FCC Part 15.247 & IC RSS-247 Certification Report

Test Lab:	Applicant:
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FCC ID: **IC:**	SP8-FAP5015025 9568A-FAP5015025	**Test Report Date**	July 25, 2017
Platform	N/A	**RTL Work Order Number**	2017026
Model #	FAP5015-025	**RTL Quote Number**	QRTL17-026A
American National Standard Institute	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
FCC Classification	DTS – Part 15 Digital Transmission System		
FCC Rule Part(s)	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz (10-01-2016)		
IC Rule Part(s)	RSS-247 Issue 2-2017: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices		

Frequency Range (MHz)	Output Power (W)*	Frequency Tolerance	Emission Designator
903 – 927	0.039	N/A	537KF1D

*Power is conducted maximum RMS

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, ANSI C63.10, and IC RSS-247.

Signature:  Date: July 25, 2017

Typed/Printed Name: Desmond A. Fraser Position: President

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and Innovative Wireless Technologies. The test results relate only to the item(s) 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.

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1 General Information

1.1 Scope

Applicable Standards:

FCC Rules Part 15.247-2016: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

RSS-247 Issue 2-2017: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.2 Description of EUT

Equipment Under Test	Sentinel Personnel Tracking Tag
Model #	FAP5015-025
Power Supply	3 AA Alkaline Batteries
Modulation Type	2-FSK
Frequency Range	903 – 927 MHz
Antenna Type	Internal trace

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.10 2013).

1.4 Related Submittal(s)/Grant(s)

This is an original application for certification for Innovative Wireless Technologies, Inc. Model # FAP5015-025, SENTINEL^{tm} Personnel Tracking Tag; FCC ID: SP8-FAP5015025, IC: 9568A-FAP5015025.

1.5 Modifications

No modifications were required for compliance.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Frequencies Tested

Channel	Frequency
Low	903.185
Mid	914.980
High	926.980

2.2 Exercising the EUT

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.247), IC RSS-247/RSS-Gen

FCC Reference	IC Reference	C63.10 Procedure	Test	Pass/Fail or N/A
FCC 15.207	RSS-Gen 8.8	6.2	AC Power Conducted Emissions	Pass
FCC 15.209	RSS-Gen 8.10	6.5, 6.6	Radiated Emissions	Pass
FCC 15.247(b)	RSS-247 5.4(d)	6.10	Maximum Peak Power Output	Pass
FCC 15.247(d)	RSS-247 5.5	6.7	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(d)	RSS-247 5.5	6.9.2	Band Edge	Pass
FCC 15.247(a)(2)	RSS-247 5.2(a)	6.9.1	6 dB Bandwidth	Pass
FCC 15.247(e)	RSS-247 5.2(b)	6.11	Power Spectral Density	Pass

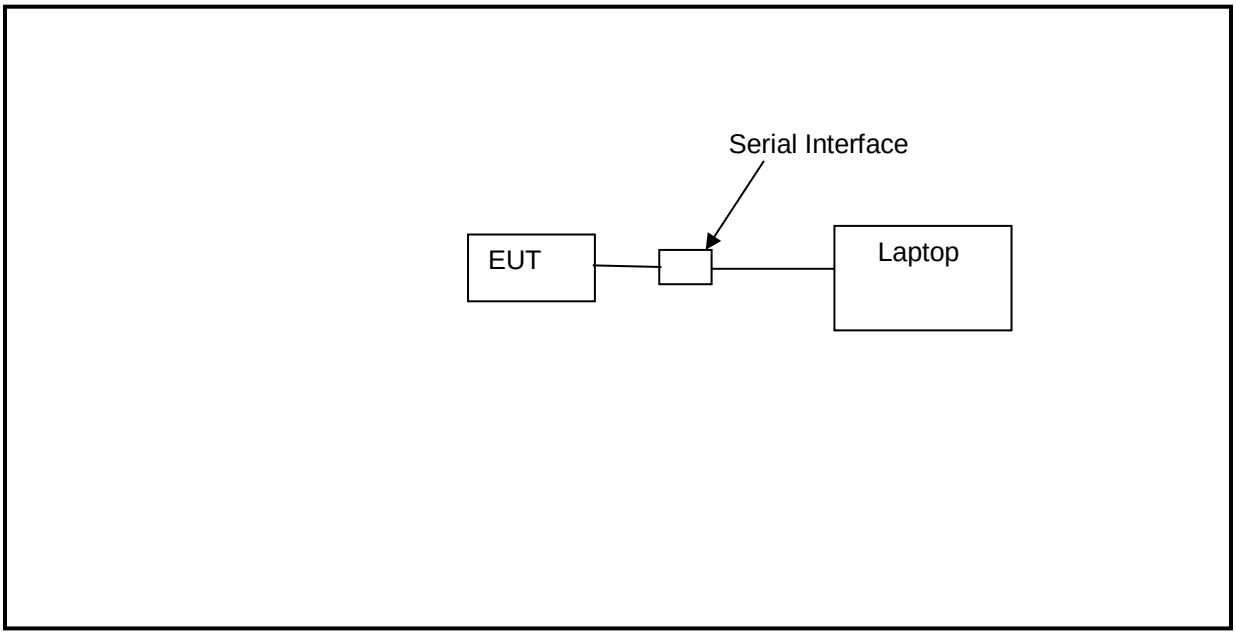
2.4 Test System Details

The test samples were received on July 6, 2017. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following tables.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model #	Serial Number	FCC ID	RTL Bar Code
Sentinel Personnel Tracking Tag	IWT	FAP5015-025	PT1704002	SP8-FAP5015025	22543

2.5 Configuration of Tested System



3 Maximum Conducted Output Power – FCC 15.247(b)(3); IC RSS-247 5.4(d)

3.1 Power Output Test Procedure

A conducted power measurement of the EUT was taken using a Rhode & Schwarz spectrum analyzer.

Procedure: C63.10-2013 11.9.2 (average)

Table 3-1: Power Output Test Equipment

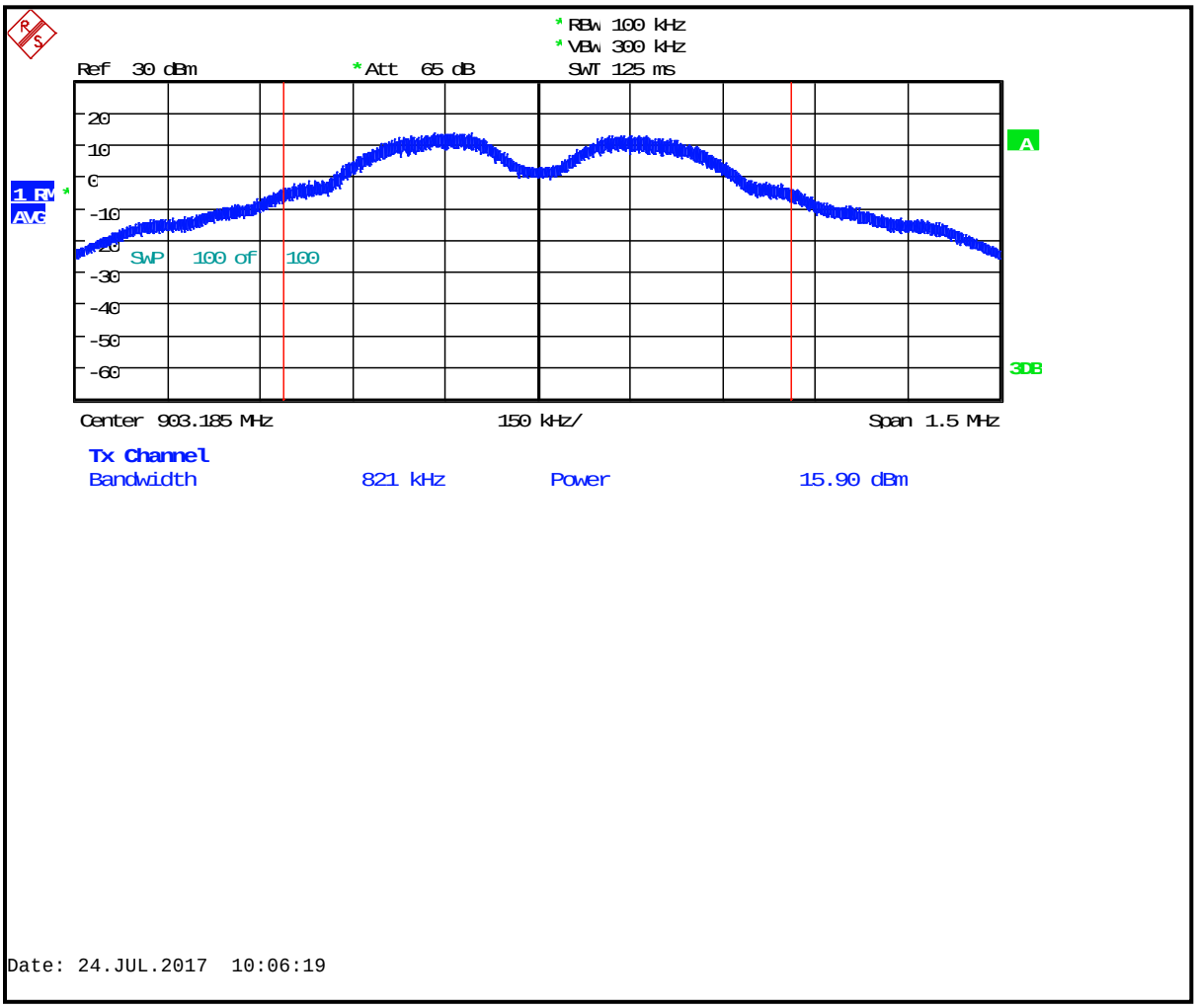
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rhode & Schwarz	FSU 20 Hz-50 GHz	Spectrum Analyzer	1166.1660.50	3/22/18

3.2 Power Output Test Data

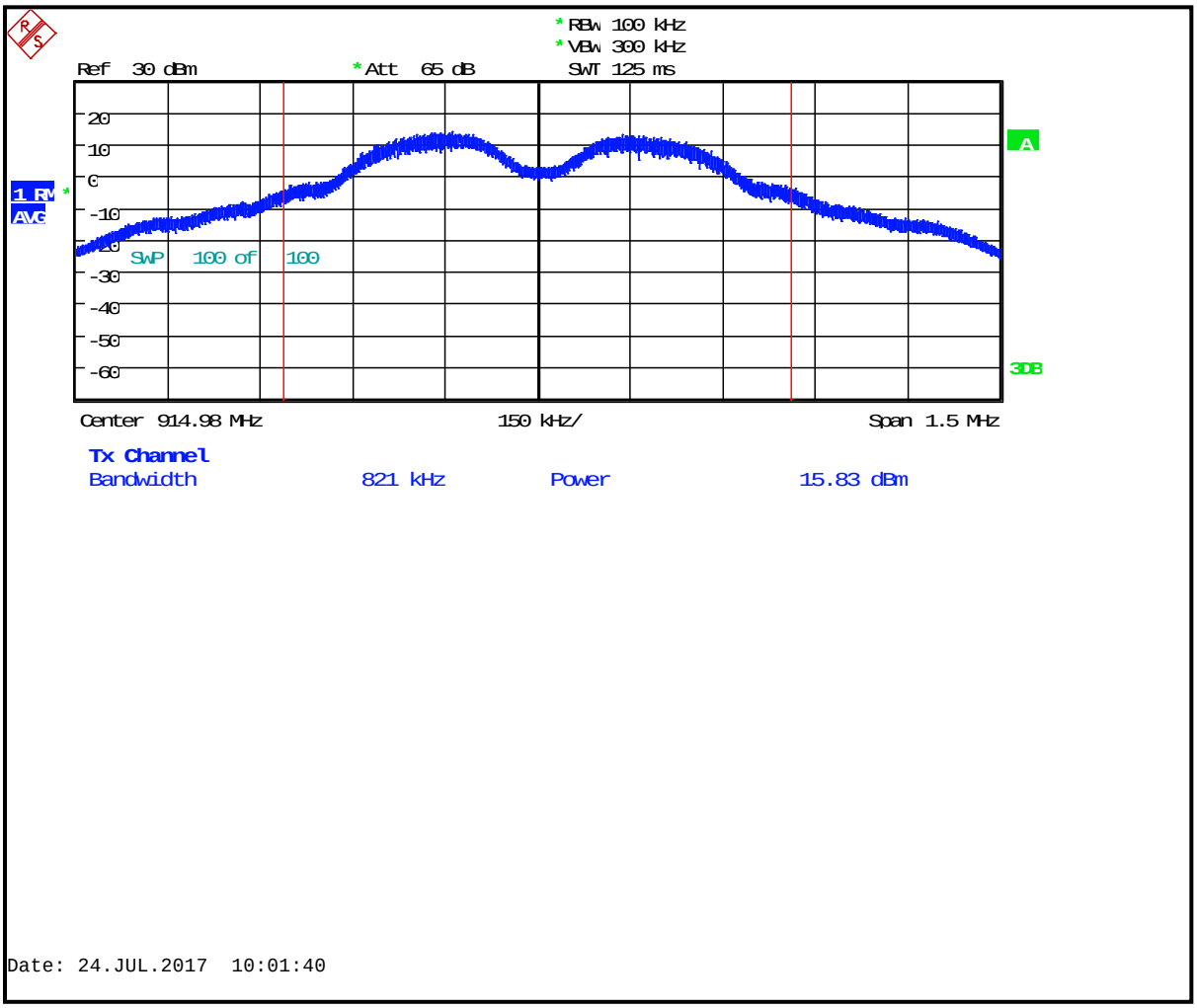
Table 3-2: Power Output Test Data

Frequency (MHz)	Peak Conducted Power (dBm)
903.185	15.9
914.980	15.8
926.980	15.6

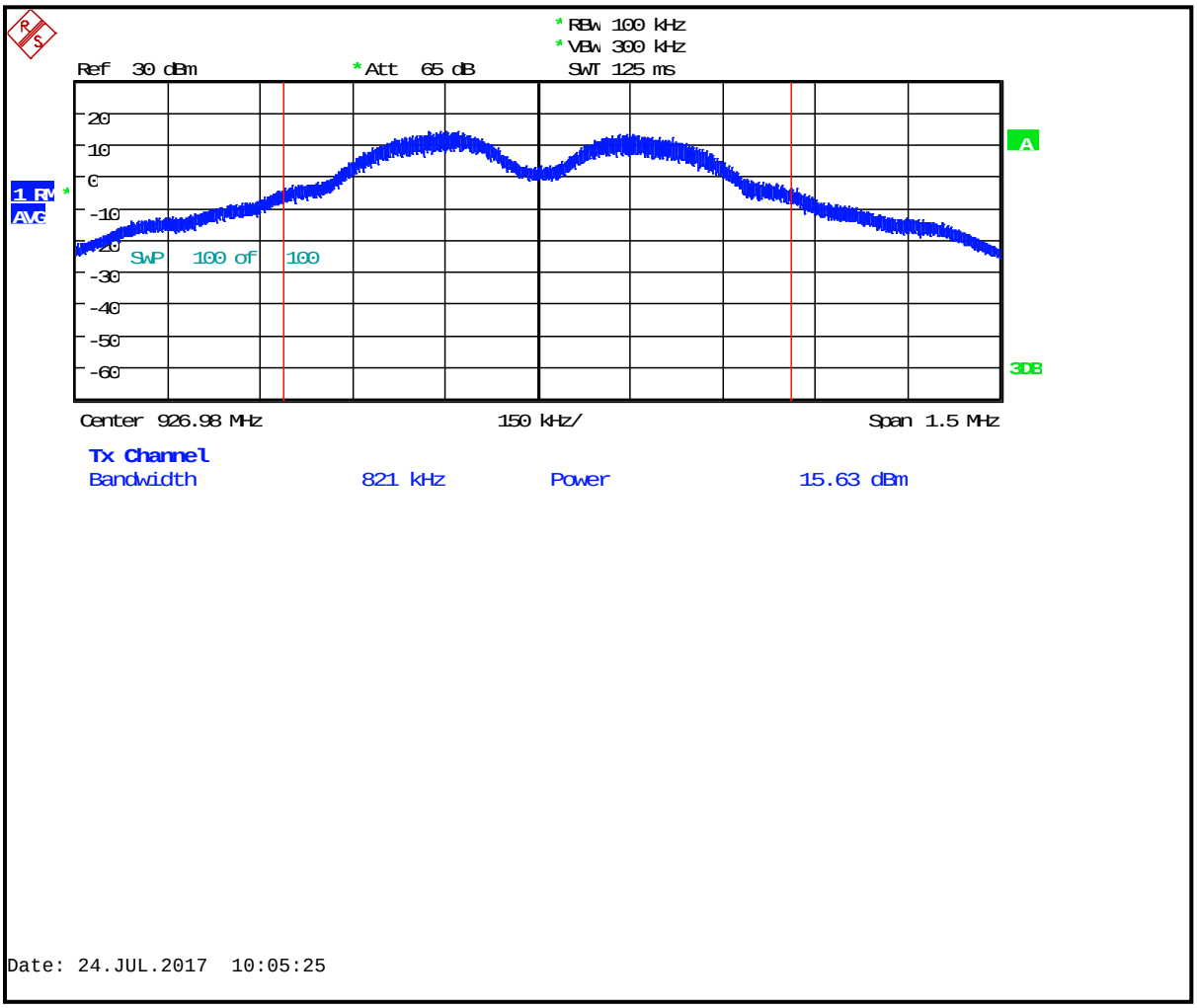
Plot 3-1: Maximum Conducted Output Power (903.185 MHz)



Plot 3-2: Maximum Conducted Output Power (914.980 MHz)



Plot 3-3: Maximum Conducted Output Power (926.980 MHz)



Test Personnel:

Dan Baltzell		July 24, 2017
Test Engineer	Signature	Date of Test

4 Band Edge Compliance of RF Conducted Emissions – FCC 15.247(d); IC RSS-247 5.5

4.1 Band Edge Test Procedure

Procedure: C63.10-2013 11.13

The EUT was connected to the spectrum analyzer through suitable attenuation. The spectrum analyzer was set to the following:

Center Frequency:	Frequency of the emissions to be measured
Span:	5 MHz
RBW:	100 kHz
VBW:	3 x RBW
Detector:	Peak
Sweep:	Auto
Trace:	Max Hold

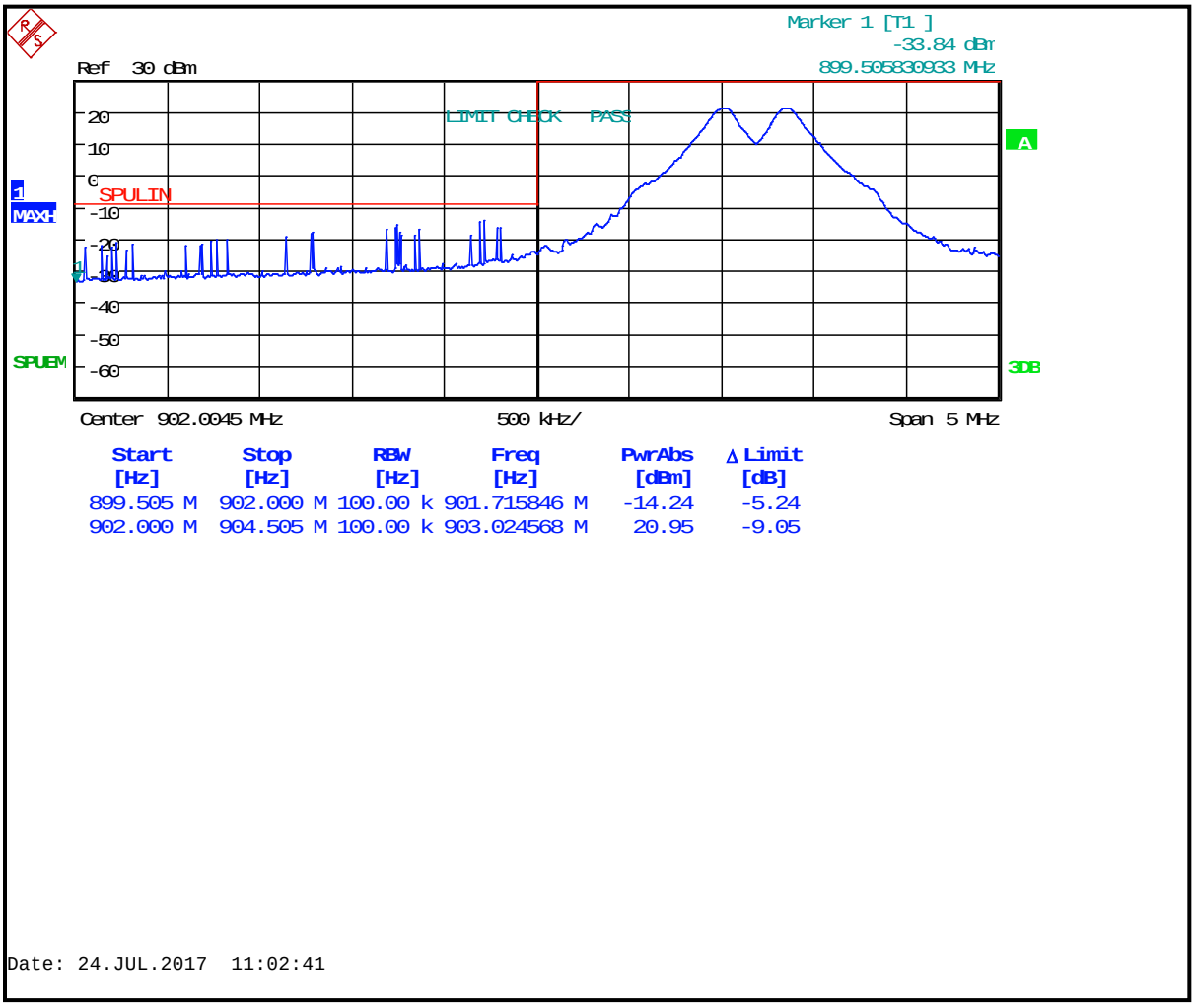
The trace was allowed to stabilize. The marker was set on the emission at the band edge. The marker-delta was used to show the delta between the maximum in-band emission and the emission at the band edge, and was compared to the 30 dBm requirement of 15.247(d) since we are measuring and reporting power as average.

Table 4-1: Test Equipment

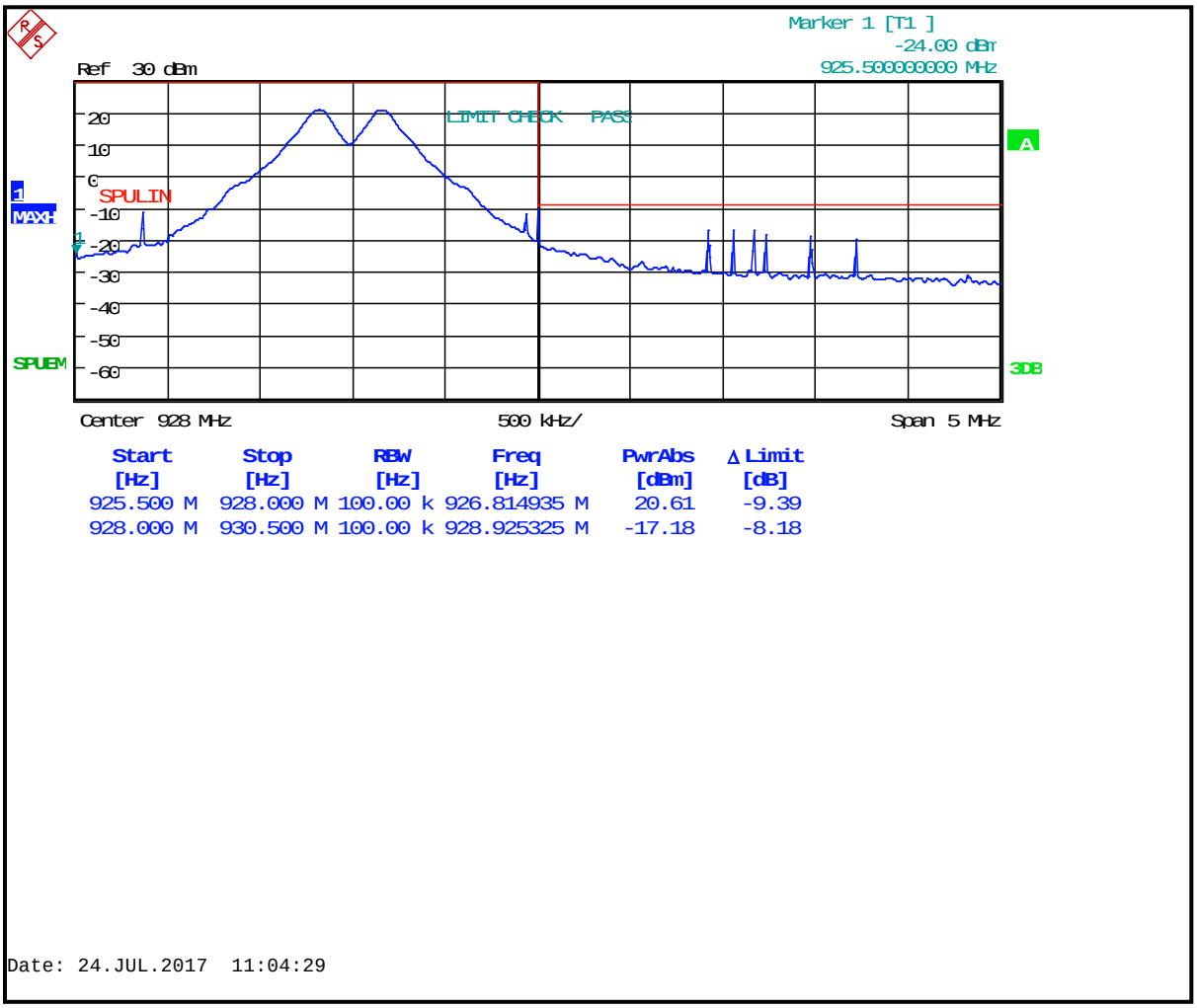
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rhode & Schwarz	FSU 20 Hz-50 GHz	Spectrum Analyzer	1166.1660.50	3/22/18

4.2 Test Results

Plot 4-1: Lower Band Edge (902 MHz Band Edge, 903.185 MHz Carrier)



Plot 4-2: Upper Band Edge (928 MHz Band Edge, 926.980 MHz Carrier)



Test Personnel:

Dan Baltzell		July 24, 2017
Test Engineer	Signature	Date of Test

5 Antenna Conducted Spurious Emissions – FCC 15.247(d); IC RSS-247 5.5

5.1 Antenna Conducted Spurious Emissions Test Procedures

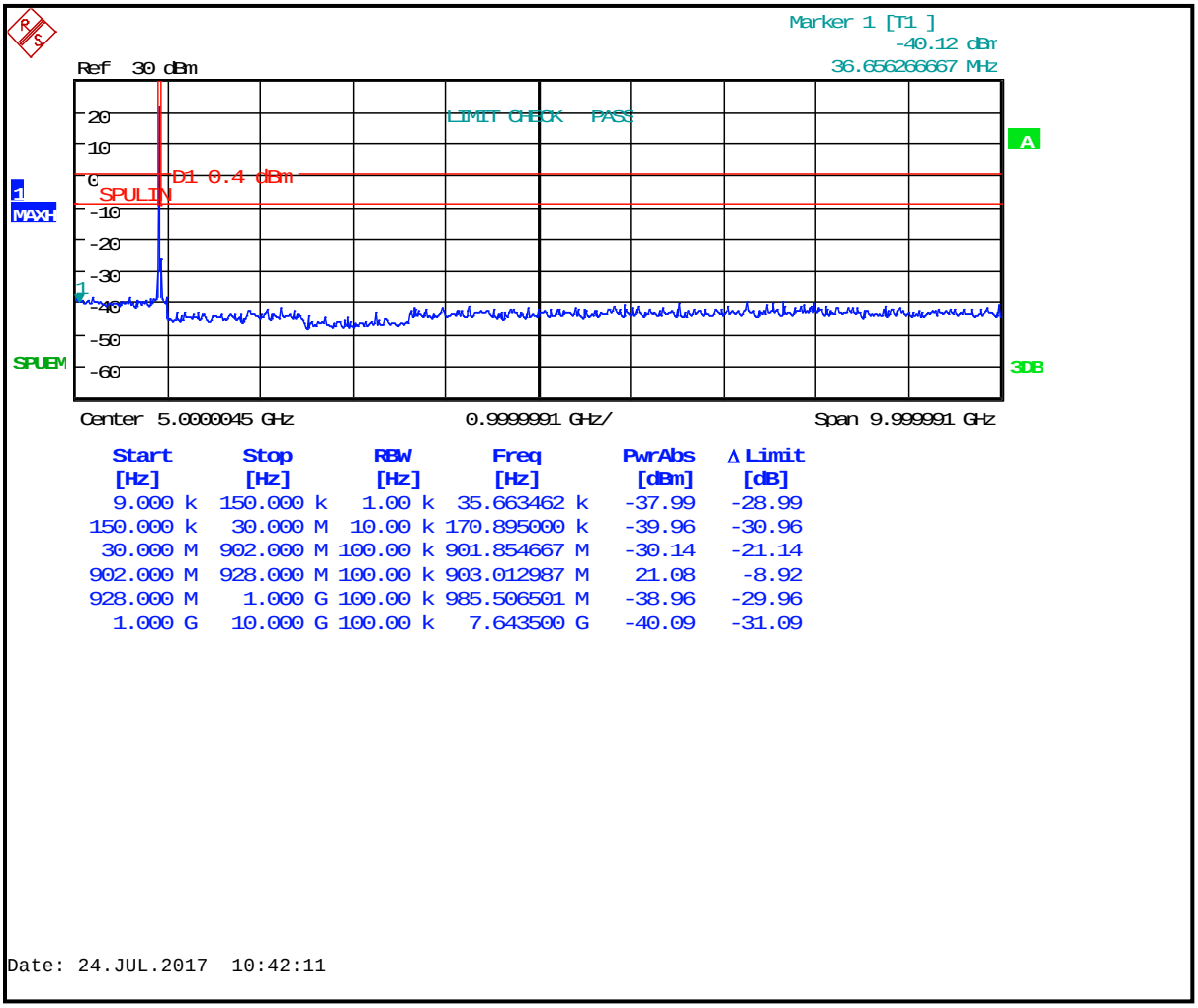
Procedure: C63.10-2013 11.12.2.

Antenna spurious emissions per FCC 15.247(d) were measured from the EUT antenna port using a 50-ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated carrier was identified at the following frequencies: 903.185 MHz, 914.980 MHz and 926.980 MHz. The carrier to the 10th harmonic of the carrier frequency was investigated.

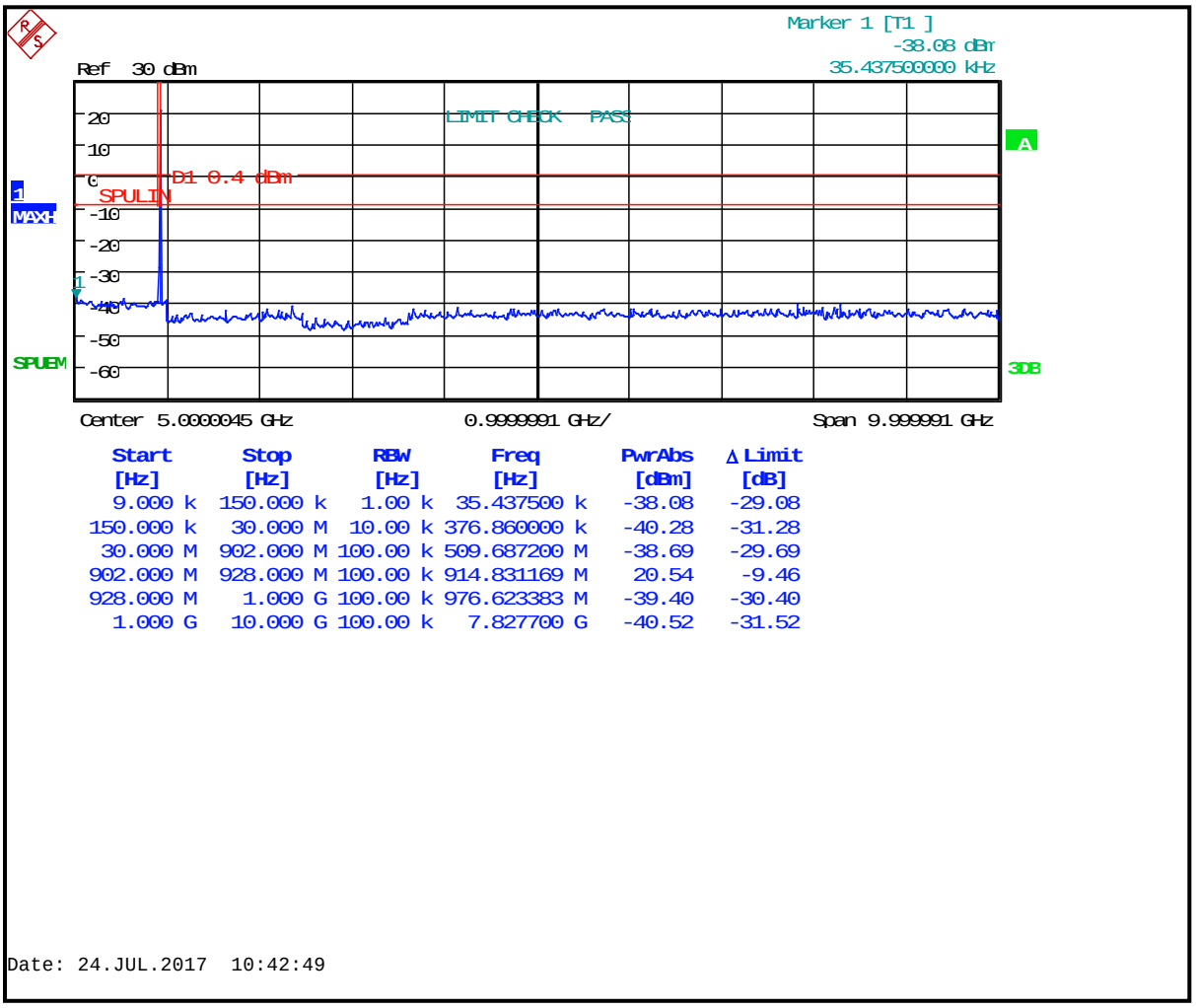
5.2 Antenna Conducted Spurious Emissions Test Results

All spurious emissions were greater than 20 dB below the limit (note that we are reporting power as average so the limit is 30 dBc).

Plot 5-1: Antenna Conducted Spurious Emissions (903.185 MHz)



Plot 5-2: Antenna Conducted Spurious Emissions (914.980 MHz)



Plot 5-3: Antenna Conducted Spurious Emissions (926.980 MHz)

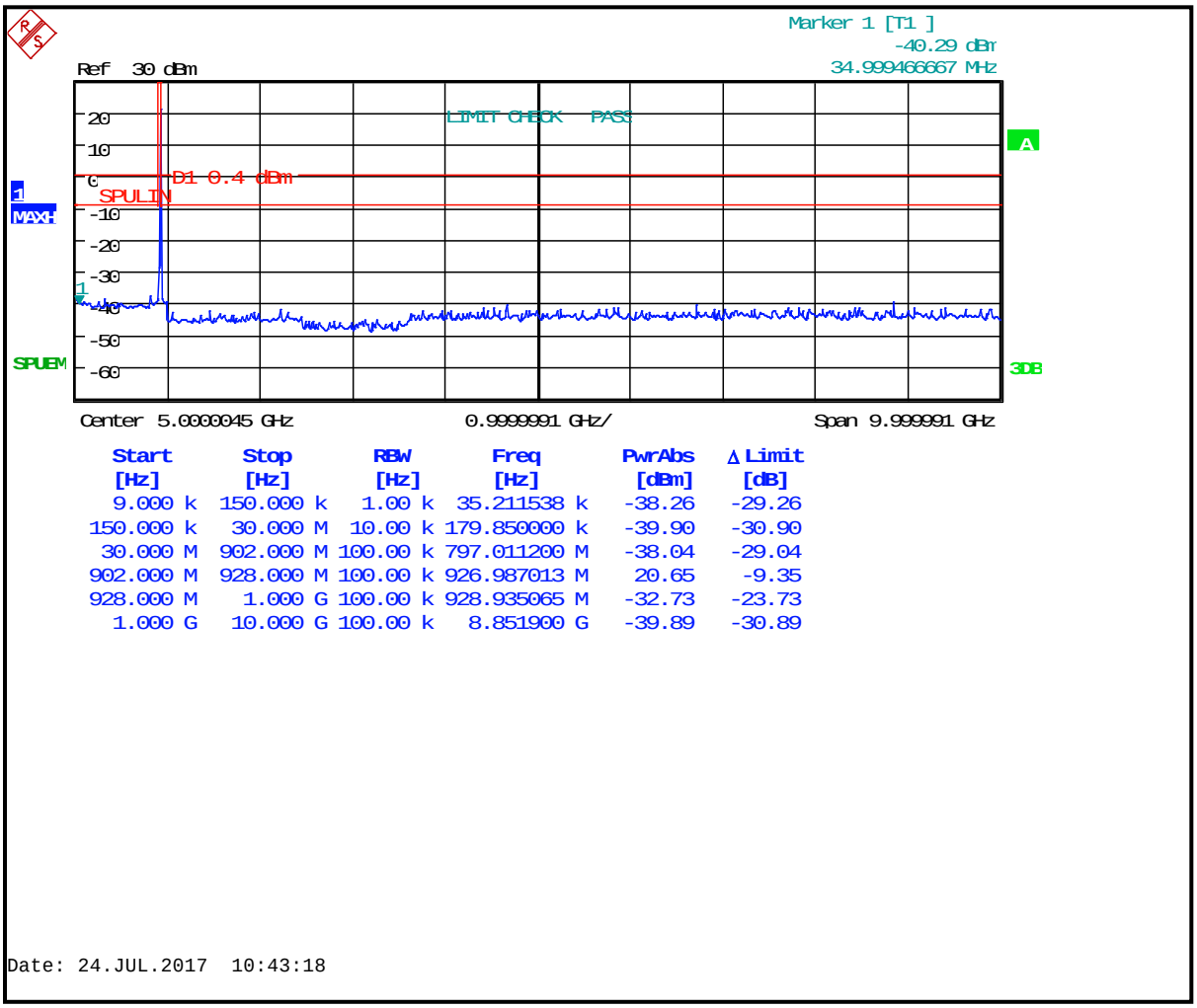


Table 5-1: Antenna Conducted Spurious Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rhode & Schwarz	FSU 20 Hz-50 GHz	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Dan Baltzell		July 24, 2017
Test Engineer	Signature	Date of Test

6 Bandwidth – FCC 15.247(a)(2); IC RSS-247 5.2(a)

6.1 Bandwidth Test Procedure

Procedure: C63.10-2013 11.8.

The minimum 6 dB bandwidths per FCC 15.247(a)(2) were measured using a 50-ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The device was modulated. The minimum 6 dB bandwidths are presented below.

Table 6-1: 6 dB Bandwidth Test Equipment

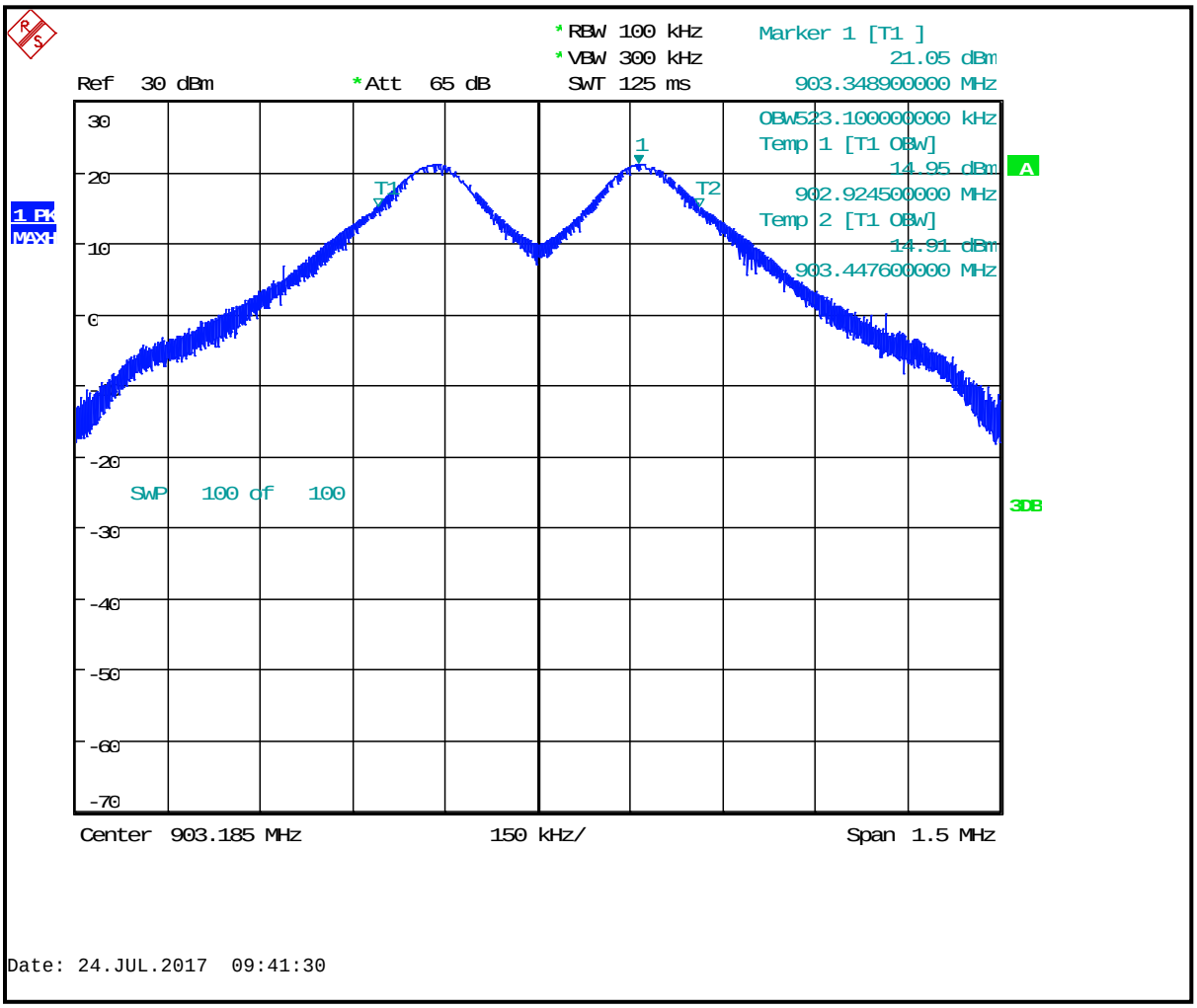
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rhode & Schwarz	FSU 20 Hz-50 GHz	Spectrum Analyzer	1166.1660.50	3/22/18

6.2 Bandwidth Test Results

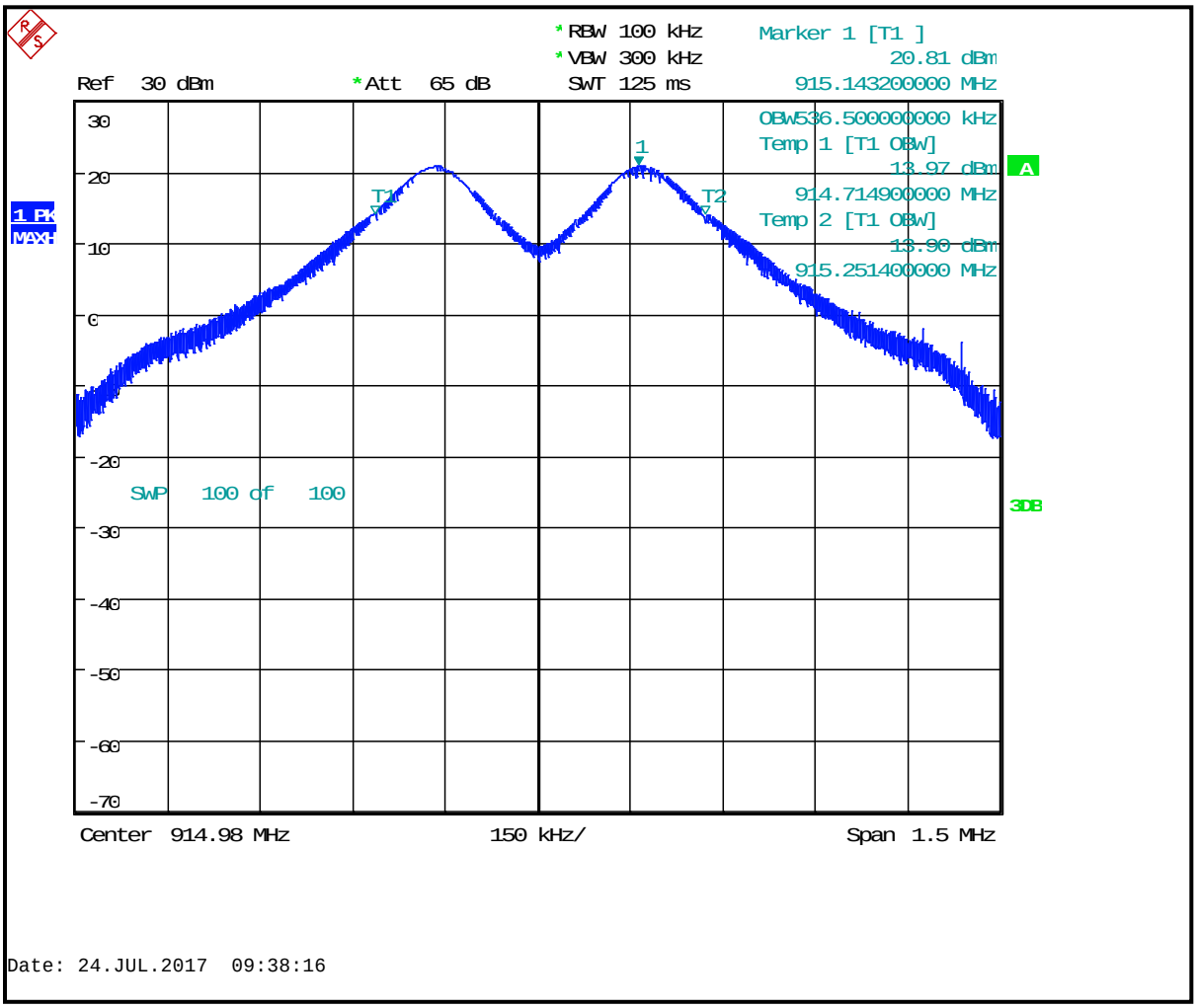
Table 6-2: 6 dB Bandwidth Test Data

Frequency (MHz)	Bandwidth (kHz)	Minimum Limit (kHz)	Pass/Fail
903.185	523.1	500	Pass
914.980	536.5	500	Pass
926.980	536.5	500	Pass

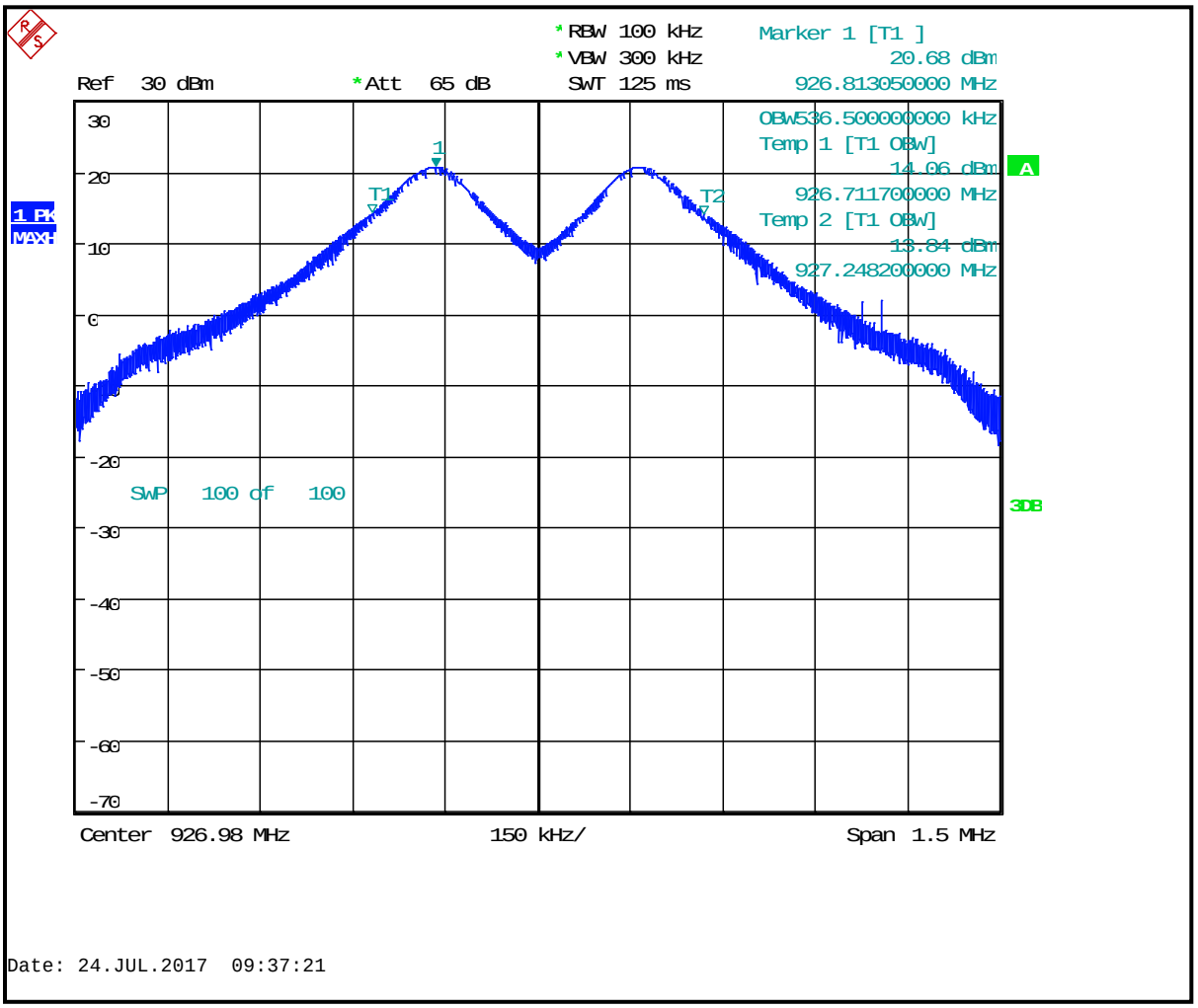
Plot 6-1: 6 dB Bandwidth – 903.185 MHz



Plot 6-2: 6 dB Bandwidth – 914.980 MHz



Plot 6-3: 6 dB Bandwidth – 926.980 MHz



Test Personnel:

Dan Baltzell		July 24, 2017
Test Engineer	Signature	Date of Test

7 Power Spectral Density – FCC 15.247(e); IC RSS-247 5.2(b)

7.1 Power Spectral Density Test Procedure

Procedure: C63.10-2013 11.10.3

The power spectral density per FCC 15.247(e) was measured using a 50-ohm spectrum analyzer with the resolution bandwidth set at 3 kHz, the video bandwidth set at 10 kHz. RMS trace averaging over 100 sweeps was used to resolve the spectral density for the modulated carriers at 903.185, 914.980 and 926.980 MHz. These levels are below the +8 dBm limit. See the power spectral density table and plots that follow.

Table 7-1: Power Spectral Density Test Equipment

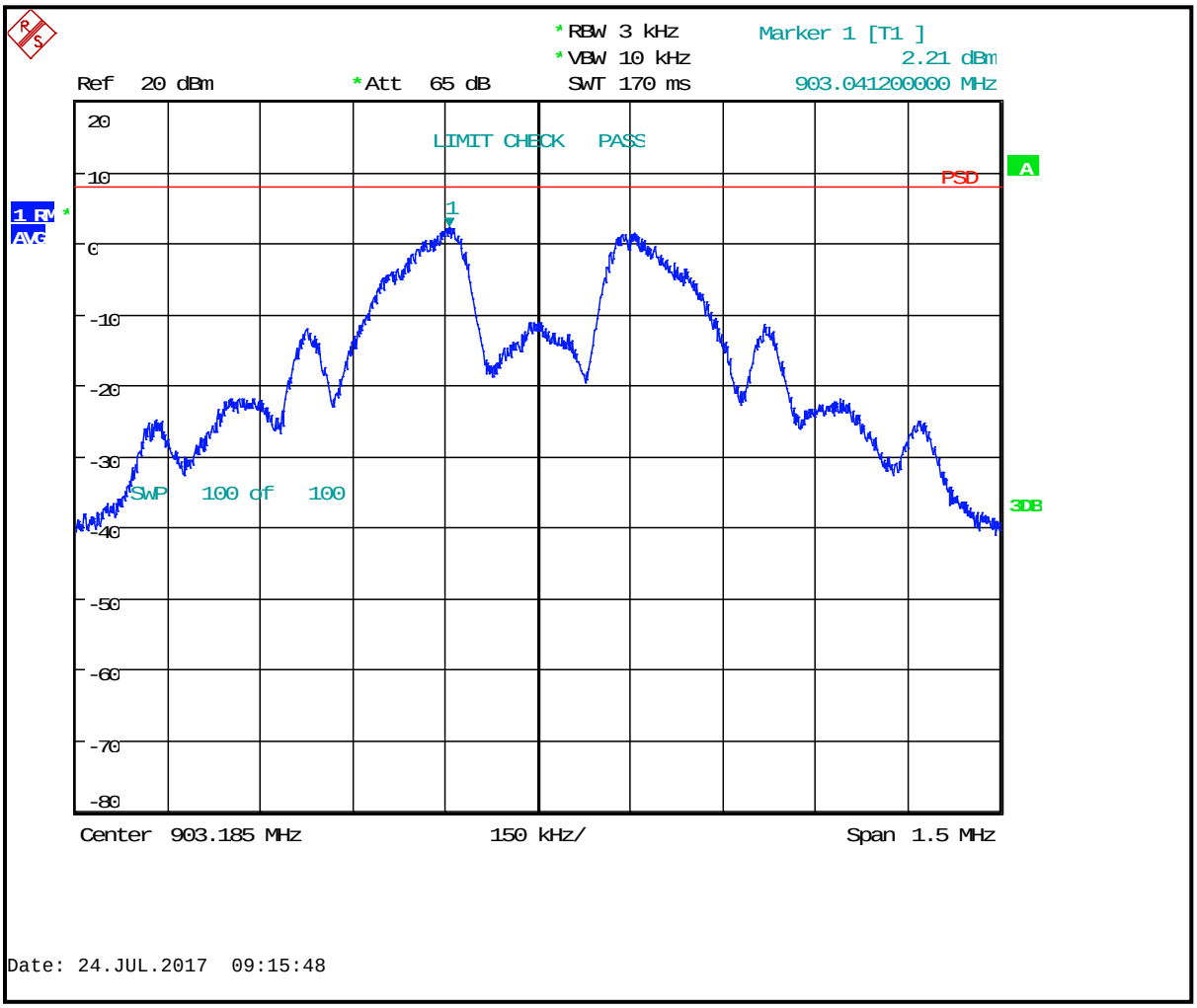
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rhode & Schwarz	FSU 20 Hz-50 GHz	Spectrum Analyzer	1166.1660.50	3/22/18

7.2 Power Spectral Density Test Data

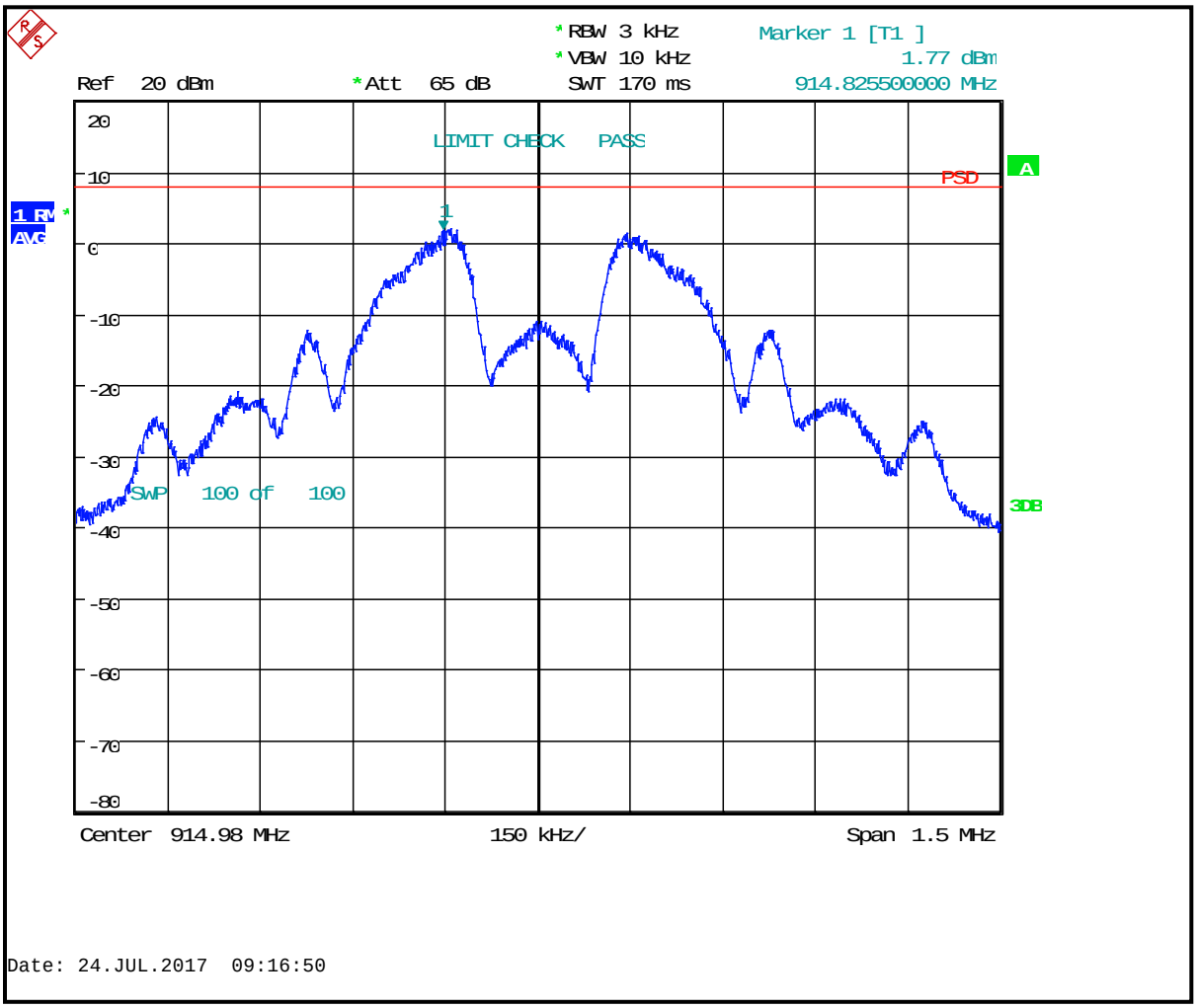
Table 7-2: Power Spectral Density Test Data

Frequency (MHz)	RF Power Level (dBm)	Maximum Limit +8 dBm	Pass/Fail
903.185	2.2	8	Pass
914.980	1.8	8	Pass
926.980	2.3	8	Pass

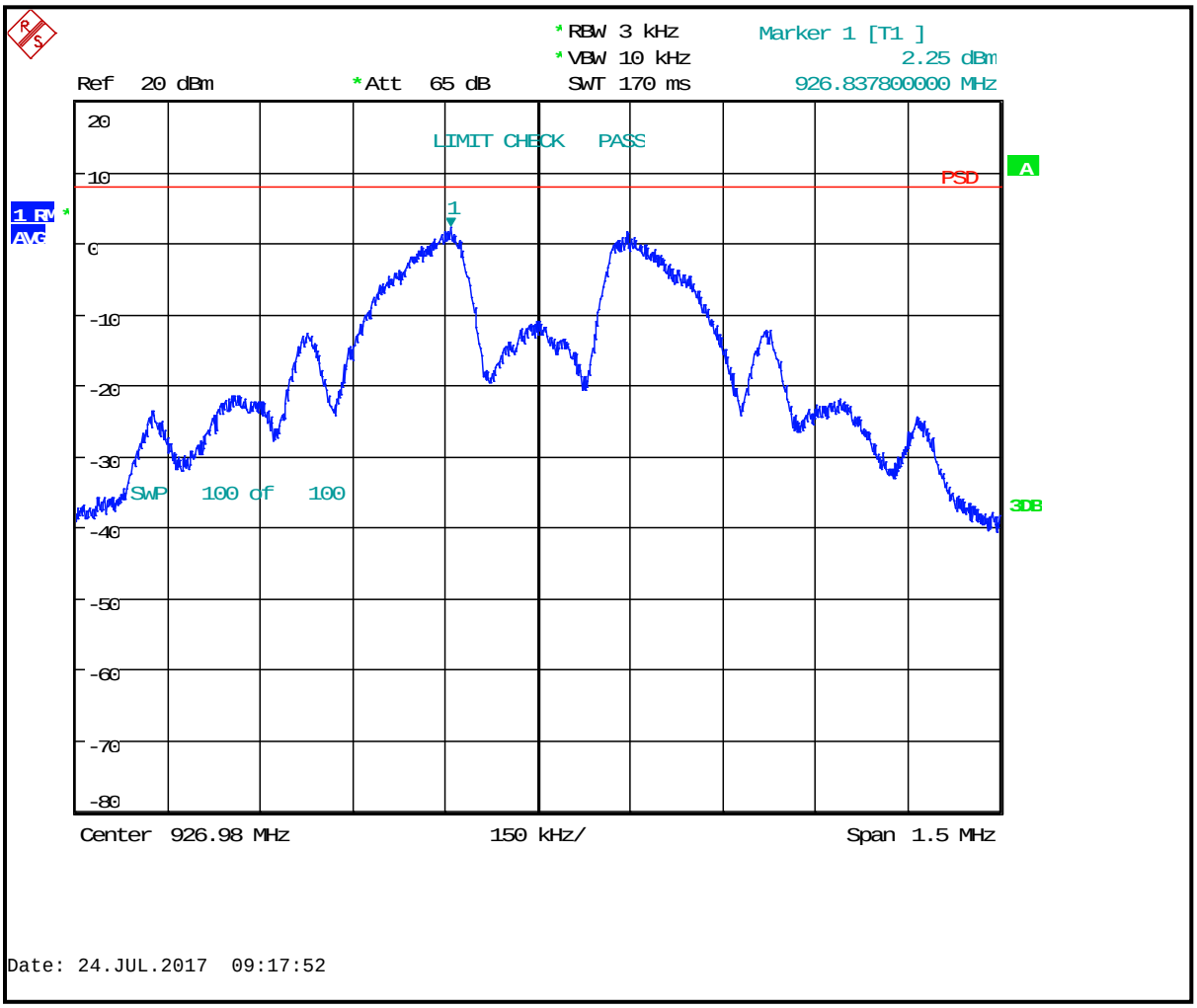
Plot 7-1: Power Spectral Density – 903.185 MHz



Plot 7-2: Power Spectral Density – 914.980 MHz



Plot 7-3: Power Spectral Density – 926.980 MHz



Test Personnel:

Dan Baltzell		July 24, 2017
Test Engineer	Signature	Date of Test

8 Conducted Emissions Measurement Limits – FCC 15.207; IC RSS-Gen

8.1 Limits of Conducted Emissions Measurement

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

8.2 Conducted Emissions Measurement Test Procedure

Procedure: C63.10-2009 6.2

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50-ohm / 50 micro Henry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

8.3 Conducted Line Emissions Test Data

N/A – EUT is battery operated.

9 Radiated Emissions – FCC 15.209; IC RSS-247, RSS-Gen

9.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	24000/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

9.2 Radiated Emissions Measurement Test Procedure

Procedure: C63.10-2013 11.12.1

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (9 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1,000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 9-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900878	Rhein Tech Laboratories, Inc.	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	N/A
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	8/3/17
901242	Rhein Tech Laboratories, Inc.	WRT-000-0003	Wood rotating table	N/A	N/A
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/9/18
900321	EMCO	3161-03	Horn Antennas (4 - 8,2 GHz)	9508-1020	4/9/18
900323	EMCO	3160-7	Horn Antennas (8,2 - 12,4 GHz)	9605-1054	4/9/18
901413	Agilent Technologies	E4448A	Spectrum Analyzer (3 Hz - 50 GHz)	US44020346	4/4/19
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	6/11/18

9.3 Radiated Emissions Test Results

9.3.1 Radiated Emissions Unintentional

Table 9-2: Peak Radiated Emissions Unintentional

Emission Frequency (MHz)	Peak Detector Level (dBuV) (100 kHz RBW/ 500 kHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
32.019	23.5	18.2	41.7	60.0	-18.3
120.673	31.2	13.0	44.2	63.5	-19.3
192.147	19.6	10.5	30.1	63.5	-33.4
200.962	21.7	10.7	32.4	63.5	-31.1
209.455	25.1	10.2	35.3	63.5	-28.2
304.327	16.3	14.8	31.1	66.0	-34.9
404.808	9.7	18.1	27.8	66.0	-38.2
504.487	9.2	19.2	28.4	66.0	-37.6
683.494	9.3	20.6	29.9	66.0	-36.1
902.244	13.8	23.2	37.0	66.0	-29.0

Table 9-3: Quasi-Peak Radiated Emissions Unintentional

Emission Frequency (MHz)	Quasi-Peak Detector Level (dBuV) (120 kHz RBW/ 500 kHz VBW)	Site Correction Factor (dB/m)	Quasi-Peak Emission Level (dBuV/m)	Quasi-Peak Limit (dBuV/m)	Quasi-Peak Margin (dB)
32.019	16.5	18.2	34.7	40.0	-5.3
120.673	13.1	13.0	26.1	43.5	-17.4
192.147	14.7	10.5	25.2	43.5	-18.3
200.962	11.9	10.7	22.6	43.5	-20.9
209.455	4.4	10.2	14.6	43.5	-28.9
304.327	2.1	14.8	16.9	46.0	-29.1
404.808	1.6	18.1	19.7	46.0	-26.3
504.487	1.6	19.2	20.8	46.0	-25.2
683.494	1.6	20.6	22.2	46.0	-23.8
902.244	2.8	23.2	26.0	46.0	-20.0

9.3.2 Radiated Emissions Harmonics/Spurious

Table 9-4: Peak Radiated Emissions Harmonics/Spurious TX Frequency – 903.185 MHz

Emission Frequency (MHz)	Peak Detector Level (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2709.555	27.4	25.8	53.2	74.0	-20.8
3612.740	20.3	27.5	47.8	74.0	-26.2
4515.925	17.0	33.7	50.7	74.0	-23.3
5419.110	13.0	33.8	46.8	74.0	-27.2
8128.665	12.8	41.5	54.3	74.0	-19.7
9031.850	13.3	42.2	55.5	74.0	-18.5

Table 9-5: Average Radiated Emissions Harmonics/Spurious TX Frequency – 903.185 MHz

Emission Frequency (MHz)	Average Detector Level (dBuV)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2709.555	26.4	25.8	52.2	54.0	-1.8
3612.740	18.6	27.5	46.1	54.0	-7.9
4515.925	14.7	33.7	48.4	54.0	-5.6
5419.110	9.4	33.8	43.2	54.0	-10.8
8128.665	7.2	41.5	48.7	54.0	-5.3
9031.850	9.2	42.2	51.4	54.0	-2.6

Table 9-6: Peak Radiated Emissions Harmonics/Spurious TX Frequency – 914.980 MHz

Emission Frequency (MHz)	Peak Detector Level (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2744.940	20.6	25.8	46.4	74.0	-27.6
3659.920	21.8	27.6	49.4	74.0	-24.6
4574.900	16.3	33.5	49.8	74.0	-24.2
7319.840	15.1	35.7	50.8	74.0	-23.2
8234.820	12.4	41.7	54.1	74.0	-19.9
9149.800	11.9	41.9	53.8	74.0	-20.2

Table 9-7: Average Radiated Emissions Harmonics/Spurious TX Frequency – 914.980 MHz

Emission Frequency (MHz)	Average Detector Level (dBuV)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2744.940	18.3	25.8	44.1	54.0	-9.9
3659.920	20.4	27.6	48.0	54.0	-6.0
4574.900	13.4	33.5	46.9	54.0	-7.1
7319.840	11.3	35.7	47.0	54.0	-7.0
8234.820	7.0	41.7	48.7	54.0	-5.3
9149.800	7.1	41.9	49.0	54.0	-5.0

Table 9-8: Peak Radiated Emissions Harmonics/Spurious TX Frequency – 926.980 MHz

Emission Frequency (MHz)	Peak Detector Level (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2780.940	23.0	25.9	48.9	74.0	-25.1
3707.920	24.6	27.7	52.3	74.0	-21.7
4634.900	15.6	33.4	49.0	74.0	-25.0
7415.840	11.2	35.8	47.0	74.0	-27.0
8342.820	12.0	41.8	53.8	74.0	-20.2

Table 9-9: Average Radiated Emissions Harmonics/Spurious TX Frequency – 926.980 MHz

Emission Frequency (MHz)	Average Detector Level (dBuV)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2780.940	21.1	25.9	47.0	54.0	-7.0
3707.920	23.4	27.7	51.1	54.0	-2.9
4634.900	13.1	33.4	46.5	54.0	-7.5
7415.840	6.4	35.8	42.2	54.0	-11.8
8342.820	6.3	41.8	48.1	54.0	-5.9

Test Personnel:

Dan Baltzell		July 25, 2017
EMC Test Engineer	Signature	Date of Test

10 Conclusion

The data in this measurement report shows the Innovative Wireless Technologies, Inc. Model # FAP5015-025, SENTINEL[tm] Personnel Tracking Tag, FCC ID: SP8-FAP5015025, IC: 9568A-FAP5015025, complies with the applicable requirements of Parts 2 and 15 of the FCC rules and regulations, and RSS-247 and RSS-Gen of the Industry Canada rules and regulations.