

Test Report # 317134 A

Equipment Under Test: RG191-M2

Test Date(s): 4/19/17 – 5/31/17

Prepared for: Laird Technologies, Inc.
Attn: Josh Bablitch
W66N220 Commerce Ct.
Cedarburg, WI 53012

Report Issued by: Shane Dock, EMC Engineer

Signature:



Date: 6/23/17

Report Reviewed by: Adam Alger, Quality Systems Engineer

Signature: 

Date: 6/23/17

Report Constructed by: Shane Dock, EMC Engineer

Signature:



Date: 6/23/17

This test report may not be reproduced, except in full, without written approval of Laird Technologies, Inc.

Company: Laird Technologies, Inc.	Page 1 of 34	Name: RG191-M2
Report: 317134 A		Model: RG191-M2
Job: C-2722		Serial: 00027

CONTENTS

Contents.....	2
Laird Technologies Test Services in Review	3
1 Test Report Summary	4
2 Client Information.....	5
2.1 Equipment Under Test (EUT) Information	5
2.2 Product Description	5
2.3 Modifications Incorporated for Compliance.....	5
2.4 Deviations and Exclusions from Test Specifications	5
2.5 Additional Information.....	5
2.6 Additional Information.....	6
3 References	7
4 Uncertainty Summary	8
5 Test Data	9
5.1 Antenna Port Conducted Emissions.....	9
5.2 Radiated Emissions	24
5.3 AC Mains Conducted Emissions	31
6 Revision History	34

Laird Technologies Test Services in Review

The Laird Technologies, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:



A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein, unless otherwise noted.



Federal Communications Commission (FCC) – USA

Accredited recognition of two 3 meter Semi-Anechoic Chambers

Accredited Test Firm Registration Number: 953492



**Government
of Canada**

Innovation, Science and Economic Development Canada

ISED Site listing of two 3 meter Semi-Anechoic Chambers based on RSS-GEN – Issue 4

File Number: IC 3088A-2

File Number: IC 3088A-3

Company: Laird Technologies, Inc.	Page 3 of 34	Name: RG191-M2
Report: 317134 A		Model: RG191-M2
Job: C-2722		Serial: 00027

1 TEST REPORT SUMMARY

During **4/19/17 – 5/31/17** the Equipment Under Test (EUT), **RG191-M2**, as provided by **Laird Technologies, Inc.** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(2) IC: RSS-247 5.2 (1)	Digital Modulation System 6 dB bandwidth	500 kHz	KDB 558074	Pass
FCC: 2.1049 IC: RSS-GEN 6.6	Occupied Bandwidth	Reported	KDB 558074	Pass
FCC: 15.247 (b)(3) IC: RSS-247 5.4 (4)	Maximum Conducted Output Power	30 dBm	KDB 558074	Pass
FCC: 15.247 (e) IC: RSS-247 5.2 (2)	Digital Modulation System Power Spectral Density	8 dBm / 3 kHz	KDB 558074	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	20 dBc	KDB 558074	Pass
FCC: 15.247 (d) IC: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Pass
FCC: 2.1055 (d) IC: RSS-GEN 6.11	Frequency Stability	Reported	ANSI C63.10	Pass
FCC: 15.207 IC: RSS-GEN 8.8	AC Power Line Conducted Emissions	0.150-30 MHz	ANSI C63.10	Pass

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	Laird Technologies, Inc.
Contact Person	Josh Bablitch
Address	W66N220 Commerce Ct. Cedarburg, WI 53012

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	RG191-M2
Model Number	RG191-M2
Serial Number	00027
FCC / IC ID	SQG-1001 / 3147A-1001

2.2 Product Description

The Laird Sentrius M2.COM Card is an easy to integrate LoRa-enabled concentrator card for use in a LoRaWAN network.

The antenna is an LSR 900 MHz Dipole Antenna with a gain of 2 dBi.

2.3 Modifications Incorporated for Compliance

Cable implemented to separate module from host board units.

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

EUT programmed via serial connection (PuTTY v 0.69 used for testing). Module is provided with 5V dc power from the host board. For AC Mains Emissions and Frequency Stability Test, this 5V was supplied to the unit directly from an auxiliary DC source.

2.6 Additional Information

Unit tested at spreading factors of 7 and 12. Unit has a modulation bandwidth of 500kHz. High Power Setting is a PA Gain of 3 and a Mixer Gain of 13. Low Power Setting is PA Gain 0 and Mixer Gain 13.

Low – 923.3 MHz

Mid – 925.7 MHz

High – 927.5 MHz

Company: Laird Technologies, Inc.	Page 6 of 34	Name: RG191-M2
Report: 317134 A		Model: RG191-M2
Job: C-2722		Serial: 00027

3 REFERENCES

Publication	Edition	Date
CFR 47 Part 15	-	2017
ANSI C63.10	-	2013
RSS-247	2	2017
RSS GEN	4	2014
KDB 558074	4	2017

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of $k = 2$.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty \pm
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

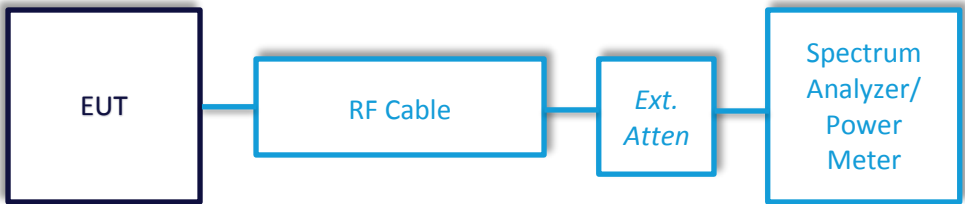
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	<p>The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter.</p> <p>The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.</p>
Example Calculations	<p>Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm)</p> <p>Margin (dB) = Limit (dBm) – Corrected Reading (dBm)</p>

Block Diagram





5.1.1 Antenna Port Conducted Emissions – DTS/99% Bandwidth

Operator	Shane Dock
QA	Kim Bay
Test Date	4/19/17
Location	Conducted RF Area
Temp. / R.H.	75/37
Requirement	FCC 15.247 (a)(2) IC: RSS-247 5.2 (1)
Method	KDB 558074 Section 8.2

Limits:

Minimum 6 dB BW (MHz)
0.5

Test Parameters

Frequency	923.3-927.5 MHz
EUT	Unit Tested on Low, Mid, and High Channel

Instrumentation



Date : 17-Apr-2017 Test : Conducted Power Output Job # : C-2722
PE: Shane Customer : LSR Quote # : 317134

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960088	EM Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration
2	AA 960143	Phaseflex	Gore	EK001D01048.0	5546519	6/29/2016	6/29/2017	Active Calibration
3	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration

Tested By: Shane Dock

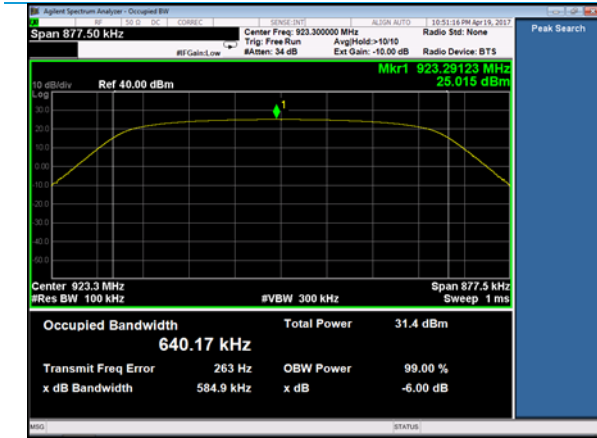
Quality Assurance: Kim Bay

Table

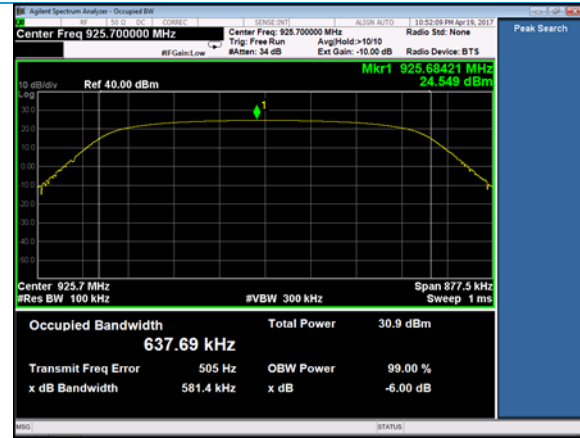
Channel	Low	Mid	High
6 db BW (kHz)	584.9	581.4	582.4
99% BW (kHz)	518.5	518.4	518.6

Worst Case Margin = Closest Measurement – Limit = 518.4 kHz – 500kHz = 18.4 kHz

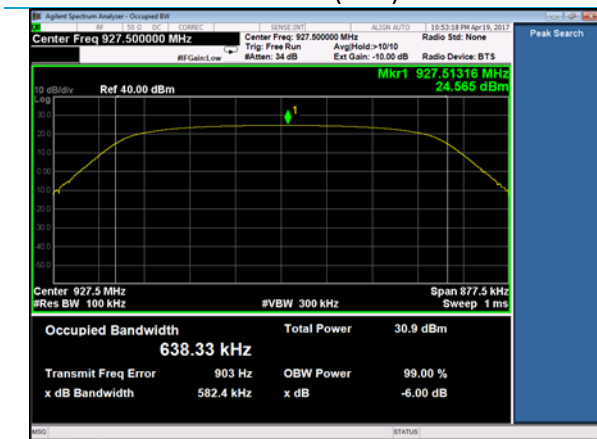
Plots



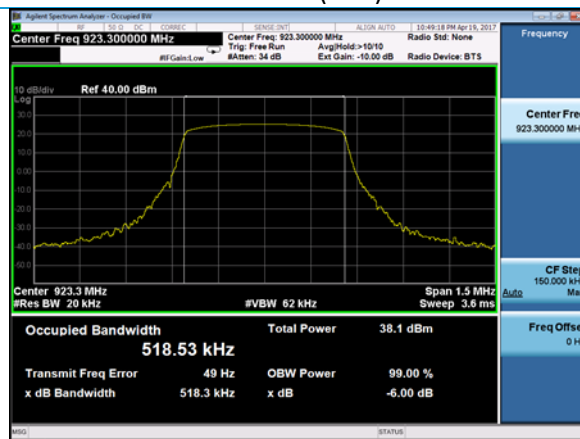
DTS BW (Low)



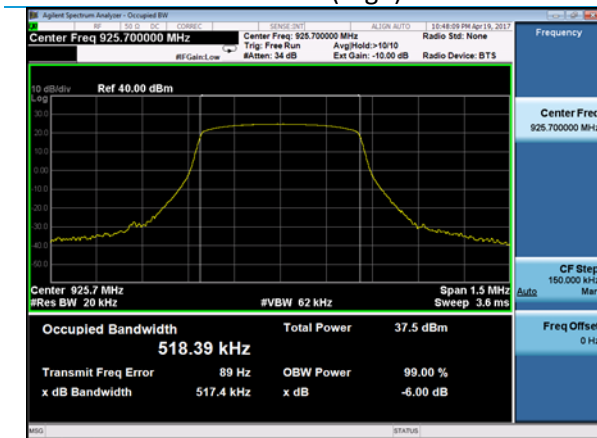
DTS BW (Mid)



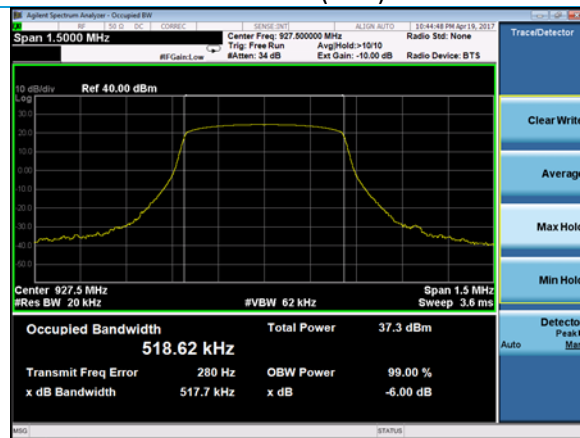
DTS BW (High)



99% BW (Low)



99% BW (Mid)



99% BW (High)

5.1.2 Antenna Port Conducted Emissions – Conducted Output Power

Operator	Shane Dock
QA	Kim Bay
Test Date	5/12/17, 6/9/17
Location	Conducted RF Area
Temp. / R.H.	73/40
Requirement	FCC: 15.247 (b)(3) IC: RSS-247 5.4 (4)
Method	KDB 558074 Section 9.2.2.3

Limits: (Measured as Average)

Maximum Conducted Output Power (dBm)	Maximum Conducted Output Power (watts)
30	1

Test Parameters

Frequency	923.3 – 927.5 MHz
Settings	Low, Mid, and High Channels Checked on SF 7 and SF 12
Settings	Unit measured at full power and minimum power. Duty cycle of 100%.

Table

Max Power (dBm)

	Low	Mid	High
SF 7	27.5	27.2	27.2
SF 12	27.7	27.4	27.3

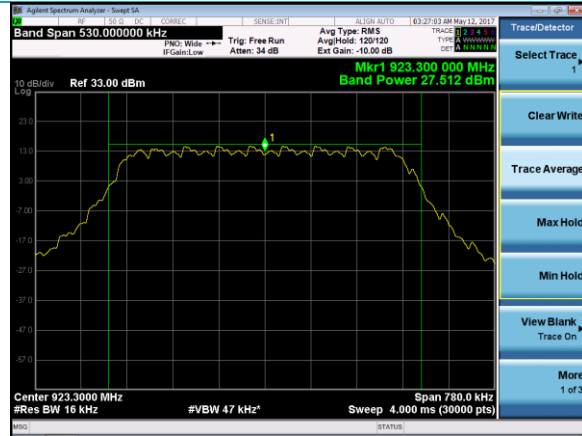
Min Power (dBm)

	Low	Mid	High
SF 7	1.5	0.8	0.8
SF 12	1.3	-0.1	-0.0

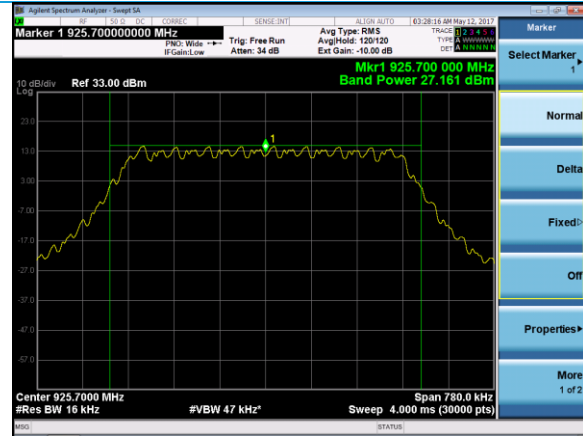
Worst Case Margin = Limit - Closest Measurement = 30.0 dBm – 27.7 dBm = 2.3 dB

Plots

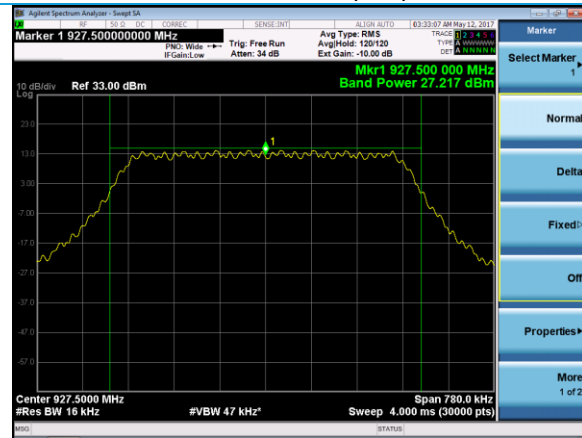
Maximum Power



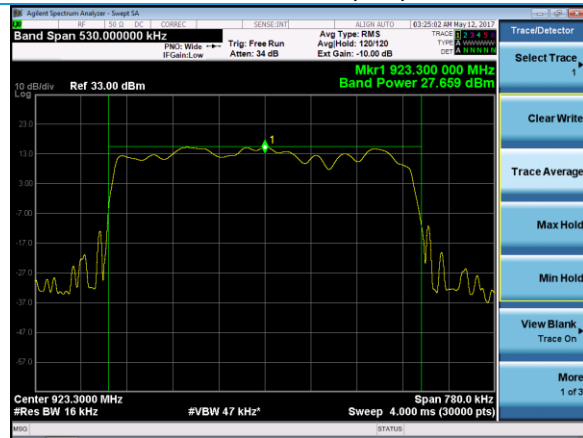
Low Channel (SF7)



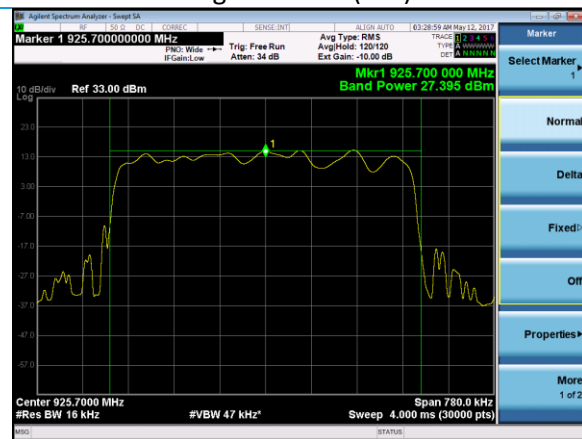
Mid Channel (SF7)



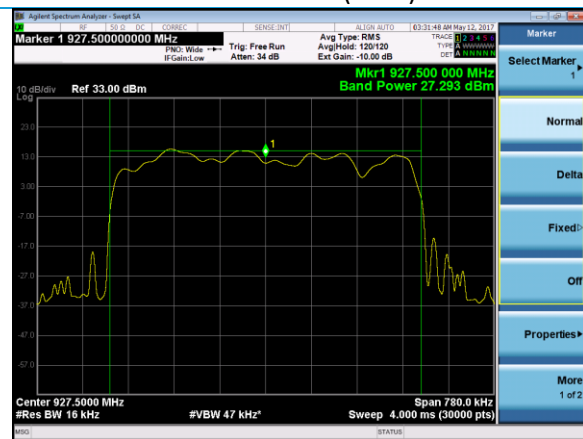
High Channel (SF7)



Low Channel (SF12)



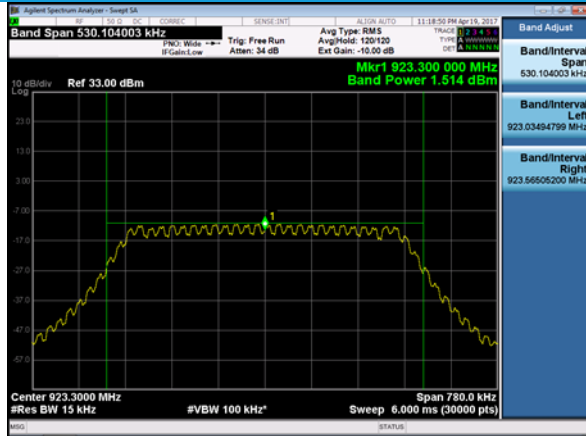
Mid Channel (SF 12)



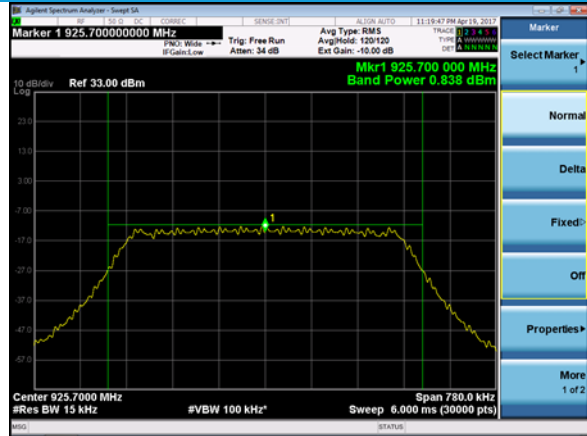
High Channel SF (12)

Company: Laird Technologies, Inc.	Page 14 of 34	Name: RG191-M2
Report: 317134 A		Model: RG191-M2
Job: C-2722		Serial: 00027

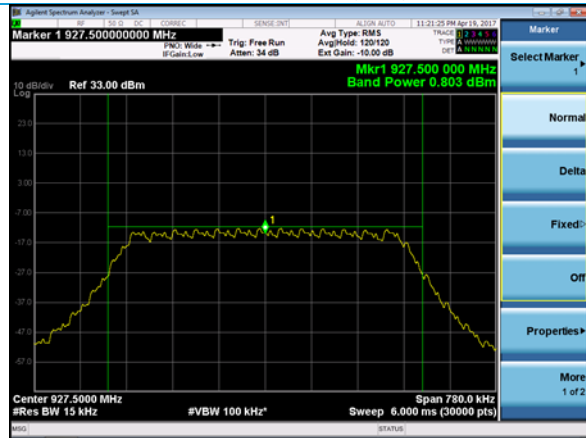
Minimum Power



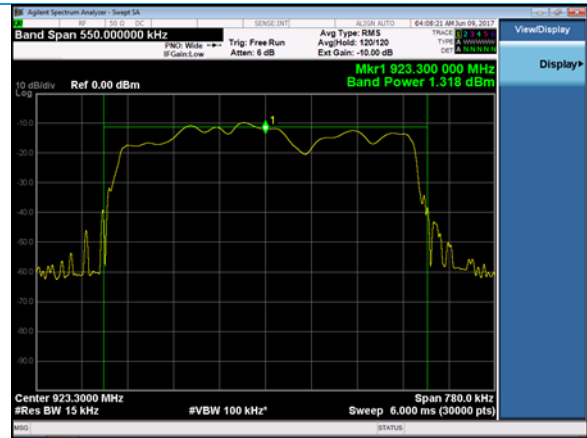
Low Channel (SF7)



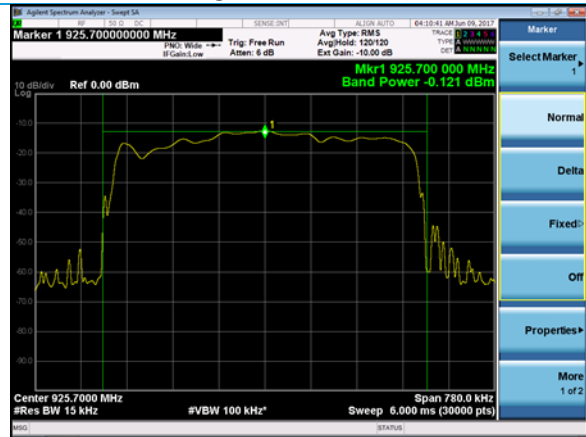
Mid Channel (SF7)



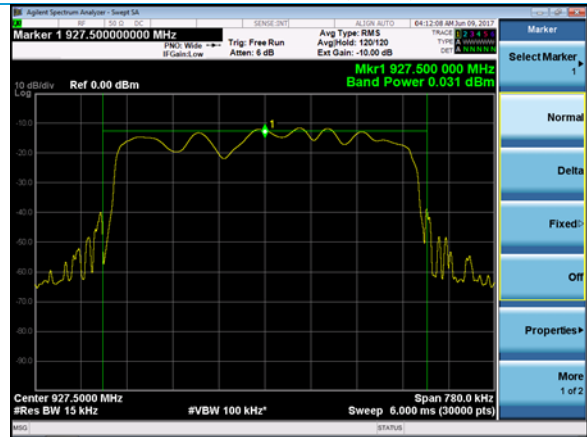
High Channel (SF7)



Low Channel (SF12)



Mid Channel (SF 12)



High Channel SF (12)

5.1.3 Antenna Port Conducted Emissions – Power Spectral Density

Operator	Shane Dock
QA	Kim Bay
Test Date	4/19/17
Location	Conducted RF Area
Temp. / R.H.	73 degrees F/ 40% RH
Requirement	FCC: 15.247 (e) IC: RSS-247 5.2 (2)
Method	KDB 558074 Section 10.4

Limits:

Power Spectral Density (dBm/ 3 kHz)
8

Test Parameters

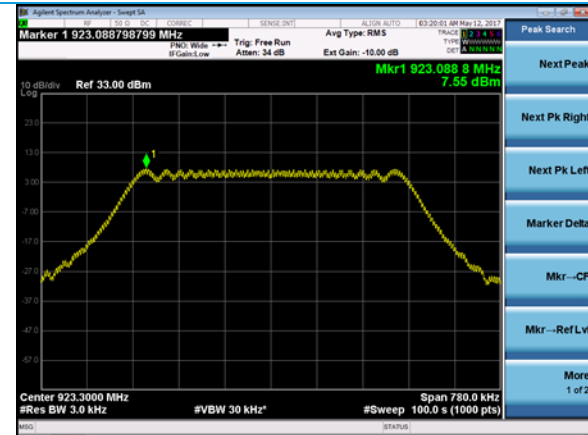
Frequency	923.3 – 927.5 MHz
Settings	Low, Mid, and High Channels Checked on SF 7 and SF 12
Settings	Unit measured at full power.

Table

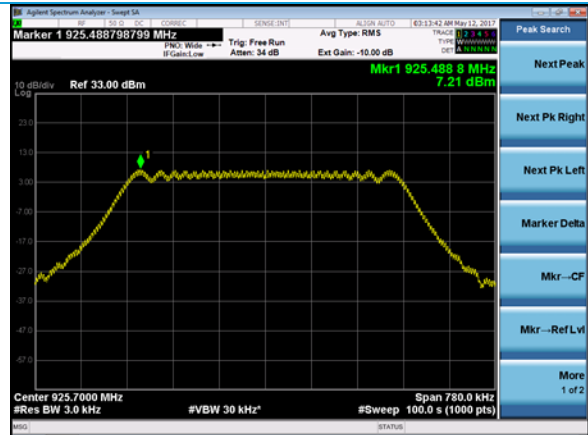
SF Value	PSD by Channel (dBm/ 3 kHz)		
	Low	Mid	High
SF 12	6.2	6.0	5.8
SF 7	7.6	7.2	7.1

Worst Case Margin = Limit - Closest Measurement = 8 dBmz – 7.6 dBm = 0.4 dB

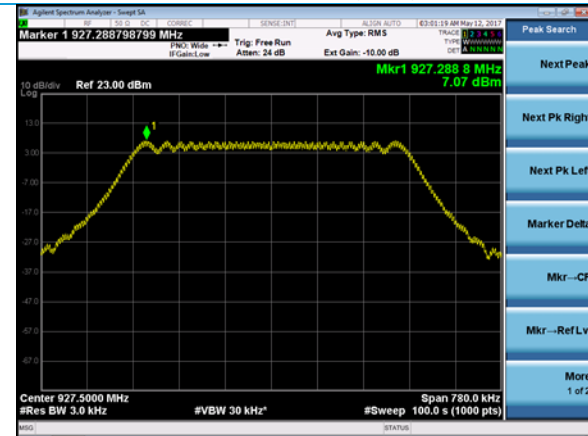
Plots



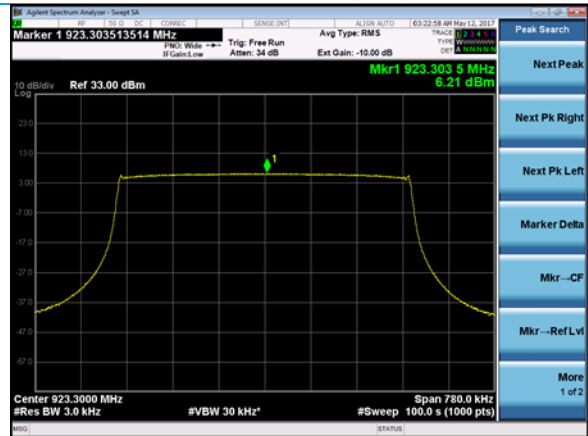
Low Channel (SF 7)



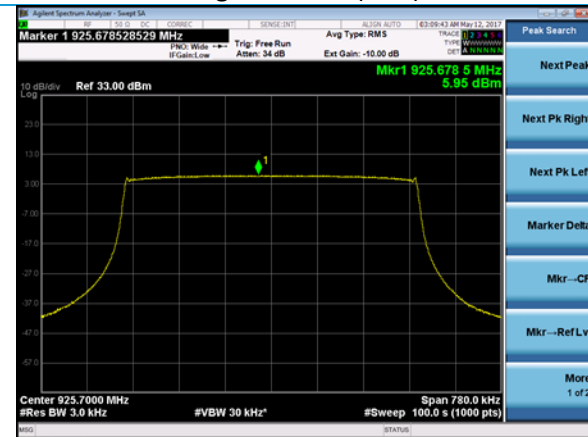
Mid Channel (SF 7)



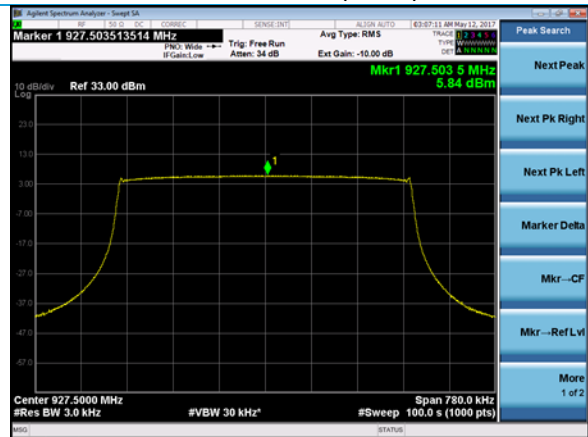
High Channel (SF 7)



Low Channel (SF 12)



Mid Channel (SF 12)



High Channel (SF 12)

5.1.4 Antenna Port Conducted Emissions – Tx Conducted Spurious

Operator	Shane Dock
QA	Kim Bay
Test Date	4/19/17
Location	Conducted RF Area
Temp. / R.H.	73 degrees F/ 40% RH
Requirement	FCC: 15.247 (d) IC: RSS-247 5.5
Method	KDB 558074 Section 11

Limits:

Spurious Emissions Limit (dBc from Reference Point)
30

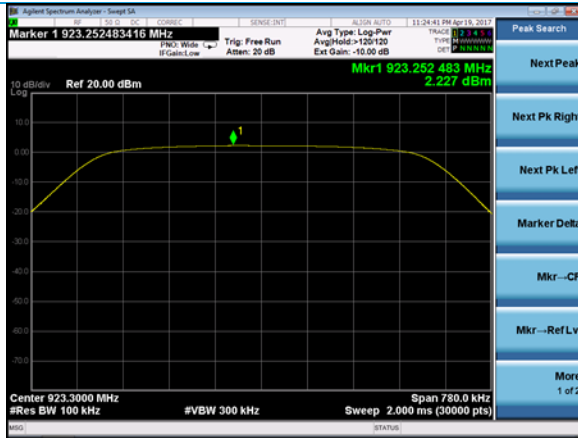
Test Parameters

Frequency	30-10000 MHz
Settings	100k RBW/ 300k RBW
EUT	Low, Mid, High Checked at High and Low Power

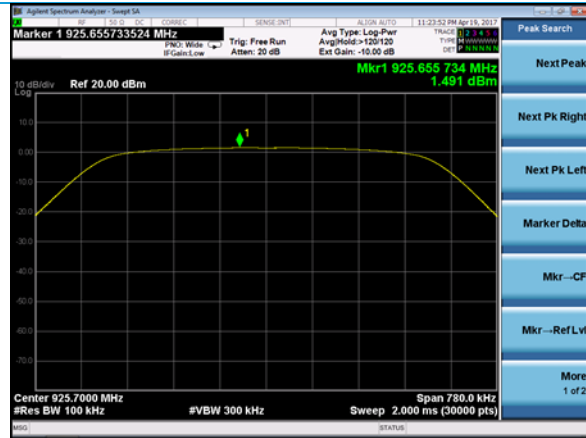
Worst Case Margin = Limit - Closest Measurement = -2.50 dBm – 16.73 dBm = 14.23 dB

Plots

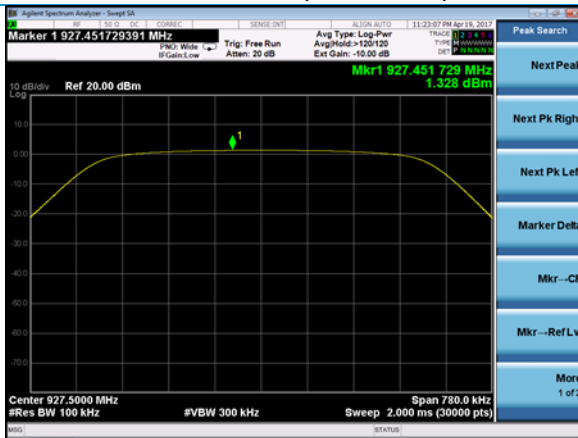
Reference Levels



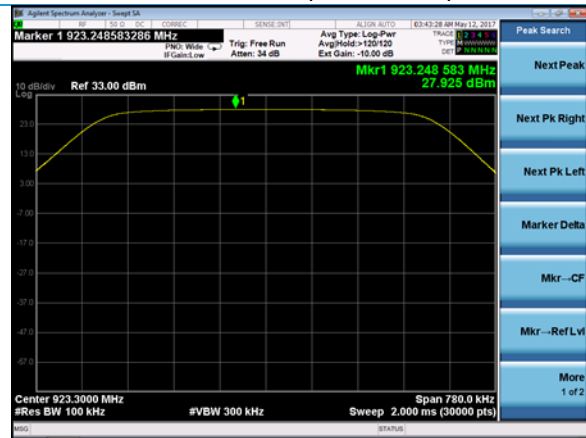
Low Channel (Low Power)



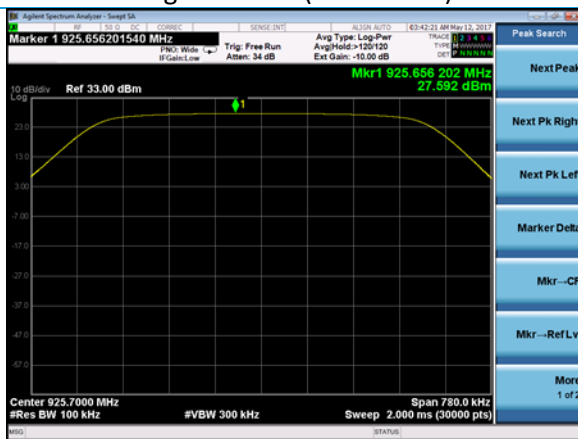
Mid Channel (Low Power)



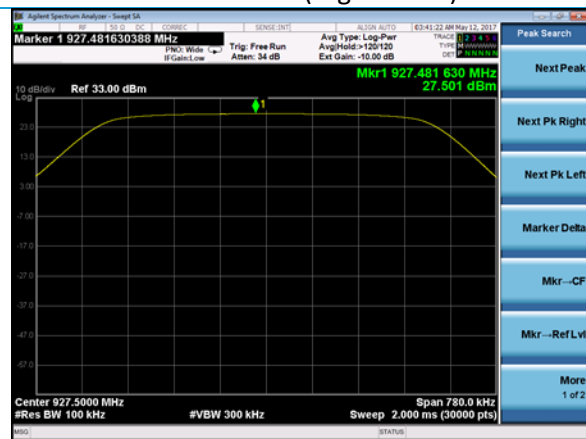
High Channel (Low Power)



Low Channel (High Power)

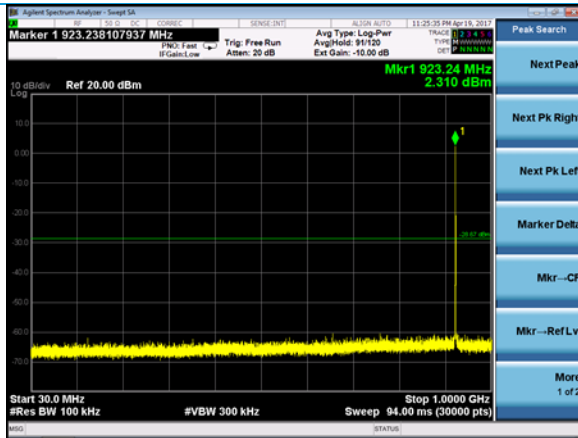


Mid Channel (High Power)

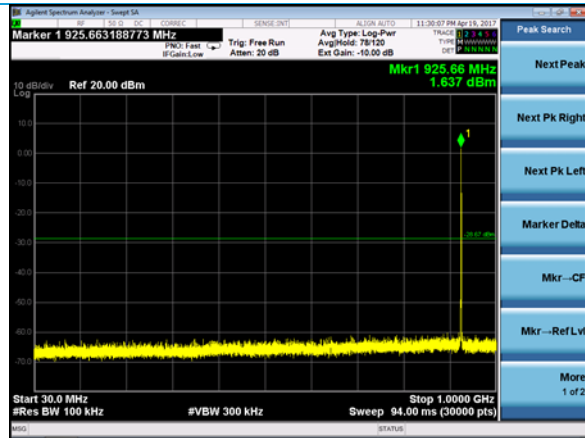


High Channel (High Power)

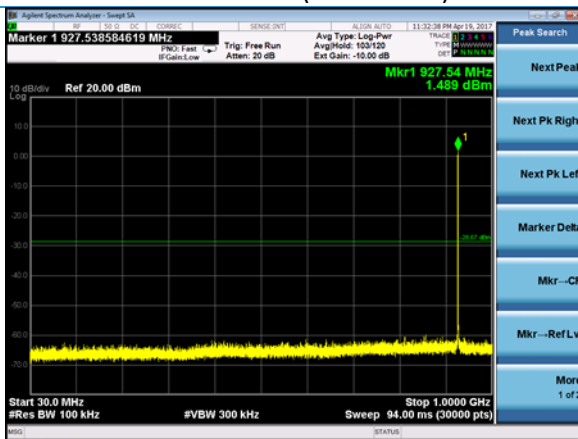
30-1000 MHz



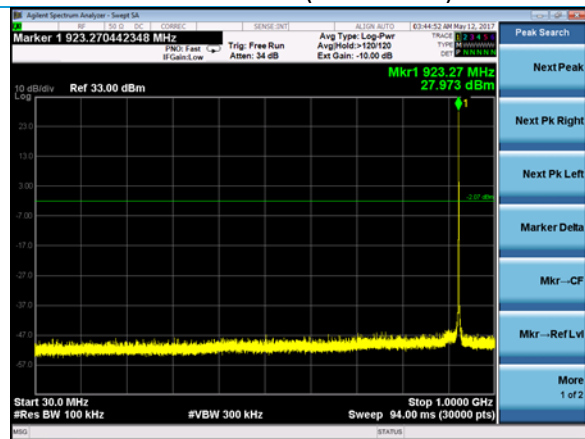
Low Channel (Low Power)



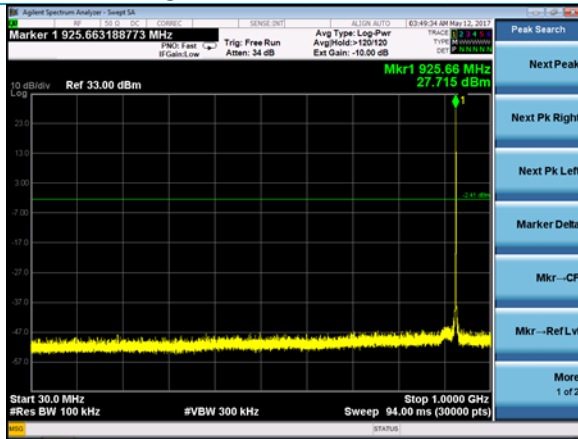
Mid Channel (Low Power)



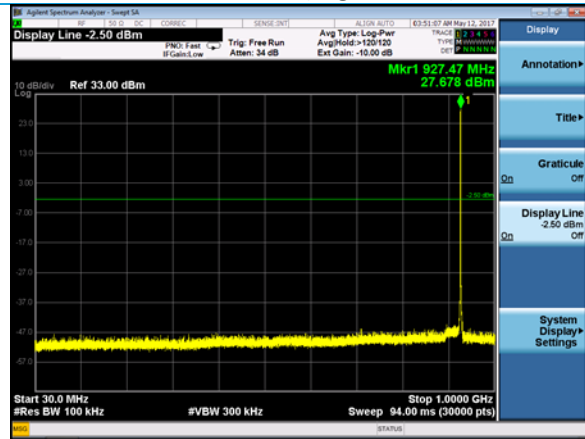
High Channel (Low Power)



Low Channel (High Power)

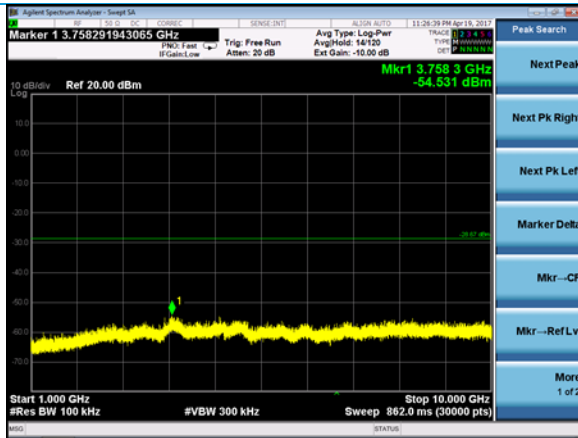


Mid Channel (High Power)

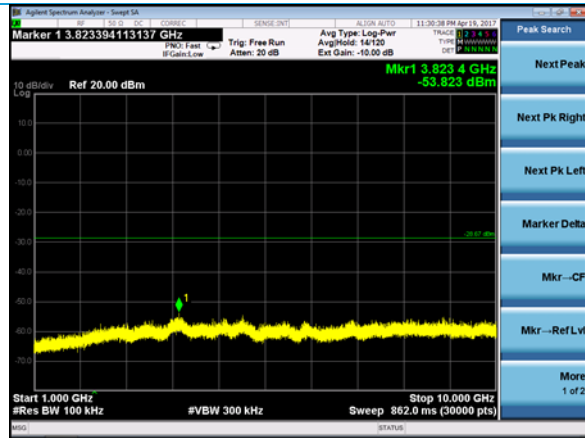


High Channel (High Power)

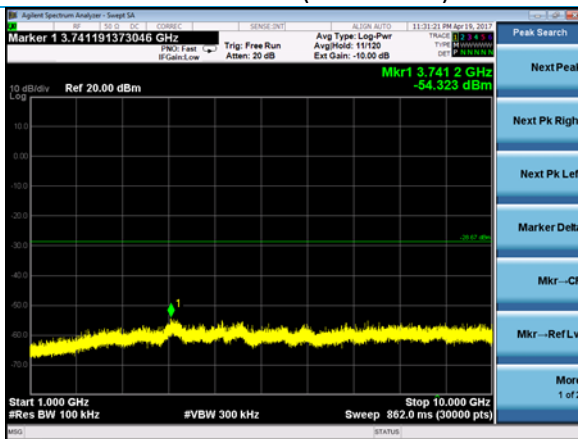
1000-10000 MHz



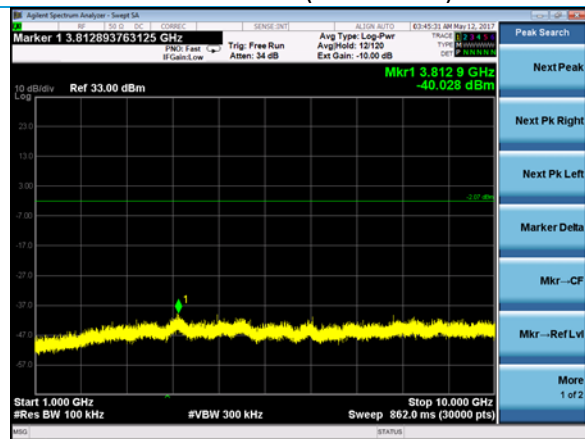
Low Channel (Low Power)



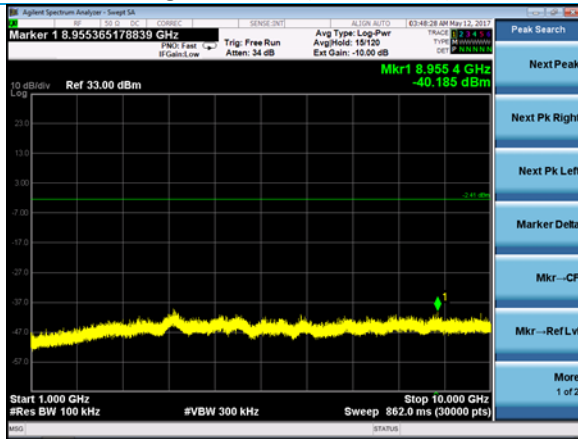
Mid Channel (Low Power)



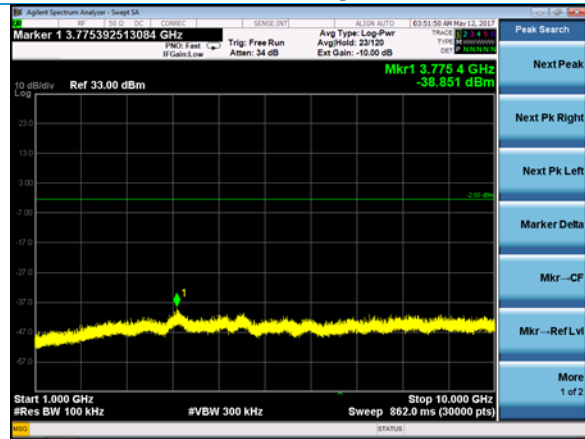
High Channel (Low Power)



Low Channel (High Power)

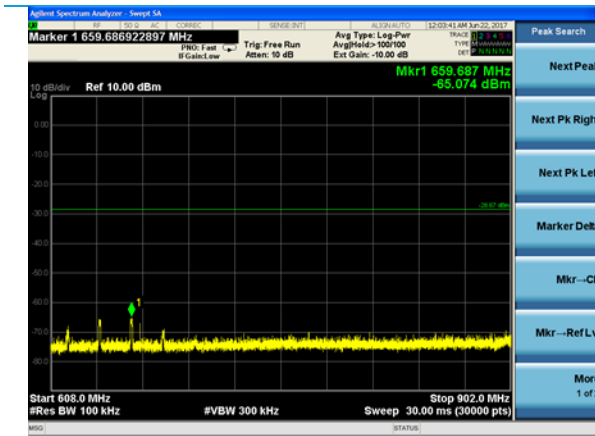


Mid Channel (High Power)

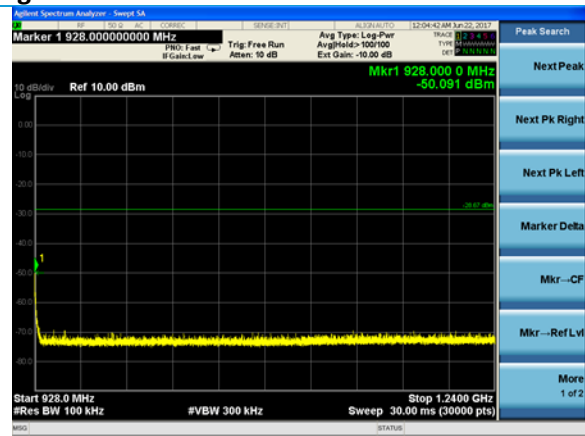


High Channel (High Power)

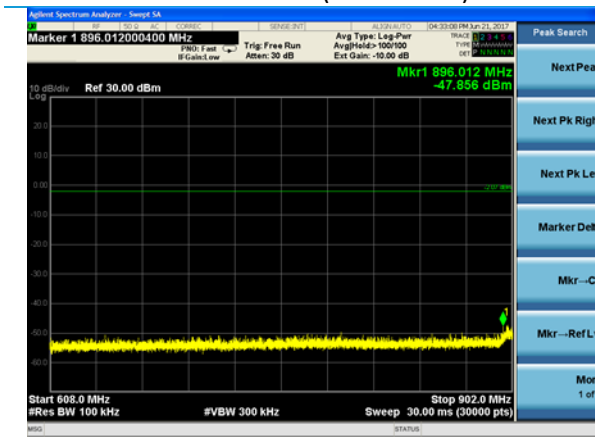
Band Edges



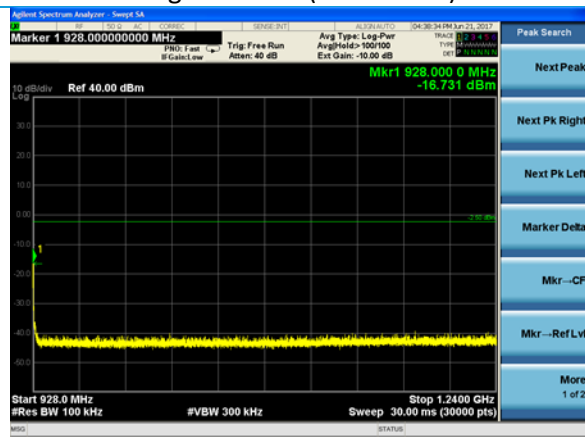
Low Channel (Low Power)



High Channel (Low Power)



Low Channel (High Power)



High Channel (High Power)

5.1.5 Antenna Port Conducted Emissions – Frequency Stability

Operator	Shane Dock
Test Date	5/31/17
Location	Conducted RF Area
Temp. / R.H.	72 degrees Fahrenheit / 42% RH
Requirement	FCC: 2.1055 (d) IC: RSS-GEN 6.11
Method	ANSI C63.10 Section 6.8

Test Parameters

Frequency	923.3 – 927.5 MHz
Settings	Voltage range of 4.25-5.5 VDC
Settings	Transmit in CW mode

Table

Channel	4.25 VDC Frequency (Hz)	5.00 VDC Frequency (Hz)	5.50 VDC Frequency (Hz)	Deviation (Hz)
Low	923298900	923299900	923299500	1000
Mid	925698600	925690600	925699900	9300
High	927495600	927486400	927496100	9700

5.2 Radiated Emissions

<p>Description of Measurement</p>	<p>The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna.</p> <p>The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values.</p> <p>The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.</p>
<p>Example Calculations</p>	<p>Measurement (dBμV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBμV/m)</p> <p>Margin (dB) = Limit (dBμV/m) - Corrected Reading (dBμV/m)</p> <p>Example at 4000 MHz: Reading = 40 dBμV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBμV/m Average Limit = 20 log (500) = 54 dBμV/m Margin = 54 dBμV/m - 50.8 dBμV/m = 3.2 dB</p>

Block Diagram



5.2.1 Radiated Emissions

Operator	Shane Dock
QA	Kim Bay
Test Date	4/24/17- 5/9/17
Location	Chamber 5
Temp. / R.H.	72 degrees Fahrenheit/ 32% RH
Requirement	FCC: 15.247 (d) IC: RSS-GEN 8.10
Method	ANSI C63.10 Sections 6.3, 6.5, 6.6

Limits:

	30-88 MHz	88-216 MHz	216 – 960 MHz	960+ MHz
Field Strength (μV/m)	100	150	200	500
Field Strength (dBμV/m)	40.0	43.5	46.0	54.0

Test Parameters

Frequency	30-10000
Distance	3 meters
Settings	Unit tested at 923.3, 925.7, and 927.5 MHz channels.
Settings	RBW = 120kHz, VBW = 1.2 MHz (<1 GHz) RBW = 1 MHz, VBW = 3 MHz (>1 GHz) (10 Hz for Average)
EUT	Unit tested and measured in three orientations.
Notes	Measurements taken in restricted bands. For measurements above 1 GHz, antenna used with a tilt gear to keep EUT within the cone of radiation. Absorbers were also added to the floor of the chamber while measuring emissions above 1 GHz. Below 200 MHz, the emissions observed are a function of the host board engineering setup, not the module. (Module extended off host board to meet modular setup requirements)
Example Calculation	Limit (dBμV) = 20* Log[Limit (μV)] 40 = 20* log (100) Raw Data + Antenna Factor + Cable Factor = Reported Data 19.77 dBμV + 12.50 dB/m + 0.93 dB = 38.80 dBμV/m



Instrumentation



Date : 17-Apr-2017 Test : Spurious Emissions Job # : C-2722
 PE : Shane Dock Customer : LSR Quote # : 317134

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	10/13/2016	10/13/2017	Active Calibration
3	EE 960159	Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	462101702	4/12/2017	4/12/2018	Active Calibration
4	AA 960171	Cable - low loss 6m	A.H. Systems, Inc	SAC-26G-6	386	3/31/2016	6/24/2017	Active Verification
5	AA 960163	Log Periodic Antenna	A.H. Systems, Inc	SAS-512-2	500	3/28/2017	3/28/2018	Active Calibration
6	AA 960150	Biconical Antenna	ETS Lindgren	3110B	0003-3346	3/3/2017	3/3/2018	Active Calibration
7	EE 960088	EMI Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration

Tested By: *Shane Dock* Quality Assurance: *Kimberly B. Bay*

Table

Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Average Reading (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Margin (dB)	Avg. Margin (dB)	Antenna Polarity	EUT orientation	Channel
8331.49	202.42	123.00	59.7	45.9	74.0	54.0	14.3	8.1	H	H	925.7
2777.04	146.95	239.75	46.3	37.0	74.0	54.0	27.7	17.0	H	H	925.7
7405.58	193.71	166.25	48.6	38.4	74.0	54.0	25.4	15.6	H	H	925.7
9257.37	200.90	188.25	35.8	49.8	74.0	54.0	38.2	4.2	V	H	925.7
3703.70	125.00	166.50	47.9	34.8	74.0	54.0	26.1	19.2	V	V	925.7
1463.00	150.00	219.50	43.9	40.8	74.0	54.0	30.1	13.2	H	F	925.7
8347.48	194.23	116.00	58.1	45.2	74.0	54.0	15.9	8.9	H	H	927.5
2782.60	128.61	238.00	42.9	36.7	74.0	54.0	31.2	17.3	H	H	927.5
7419.98	106.14	158.50	43.8	37.1	74.0	54.0	30.2	16.9	H	H	927.5
9274.00	205.00	167.25	48.6	37.4	74.0	54.0	25.4	16.6	V	H	927.5
3710.00	186.90	161.00	45.1	33.0	74.0	54.0	28.9	21.0	V	V	927.5
1463.00	150.47	217.25	43.6	40.4	74.0	54.0	30.4	13.6	H	F	927.5
8311.00	187.28	118.25	60.2	46.5	74.0	54.0	13.8	7.5	H	H	923.3
2770.05	145.38	237.00	47.0	37.9	74.0	54.0	27.0	16.1	H	H	923.3
7419.98	230.42	165.50	47.9	37.7	74.0	54.0	26.1	16.3	H	H	923.3
9233.00	150.00	133.25	46.0	32.4	74.0	54.0	28.0	21.6	V	H	923.3
3710.00	189.42	166.50	44.1	30.1	74.0	54.0	29.9	23.9	V	V	923.3
1463.00	150.61	214.00	43.5	39.8	74.0	54.0	30.5	14.2	H	F	923.3



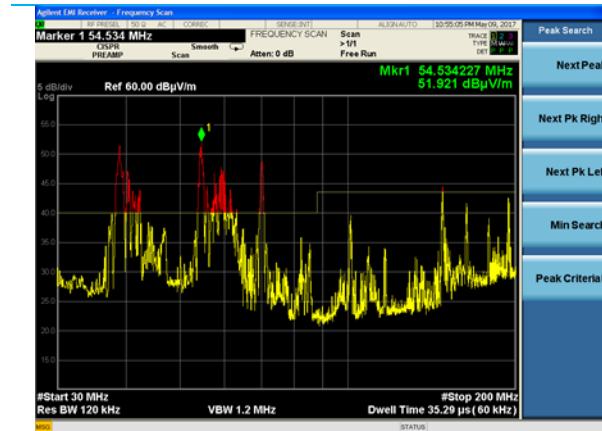
Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Average Reading (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Peak Margin (dB)	Avg. Margin (dB)	Antenna Polarity	EUT orientation	Channel
1197.00	225.66	357.00	50.6	48.6	74.0	54.0	23.4	5.4	V	H	923.3
1197.00	239.57	118.25	52.3	48.9	74.0	54.0	21.7	5.1	H	H	923.3
1196.94	203.71	215.50	53.2	49.7	74.0	54.0	20.8	4.3	H	F	923.3
1197.05	145.61	63.00	50.3	45.9	74.0	54.0	23.7	8.1	V	F	923.3
1197.06	100.00	94.00	52.5	48.1	74.0	54.0	21.5	5.9	V	V	923.3
1196.97	134.66	149.00	51.4	47.6	74.0	54.0	22.6	6.4	H	V	923.3
1196.90	178.23	219.50	53.4	49.8	74.0	54.0	20.6	4.2	H	F	925.7
1196.94	203.33	215.00	52.9	50.0	74.0	54.0	21.1	4.0	H	F	927.5

Table (Under 1 GHz)

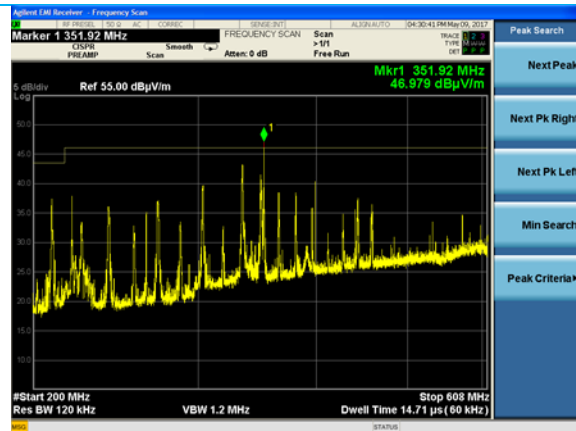
Frequency (MHz)	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)	Antenna Polarity	EUT orientation
240.85	133.57	64.25	36.5	46.0	9.5	H	F
256.22	100.00	102.00	30.9	46.0	15.1	H	F
263.99	102.00	294.75	39.5	46.0	6.5	H	F
271.84	107.61	283.75	30.0	46.0	16.0	H	F
333.80	145.95	0.00	37.4	46.0	8.6	V	F
271.80	156.80	0.00	30.6	46.0	15.4	V	F
240.71	165.90	82.50	29.3	46.0	16.7	V	F
263.90	100.00	10.50	33.5	46.0	12.5	V	F
255.86	100.00	63.75	25.6	46.0	20.4	V	F
333.80	145.66	0.25	38.1	46.0	7.9	V	H
240.70	186.61	0.00	31.7	46.0	14.3	V	H
263.90	100.00	247.25	34.6	46.0	11.4	V	H
271.70	167.80	0.00	31.5	46.0	14.5	V	H
256.16	100.00	85.75	24.8	46.0	21.2	V	H
334.22	100.00	304.25	38.0	46.0	8.0	H	H
263.99	118.28	23.50	41.7	46.0	4.3	H	H
240.50	128.09	339.00	35.3	46.0	10.7	H	H
256.16	114.52	336.25	30.9	46.0	15.1	H	H
333.90	100.09	284.75	37.9	46.0	8.1	H	V
264.00	114.71	77.50	38.5	46.0	7.5	H	V
240.68	136.57	279.00	32.1	46.0	13.9	H	V
333.86	154.76	302.50	36.1	46.0	9.9	V	V
240.60	212.85	0.00	34.8	46.0	11.2	V	V
264.00	100.00	72.25	36.8	46.0	9.3	V	V
271.70	100.00	64.75	31.9	46.0	14.1	V	V

Frequency (MHz)	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)	Antenna Polarity	EUT orientation
38.25	129.52	0.00	33.3	40.0	6.7	V	V
74.78	100.00	153.75	22.5	40.0	17.5	V	V
108.42	100.00	281.50	27.8	43.5	15.7	V	V
162.99	170.33	331.00	31.3	43.5	12.2	V	V
116.57	185.47	265.00	26.9	43.5	16.6	H	V
131.92	231.52	259.00	26.8	43.5	16.7	H	V
116.86	305.00	282.00	28.1	43.5	15.4	H	H
132.24	195.57	102.25	26.0	43.5	17.6	H	H
108.52	172.57	265.00	23.2	43.5	20.3	H	H
38.25	100.00	351.75	35.4	40.0	4.6	V	H
74.96	100.00	158.75	23.2	40.0	16.8	V	H
108.42	100.00	257.25	29.8	43.5	13.7	V	H
163.11	100.00	309.50	34.0	43.5	9.5	V	H
162.90	100.00	325.25	32.8	43.5	10.7	V	F
108.48	100.00	153.75	29.8	43.5	13.7	V	F
73.18	100.00	107.25	20.8	40.0	19.2	V	F
38.25	100.00	0.00	34.9	40.0	5.1	V	F
163.20	124.52	265.75	31.3	43.5	12.2	H	F
132.09	223.38	266.75	26.9	43.5	16.6	H	F

Plots (Worst Case Shown)



30-200 MHz (Vertical Antenna, Horizontal EUT)



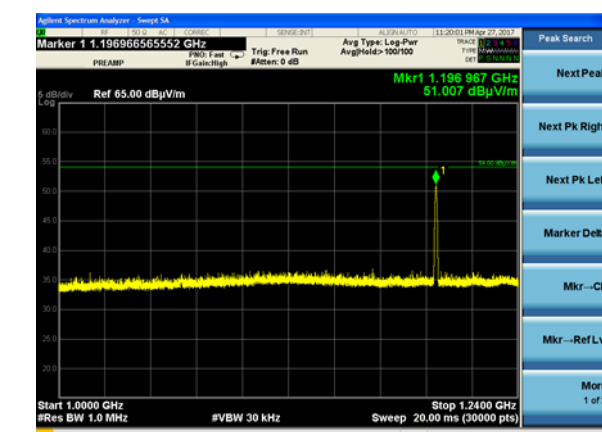
200-608 MHz (Vertical Antenna, Flat EUT)



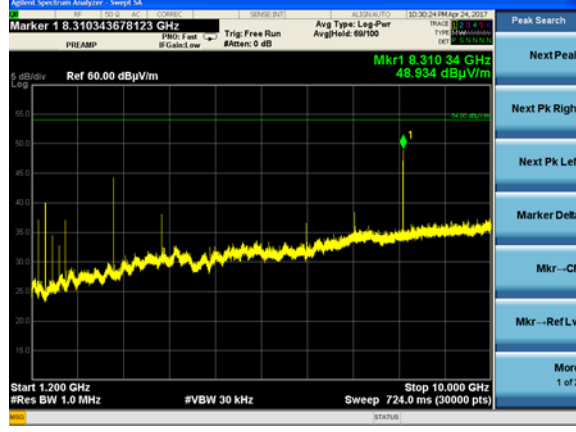
608-614 MHz (Horizontal Antenna, Flat EUT)



960-1000 MHz (Horizontal Antenna, Flat EUT)



1-1.24 GHz (Horizontal Antenna, Flat EUT)



1.2 – 10 GHz (Horizontal Antenna, Horizontal EUT)

5.3 AC Mains Conducted Emissions

A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains.

Description of Measurement

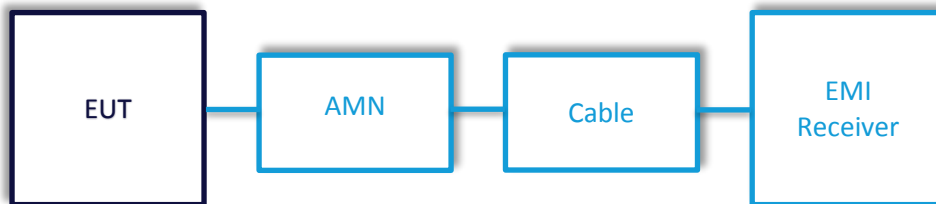
The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values.

Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)

Example Calculations

Measurement (dBμV) + Cable factor (dB) + Other (dB) = Corrected Reading (dBμV)
 Margin (dB) = Limit (dBμV) - Corrected Reading (dBμV)

Block Diagram



5.3.1 AC Mains Conducted Emissions

Operator	Shane Dock
Test Date	5/31/17
Location	Conducted Ground Plane
Temp. / R.H.	73 degrees Fahrenheit / 47% RH
Requirement	FCC: 15.207 IC: RSS-GEN 8.8
Method	ANSI C63.10 Section 6.2

Limits:

Frequency of Emission (MHz)	Quasi-Peak Limit (dBuV)	Average Limit (dBuV)
0.15 - 0.50	66 to 56	56 to 46
0.5 – 5	56	46
5-30	60	50

Test Parameters

Frequency	150 kHz - 30 MHz
Settings	RBW 9 kHz
Settings	VBW 90 kHz
EUT Power	120V 60 Hz (With an AC-DC Adapter for 12 VDC supplied with unit)

Instrumentation



Date : 17-Apr-2017

Test : Conducted Emissions

Job # : C-2722

PE: Shane Dock

Customer : LSR

Quote # : 317134

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960088	EMI Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration
2	EE 960162	LISN	COM-POWER	LI-215A	191969	8/15/2016	8/15/2017	Active Calibration
3	EE 960089	LISN	COM-POWER	LI-215A	191943	3/13/2017	3/13/2018	Active Calibration

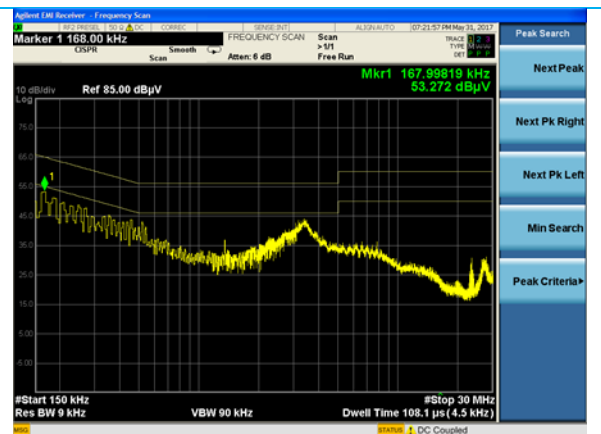
Table

Line	Frequency (MHz)	Q-Peak Reading (dBμV)	Q-Peak Limit (dBμV)	Quasi-Peak Margin (dB)	Average Reading (dBμV)	Average Limit (dBμV)	Average Margin (dB)
1	3.390	44.1	56.0	11.9	26.3	46.0	19.7
1	3.637	45.2	56.0	10.8	25.6	46.0	20.4
1	2.764	39.0	56.0	17.0	25.5	46.0	20.5
1	1.887	44.0	56.0	12.0	26.4	46.0	19.6
1	26.945	37.6	60.0	22.4	22.3	50.0	27.7
1	4.528	39.8	56.0	16.2	19.4	46.0	26.6
2	0.168	51.2	65.1	13.9	39.2	55.1	15.8
2	0.186	49.7	64.2	14.5	38.7	54.2	15.5
2	0.519	40.6	56.0	15.4	29.6	46.0	16.4
2	3.389	40.2	56.0	15.8	27.0	46.0	19.0
2	6.580	30.7	60.0	29.3	21.1	50.0	28.9
2	27.791	26.3	60.0	33.7	16.1	50.0	33.9

Plots



Line 1



Line 2

Company: Laird Technologies, Inc.	Page 33 of 34	Name: RG191-M2
Report: 317134 A		Model: RG191-M2
Job: C-2722		Serial: 00027

6 REVISION HISTORY

Version	Date	Notes	Person
V0	6/14/17	Rough Draft	Shane Dock
V1	6/19/17	Updated Draft	Shane Dock
V2	6/21/17	2 nd Update	Shane Dock
V3	6/23/17	Final Version	Shane Dock

END OF REPORT