Testing Tomorrow's Technology

Application

For

Permissive Change:

Title 47 USC Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, Paragraphs 15.207 and 15.209

And

Industry Canada, Radio Standards Specifications: RSS Gen Issue 4 and RSS-210 Issue 8

For the

Radio Systems

Model: 300-3078

FCC ID: KE3-3001070
IC: 2721A-3001070

UST Project: 15- 0197
Issue Date: August 3, 2015

Total Pages in This Report: 18

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Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date August 3, 2015

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Radio Systems

MODEL: 300-3078

FCC ID: KE3-3001070

IC: 2721A-3001070

DATE: August 3, 2015

This report concerns (check one): Original grant
Class II change [X]

Equipment type: 18.7 khz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: _____N/A_____
date

agrees to notify the Commission by N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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Alpharetta, GA 30004

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning changes made to this product and the continued suitability of this product to meet the FCC Rules and Regulations Part 15, Section 207 and 209, and IC RSS 210 Issue 8.

The change involves adding an additional alarm circuit to the device. The additional alarm circuit addition required that the main PCB be laid out differently; however none of the RF circuits were changed. Only small portions of the digital circuits were rearranged for the additional circuit. Please see the newly submitted schematics for details.

Based on the changes above, the sample was retested for compliance to 15.209 and 15.207 to ensure that the radio continues to comply. The test results are presented in this report.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on July 16, 2015 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Radio Systems Model 300-3078. The 300-3078 transmitter is designed to transmit a signal through an internal wire-wound antenna as part of pet containment system. It produces a signal that communicates with your pet's collar unit to keep your pet confined to the desired area. The signal is delivered from the transmitter through loop inductive antennas which can cover a wide distance. The EUT operates at 18.7 kHz and utilizes OOK modulation.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2009 and ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* for FCC subpart A Digital equipment Verification requirements and per *ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for FCC subpart C Intentional Radiators.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

a) Certification under section 15.207 and 15.209 as a transmitter.
b) Verification under 15.101 as a digital device.

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (Parts 15.107 and 15.109) for the EUT is included herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID:	CABLES P/D
Stay and Play Radio Systems Corp (EUT)	300-3078	Engineering Sample	KE3-3001070/ 2721A-3001070	2 m U P
Power Supply Radio Systems Corp	ITC-24V1.5C	Engineering Sample	None	2 m U P
Pet Collar PetSafe	300-1114	Engineering Sample	None	None
Antenna See antenna details	--	--	--	--

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2747A05665	5/7/2015
PRE-AMPLIFIER LF	8447D	HEWLETT-PACKARD	1937A02980	RA104
BICONICAL ANTENNA	3110B	EMCO	9306-1708	11/24/2014 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	7/8/2014 2 yr
LISN	9247-50-TS-50-N	SOLAR ELECTRONICS	955824 and 955825	12/30/2014
6 db Attenuator	65-6-34	WEINSCHEL	LL910	12/16/2014

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were necessary for the EUT to meet the applicable requirements of 15.209 and 15.207.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

The EUT operates at 18.7 kHz, only.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG) the duty cycle factor calculated will be applied.

2.6 EUT Antenna Requirements (CFR 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna 1	Radio Systems	Integral Loop Antenna	Engineering Sample	*	Integral Loop Antenna

Note: *See included Antenna Schematics.

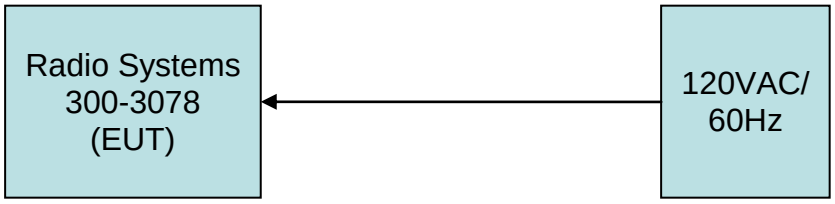

Figure 1. Block Diagram of Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated Harmonics and other Spurious Emissions are examined for this requirement; see paragraph 2.1.

2.8 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

The EUT is powered by AC power 120/60 Hz. Power line conducted emissions testing was performed to ensure that the EUT is still in compliance. The EUT was tested with the field level set to High and dial at 4. The system continues to meet the applicable requirements for CFR 15.207. These measurements were completed while the EUT was connected to 120VAC/60Hz. Results are displayed along with the 15.107 power line test data in the sections below.

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, (IC RSS 210))

Radiated Radio measurements: A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product. To obtain the worst case results, the EUT was placed on the table top of a non-conductive table, 80 cm above the ground floor. The EUT was positioned 3 meters away from the

receiving antenna during testing. The EUT was tested in the configuration that represented normal operation, upright on the table top. Radiated measurements below 30 MHz were tested with a RBW = 9 kHz; emissions below 1 GHz were tested with a RBW = 120 kHz and radiated measurements above 1 GHz were measured using a RBW =1 MHz. VBW was set to three times the RBW value.

The test data is detailed below for this section. For radiated emissions, any emission that was greater than 20 dB from the applicable limit was not recorded. If radiated emissions were measured at a distance of 1 meter, the measured value at 1 meter was extrapolated to the results at 3 meters using an inverse distance extrapolation factor of -20 dB/decade.

2.10 99% Occupied Bandwidth (IC RSS 210, A8.1)

These measurements were performed while the EUT was in a constant transmit mode. A method similar to the marker delta method was used to capture the points. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 7 and Figure 2.

Table 5. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (kHz)	99% Occupied Bandwidth (kHz)
18.7	2.24

Note: from original test report, test date: February 13, 2012

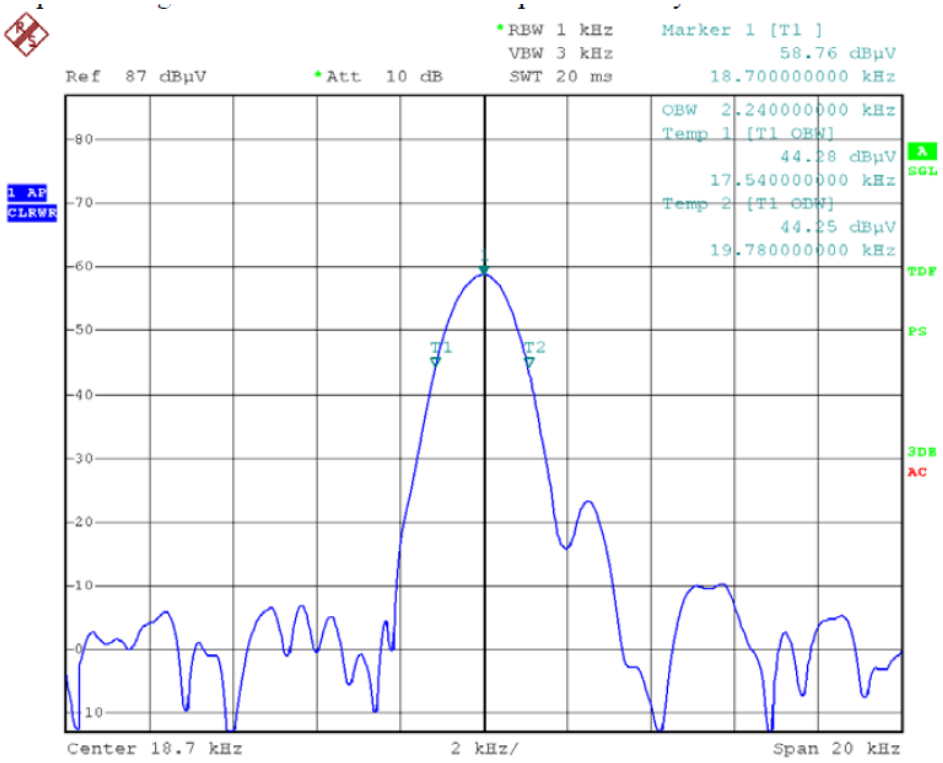

Figure 2. 99% Bandwidth

2.11 Unintentional/Intentional Radiator, Power line Emissions (CFR 15.107 and 15.207)

The power line conducted voltage emissions measurements have been carried out in accordance with CFR 15.107, per ANSI C63.4:2009 and ANSI C63.4:2013, Paragraph 7, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission. The worst case measurement occurred on the Phase line at 0.5823 MHz. The emission level was 8.4 dB from the applicable limit. All other emissions were at least 9.7 dB from the limit. Those results are given in the table following.

Table 6. Transmitter Power Line Conducted Emissions Test Data, (15.107 and 15.207)

150 KHz to 30 MHz with Class B Limits						
Test: Power Line Conducted Emissions				**Client:** Radio Systems		
Project: 15-0197				**Model:** 300-3078		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
120 VAC, 60 Hz Phase						
0.1521	54.80	1.40	56.20	*65.9	9.7	**PK**
0.1521	32.00	1.40	33.40	55.9	22.5	**AVG**
0.5823	37.30	0.26	37.56	46.0	8.4	**PK**
1.0520	30.50	0.26	30.76	46.0	15.2	**PK**
8.3800	27.60	0.46	28.06	50.0	21.9	**PK**
16.6200	32.70	0.51	33.21	50.0	16.8	**PK**
21.6700	30.60	0.57	31.17	50.0	18.8	**PK**
120VAC, 60 Hz Neutral						
0.1577	52.50	1.40	53.90	*65.6	11.7	**PK**
0.1577	19.10	1.40	20.50	55.6	35.1	**AVG**
0.5623	31.90	0.24	32.14	46.0	13.9	**PK**
1.0560	27.80	0.26	28.06	46.0	17.9	**PK**
8.3850	31.30	0.43	31.73	50.0	18.3	**PK**
18.0200	32.00	0.46	32.46	50.0	17.5	**PK**
20.7800	30.30	0.52	30.82	50.0	19.2	**PK**

Note: (*) Indicates that the limit used is Quasi-Peak (QP)

SAMPLE CALCULATION at .1521 MHz:

Magnitude of Measured Frequency	54.80	dBuV
+ Cable Loss+ LISN Loss	1.40	dB
=Corrected Result	56.20	dBuV
Limit	*65.90	dBuV
-Corrected Result	56.20	dBuV
Margin	9.7	dB

Test Date: July 27, 2015
Tested By
Signature: Name: Robert Nevels

2.12 Unintentional/Intentional Radiator, Radiated Emissions (CFR 15.109 and 15.209)

Radiated emissions disturbance Measurements were performed with EUT in constant transmit mode and using an instrument having both peak and quasi-peak detectors over the frequency range of 9 kHz to 1 GHz. Measurements of the radiated emissions were made with the receiver antenna at a distance of 3 m from the boundary of the test unit.

The test antenna was varied from 1 m to 4 m in height while watching the analyzers' display for the maximum magnitude of the signal at the test frequency. The antenna polarization (horizontal or vertical) and test sample azimuth were varied during the measurements to find the maximum field strength readings to record.

Note: measurements were not retested below 30 MHz.

The worst-case radiated emission in the range of 30 MHz to 1 GHz was 3.8 dB below the limit at 70.9200 MHz. This signal is found in the table following. All other radiated emissions were 5.0 dB or more below the limit.

Table 7. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109, 15.209), 30 MHz to 1000 MHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** Radio Systems			
Project: 15-0197				**Model:** 300-3078			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or QP**
37.88	49.30	-15.73	33.57	40.0	3m./VERT	6.4	**PK**
49.21	46.60	-16.64	29.96	40.0	3m./VERT	10.0	**QP**
58.73	49.10	-17.07	32.03	40.0	3m./VERT	8.0	**QP**
65.11	50.30	-17.67	32.63	40.0	3m./VERT	7.4	**PK**
70.65	51.50	-18.00	33.50	40.0	3m./VERT	6.5	**PK**
114.37	53.00	-14.53	38.47	43.5	3m./VERT	5.0	**PK**
135.38	47.70	-12.87	34.83	43.5	3m./VERT	8.7	**PK**
58.40	44.10	-17.17	26.93	40.0	3m./HORZ	13.1	**QP**
70.92	53.50	-17.30	36.20	40.0	3m./HORZ	3.8	**PK**
72.35	50.90	-17.30	33.60	40.0	3m./HORZ	6.4	**PK**
86.96	49.60	-17.05	32.55	40.0	3m./HORZ	7.5	**PK**
115.2700	49.70	-14.73	34.97	43.5	3m./HORZ	8.5	**PK**
132.3800	44.60	-13.27	31.33	43.5	3m./HORZ	12.2	**PK**
599.9700	32.60	-1.90	30.70	46.0	3m./HORZ	15.3	**PK**
398.8200	33.10	-7.62	25.48	46.0	3m./VERT	20.5	**PK**

Tested from 30 MHz to 1 GHz

SAMPLE CALCULATION at 37.88 MHz:

Magnitude of Measured Frequency	49.30	dBuV
+ Cable Loss+ LISN Loss	-15.73	dB
=Corrected Result	33.57	dBuV
Limit	40.00	dBuV
-Corrected Result	33.57	dBuV
Margin	6.4	dB

Test Date: July 28, 2015
Tested By
Signature: Name: Robert Nevels

2.13 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.13.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.78 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.

2.13.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.39 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.18 dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty. Therefore, the EUT conditionally meets this requirement.