RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.231 Test Data

433.92 MHz Sensor

Model: 56-0098-03 RevA00
And RE361

for

Resolution Engineering, Inc.
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: 2018013

March 27, 2018

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.

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 Resolution Engineering. No average data is presented in this report. Data is also presented for spurious, non-harmonic radiated emissions per 15.209. The Equipment Under Test (EUT) was the **433.92 MHz 56-0098-03 RevA00 Sensor (RTL Bar Code 22686) (CW)** and **433.2 MHz RE361 Sensor (RTL Bar Code 22873) (CW)**.

Test Procedure

Radiated fundamental and spurious emissions were tested at three meters. 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 Harmonics Emissions Test Data – Peak: 56-0098-03 RevA00

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)
433.92	PK	H	106.0	-8.6	97.4	100.8	-3.4
867.84	PK	H	62.5	-16.6	45.9	80.8	-34.9
1301.76	PK	H	69.9	-11.1	58.8	74.0	-15.2
1735.68	PK	H	50.0	-8.0	42.0	80.8	-38.8
2169.60	PK	H	51.1	-17.1	34.0	80.8	-46.8
2603.52	PK	H	55.5	-15.1	40.4	80.8	-40.4
3037.44	PK	H	49.4	-12.8	36.6	80.8	-44.2
3471.36	PK	H	55.3	-11.5	43.8	80.8	-37.0
3905.28	PK	H	39.9	-10.3	29.6	74.0	-44.4
4339.20	PK	H	46.2	-13.2	33.0	74.0	-41.0

All spurious emissions in the applicable frequency range were investigated; only harmonic emissions were present as noted above.

15.231 Radiated Spurious Harmonics Emissions Test Data – Peak: RE361

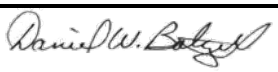
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.92	PK	V	100.7	-1.4	99.3	100.8	-1.5
867.84	PK	V	53.6	3.3	56.9	79.3	-22.4
1301.76	PK	H	58.5	-12.0	46.5	74.0	-27.5
1735.68	PK	H	50.9	-8.0	42.9	80.8	-37.9
2169.60	PK	H	53.6	-4.7	48.9	80.8	-31.9
2603.52	PK	H	57.4	-11.3	46.1	80.8	-34.7
3037.44	PK	H	57.3	-8.8	48.5	80.8	-32.3
3471.36	PK	H	59.1	-8.7	50.4	80.8	-30.4
3905.28	PK	V	51.1	-7.4	43.7	74.0	-30.3
4339.20	PK	H	50.5	-6.6	43.9	74.0	-30.1

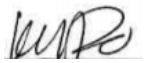
All spurious emissions in the applicable frequency range were investigated; only harmonic emissions were present as noted above.

Radiated Emissions Test Equipment

RTL Bar Code	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20’	NA	8/18/18
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36”	NA	8/18/18
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	2/06/20
901135	Par Electronics	400-512 (25W)	UHF Notch Filter	N/A	8/21/18
900811	Rhein Tech Laboratories, Inc.	PR-1040	Amplifier (20 MHz – 2 GHz)	900811	8/18/18
900932	Hewlett Packard	8449B OPT H02	Amplifier (1-26.5 GHz)	3008A00505	8/18/18
901669	ETS-Lindgren	3142E	Biconilog Antenna (30 MHz – 6000 MHz)	00166065	2/18/19
900772	EMCO	3161-02	Horn Antenna 2 - 4 GHz	9804-1044	4/9/18
900321	EMCO	3161-03	Horn Antenna 4.0-8.2 GHz	9508-1020	4/9/18

Test Personnel:

Dan Baltzell		January 22, 2018
Test Engineer	Signature	Date of Test

Khue Do		March 15, 2018
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
Timing correction	FCC 15.35(b)	RSS-Gen Issue 4 6.10
Restricted Band	FCC 15.205	RSS-Gen Issue 4 8.10
General Field Strength	FCC 15.209	RSS-Gen Issue 4 8.9
Bandwidth	FCC 15.231(c)	RSS-210 Issue 9 A1.3

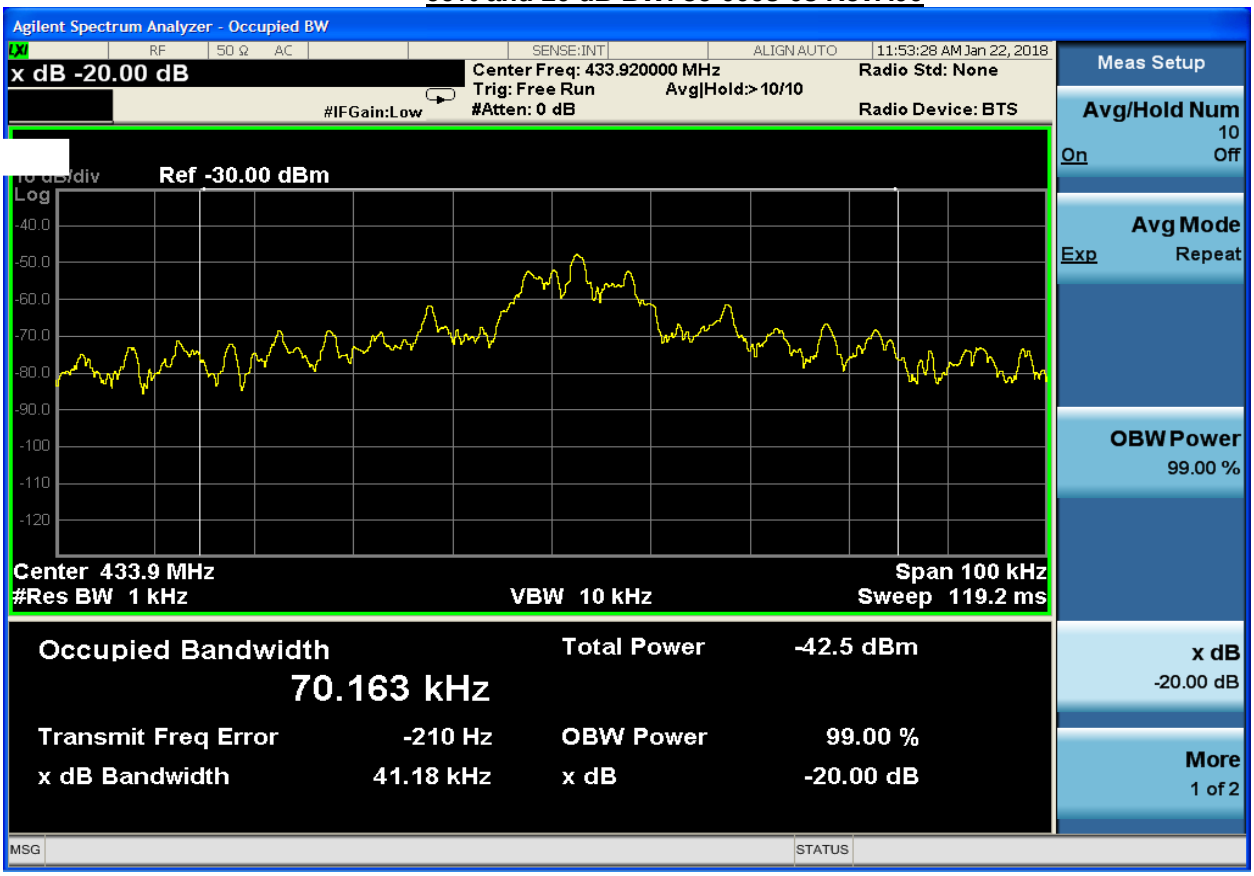
Occupied Bandwidth

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

56-0098-03 RevA00:

433.92 MHz * 0.25% = 1085 kHz = Limit
99% Bandwidth is 70.163 kHz
20 dB Bandwidth is 41.18 kHz

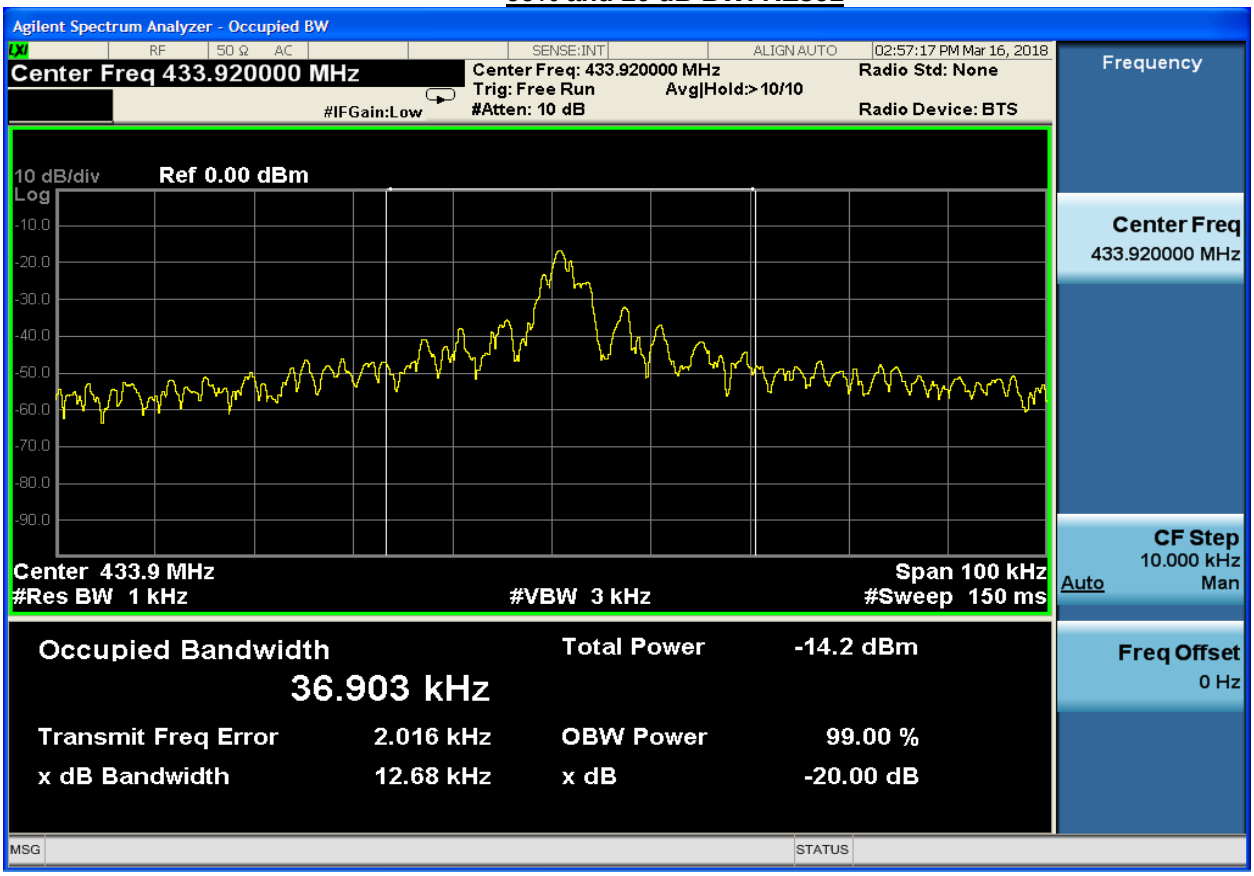
99% and 20 dB BW: 56-0098-03 RevA00



RE361

433.92 MHz * 0.25% = 1085 kHz = Limit
99% Bandwidth is 36.90 kHz
20 dB Bandwidth is 12.68 kHz

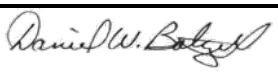
99% and 20 dB BW: RE361

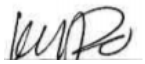


Occupied Bandwidth Test Equipment

RTL Bar Code	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	2/06/20

Test Personnel:

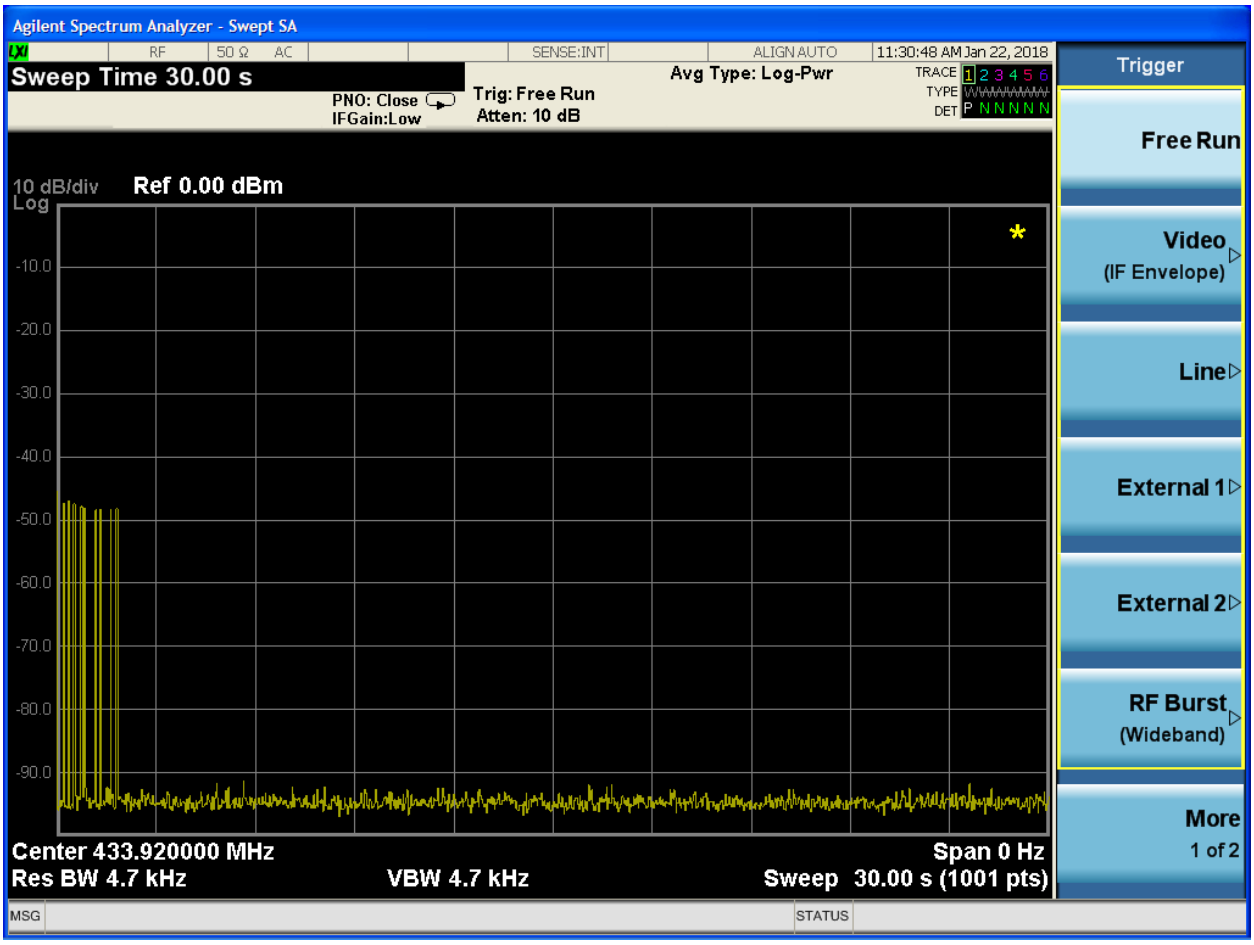
Dan Baltzell		January 22, 2018
Test Engineer	Signature	Date of Test

Khue Do		March 16, 2018
Test Engineer	Signature	Date of Test

Transmitter Deactivation

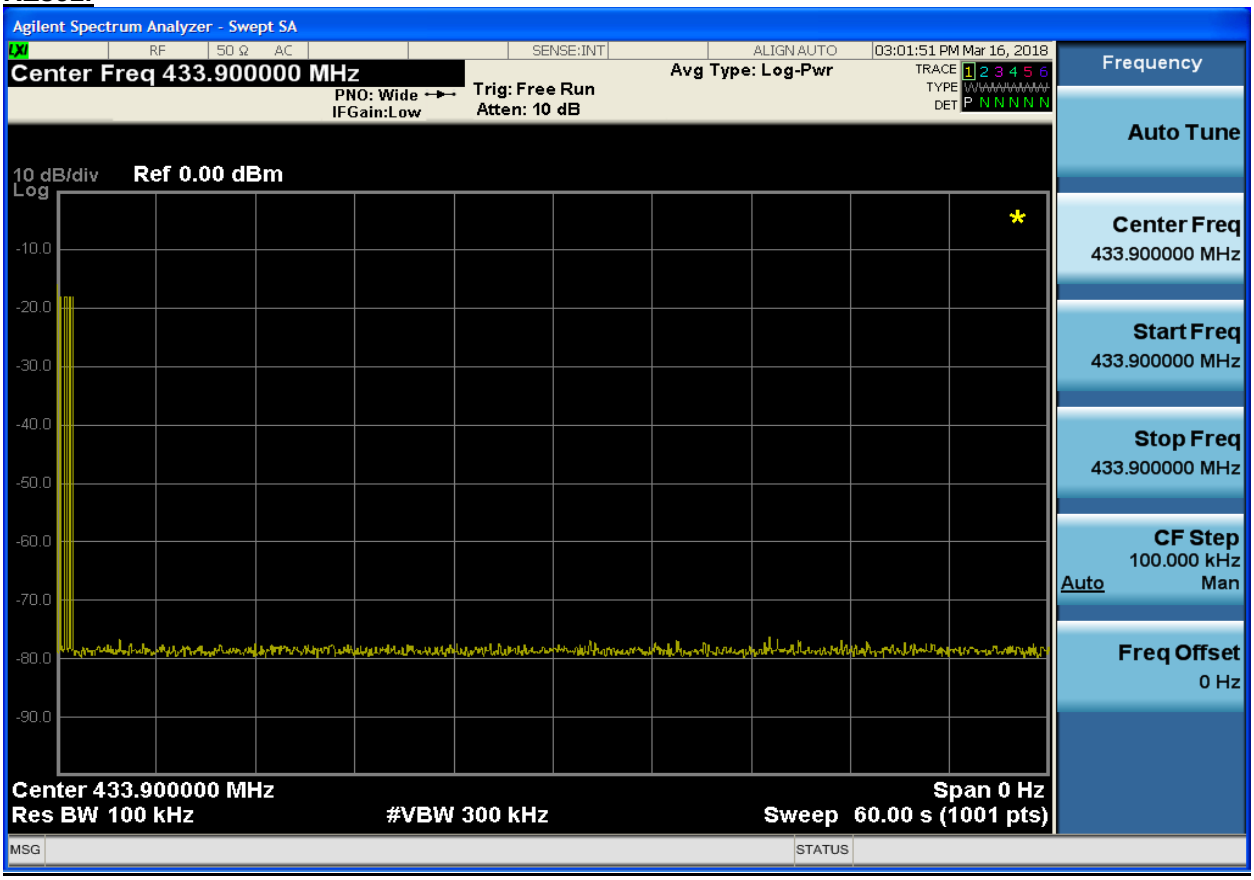
15.231(a)
(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

56-0098-03 RevA00:



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.

RE361:



Test Equipment

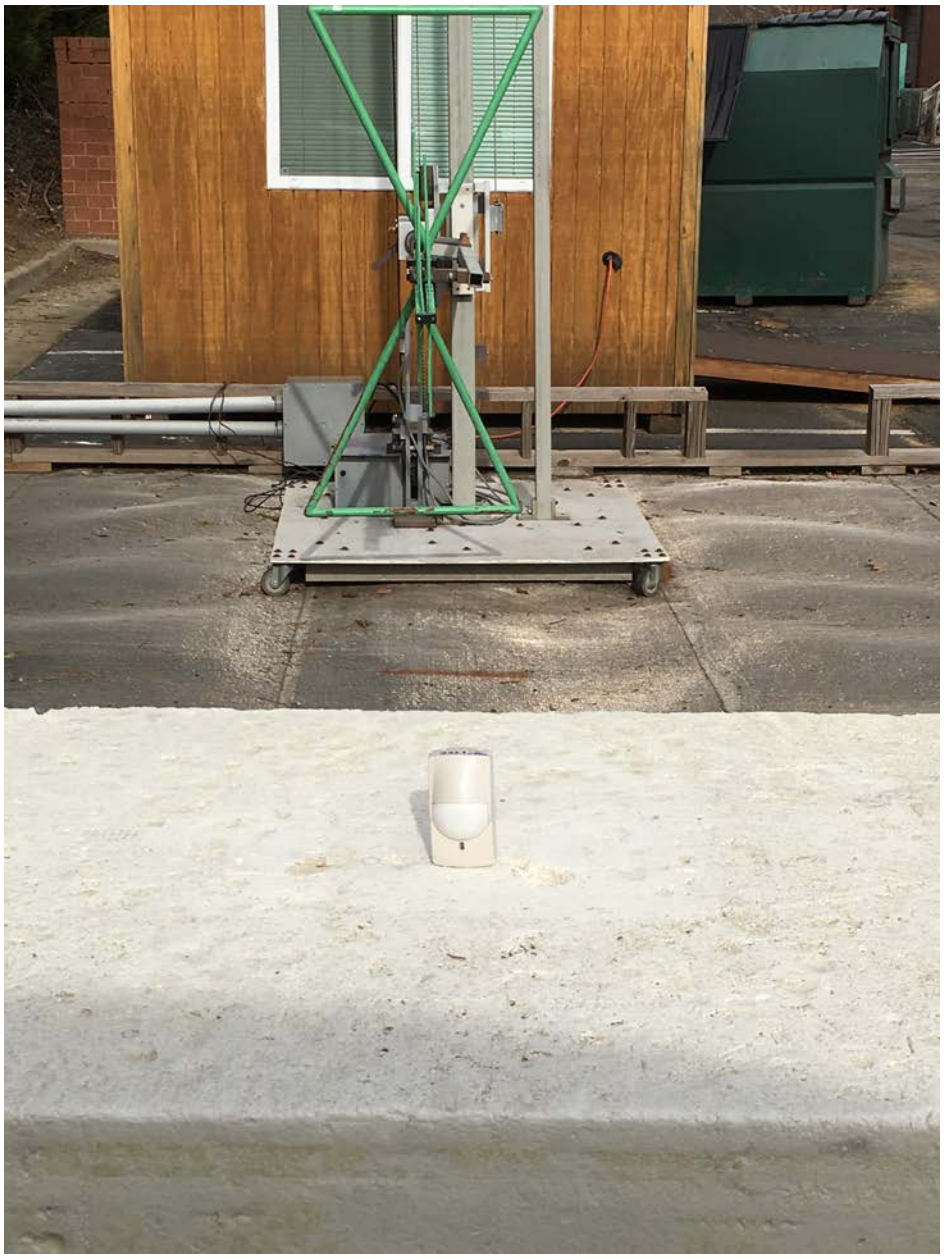
RTL Bar Code	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	N9010A	EXA Signal Analyzer (10 Hz-26.5 GHz)	MY51250846	2/06/20

Test Personnel:

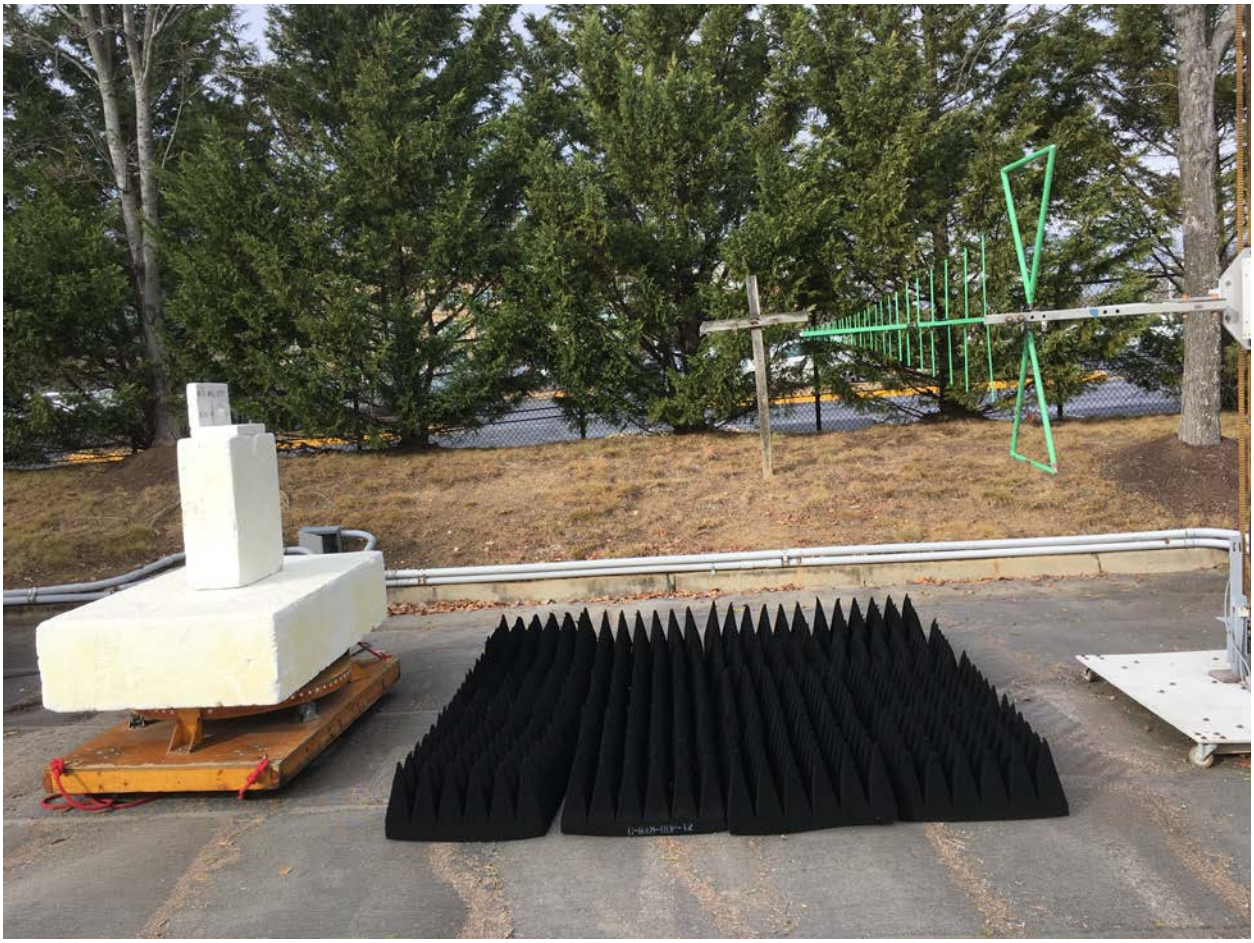
Dan Baltzell		January 22, 2018
Test Engineer	Signature	Date of Test

Khue Do		March 16, 2018
Test Engineer	Signature	Date of Test

Appendix A: Test Configuration Photographs



Radiated Emissions (Less Than 1 GHz)



Radiated Emissions (Greater Than 1 GHz)