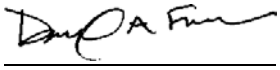
FCC 15.247 & IC RSS-247 Certification Report

Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com	Medeco Security Locks, Inc. Tel: 540-380-5000 3626 Alleghany Drive P.O. Box 3075 Salem, VA 24153

FCC ID **IC**	VR3-92 7465A-92	**Test Report Date**	September 30, 2016
Platform	N/A	**RTL Work Order #**	2016160
Model	EA-150092	**RTL Quote #**	QRTL16-160A
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)/Guidance	FCC Rules Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System (10/01/2015)		
Industry Canada	RSS-247 Issue 1 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices		

Frequency Range (MHz)	Output Power (mW)	Frequency Tolerance	Emission Designator
2402 - 2480	0.05	N/A	558KF1D

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, Industry Canada RSS-247, RSS-Gen, and ANSI C63.10.

Signature:  Date: September 30, 2016

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

These test(s) are accredited under Rhein Tech Laboratories, Inc. ISO/IEC 17025 accreditation issued by ANAB. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This is an original FCC and Industry Canada certification application request.

1.2 Description of EUT

Equipment Under Test	Bluetooth LE Key
Model	EA-150092
Power Supply	3.0 VDC battery
Modulation Type	BLE
Frequency Range	2402-2480 MHz
Antenna Type & Gain	2.4 GHz Internal Chip

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.

1.4 Related Submittal(s)/Grant(s)

This is an original application for Medeco Model EA-150092, FCC ID: VR3-92, IC: 7465A-92.

1.5 Modifications

No modifications were made to the equipment during testing in order to achieve compliance with these standards.

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: Channels Tested

Channel	Frequency
Low	2402
Middle	2440
High	2480

2.2 Exercising the EUT

The EUT was supplied with test software instructions to change channels, with a high, mid, and low channel for testing. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously 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

Test	FCC Reference	IC Reference	Result
AC Power Conducted Emissions	FCC 15.207	IC RSS-Gen 8.8	N/A
Radiated Emissions	FCC 15.209	IC RSS-247 5.5; IC RSS-Gen 6.13/7.1	Pass
Maximum Peak Power Output	FCC 15.247(b)(3)	IC RSS-247 5.4(4), IC RSS-Gen 6.12	Pass
Peak Power Spectral Density	FCC 15.247(e)	IC RSS-247 A8.1(b)	Pass
Antenna Conducted Spurious Emissions	FCC 15.247(d)	IC RSS-247 5.5, IC RSS-Gen 6.13	Pass
Band Edge Measurement	FCC 15.247(d)	IC RSS-247 5.5	Pass
Bandwidth	FCC 15.247(a)(2)	IC RSS-247 A8.1(a)(b)(d)	Pass

2.4 Test System Details

The test samples were received on September 2, 2016. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Key (for conduct tests)	Medeco Security Locks, Inc.	EA-150092	N/A	VR3-92	N/A	22181
Key (for radiated tests)	Medeco Security Locks, Inc.	EA-150092	N/A	VR3-92	N/A	22176

2.5 Configuration of Tested System

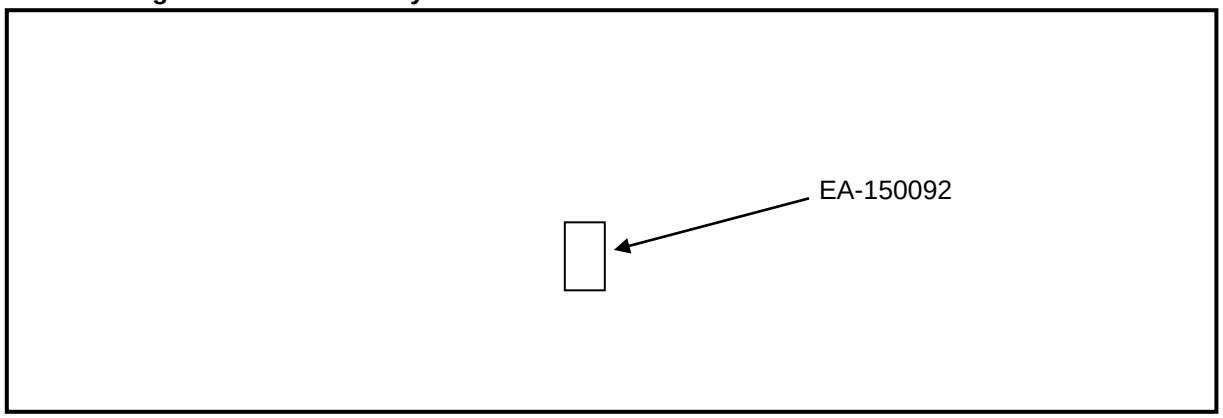


Figure 2-1: Configuration of System Under Test

3 Peak Output Power – FCC 15.247(b)(1); IC RSS-247 5.4(2), RSS-Gen 6.12

3.1 Power Output Test Procedure

Procedure: C63.10-2013

3.2 Power Output Test Data

Table 3-1: Power Output Test Data

Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)
2402	-13.0	30.0	-43.0
2440	-13.3	30.0	-43.3
2480	-13.8	30.0	-43.8

Table 3-2: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Dan Baltzell		September 14, 2016
EMC Test Engineer	Signature	Date of Test

4 Duty Cycle

4.1 Duty Cycle Test Procedure

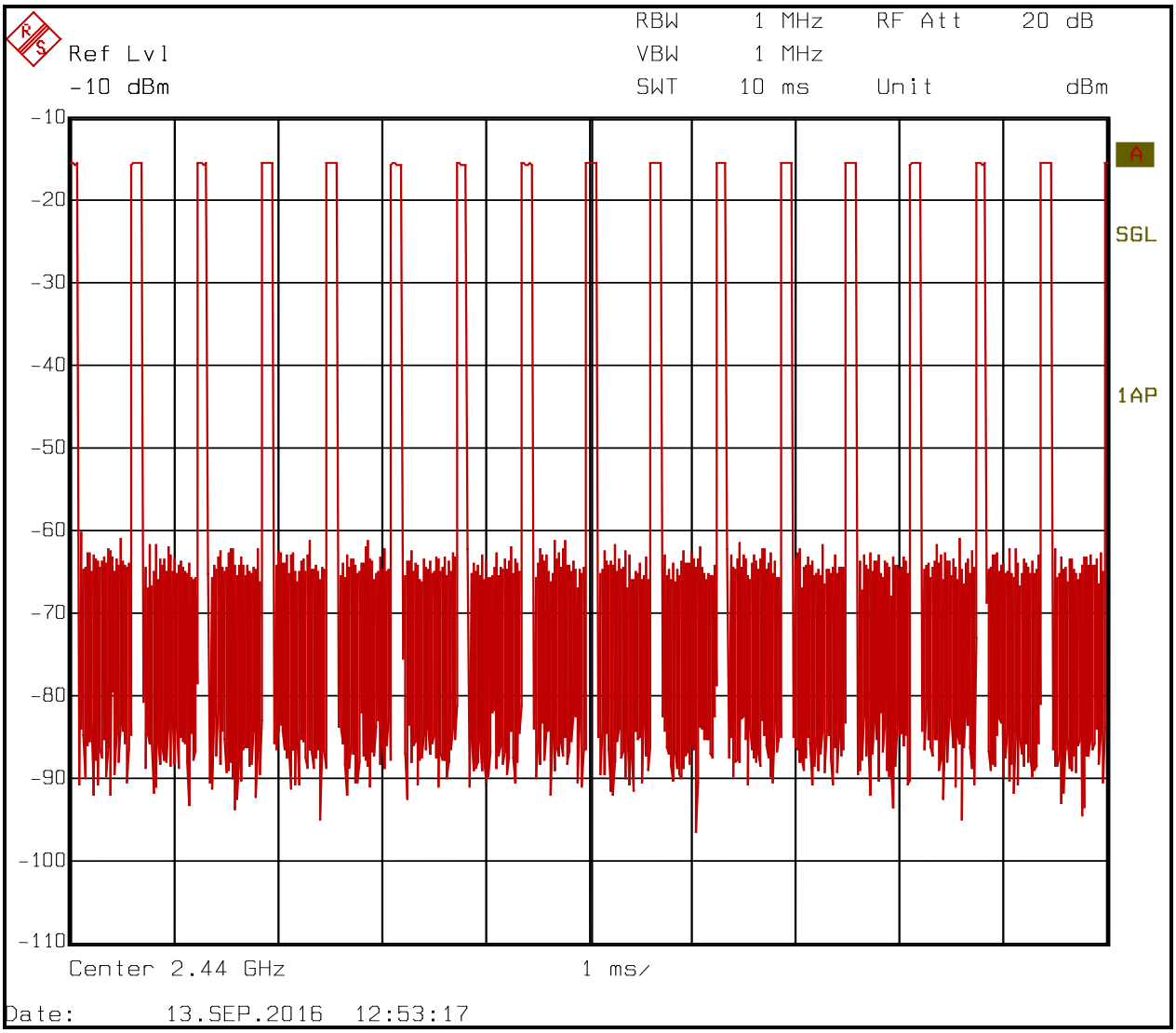
Plots of pulse width and number of pulses in 10 ms were taken for calculation of duty cycle.

Table 4-1: Duty Cycle Test Equipment

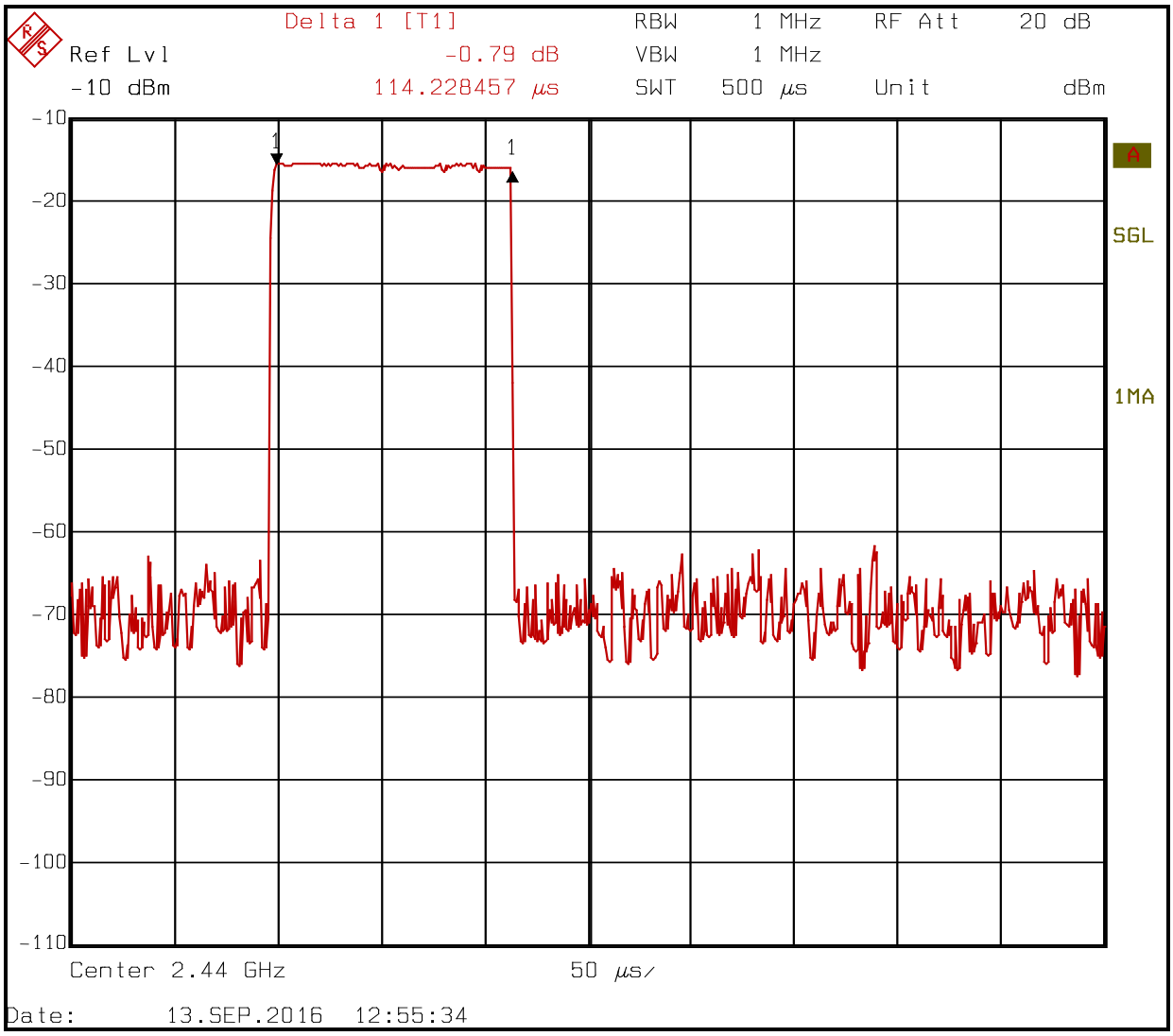
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901672	Rohde & Schwarz	FSEM30	Spectrum Analyzer	FSEM30	4/17/2019

4.2 Duty Cycle Test Data

Plot 4-1: Duty Cycle (16 pulses in 10 ms)



Plot 4-2: Duty Cycle – Pulse Width (114.2 us)



Calculation: 16 pulses in 10 ms = 160 pulses in 100 ms

(160 pulses x 114.2 us) = 0.0183 s (on time in 100 ms)

Duty cycle = (18.3ms/100 ms)/100 = 18.3 %

Duty cycle correction = 20 x Log (0.183) = -14.8 dB

Test Personnel:

Dan Baltzell		September 13, 2016
Test Engineer	Signature	Date of Test

5 Peak Power Spectral Density – FCC 15.247(e); IC RSS-247 5.2(2)

5.1 Peak Spectral Density Test Procedure

Digitally modulated systems shall have conducted peak power spectral density of 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Table 5-1: Power Spectral Density Test Equipment

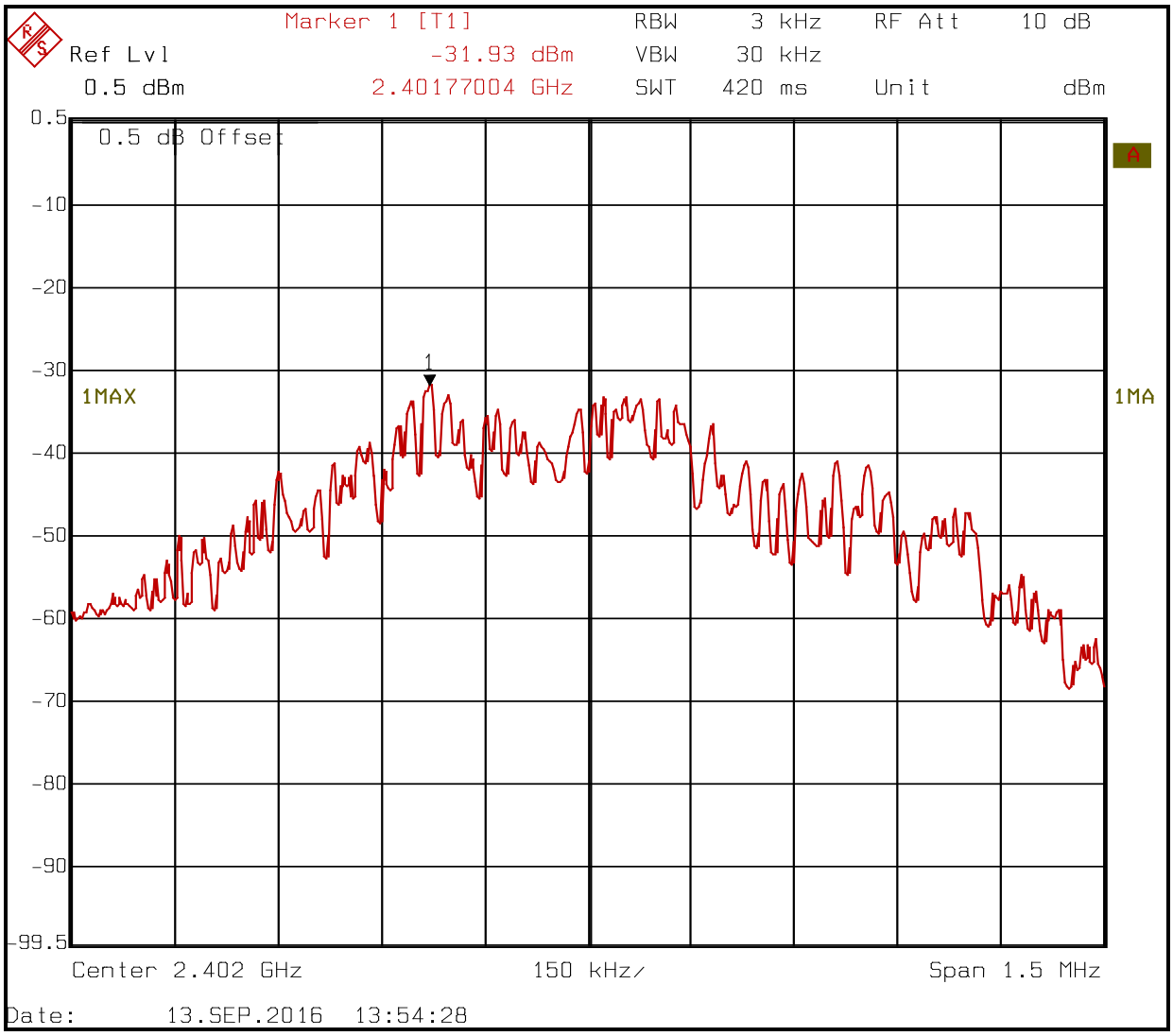
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901672	Rohde & Schwarz	FSEM30	Spectrum Analyzer	FSEM30	4/17/2019

5.2 Peak Spectral Density Test Data

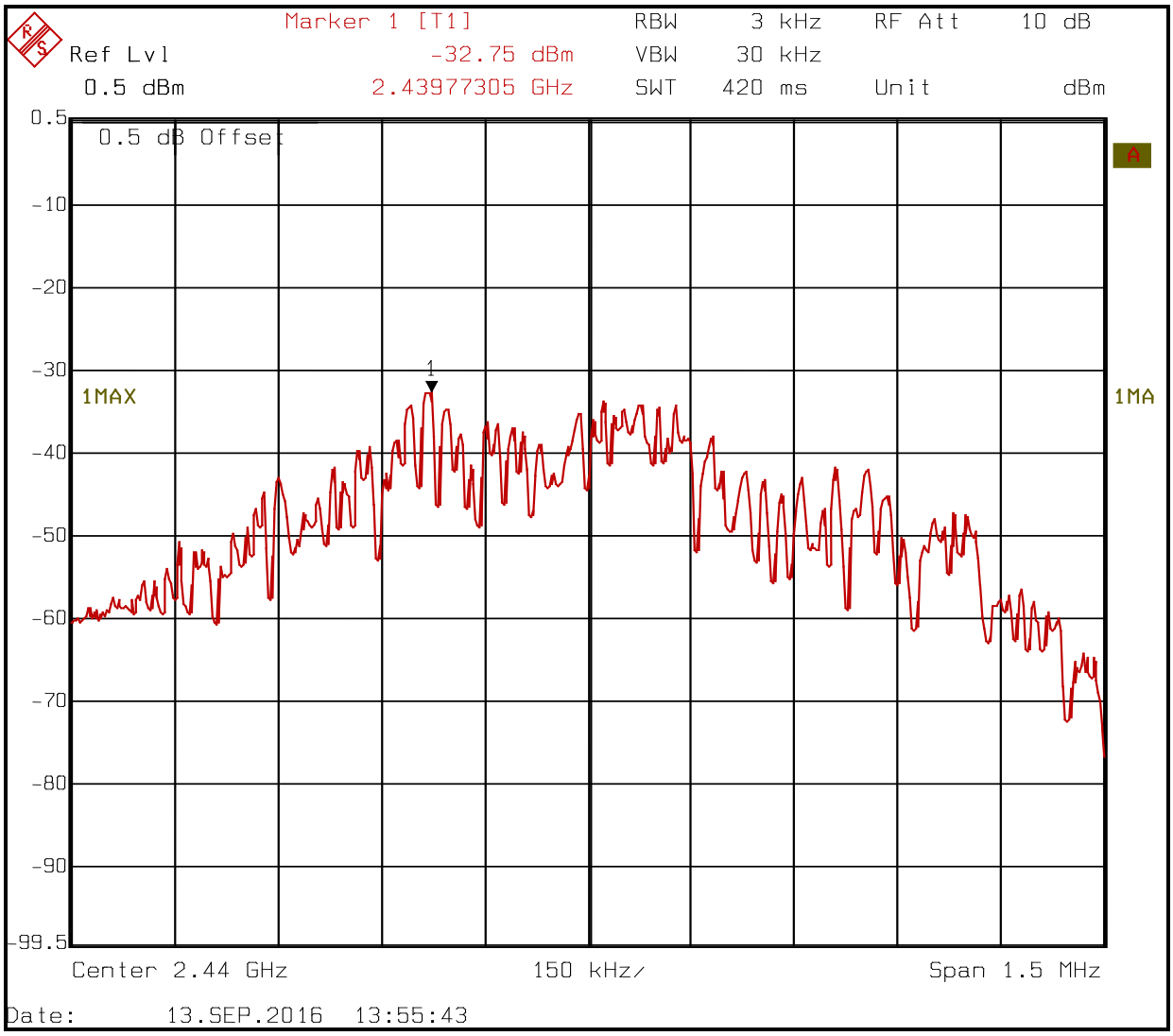
Table 5-2: Peak Spectral Density Test Data

Channels	Frequency (MHz)	Peak Output Power (dBm)
Low	2402	-31.9
Mid	2440	-32.8
High	2480	-34.3

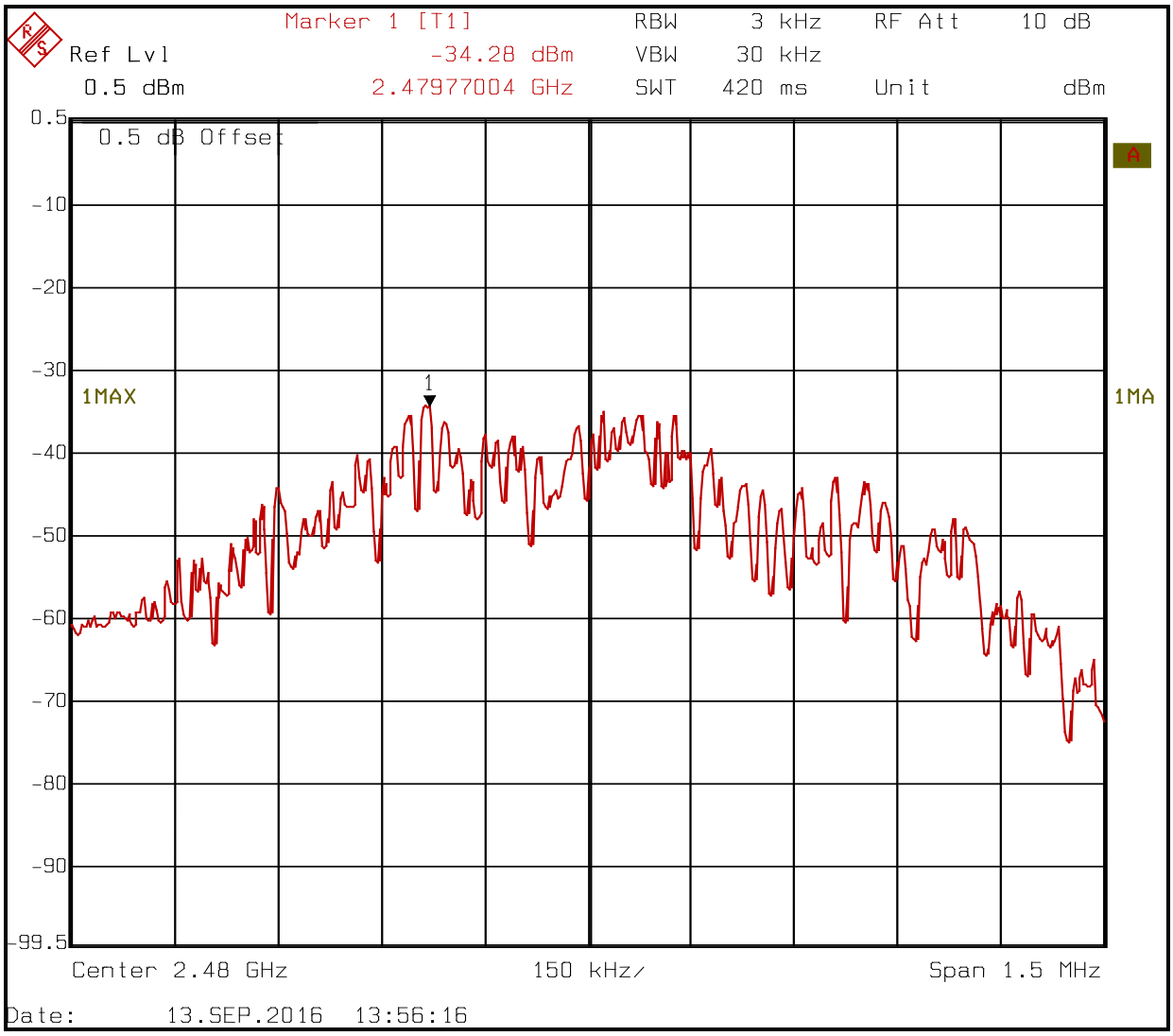
Plot 5-1: Peak Spectral Density – 2402 MHz



Plot 5-2: Peak Spectral Density – 2440 MHz



Plot 5-3: Peak Spectral Density – 2480 MHz



Test Personnel:

Dan Baltzell		September 13, 2016
Test Engineer	Signature	Date of Test

6 Antenna Conducted Spurious Emissions – FCC 15.247(d), RSS-247 5.5

6.1 Antenna Conducted Spurious Emissions Test Procedure

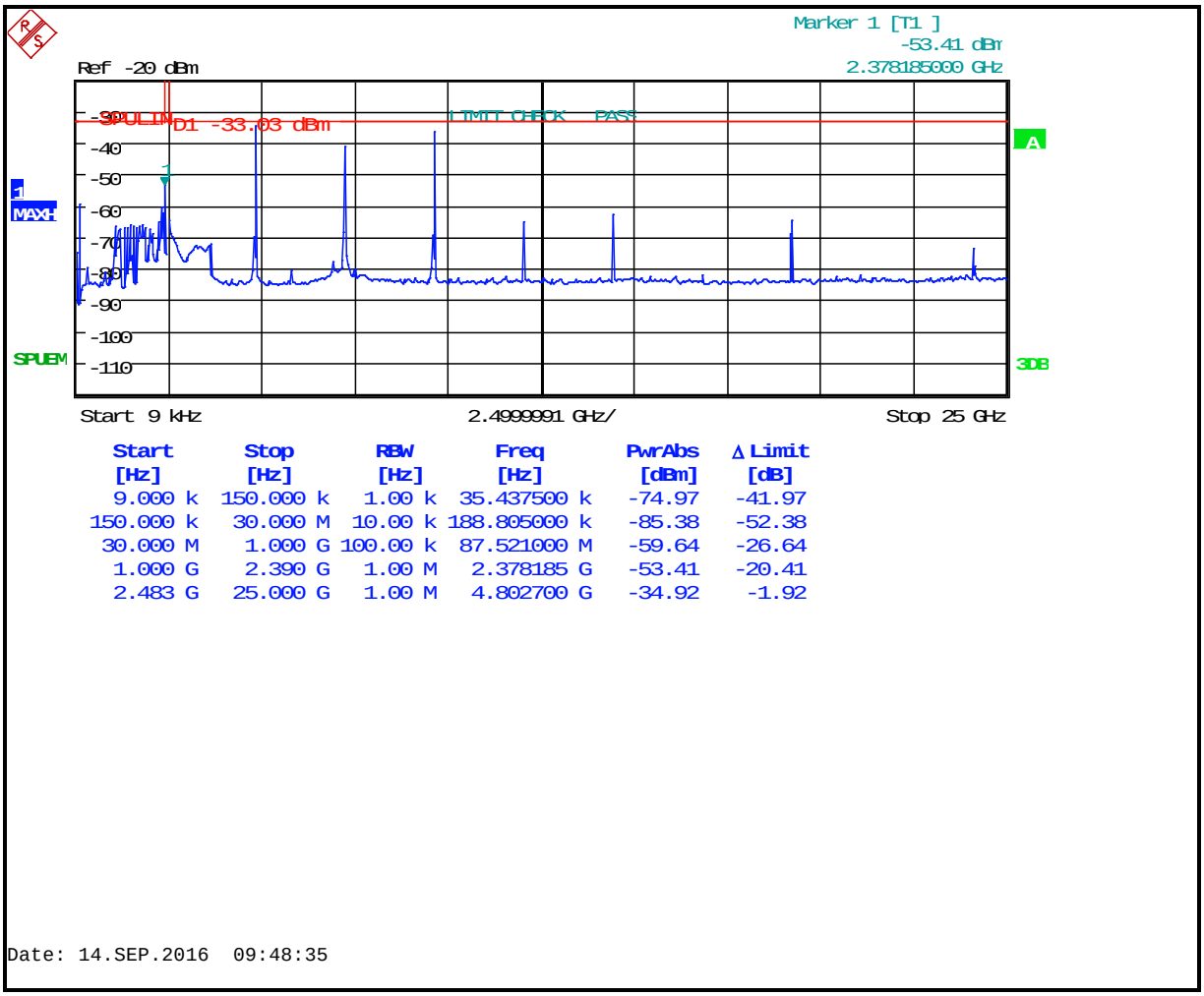
An SMA connector provided a port for measurement from 9 kHz to the 10th harmonic with the spectrum analyzer, for the low, mid, and high channels.

Table 6-1: Antenna Conducted Spurious Emissions Test Equipment

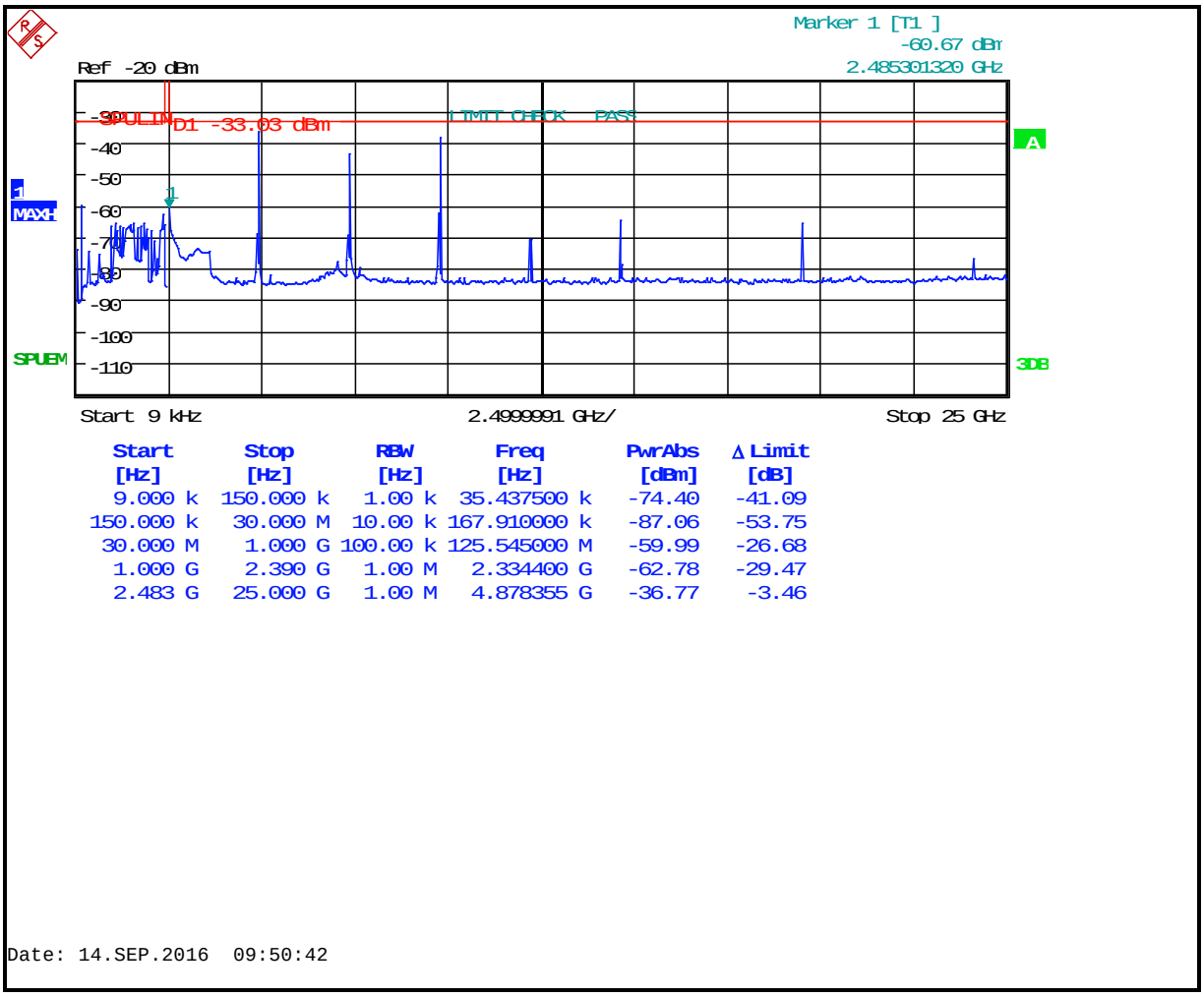
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

6.2 Antenna Conducted Spurious Emissions Test Data

Plot 6-1: Antenna Conducted Spurious Emissions – 2402 MHz



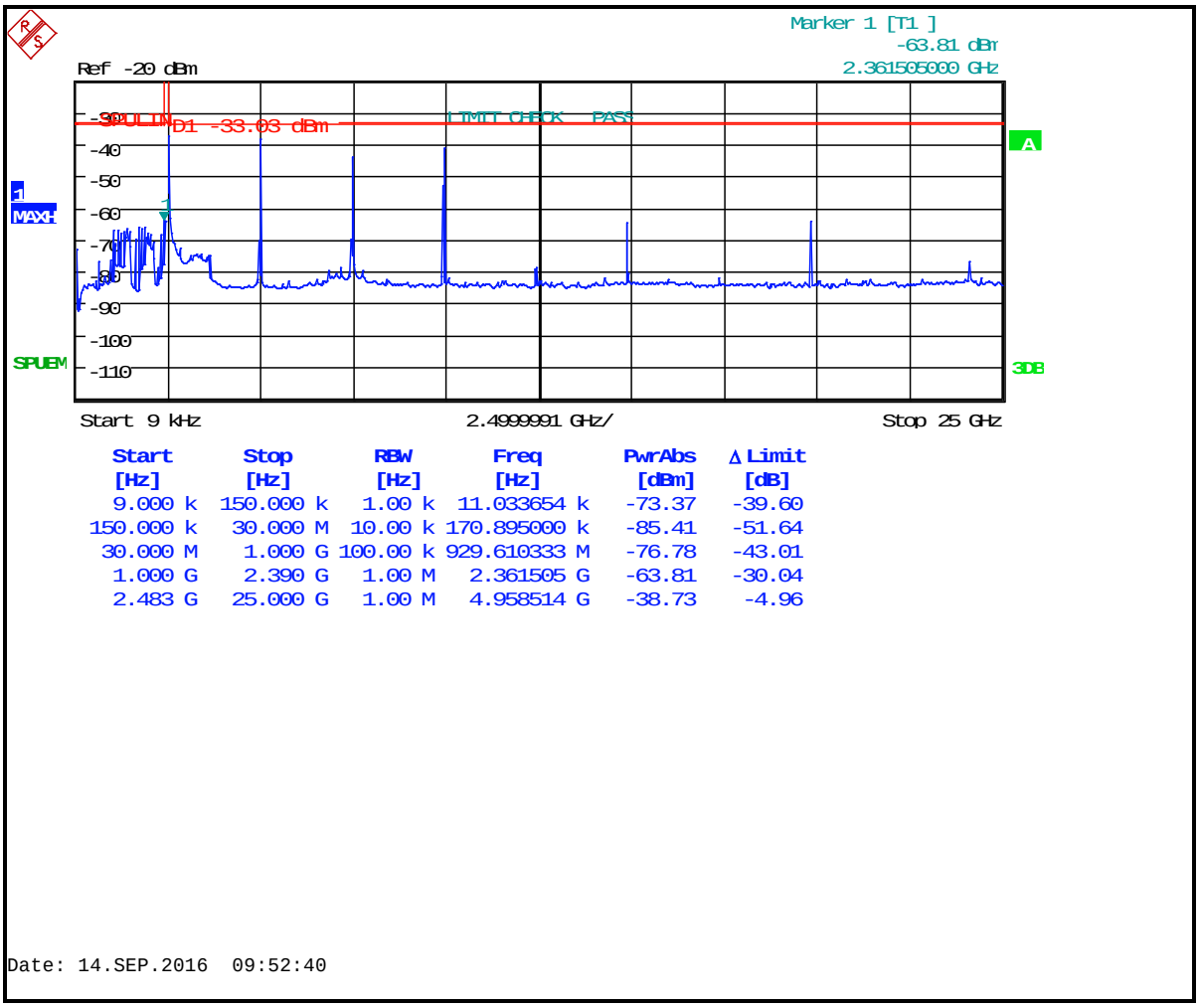
Plot 6-2: Antenna Conducted Spurious Emissions – 2440 MHz



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	35.437500 k	-74.40	-41.09
150.000 k	30.000 M	10.00 k	167.910000 k	-87.06	-53.75
30.000 M	1.000 G	100.00 k	125.545000 M	-59.99	-26.68
1.000 G	2.390 G	1.00 M	2.334400 G	-62.78	-29.47
2.483 G	25.000 G	1.00 M	4.878355 G	-36.77	-3.46

Date: 14.SEP.2016 09:50:42

Plot 6-3: Antenna Conducted Spurious Emissions – 2480 MHz



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	11.033654 k	-73.37	-39.60
150.000 k	30.000 M	10.00 k	170.895000 k	-85.41	-51.64
30.000 M	1.000 G	100.00 k	929.610333 M	-76.78	-43.01
1.000 G	2.390 G	1.00 M	2.361505 G	-63.81	-30.04
2.483 G	25.000 G	1.00 M	4.958514 G	-38.73	-4.96

Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	September 14, 2016
EMC Test Engineer	Signature	Date of Test

7 Compliance with the Band Edge – FCC 15.247(d); RSS-247 5.5

7.1 Band Edge Test Procedure

Conducted measurements were taken. The span was set wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The spectrum analyzer was set to the following:

RBW = 1% of span
VBW > = RBW
Sweep = auto
Detector function = peak
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 20 dBc requirement of 15.247(d) (when using peak emissions) or restricted band.

Table 7-1: Radiated Band Edge Emissions Test Data

Frequency (MHz)	Peak Spectrum Analyzer Level (1 MHz RBW/ VBW) (dBuV)	Average Duty Cycle Calculation (Factor -14.1) (dBuV)	Site Correction Factor (dB/m)	Calculated Average Level (dBuV/m)	Delta Measurement from Plots (dB)	Average Limit (dBuV/m)	Margin (dB)
2402.0	58.2	44.1	25.1	69.2	39.0	54.0	-23.8
2480.0	54.4	40.3	25.3	65.6	42.0	54.0	-30.4

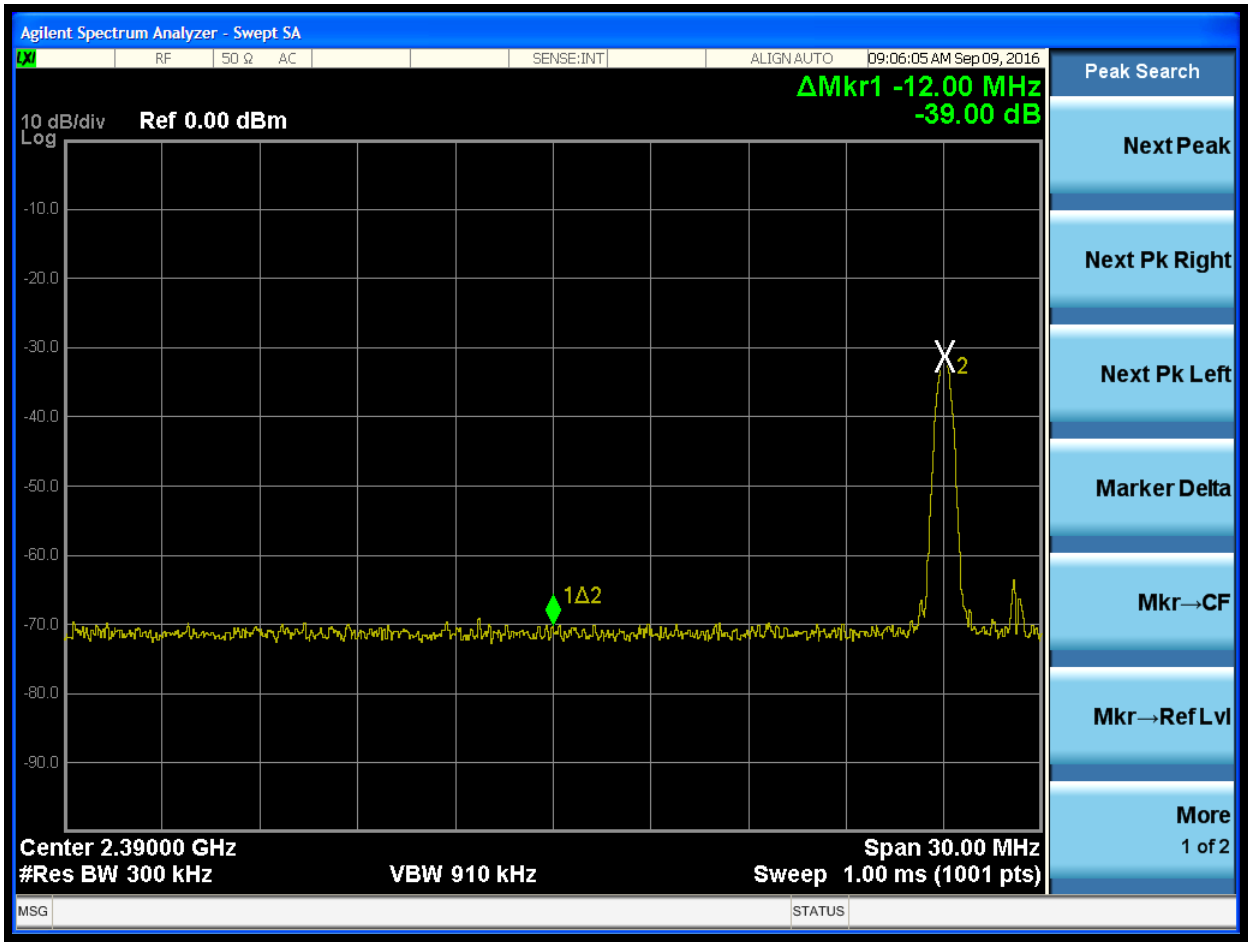
Table 7-2: Band Edge Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent	EXA N9010A	Spectrum Analyzer	MY51250846	4/21/17

7.2 Band Edge Test Results

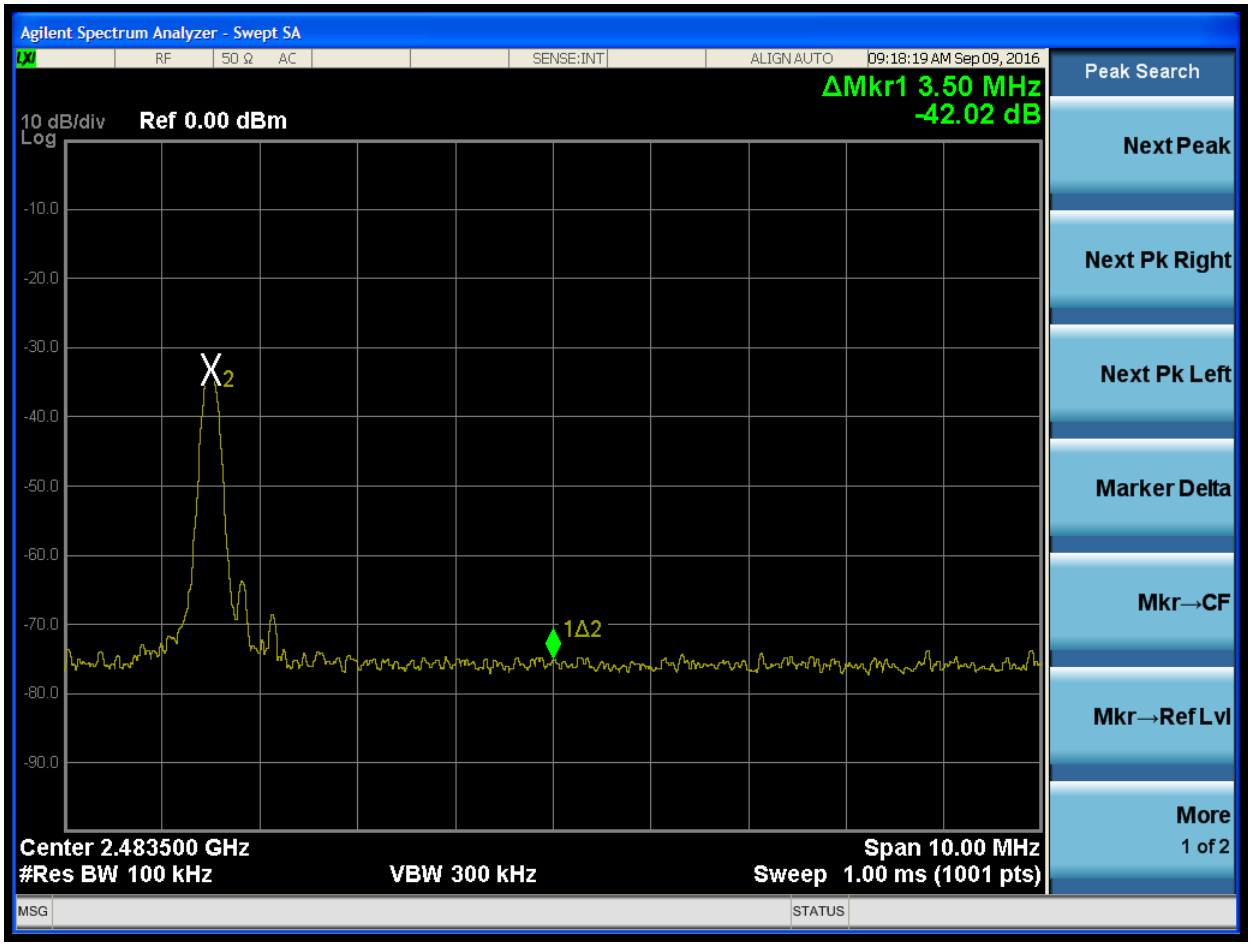
7.2.1 Lower Band Edge – Plots

Plot 7-1: Lower Band Edge - Peak



7.2.2 Upper Band Edge Plots

Plot 7-2: Upper Band Edge – Peak



Test Personnel:

Jon Wilson		September 9, 2016
EMC Test Engineer	Signature	Date of Test

8 Bandwidth – FCC 15.247(a)(2); RSS-247 5.2(1)

8.1 6 dB Bandwidth Test Procedure

The minimum 6 bandwidth per FCC 15.247 (a)(1) and RSS-247 was measured using a 50-ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was set to auto and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 100 kHz, and the video bandwidth set at 300 kHz.

Table 8-1: 6 dB Bandwidth Test Equipment

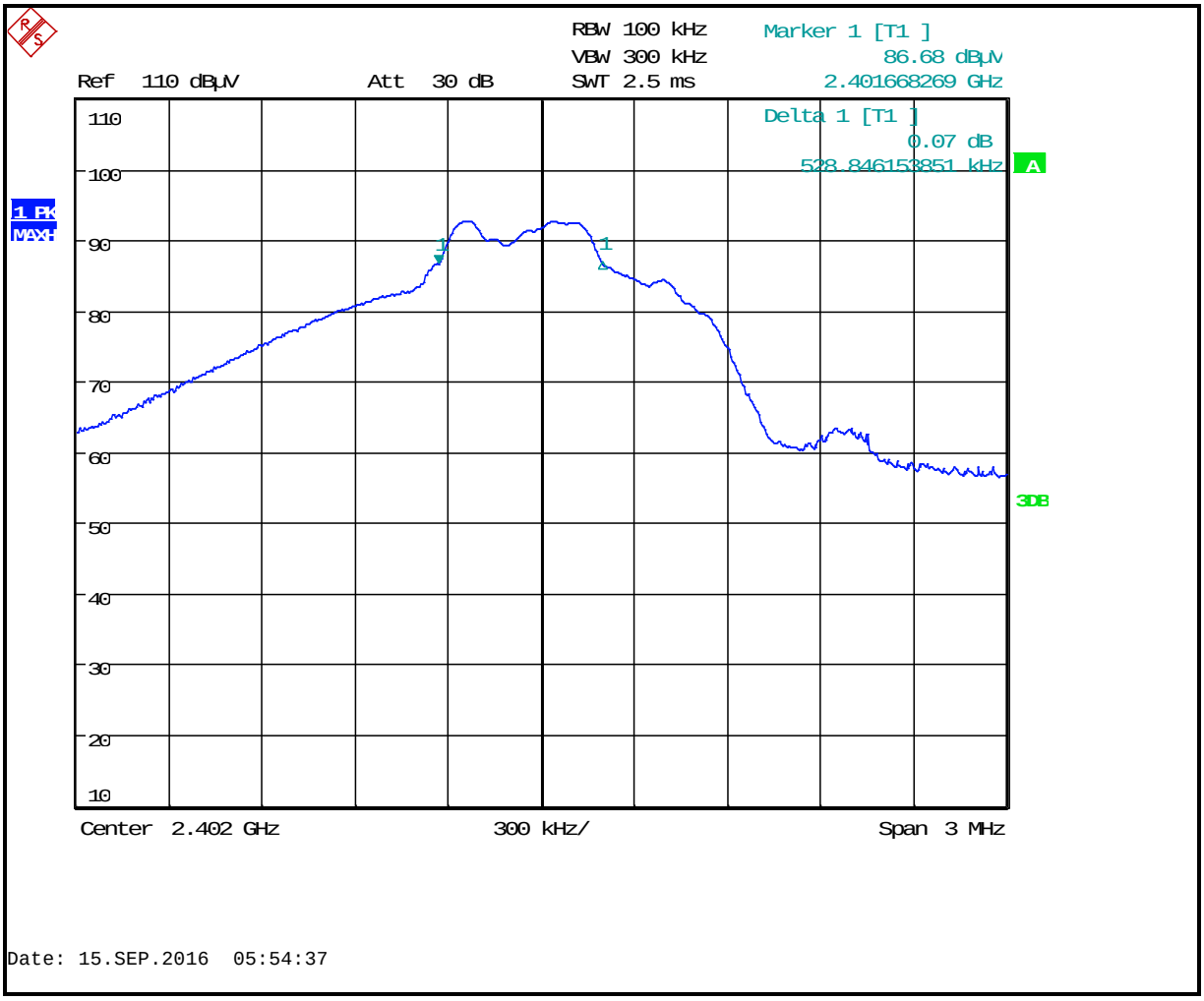
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

8.2 Bandwidth Test Results

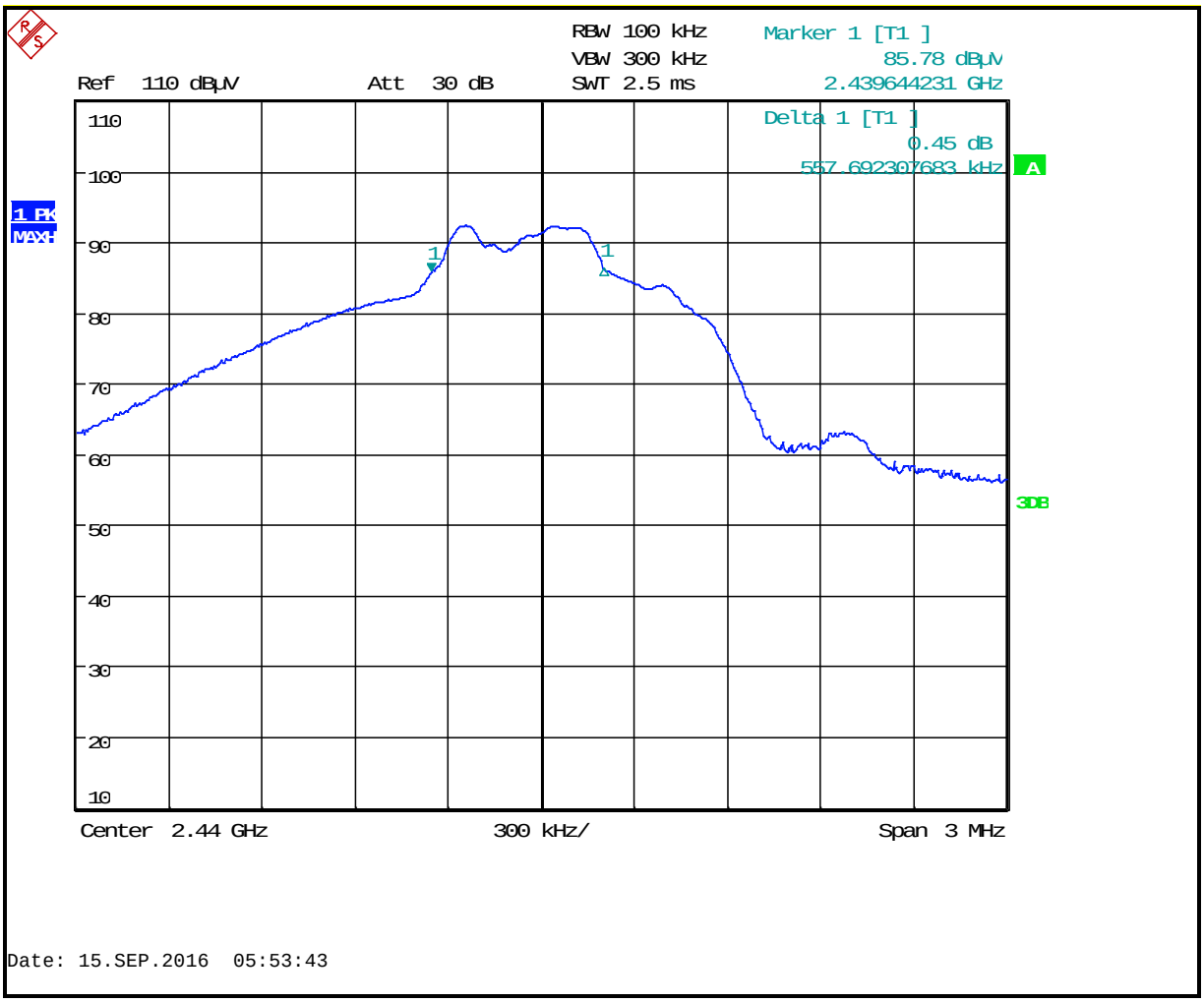
Table 8-2: 6 dB Bandwidth Test Data

Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (MHz)	Pass/Fail
2402	528	0.5	Pass
2440	557	0.5	Pass
2480	558	0.5	Pass

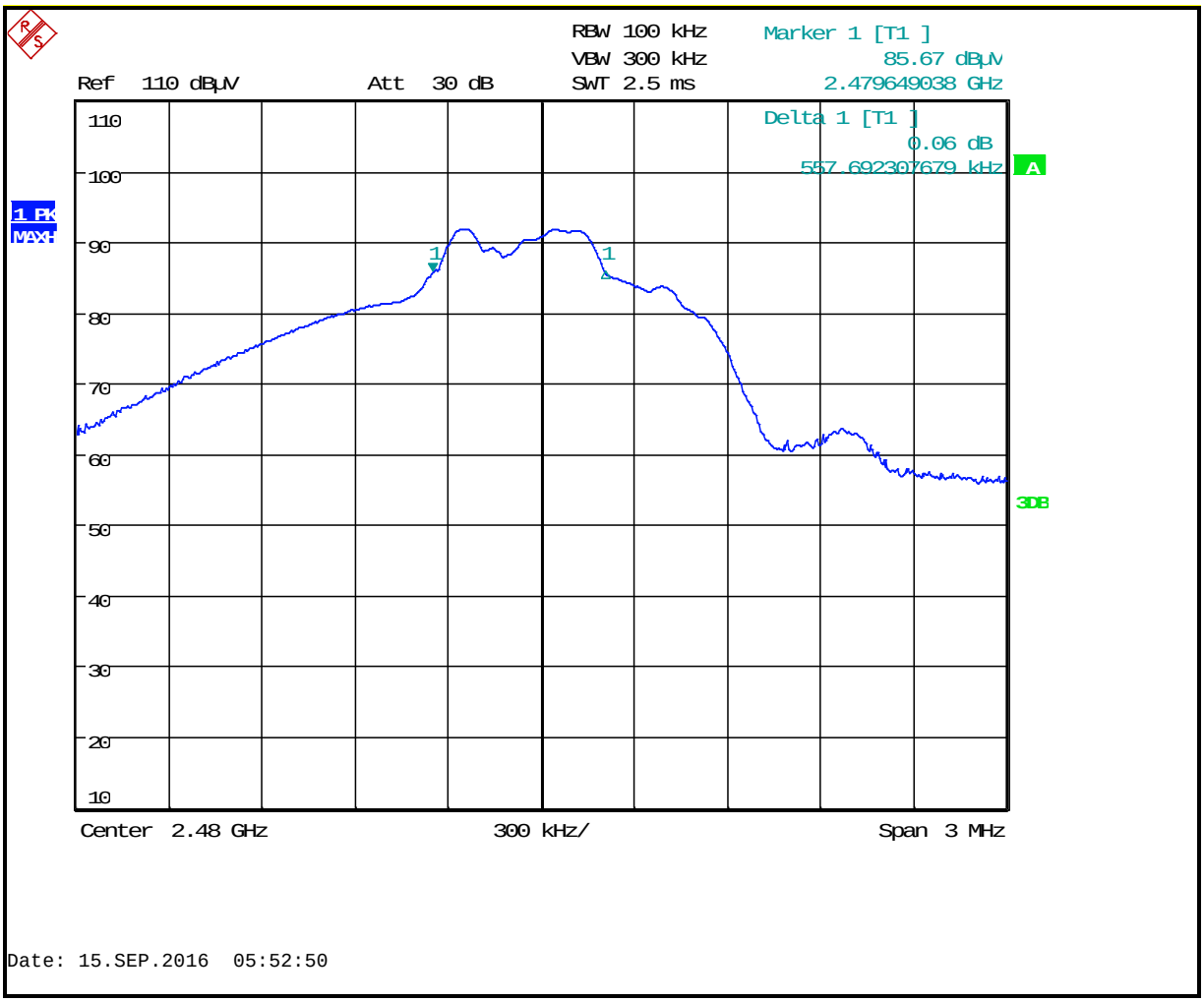
Plot 8-1: 6 dB Bandwidth – 2402 MHz



Plot 8-2: 6 dB Bandwidth – 2440 MHz



Plot 8-3: 6 dB Bandwidth – 2480 MHz



Test Personnel:

Dan Baltzell		September 15, 2016
Test Engineer	Signature	Date of Test

9 Radiated Emissions - 15.209; RSS-247 2.2; RSS-Gen 6.13/7.1

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	2400/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

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 m (<1 GHz) / 1.5 m (>1 GHz) above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (10 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 1000 MHz, emissions are measured using a VBW of 10 Hz, 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	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	Not Required
900791	Chase	CBL6112	Antenna (30 MHz – 2 GHz)	2099	6/11/17
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz - 6.5 GHz)	3325A00159	12/9/17
900914	Hewlett Packard	85460A	RF Filter Section (100 kHz - 6.5 GHz)	3330A00107	12/9/17
901583	Agilent	EXA N9010A	Spectrum Analyzer	MY51250846	4/21/17
900932	Rhein Tech Laboratories	8449B OPT H02	Amplifier (1 – 26.5 GHz)	3008A00505	9/11/17
900905	Rhein Tech Laboratories, Inc.	PR-1040	Amplifier (20 MHz - 2 GHz)	900905	9/11/17
N/A	Rhein Tech Laboratories, Inc.	Automated Emission Tester	Emissions Testing Software	Rev. 14.0.2	N/A
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
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/9/18
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	4/9/18
901218	EMCO	3160-09	Horn Antenna (18 - 26 GHz)	960281-003	4/14/18
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	6/11/17

9.3 Radiated Emissions Test Results

9.3.1 Unintentional Radiated Emissions Test Data

Table 9-2: Digital Radiated Emissions Test Data

Temperature: 92°F Humidity: 45%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
168.000	Qp	V	190	1.0	42.3	-19.4	22.9	43.5	-20.6	Pass
602.300	Qp	H	275	1.5	34.5	-6.0	28.5	46.0	-17.5	Pass
745.840	Qp	V	255	1.0	32.9	-3.5	29.4	46.0	-16.6	Pass
756.345	Qp	V	240	1.2	36.5	-3.2	33.3	46.0	-12.7	Pass
883.400	Qp	V	90	1.0	33.2	-0.5	32.7	46.0	-13.3	Pass
889.875	Qp	H	75	1.0	25.1	-0.6	24.5	46.0	-21.5	Pass

9.3.2 Spurious/Harmonics Radiated Emissions Test Data

Table 9-3: Peak Radiated Emissions Spurious/Harmonics – 2402 MHz

Emission Frequency (MHz)p	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4804.0	49.6	-1.4	48.2	74.0	-25.8
12010.0	44.9	9.6	54.5	74.0	-19.5
19216.0	40.8	21.8	62.6	74.0	-11.4

Table 9-4: Calculated Average Radiated Emissions Spurious/Harmonics – 2402 MHz

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Calculation Factor (dB)	Calculated Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4804.0	48.2	-14.8	33.4	54.0	-20.6
12010.0	54.5	-14.8	39.7	54.0	-14.3
19216.0	62.6	-14.8	47.8	54.0	-6.2

Table 9-5: Peak Radiated Emissions Spurious/Harmonics - 2440 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4880.0	46.9	-1.3	45.6	74.0	-28.4
7320.0	58.9	0.8	59.7	74.0	-14.3
12200.0	43.1	9.9	53.0	74.0	-21.0
19520.0	43.4	20.1	63.5	74.0	-10.5

Table 9-6: Calculated Average Radiated Emissions Spurious/Harmonics – 2440 MHz

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Calculation Factor (dB)	Calculated Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4880.0	45.6	-14.8	30.8	54.0	-23.2
7320.0	59.7	-14.8	44.9	54.0	-9.1
12200.0	53.0	-14.8	38.2	54.0	-15.8
19520.0	63.5	-14.8	48.7	54.0	-5.3

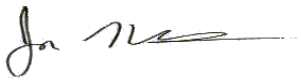
Table 9-7: Peak Radiated Emissions Spurious/Harmonics - 2480 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
4960.0	49.6	-1.4	48.2	74.0	-25.8
7440.0	58.6	1.0	59.6	74.0	-14.4
12400.0	41.9	10.1	52.0	74.0	-22.0
19840.0	40.0	22.0	62.0	74.0	-12.0
22320.0	37.4	21.8	59.2	74.0	-14.8

Table 9-8: Calculated Average Radiated Emissions Spurious/Harmonics – 2480 MHz

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Calculation Factor (dB)	Calculated Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4960.0	48.2	-14.8	33.4	54.0	-20.6
7440.0	59.6	-14.8	44.8	54.0	-9.2
12400.0	52.0	-14.8	37.2	54.0	-16.8
19840.0	62.0	-14.8	47.2	54.0	-6.8
22320.0	59.2	-14.8	44.4	54.0	-9.6

Test Personnel:

Jon Wilson		September 9, 2016
EMC Test Engineer	Signature	Date of Test

10 Conclusion

The data in this measurement report shows that the EUT as tested, Model EA-150092, FCC ID: VR3-92, IC: 7465A-92, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations and Industry Canada RSS-247 and RSS-Gen.