / Fail)
433.92	5.0	Pass

**Plot: Transmitter Deactivation**




Note: Marker 1 shows the 5 second mark after the transmitter was triggered.

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.

**Deactivation Test Equipment**

RTL Asset #	Part Type	Manufacturer	Model	Serial Number	Calibration Due Date
901583	EXA Signal Analyzer	Agilent	N9010A	MY51250846	7/18/2021

**Test Personnel:**

Jon Wilson		July 1, 2021
EMC Test Engineer	Signature	Date of Test

### 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.

15.231(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (µV/m)	Field Strength of Spurious Emissions (µV/m)
40.66 – 40.70	2 250	225
70 – 130	1 250	125
130 – 174	1 250 to 3 750	125 to 375
174 – 260	3 750	375
260 – 470	3 750 to 12 500 <sup>1</sup>	375 to 1 250 <sup>1</sup>
Above 470	12 500	1 250

<sup>1</sup> Linear Interpolation

### 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 (dBµV/m)	Site Correction Factor (dB/m)	Corrected Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result (Pass / Fail)
433.92	V	69.3	23.0	92.3	100.8	-8.5	Pass
867.84	V	50.0	1.2	51.2	80.8	-29.6	Pass
1301.76	H	50.0	7.1	57.1	74.0	-16.9	Pass
1735.68	V	50.8	10.9	61.7	80.8	-19.1	Pass
2169.60	H	55.0	-9.4	45.6	80.8	-35.2	Pass
2603.52	V	70.8	-8.4	62.4	80.8	-18.4	Pass
3037.44	H	58.2	-8.2	50.0	80.8	-30.8	Pass
3471.36	V	56.6	-8.9	47.7	80.8	-33.1	Pass
3905.28	H	44.9	-5.9	39.0	74.0	-35.0	Pass
4339.20	H	35.0	-0.9	34.1	74.0	-39.9	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 Asset #	Part Type	Manufacturer	Model	Serial Number	Calibration Due Date
900321	Horn Antennas (4.0 – 8.2 GHz)	EMCO	3161-03	9508-1020	8/17/2021
900772	Horn Antenna (2 – 4 GHz)	EMCO	3161-02	9804-1044	8/17/2021
901699	Bilog Antenna (26 – 6000 MHz)	Chase	3142E	00166065	4/24/2022
900811	Preamplifier (10 – 2000 MHz)	Rhein Tech Laboratories	PR-1040	1003	2/16/2022
901723	Preamplifier (1 – 26.5 GHz)	Hewlett Packard	8449B	3008A00762	9/17/2021
901583	EXA Signal Analyzer	Agilent	N9010A	MY51250846	7/18/2021

**Test Personnel:**

Jon Wilson		July 5, 2021
EMC Test Engineer	Signature	Date of Test

### 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. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

#### OBW Data, DWS-LL V6

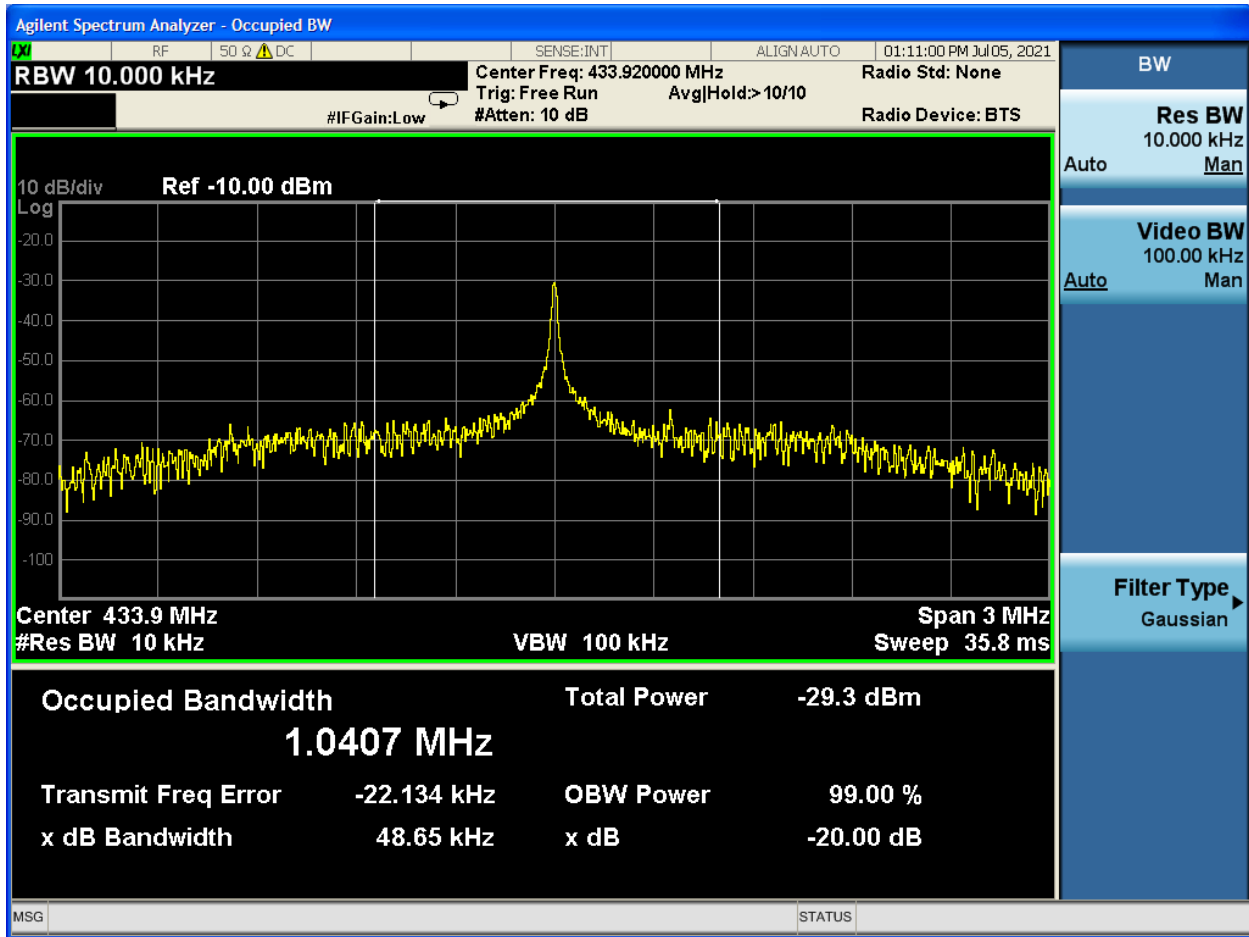
OBW 99% (kHz)	OBW 20 dB (kHz)	Limit (kHz)	Result (Pass / Fail)
1040.7	48.65	1084.8	Pass

Limit = 433.92 MHz \* 0.25% = 1.0848 MHz = 1084.8 kHz

OBW 99% = 1040.7 kHz

OBW 20 dB = 48.65 kHz

Plot: OBW 20 dB and 99%




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**

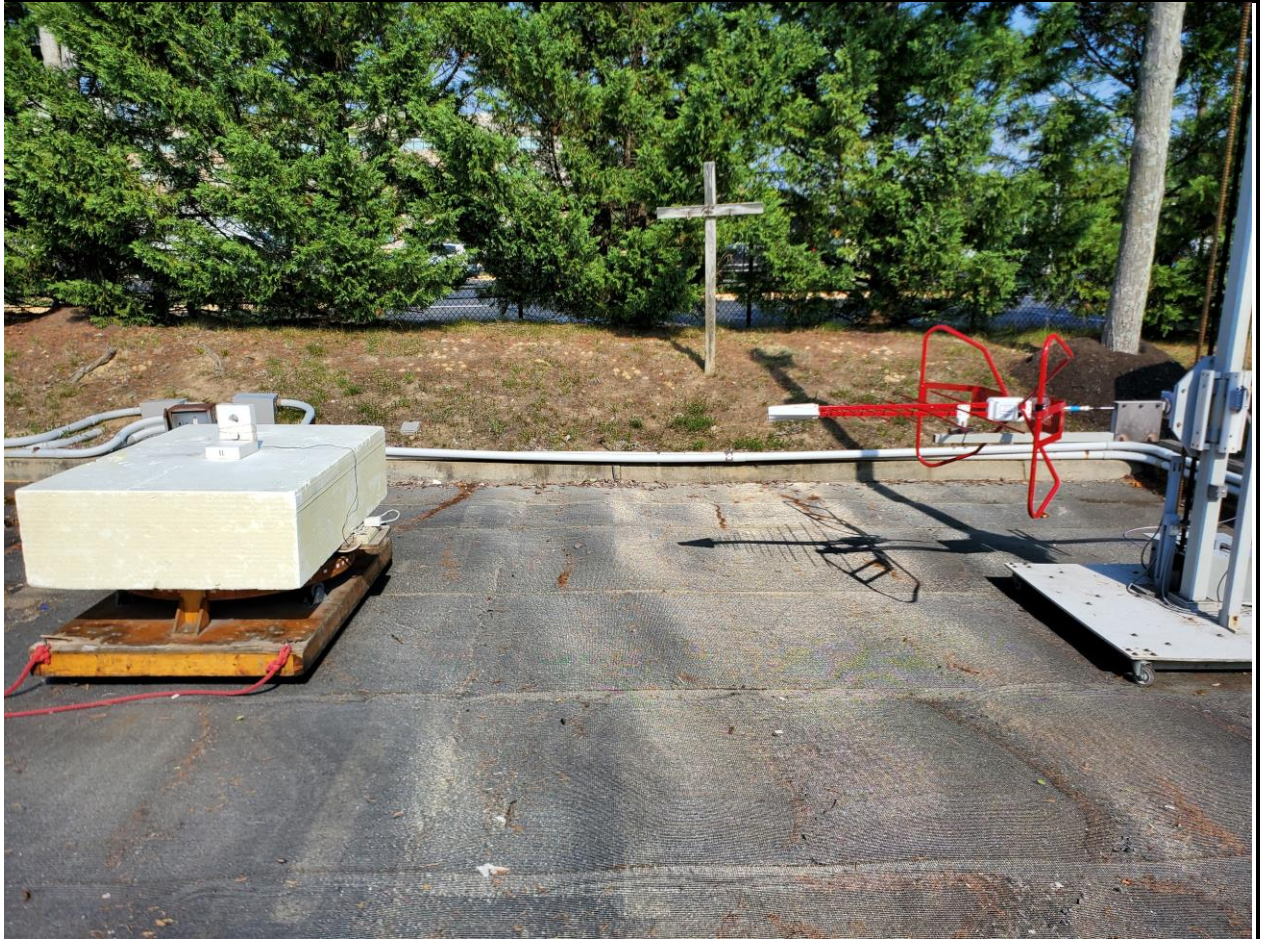
RTL Asset #	Part Type	Manufacturer	Model	Serial Number	Calibration Due Date
901583	EXA Signal Analyzer	Agilent	N9010A	MY51250846	7/18/2021

**Test Personnel:**

Jon Wilson		July 1, 2021
EMC Test Engineer	Signature	Date of Test

### Test Configuration Photographs

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





**Photograph: Radiated Emission, Above 1 GHz**



**Photograph: Radiated Emission, Close**

