

Test Report # 317205 B

Equipment Under Test: Spot-r Relay Pod

Test Date(s): 10/19/17 – 6/20/18

Prepared for: Triax Technologies
Attn: Justin Morgenthau
330 Roberts Street
Suite 205
East Hartford, CT 06108, USA


Report Issued by:

Signature:



Date: 8/14/2018

Report Reviewed by: Adam Alger, Quality Manager

Signature: 

Date: 08/14/2018

Report Constructed by:

Signature:



Date: 8/14/2018

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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
3 References.....	6
4 Uncertainty Summary.....	7
5 Test Data	8
5.1 Antenna Port Conducted Emissions.....	8
5.2 Radiated Emissions.....	21
6 Revision History	27

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: Triax Technologies	Page 3 of 27	Name: Spot-r Relay Pod
Report: 317205 B		Model: RP-2
Job: C-2756		Serial: See Section 2.1

1 TEST REPORT SUMMARY

During **10/19/17 – 6/20/18** the Equipment Under Test (EUT), **Spot-r Relay Pod**, as provided by **Triax Technologies** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(1) IC: RSS-247 5.1	Channel Separation, Number of Hopping frequencies, Time of Occupancy	FHS	ANSI C63.10	Pass
FCC: 2.1049 IC: RSS-GEN 6.6	Occupied Bandwidth	Reported	ANSI C63.10	Pass
FCC: 15.247 (b)(1) IC: RSS-247 5.4 (a)	Maximum Conducted Output Power	30 dBm	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	20 dBc	ANSI C63.10	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: 15.207 IC: RSS-GEN 8.8	AC Power Line Conducted Emissions	0.150-30 MHz	ANSI C63.10	N/A (Battery-Powered)

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	Triax Technologies
Contact Person	Justin Morgenthau
Address	330 Roberts Street Suite 205 East Hartford, CT 06108, USA

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	Spot-r Relay Pod
Model Number	RP-2
Serial Number	CRP0204-00004005
FCC/IC #	FCC: 2AGHIRP01 IC: 21358-RP01

2.2 Product Description

The Spot-r Relay Pod is a key component of the Spot-r network. It is the intermediary between all Spot-r devices (Clip, EquipTag, EvacTag, etc.) and our Cloud Pod. It communicates with our devices at regular intervals, collecting key data regarding status, position and event signal and relays this data to our Cloud Pod for transmission into the cloud.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

Unit tested on Channels 1, 32, and 64 (902.5 MHz, 914.9 MHz, 927.7 MHz). Unit programmed via serial connection with a terminal access program like PuTTY. Power setting of 15 used.

3 REFERENCES

Publication	Edition	Date
CFR 47 Part 15	-	2018
ANSI C63.10	-	2013
RSS-247	2	2017
RSS GEN	4	2014

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

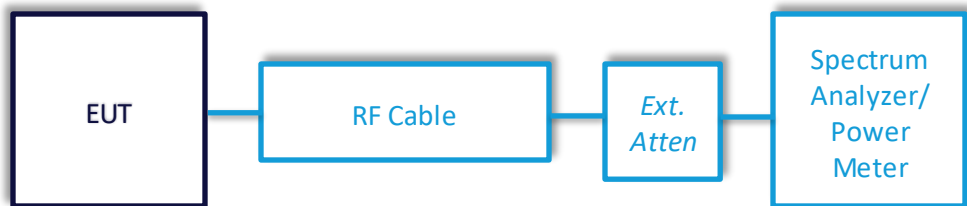
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %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

Operator	Shane Dock
Test Date	2/8/18, 6/20/18
Location	Conducted RF Area
Temp. / R.H.	71 degrees F/41 RH%
Requirement	FCC: 15.247 (a)(1) IC: RSS-247 5.1
Method	ANSI C63.10 Sections 7.8.2, 7.8.3, 7.8.4

Limits:

Frequency Separation	Number of Hopping Channels	Maximum Occupancy Time
>25 kHz or 20 dB Bandwidth	>50	0.4 seconds per 20 sec. Period

Test Parameters

Frequency	902-928 MHz
Settings	Low, Mid, and High Checked
EUT	Hopping mode Utilized on EUT

Instrumentation



Date : 1-Aug-2017 Test : Conducted RF Testing Job # : C-2756
PE: Shane Dock Customer : Triax Technologies Quote # : 317205

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	BKD01D01048.0	5546519	6/29/2016	12/31/2017	Active Calibration

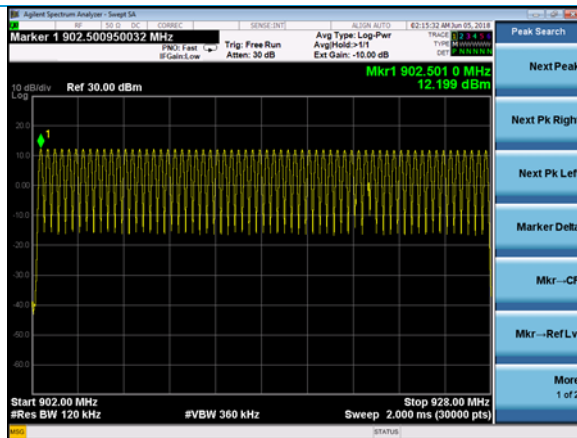
June Testing

1	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/25/2018	4/25/2019	Active Calibration
2	AA 960143	Cable	Gore	BKD01D01048.0	5546519	11/15/2017	11/15/2018	Active Verification

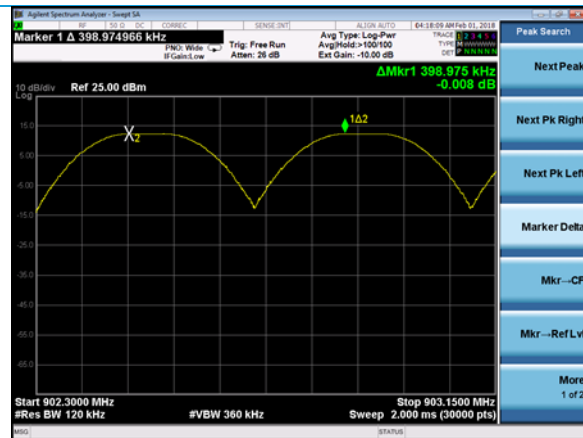
Table

Channel	Occupancy Time (ms)	Number of Transmissions	Occupancy time per 20s (ms)
Low	199.9	2	399.8
Mid	199.9	2	399.8
High	199.9	2	399.8

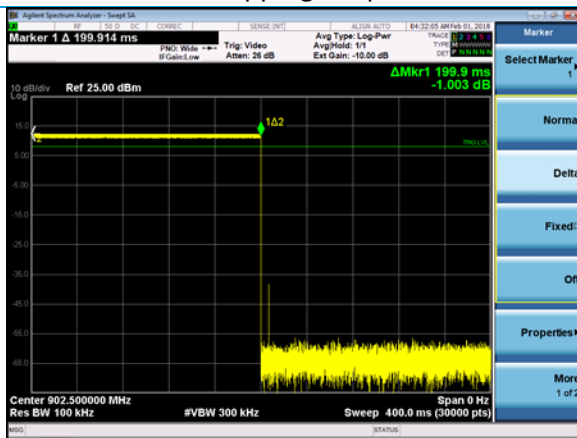
Plots



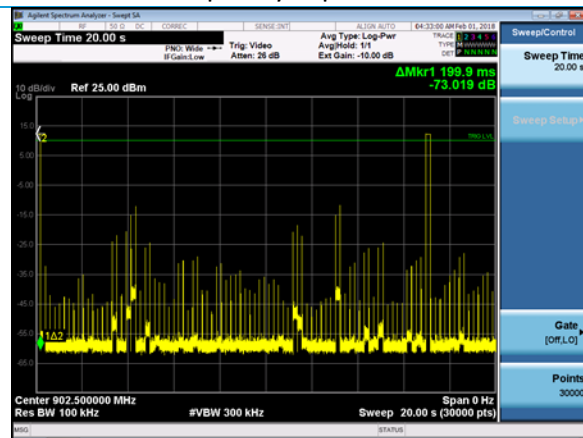
Number of Hopping Frequencies = 64



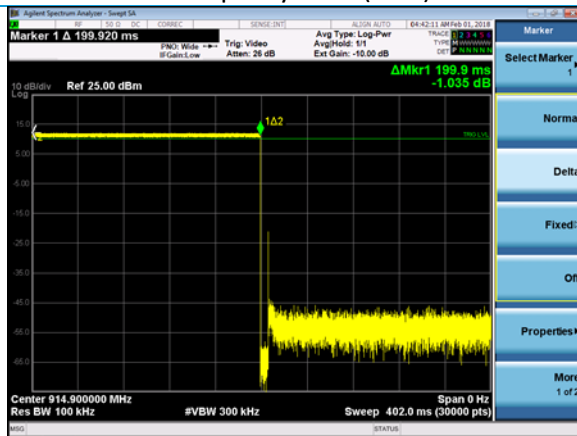
Carrier Frequency Separation = 400kHz



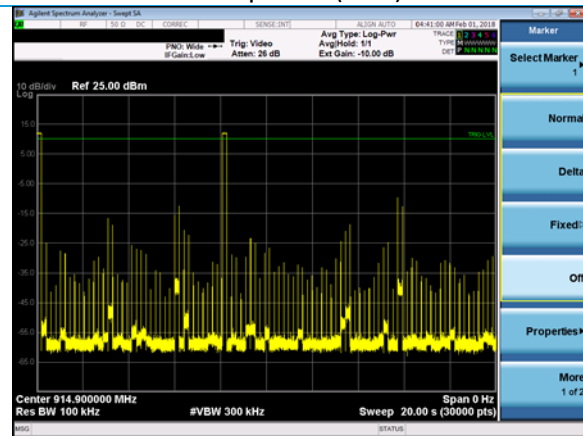
Occupancy Time (Low)



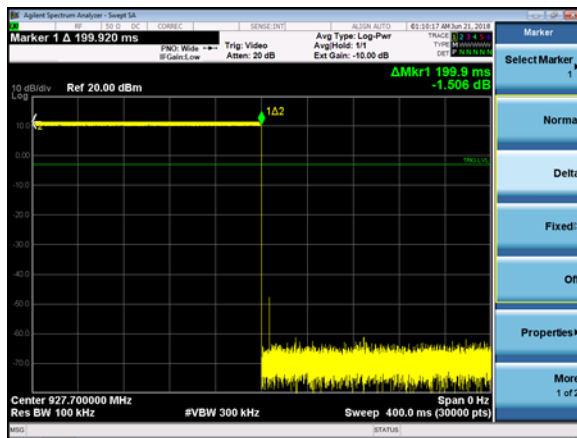
20s period (Low)



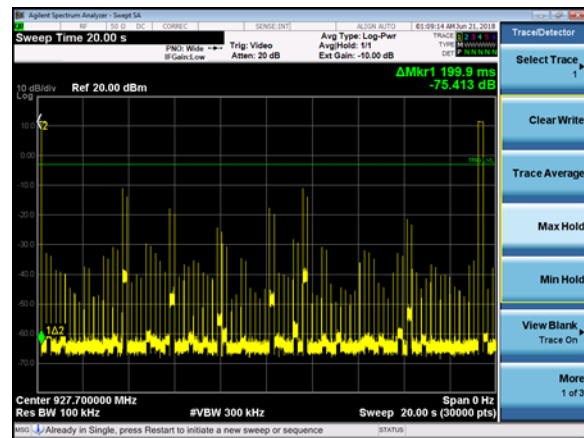
Occupancy Time (Mid)



20s period (Mid)



Occupancy Time (High)



20s period (High)

5.1.2 Antenna Port Conducted Emissions – Occupied Bandwidth

Operator	Shane Dock
Test Date	2/8/18
Location	Conducted RF Area
Temp. / R.H.	71 degrees F/41 RH%
Requirement	FCC: 2.1049 IC: RSS-GEN 6.6
Method	ANSI C63.10 Section 7.8.7

Limits:

20 dB BW (MHz)
< 500

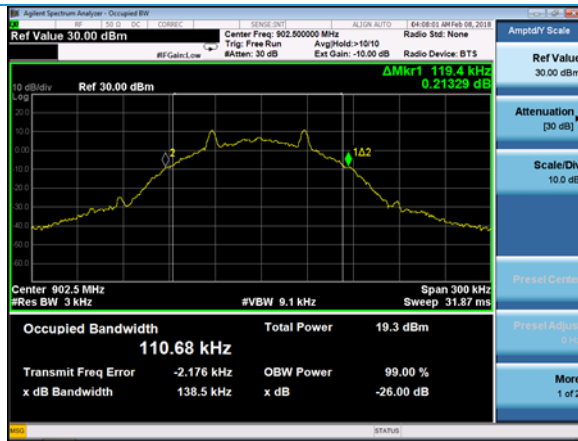
Test Parameters

Channels	Low, Mid, High Channels Checked
Settings	99% and 20 dB BW recorded

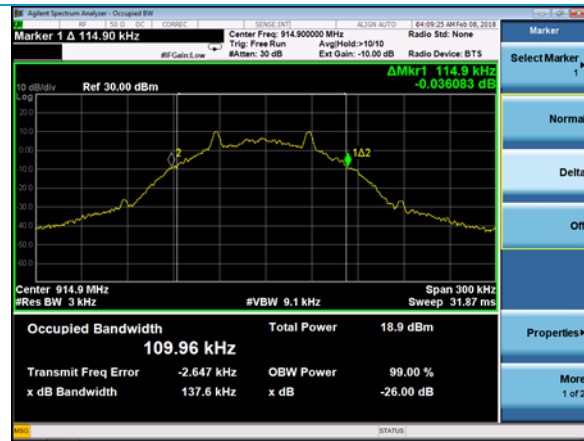
Table

Channel	Low	Mid	High
20 dB BW (kHz)	119.4	114.9	116.4
99% BW (kHz)	110.68	109.96	110.35

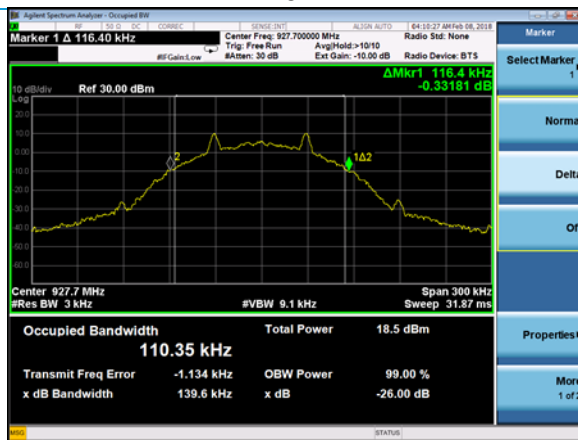
Plots



Low



Mid



High

5.1.3 Antenna Port Conducted Emissions – Maximum Conducted Output Power

Operator	Shane Dock
Test Date	6/5/18
Location	Conducted RF Area
Temp. / R.H.	71 degrees F/41 RH%
Requirement	FCC: 15.247 (b)(1) IC: RSS-247 5.4 (b)
Method	ANSI C63.10 Section 7.8.5

Limits:

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

Test Parameters

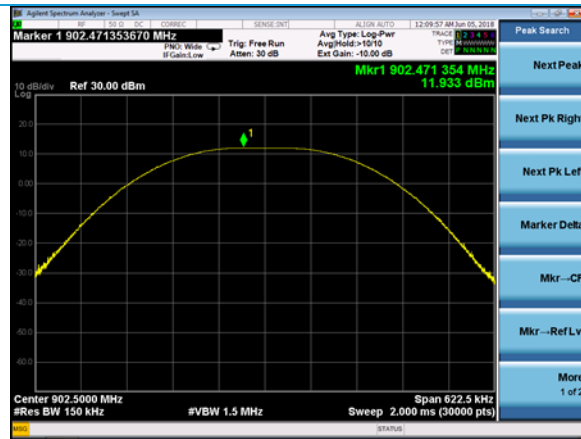
Channels	Low, Mid, High
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Table

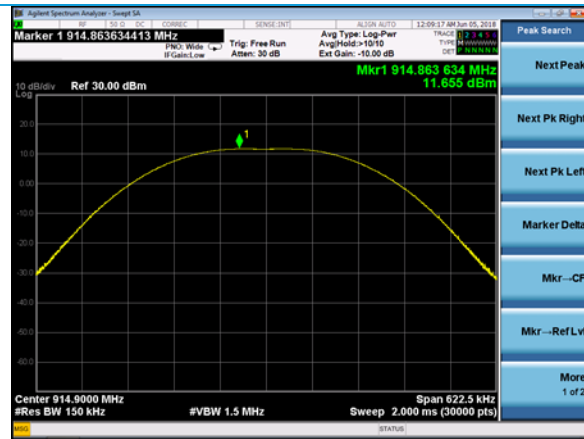
Channel	Low	Mid	High
Pout Conducted (dBm)	11.933	11.655	11.406

Worst Case Margin = 30.000 dBm – (11.933 dBm) = 18.077 dB

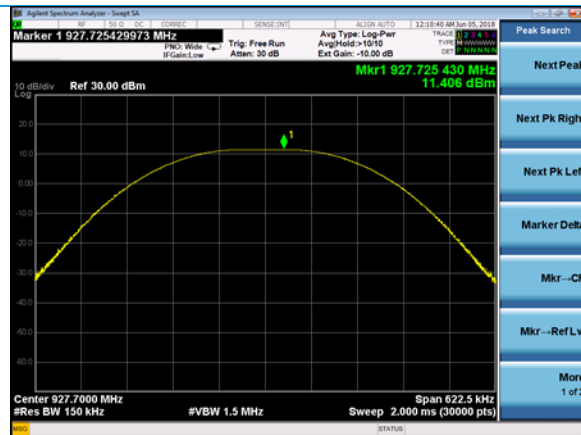
Plots



Low



Mid



High

5.1.4 Antenna Port Conducted Emissions – RF Spurious Emissions

Operator	Shane Dock
Test Date	6/4/18
Location	Conducted RF Area
Temp. / R.H.	71 degrees F/41 RH%
Requirement	FCC: 15.247 (d) IC: RSS-247 5.5
Method	ANSI C63.10 Sections 7.8.6 and 7.8.8

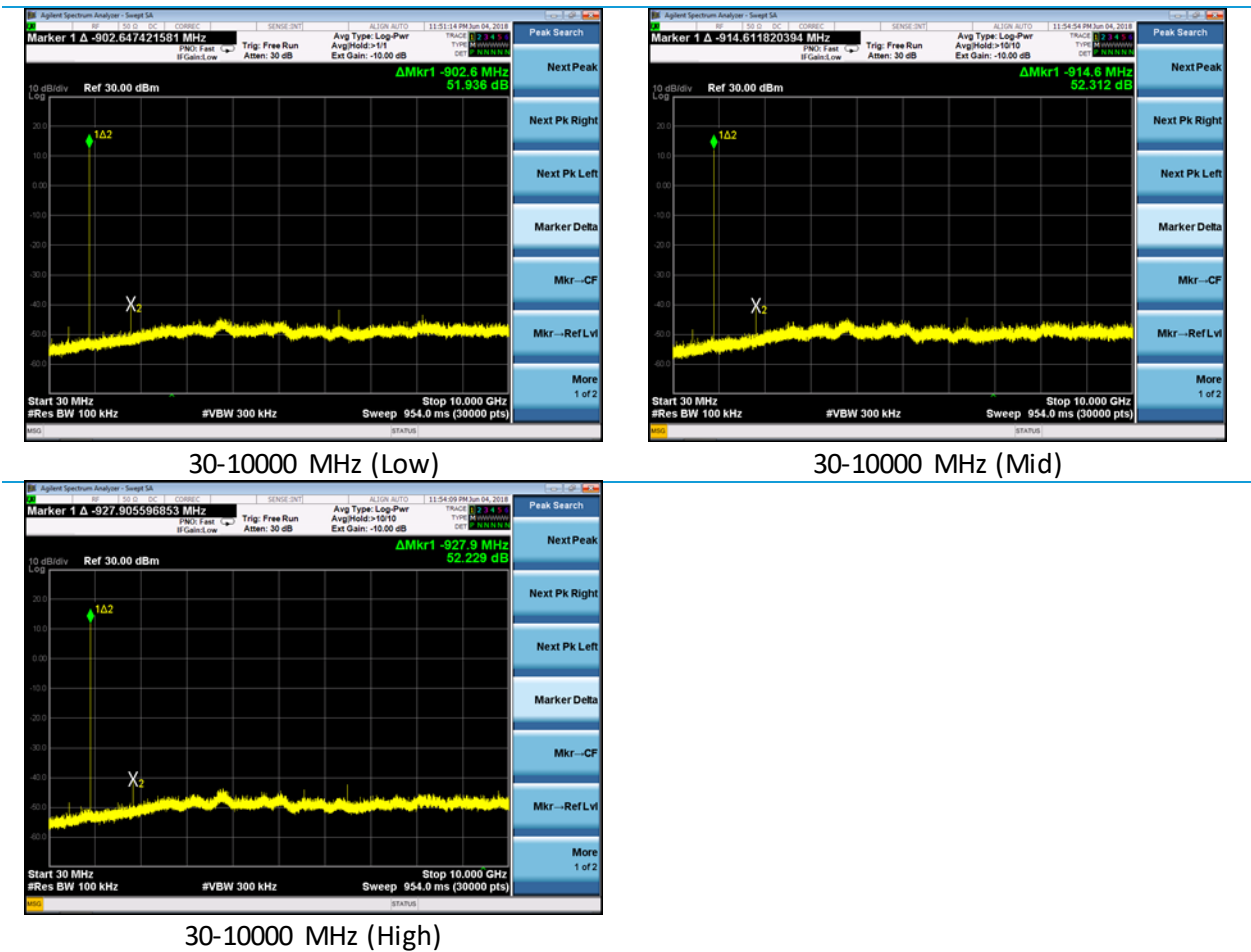
Limits:

RF Spurious Limit
20 dBc

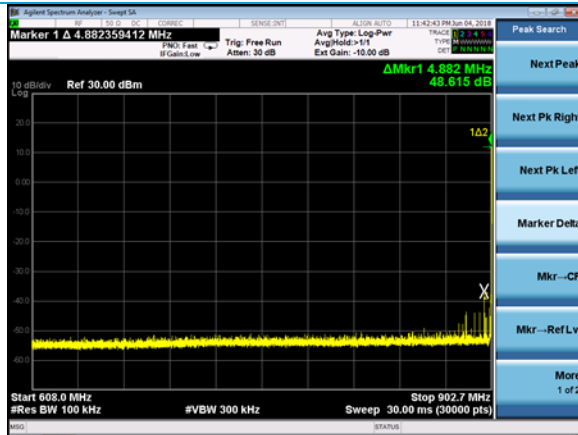
Test Parameters

Frequency	30-10000 MHz
Channels	Low, Mid, High
Notes	No emissions observed within 20dB of limit.

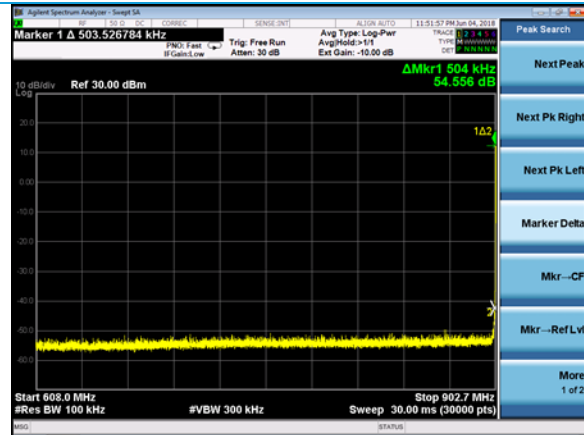
Plots



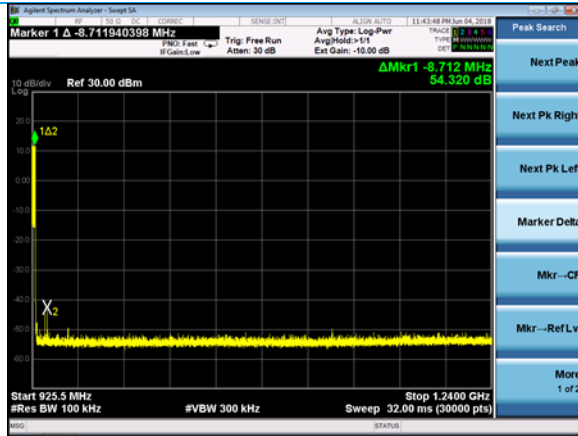
Band Edges



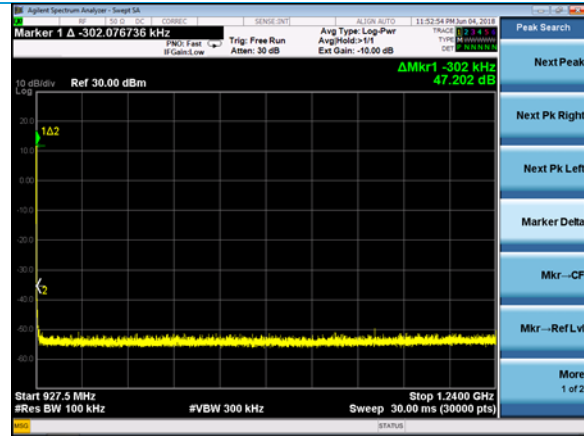
Hopping Band Edge (Low)



Non-Hopping Band Edge (Low)



Hopping Band Edge (High)



Non-Hopping Band Edge (High)

5.1.5 Antenna Port Conducted Emissions – Frequency Stability

Operator	Shane Dock
Test Date	6/4/18
Location	Conducted RF Area
Temp. / R.H.	71 degrees F/41% RH
Requirement	FCC: 2.1055 (d) IC: RSS-GEN 6.11
Method	ANSI C63.10 Section 6.8

Test Parameters

Channels	Low, Mid, High
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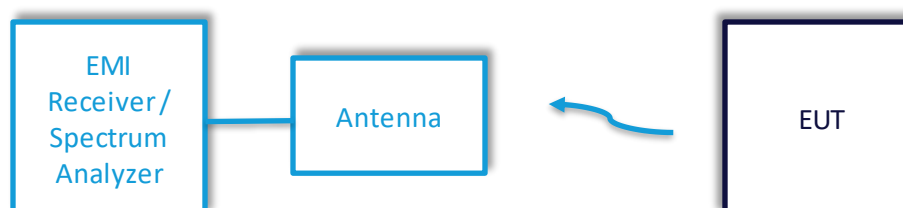
Table (Values below listed in Hz at the given voltages) – Battery Voltage

	2.7 VDC	3.2 VDC	3.7 VDC	Deviation
Low Channel	902497832	902497624	902498682	1058
Mid Channel	914896192	914895196	914896026	996
High Channel	927695009	927694304	927694159	850

5.2 Radiated Emissions

Description of Measurement	<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>
Example Calculations	<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
Test Date	10/19/17 - 2/6/18
Location	Chamber 3, Chamber 5
Temp. / R.H.	70 degrees F/40% RH
Requirement	FCC: 15.247 (d)
Method	IC: RSS-GEN 8.10

Limits:

	30-88 MHz	88-216 MHz	216 – 960 MHz	960+ MHz
Field Strength ($\mu\text{V}/\text{m}$)	100	150	200	500
Field Strength ($\text{dB}\mu\text{V}/\text{m}$)	40.0	43.5	46.0	54.0

Test Parameters

Frequency	30-25000 MHz
Distance	3m
Settings	Unit tested at Low, Mid, High Channels
Settings	RBW = 120kHz, VBW 1.2 MHz (<1 GHz) RBW = 1 MHz, VBW = 3 MHz (>1 GHz) VBW = 10 Hz for Average Measurements above 1 GHz
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.
Example Calculation	Limit ($\text{dB}\mu\text{V}$) = $20 * \log[\text{Limit } (\mu\text{V})]$ $40 = 20 * \log(100)$ Raw Data + Antenna Factor + Cable Factor = Reported Data $19.77 \text{ dB}\mu\text{V} + 12.50 \text{ dB/m} + 0.93 \text{ dB} = 33.20 \text{ dB}\mu\text{V/m}$

Instrumentation



Date : 18-Jul-2017

Test : Spurious Emissions

Job # : C-2756

PE: Shane Dock

Customer : Triax Technologies

Quote # : 317205

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	8/30/2017	8/30/2018	Active Calibration
2	AA 960171	Cable - low loss 6m	A. H. Systems, Inc	SAC-26G-6	386	3/31/2016	12/11/2017	Active Verification
3	EE960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
4	AA 960156	High Pass Filter 900 MHz	KWM	HFF-L-14185	none	8/29/2017	8/29/2018	Active Calibration
5	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	4/17/2017	4/17/2018	Active Calibration
6	AA 960128	Biconical Antenna	ETS Lindgren	3110B	00062899	4/13/2017	4/13/2018	Active Calibration
7	EE960085	BMI Receiver	Agilent	N9038A	MY51210148	5/12/2017	5/12/2018	Active Calibration
8	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	3/17/2017	3/17/2018	Active Calibration

Company: Triax Technologies

Report: 317205 B

Job: C-2756

Name: Spot-r Relay Pod

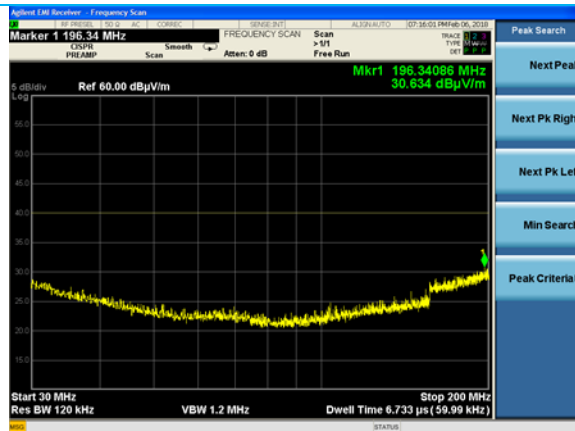
Model: RP-2

Serial: See Section 2.1

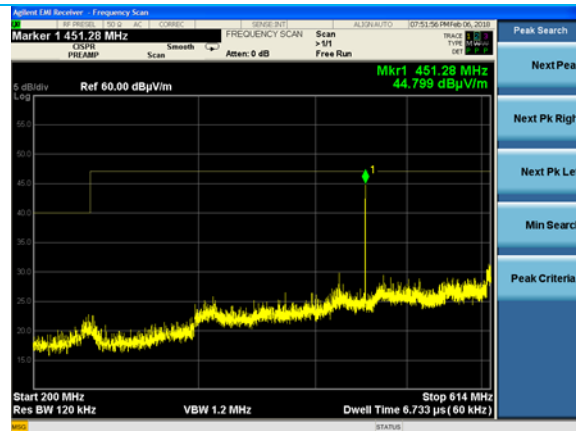
Table

Frequency (GHz)	Antenna Polarity	EUT orientation	Channel	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)
8.349	Horizontal	Horizontal	64	150	9.1	52.6	46.7	74.0	54.0	21.4	7.3
4.639	Horizontal	Horizontal	64	179	61.6	54.5	52.4	74.0	54.0	19.5	1.6
5.566	Horizontal	Horizontal	64	168	48.5	52.5	49.0	74.0	54.0	21.5	5.0
5.566	Vertical	Horizontal	64	212	12.1	46.3	37.1	74.0	54.0	27.7	16.9
5.566	Vertical	Vertical	64	150	225.3	51.6	47.3	74.0	54.0	22.4	6.7
5.566	Horizontal	Vertical	64	150	296.3	46.4	36.4	74.0	54.0	27.6	17.6
5.566	Horizontal	Flat	64	190	33.3	51.7	46.8	74.0	54.0	22.3	7.2
5.566	Vertical	Flat	64	100	180.7	49.9	44.6	74.0	54.0	24.1	9.4
7.422	Horizontal	Horizontal	64	189	18.5	48.4	37.3	74.0	54.0	25.6	16.7
5.490	Horizontal	Horizontal	32	150	43.7	49.5	44.6	74.0	54.0	24.5	9.4
7.319	Horizontal	Horizontal	32	205	145.4	50.0	40.6	74.0	54.0	24.0	13.4
7.319	Vertical	Horizontal	32	200	26.8	47.9	35.5	74.0	54.0	26.1	18.5
7.319	Vertical	Vertical	32	198	298.3	48.5	37.1	74.0	54.0	25.5	16.9
7.319	Horizontal	Vertical	32	104	97.7	47.1	34.7	74.0	54.0	26.9	19.3
7.319	Vertical	Flat	32	150	72.9	45.9	34.6	74.0	54.0	28.1	19.4
7.319	Horizontal	Flat	32	100	282.0	47.6	38.4	74.0	54.0	26.4	15.6
4.575	Horizontal	Flat	32	100	63.5	44.7	40.8	74.0	54.0	29.3	13.2
8.236	Horizontal	Horizontal	32	150	15.0	51.8	47.5	74.0	54.0	22.2	6.5
5.415	Horizontal	Horizontal	1	150	52.3	47.1	42.7	74.0	54.0	26.9	11.3
5.415	Vertical	Horizontal	1	100	57.9	45.1	37.0	74.0	54.0	28.9	17.0
5.415	Vertical	Vertical	1	145	243.8	46.1	38.4	74.0	54.0	27.9	15.6
5.415	Horizontal	Vertical	1	150	26.3	41.4	31.3	74.0	54.0	32.6	22.7
5.415	Vertical	Flat	1	240	52.3	44.2	36.8	74.0	54.0	29.8	17.2
5.415	Horizontal	Flat	1	100	314.8	46.9	42.2	74.0	54.0	27.1	11.8
4.513	Horizontal	Flat	1	143	337.8	48.0	45.4	74.0	54.0	26.0	8.6
8.124	Horizontal	Horizontal	1	150	110.5	52.6	49.2	74.0	54.0	21.4	4.8

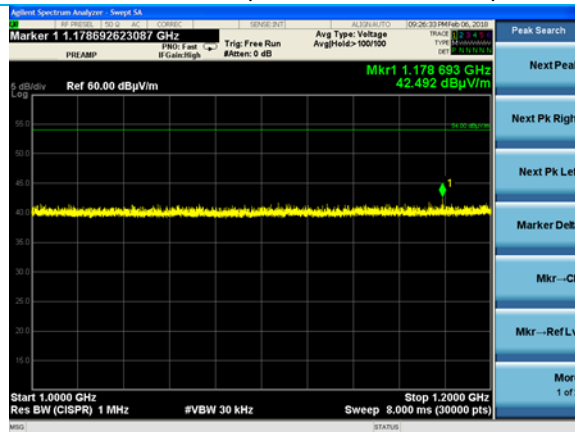
Plots – Spurious Emissions



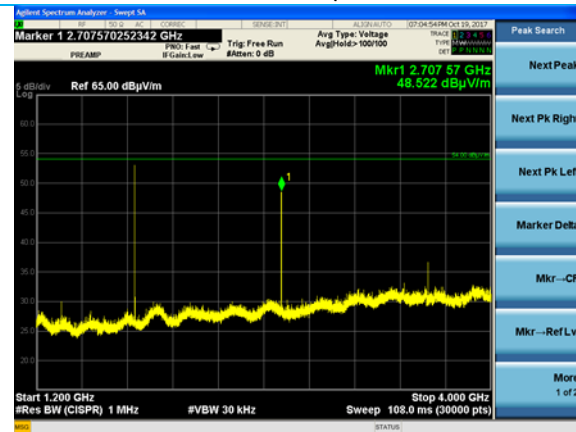
30-200 MHz (Horizontal Antenna)



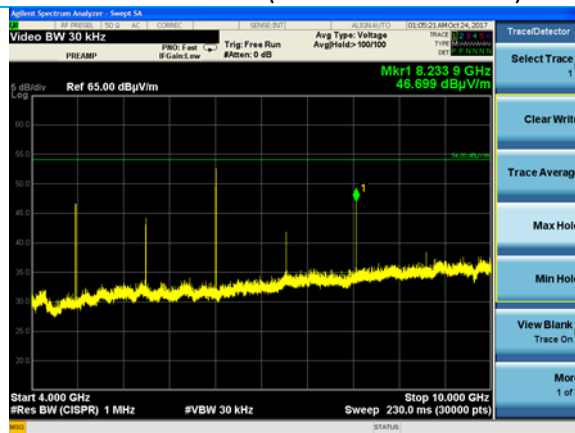
200-608 MHz (Vertical)



1000-1200 MHz (Horizontal Antenna)

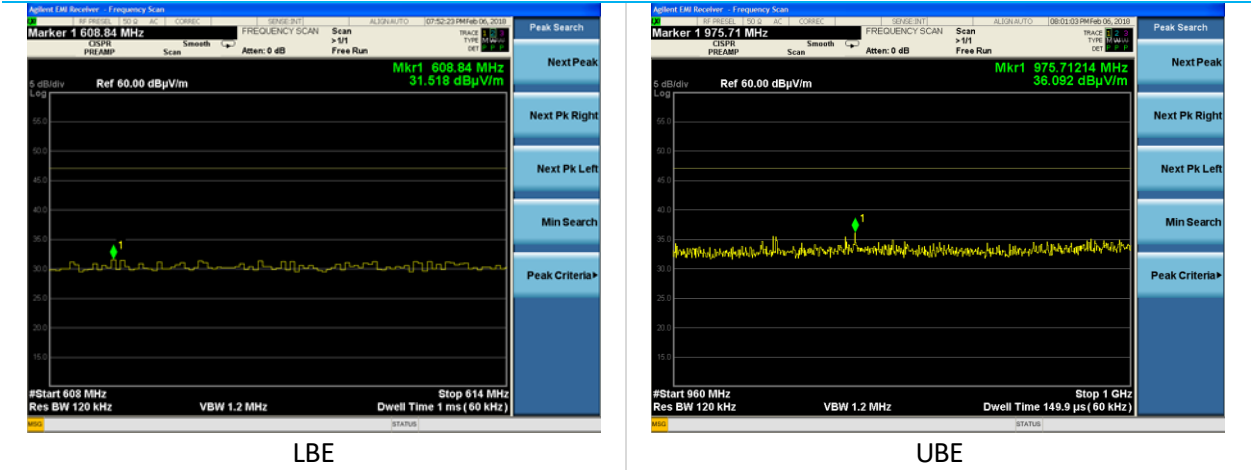


1200-4000 MHz (Reduced BW) (Vertical Antenna)



4-10 GHz (Reduced BW) (Horizontal Antenna)

Plots – Band Edges



6 REVISION HISTORY

Version	Date	Notes	Person
V0	6/14/18	First Draft	Shane Dock
V1	8/14/18	Second Draft	Shane Dock
V2	8/14/18	Final Draft	Shane Dock
V3	11/27/18	Updated Instrumentation	Shane Dock

END OF REPORT