



Testing Tomorrow's Technology

**Application
For**

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

**Innovation, Science, and Economic Development Canada
Certification Per
IC RSS-Gen General Requirements for Radio Apparatus
And
RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems
(FHSs) and License-Exempt Local Area Network (LE-LAN) Devices**

For the

Radio Systems Corp.

**SportDog TEK 2.0 GPS Unit
Model Number: SDT52-14790**

**FCC ID: KE3-3002862
IC: 2721A-3002862**

**UST Project: 20-0028
Issue Date: April 10, 2020**

Total Pages: 25

**3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
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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: April 10, 2020



NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Radio Systems Corp.
MODEL: SDT52-14790
FCC ID: KE3-3002862
IC: 2721A-3002862
DATE: April 10, 2020

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

Equipment type: 900 MHz 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:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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FCC Agency Agreement	External Photo(s)
Application Forms	FCC to IC Cross Reference
Letter of Confidentiality	Permissive Change Letter
Equipment Label(s)	Block Diagram(s)
IC Agency Agreement	Schematic(s)
Canadian Rep Letter	Internal Photograph(s)
Test Configuration Photograph(s)	Original Grants

1 General Information

1.1 Purpose of this Report

The purpose of this report is to file for a Class II Permissive Change for the following reason:

- The microcontroller and GPS module in the non-transmitter portion of the PCB has been updated to the following: Microcontroller changed from Microchip Technology/PIC18F67J94 to Cypress/CY8C2447, GPS changed from Fastrax/IT530 to Ublox/ZOE-M8Q.
- The edge plating has been removed to improve manufacturability. This change does not affect the radio section.
- SAW filters were removed from the radio section to reduce cost. The removal of the filters do not impact the operating frequency or channel output power. These parameter remain identical to the original submittal.

No other hardware changes have been made to the product. The changes described in this filing result in the same RF characteristics as in the original filing and all other original test results continue to be representative of and applicable to this equipment.

Based on the changes outline above the following tests were performed:

1. Output Power
2. Intentional Spurious emissions CFR 15.247
3. Band Edge measurements CFR 15.247
4. Intentional Spurious emissions CFR 15.209

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on February 10, 2020 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Radio Systems Corp. SportDog Tek 2.0 GPS Unit, Model: SDT52-14790. It is a collar device designed for pets that transmits GPS location to the SportDog Tek 2.0 Handheld Unit. The EUT is designed to operate in the US, Europe, Australia and New Zealand. In the US, the device operates in the bands 915.0125 MHz to 916.2375 MHz using FHSS transmission technology and GFSK modulation to communicate with the SportDog Tek 2.0 Handheld Unit.

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Marketing Name:	Sport Dog Tek 2.0 GPS Collar
Model:	SDT52-14790
Frequency Range:	915.0125 – 916.2375 MHz
Number of Channels:	50
Modulation:	GFSK
Antenna:	1 dBi whip antenna, non-detachable

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC Part 15 subpart B and C and per FCC KDB Publication number 558074 v05r02 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated verification emissions data (FCC 15.107 and 109) below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 following. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions 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.

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1.6 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

- a) Certification of the transmitter incorporated within the EUT, see test data presented herein.
- b) Verification as a digital device under Part 15 Subpart B.

Table 1. EUT and Peripherals

EUT MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
SportDog Tek 2.0 GPS Unit Radio Systems, Inc	SDT52- 14790	Engineering Sample	FCC ID: KE3-3002862 IC: 2721A-3002862	-
PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Switch mode power supply adapter Radio Systems Corp.	F5V-3.1C- 2U	Production Sample	N/A	P/U/D

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

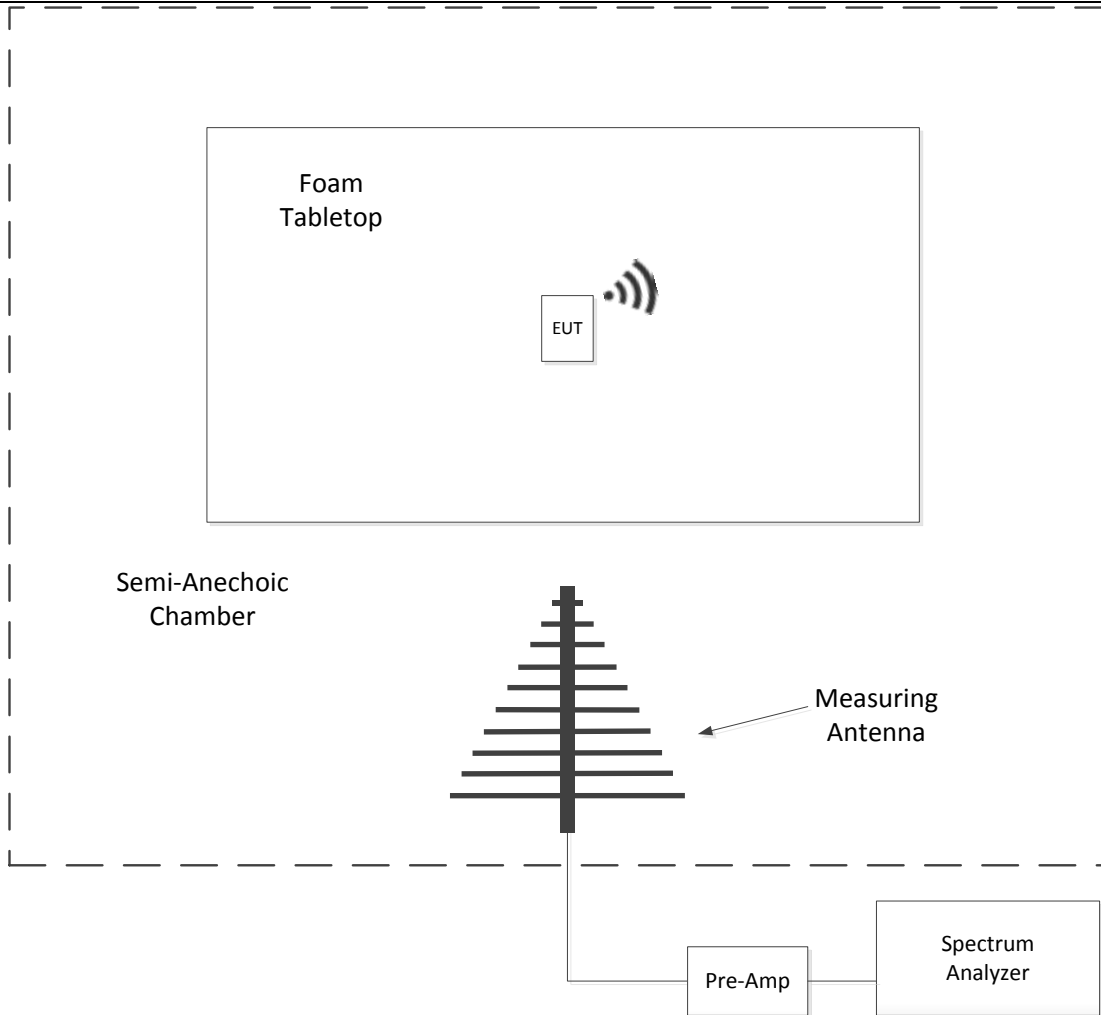


Figure 1. Block Diagram of Test Configuration

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2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/7/2020
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	4/8/2020
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/7/2021
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/1/2021
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr
HIGH PASS FILTER	VHF-1320 15542	MICROWAVE CIRCUITS	30843	4/2/2020

Note 1: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

Note 2: All testing conducted before April 2020.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (CFR 15.31(m), RSS-Gen 6.8)

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 as follows:

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

Because the EUT operates over less than 10 MHz therefore 2 frequencies were investigated.

2.4 Frequency Range of Radiated Measurements (CFR 15.33, RSS-Gen 6.13)

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. In this case, the spectrum was investigated from 30 MHz to the 10th harmonic for purposes of Class 2 Permissive Change.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-Gen 6.9, 6.13)

The radiated and conducted emissions limits shown herein are based on the parameters listed 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.

2.6 Restricted Bands of Operation (Part 15.205, RSS-Gen 8.10)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these emissions cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement see paragraph 2.10.

2.7 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

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.

In this case the antenna is designed to be permanently attached to the EUT. This is the same as previously approved.

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2.8 Maximum Peak Conducted Output Power (CFR 15.247(b)(3), RSS-247 (5.4(d)))

The EUT was programmed to operate at a normal operating output power across the bandwidth. For this test the normal operating output power of the radio was set to 24 dBm via the test firmware.

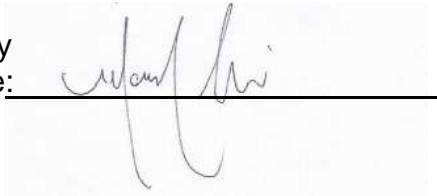
Peak power within the band 915.0125 MHz to 916.2375 MHz was measured per FCC KDB Publication 558074 v05r02. Antenna-port conducted tests were used to show compliance to the conducted emissions requirement. The final results are presented in the table below.

Table 4. Peak Antenna Conducted Output Power per Part 15.247 (b)(3)

Frequency of Fundamental (MHz)	P _{Cond}	(mW)	FCC Limit (mW Maximum)
915.0125	23.52	224.91	1000
916.2375	23.88	244.34	1000

Test Date: February 11, 2020

Tested By
Signature: _____



Name: Mark Afroozi

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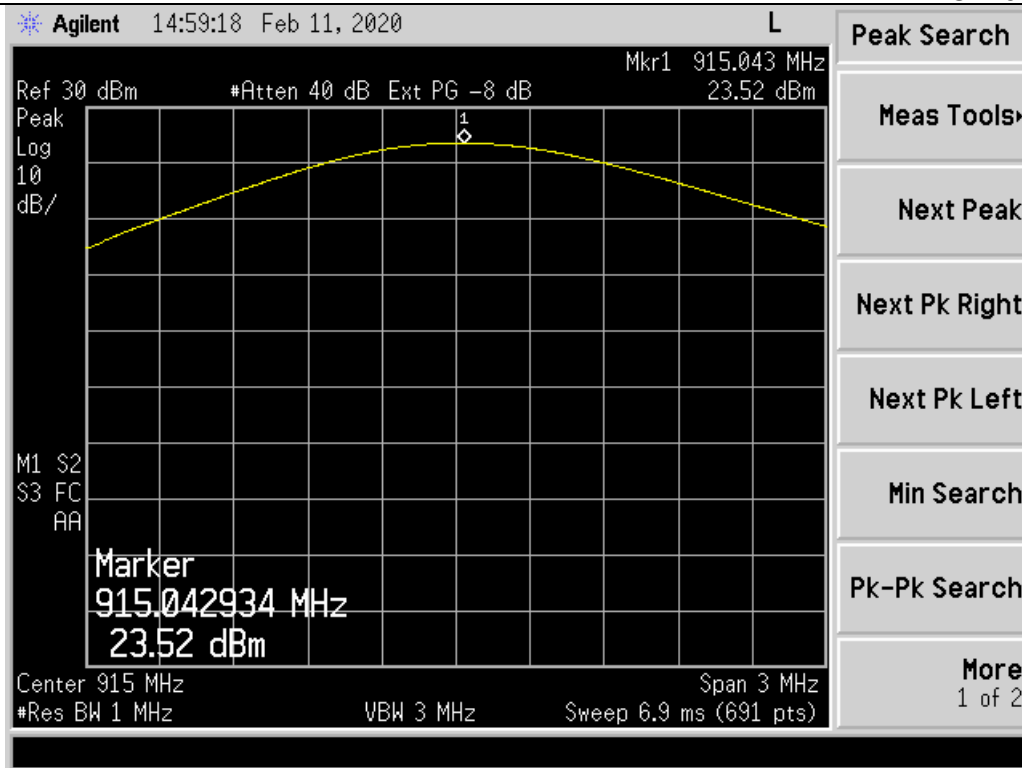


Figure 2. Peak Antenna Conducted Output Power, Low Channel

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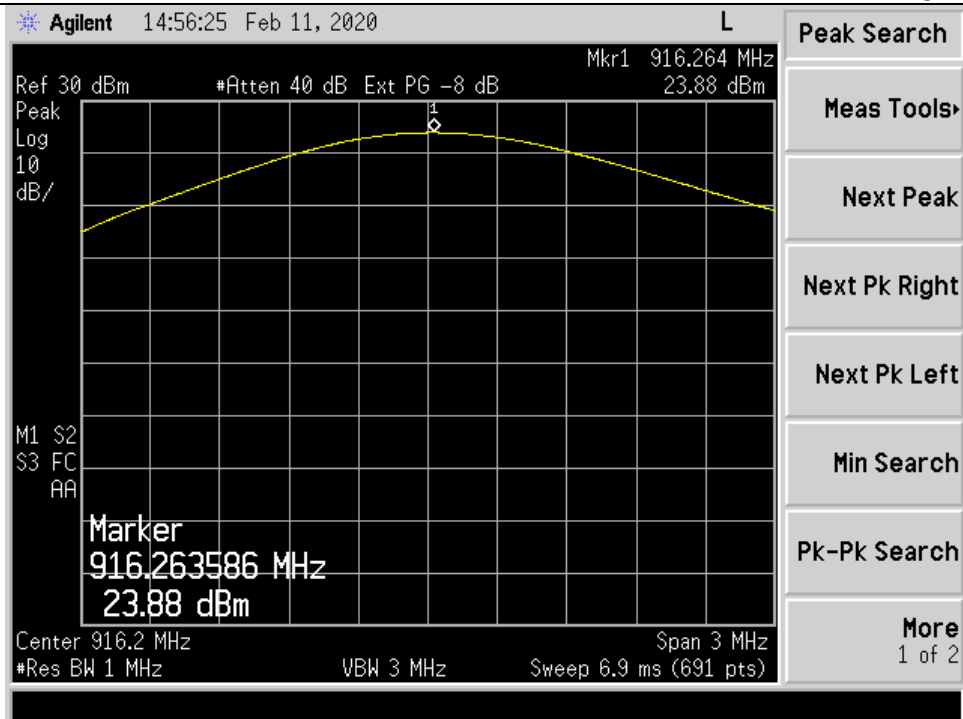


Figure 3. Peak Antenna Conducted Output Power, High Channel

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2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d), RSS-247 (5.2),(5.5))

On the test site, the EUT was mounted on top of a non-conductive table, 80 cm above the floor, by placing it in the X-Z plane along the Z axis with its bottom cover in parallel with the ground. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW $\geq 3 \times$ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 below.

For Average measurements above 1 GHz, the emissions were measured using an average detector or the duty cycle correction factor was applied to the Peak recorded value.

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Table 5. Peak Radiated Fundamental & Harmonic Emissions

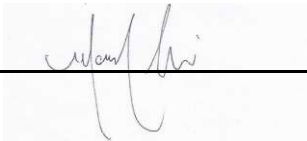
Frequency (MHz)	Test Data (dBuV)	Additional Factor	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector	
Tested By: MA		Test: FCC Part 15,247(d)			Client: Radio Systems, Inc				
		Project: 20-0028			Model: SDT52-14790				
Low Channel									
915.0125	93.12	--	25.69	118.81	--	3.0m./HORZ	--	PK	
2745.0400	54.27	--	-3.67	50.60	74.0	3.0m./HORZ	23.4	PK	
8235.1100	46.53	--	13.46	59.99	74.0	1.0m./VERT	14.0	PK	
High Channel									
916.2375	92.65	--	25.69	118.34	--	3.0m./HORZ	--	PK	
2748.7100	52.48	--	-3.77	48.71	74.0	3.0m./VERT	25.3	PK	
3664.9500	47.69	--	1.70	49.39	74.0	3.0m./HORZ	24.6	PK	
9162.3800	46.77	--	14.68	61.45	74.0	1.0m./HORZ	12.6	PK	

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2745.04 MHz:

Magnitude of Measured Frequency	54.27	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss - Amplifier Gain	-3.67	dB/m
Corrected Result	50.60	dBuV/m

Test Date: February 10, 2020

Tested By
 Signature: 

Name: Mark Afroozi

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Table 6. Average Radiated Fundamental & Harmonic Emissions

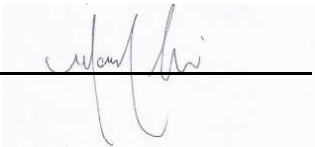
Frequency (MHz)	Test Data (dBuV)	Additional Factor	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
Low Channel								
915.0125	--	--	--	--	--	--	--	AVG
2745.0400	45.95	--	-3.67	42.28	54.0	3.0m./HORZ	11.7	AVG
8235.1100	31.08	--	13.46	44.54	54.0	1.0m./VERT	9.5	AVG
High Channel								
916.2375	--	--	--	--	--	3m./HORZ	--	AVG
2748.7100	43.74	--	-3.67	40.07	54.0	3.0m./HORZ	13.9	AVG
3664.9500	34.22	--	1.70	35.92	54.0	3.0m./HORZ	18.1	AVG
9162.3800	33.22	--	14.68	47.90	54.0	1.0m./HORZ	6.1	AVG

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2745.04 MHz:

Magnitude of Measured Frequency	45.95	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss - Amplifier Gain	-3.67	dB/m
Corrected Result	42.28	dBuV/m

Test Date: February 10, 2020

Tested By
 Signature: 

Name: Mark Afroozi

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2.10 Band Edge Measurements – (CFR 15.247(d), RSS-Gen 8.10)

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 v05r02 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW $\geq 1\%$ of the frequency span. In all cases, the VBW is set $\geq 3 \times$ RBW. See figures and calculations below for more detail.

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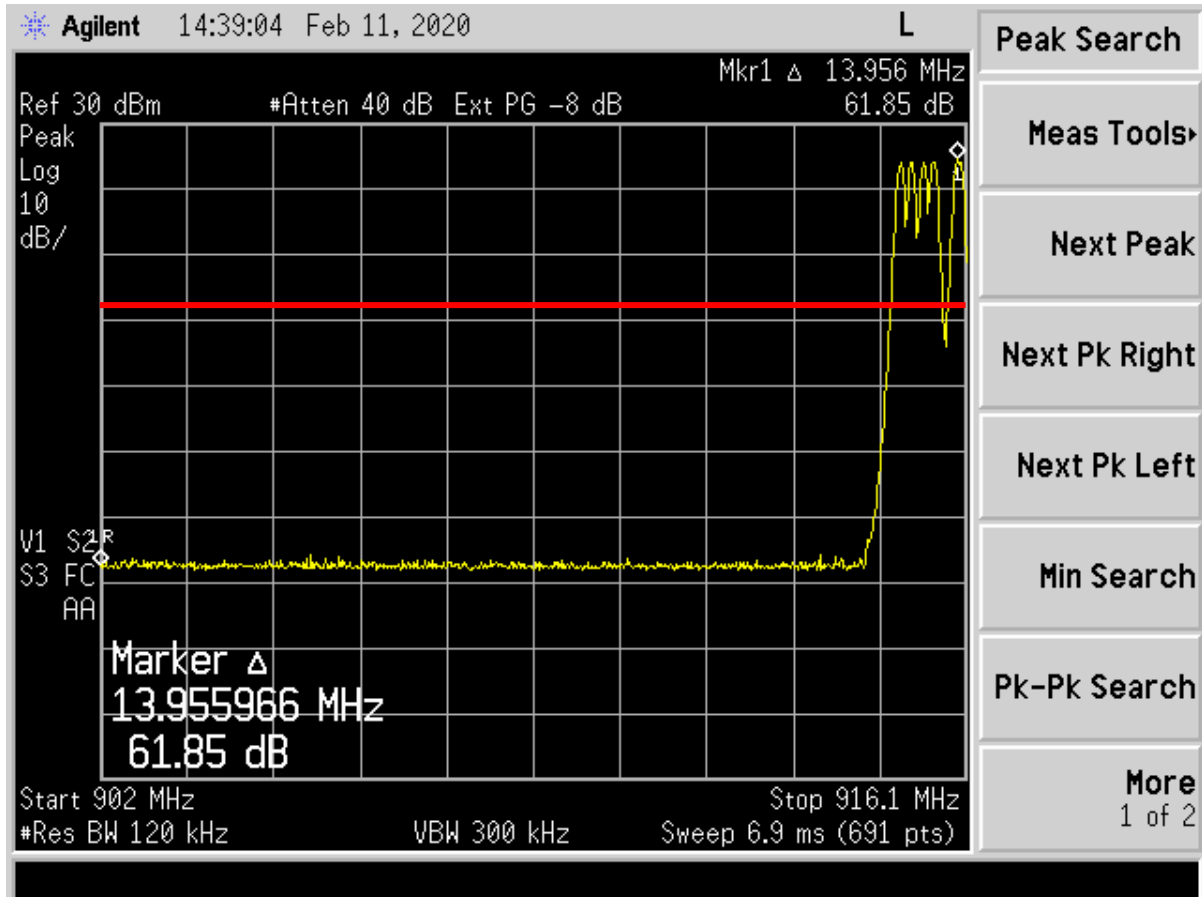
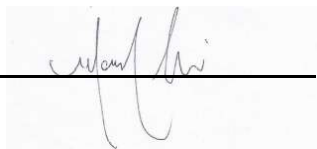


Figure 4. Band Edge Compliance – Low Channel Delta - Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	61.85	dB
Band Edge Limit	20.00	dB
Band Edge Margin	41.85	dB

Test Date: February 11, 2020

Tested By
 Signature: 

Name: Mark Afroozi

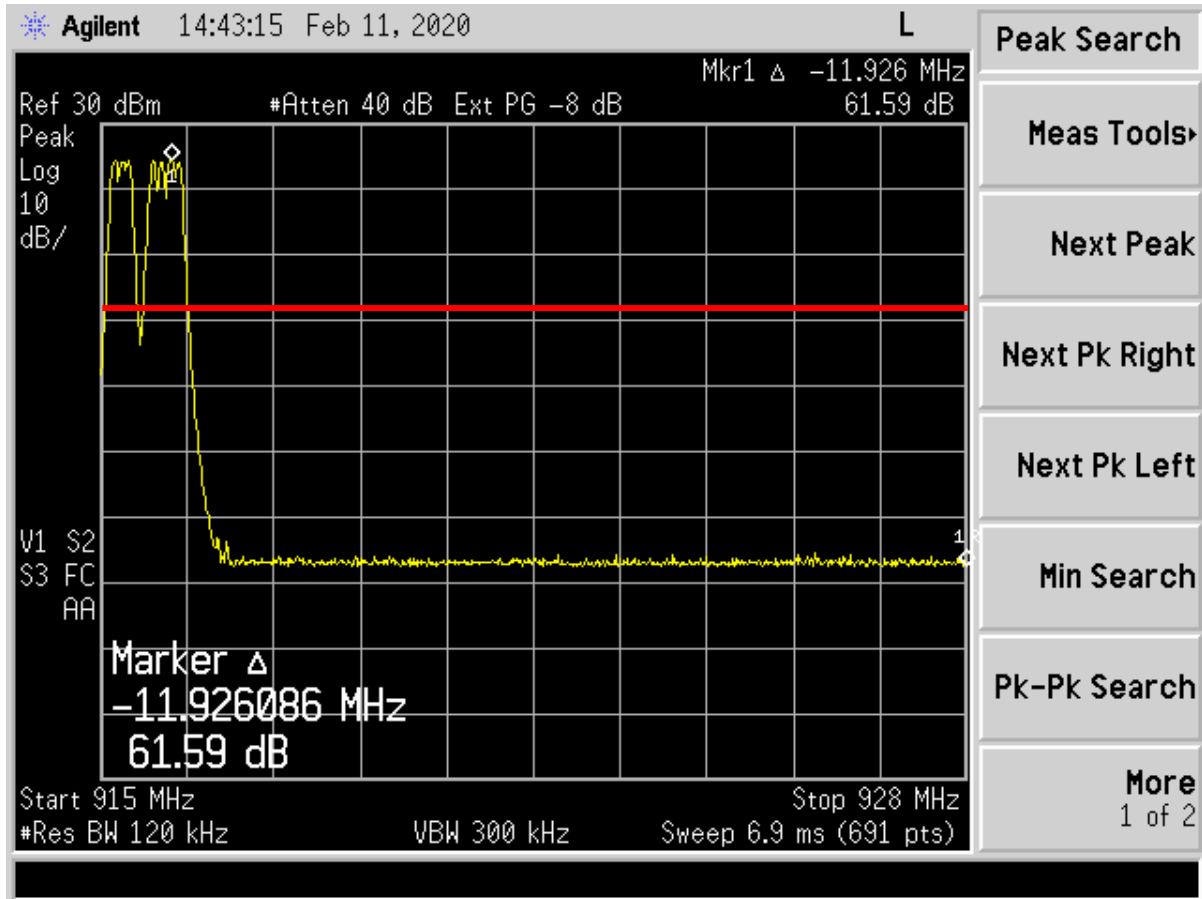
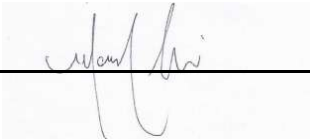


Figure 5. Band Edge Compliance – High Channel Delta - Peak

Higher band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	61.59	dB
Band Edge Limit	20.00	dB
Band Edge Margin	41.59	dB

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2.11 Unintentional Radiator and Intentional Radiator, Radiated Emissions (CFR 15.109, 15.209, RSS-Gen 8.9)

The test data provided herein is to support the verification requirement for radiated emissions coming from the EUT in a transmitting state per 15.209 and were investigated from 30 MHz to 10 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6. Data is presented in the table below.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The measurements were taken of the EUT transmitting at 915.0125 MHz, 915.6375 MHz and 916.2375 MHz. For this test, the output power of the radio was set to normal operating power.

No emissions were seen greater than ambient noise-floor levels beside intentional emissions from the fundamental and harmonics.

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

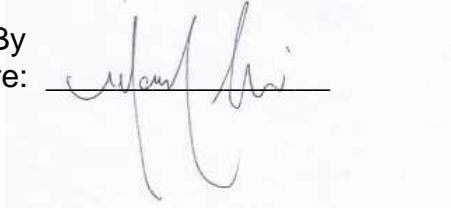
FCC Part 15/IC RSS Certification
 KE3-3002862
 2721A-3002862
 20-0028
 April 10, 2020
 Radio Systems Corp.
 SDT52-14790

Table 7. Spurious Radiated Emissions (30 MHz – 1 GHz)

Tested By: MA	Test: FCC Part 15,247(d)				Client: Radio Systems, Inc			
	Project: 20-0028				Model: SDT52-14790			
Frequency (MHz)	Test Data (dBuV)	Additional Factors	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
All emissions were more than 20 dB below the applicable limit.								

Test Date: February 11, 2020

Tested By
 Signature:



Name: Mark Afroozi

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

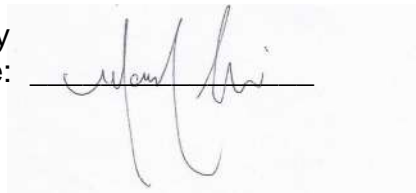
FCC Part 15/IC RSS Certification
 KE3-3002862
 2721A-3002862
 20-0028
 April 10, 2020
 Radio Systems Corp.
 SDT52-14790

Table 8. Spurious Radiated Emissions (1 GHz – 10 GHz)

Tested By: MA	Test: FCC Part 15,247(d)				Client: Radio Systems, Inc			
	Project: 20-0028				Model: SDT52-14790			
Frequency (MHz)	Test Data (dBuV)	Additional Factors	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
All emissions were more than 20 dB below the applicable limit.								

Test Date: February 11, 2020

Tested By
 Signature:



Name: Mark Afroozi

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15/IC RSS Certification
KE3-3002862
2721A-3002862
20-0028
April 10, 2020
Radio Systems Corp.
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2.12 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of $k=2$ was used to give a level of confidence of approximately 95%.

2.12.1 Conducted Emissions Measurement Uncertainty

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

2.12.2 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 ± 5.3 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 ± 5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.1 dB.

3 Test Results

The EUT is deemed to have met the requirements of the standards cited within the test report when tested as detailed in the present test report.