

Test Report # 317206 B

Equipment Under Test: Spot-r Clip

Test Date(s): 10/2/17 - 10/18/17

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


Report Issued by: Shane Dock, EMC Engineer

Signature:



Date: 9/18/2018

Report Reviewed by: Adam Alger, Quality Manager

Signature: 

Date: 08/14/2018

Report Constructed by: Shane Dock, EMC Engineer

Signature:



Date: 8/14/2018

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

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.....	6
3 References.....	7
4 Uncertainty Summary.....	8
5 Test Data	9
5.1 Antenna Port Conducted Emissions.....	9
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 Clip
Report: 317206B		Model: CL-2
Job: C-2757		Serial: See Section 2.1

1 TEST REPORT SUMMARY

During **10/2/17 – 10/18/17** the Equipment Under Test (EUT), **Spot-r Clip**, as provided by **Triax Technologies** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(2) IC: RSS-247 5.2 (a)	Digital Modulation System 6 dB bandwidth	500 kHz	ANSI C63.10	Pass
FCC: 2.1049 IC: RSS-GEN 6.6	Occupied Bandwidth	Reported	ANSI C63.10	Pass
FCC: 15.247 (b)(3) IC: RSS-247 5.4 (d)	Maximum Conducted Output Power	30 dBm	ANSI C63.10	Pass
FCC: 15.247 (e) IC: RSS-247 5.2 (b)	Digital Modulation System Power Spectral Density	8 dBm / 3 kHz	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: 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	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 Clip
Model Number	CL-2
Serial Number	CSM0202-00003043 (Conducted RF) CSM0202-00003040, -00003145 (Radiated Emissions)
FCC/IC #	FCC ID: 2AGHICSM1 IC: 21358-CSM1

2.2 Product Description

The Spot-r Clip, our flagship wearable device, automatically connects to the Spot-r network when workers arrive on site, automating time and attendance and providing real-time workforce location by floor and zone. The device detects falls at the jobsite and sends immediate email, dashboard, or text notifications to designated supervisors, including who, where, and distance of fall, improving injury response time by up to 91%. By pushing the button at the bottom of the Clip, workers can report a hazard or other injury to designated supervisors from anywhere on site. And in situations that require evacuation, authorized personnel can trigger 80 decibel alarms emitted by each worker's device.

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 63 (902.5 MHz, 914.9 MHz, 927.3 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	-	2017
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

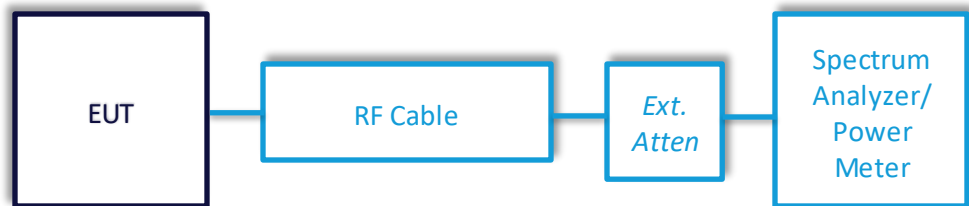
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %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

Operator	Shane Dock
Test Date	10/17/17
Location	Conducted RF Measurement Area
Temp. / R.H.	71 degrees Fahrenheit / 57%
Requirement	OBW: FCC: 2.1049 IC: RSS-GEN 6.6 DTS BW: FCC: 15.247 (a)(2) IC: RSS-247 5.2 (a)
Method	ANSI C63.10 Section 6.9.2 and 11.8

Limits:

6 dB BW (MHz)
> 500

Test Parameters

Frequency	902.5 MHz, 914.9 MHz, 927.3 MHz
------------------	---------------------------------

Tables

Channel	Low	Mid	High
6dB BW (kHz)	510.5	510.3	508.5
99% BW (kHz)	529.6	532.7	530.9

Instrumentation



Date : 18-Jul-2017

Test : Conducted RF Testing

Job # : C-2757

PE: Shane Dock

Customer : Triax Technologies

Quote # : 317206

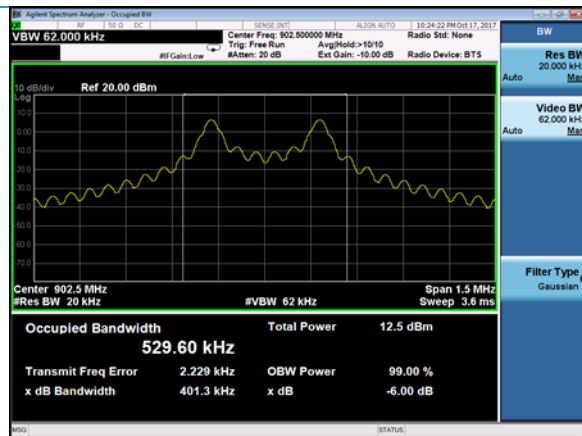
No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/29/2016	11/11/2017	Active Calibration

Company: Triax Technologies	Page 10 of 27	Name: Spot-r Clip
Report: 317206B		Model: CL-2
Job: C-2757		Serial: See Section 2.1

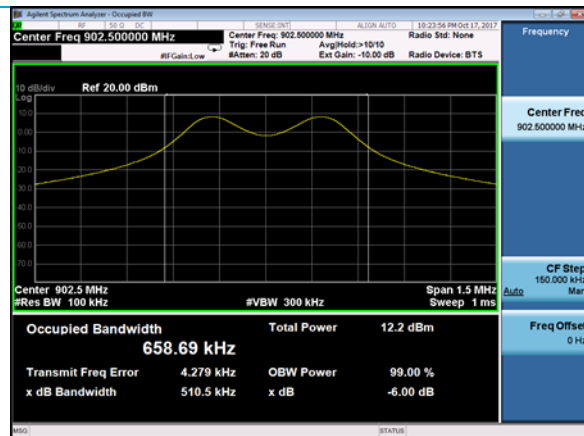
June Testing

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

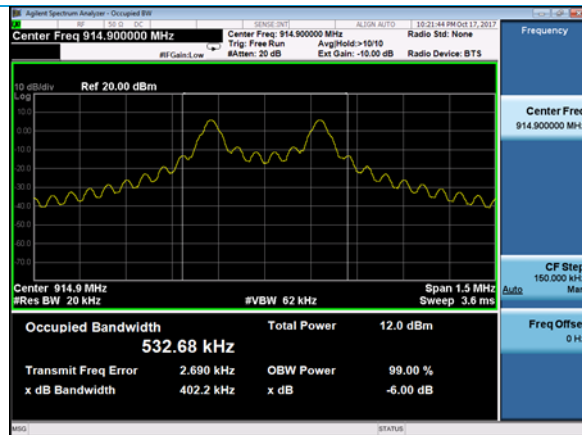
Plots



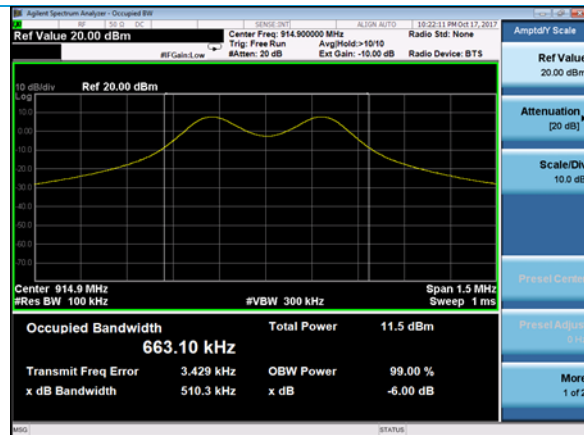
99% BW Low



6 dB BW Low



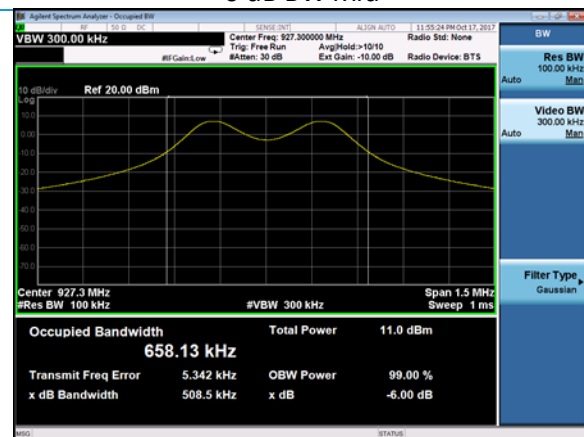
99% BW Mid



6 dB BW Mid



99% BW High



6 dB BW High

5.1.2 Antenna Port Conducted Emissions – Maximum Conducted Output Power

Operator	Shane Dock
Test Date	10/17/17
Location	Conducted RF Measurement Area
Temp. / R.H.	71 degrees Fahrenheit / 57%
Requirement	FCC: 15.247 (b)(3) IC: RSS-247 5.4 (d)
Method	ANSI C63.10 Section 11.9.1.1

Limits:

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

Test Parameters

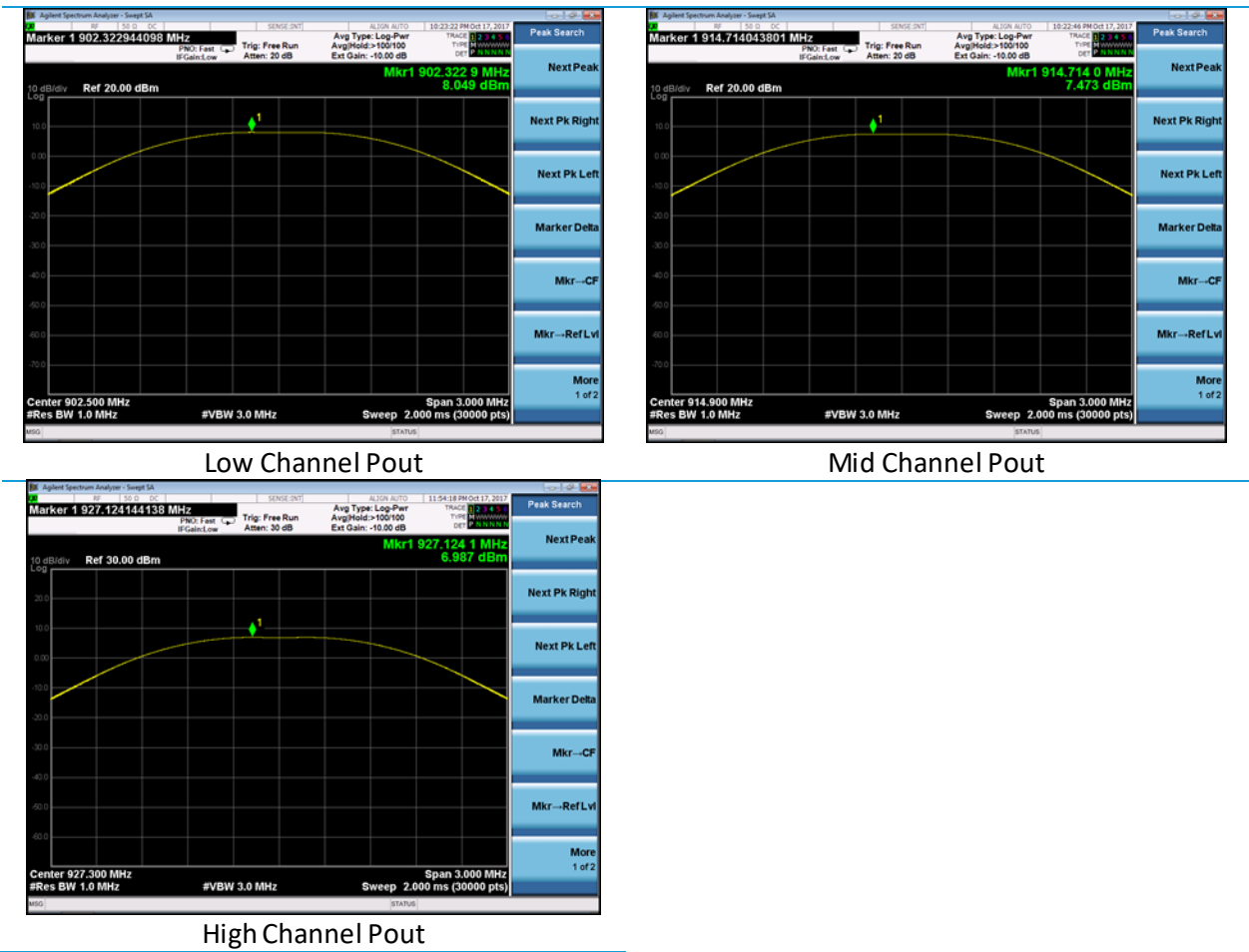
Frequency	902.5 MHz, 914.9 MHz, 927.3 MHz
RBW	1 MHz

Table

Channel	Low	Mid	High
Pout Conducted (dBm)	8.049	7.473	6.987

Worst Case Margin = 30.000 dBm – (8.049 dBm) = 21.951 dB

Plots



5.1.3 Antenna Port Conducted Emissions – RF Spurious Emissions

Operator	Shane Dock
Test Date	10/17/17
Location	Conducted RF Measurement Area
Temp. / R.H.	71 degrees Fahrenheit / 57%
Requirement	15.247 (d)
Method	ANSI C63.10 Section 11.11

Limits:

RF Spurious Limit
20 dBc

Test Parameters

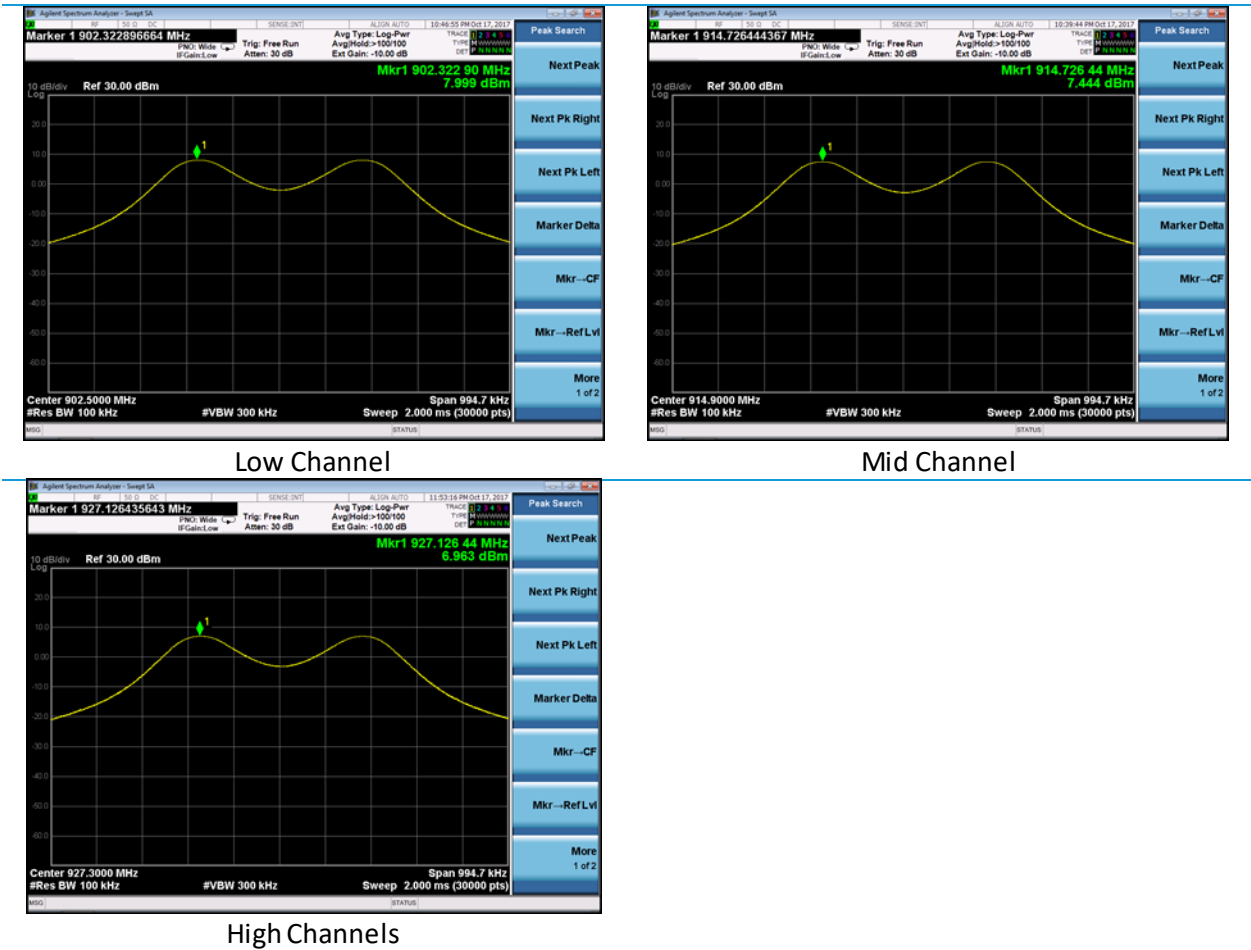
Frequency	30-25000 MHz
Settings	902.5 MHz, 914.9 MHz, 927.3 MHz
RBW	100k
VBW	300k
Trace	Max Hold
Detector	Peak

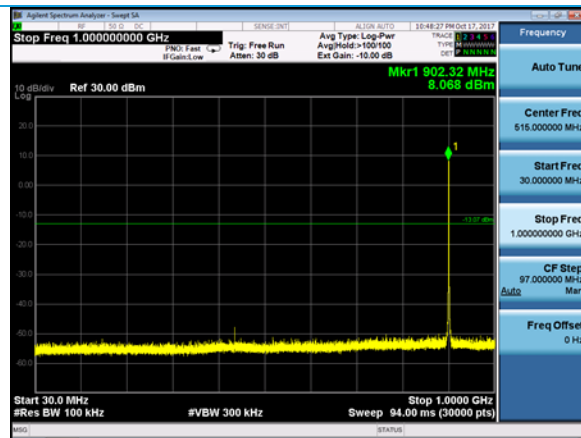
Table

Channel	Frequency (MHz)	Peak Reading (dBm)	Peak Limit (dBm)	Peak Margin (dB)
Low	902.0	-19.6	-12.0	7.6
High	928.0	-27.0	-12.0	15.0

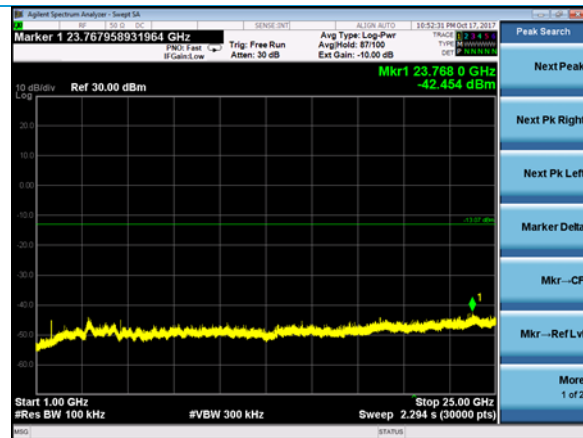
Plots

Reference Levels (Worst-Case Shown)

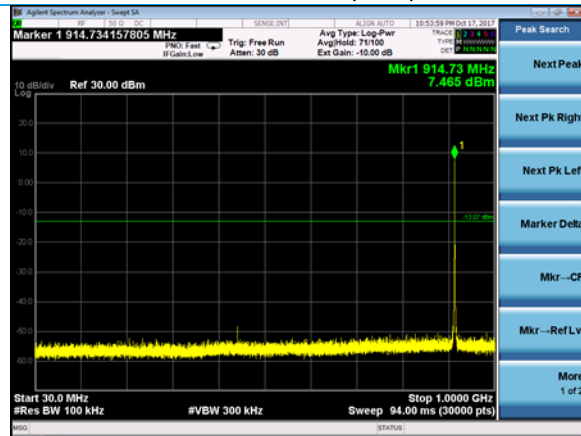




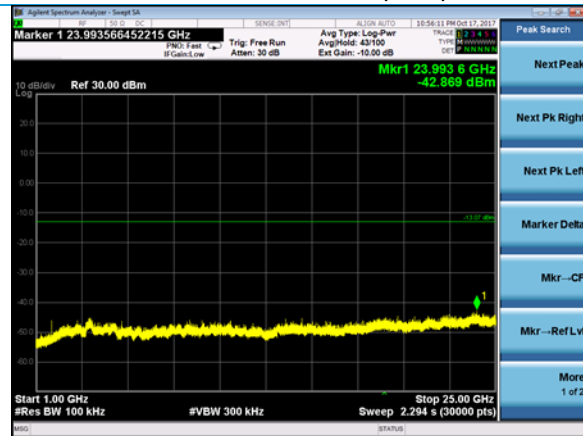
30-1000 MHz (Low)



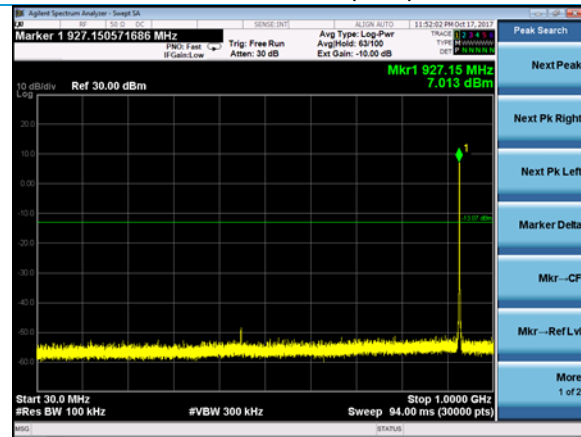
10000-25000 MHz (Low)



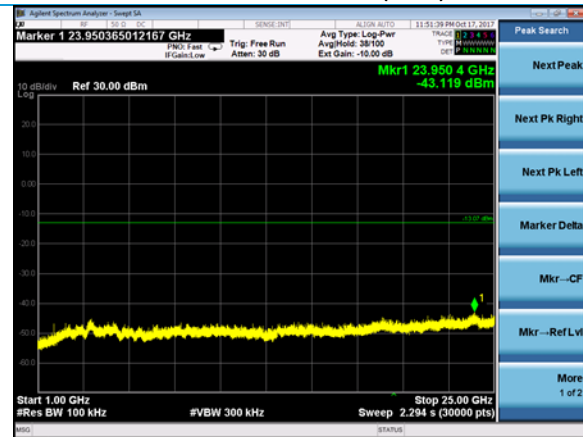
30-1000 MHz (Mid)



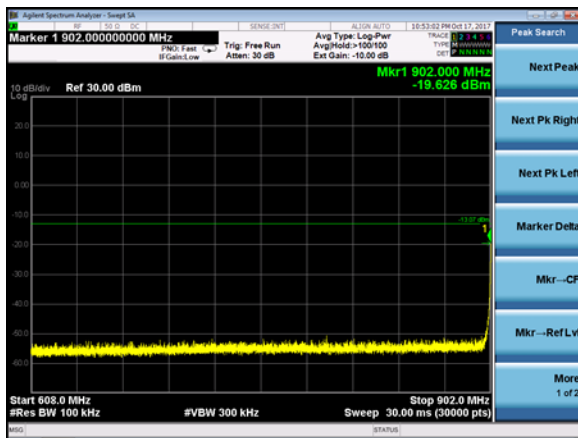
10000-25000 MHz (Mid)



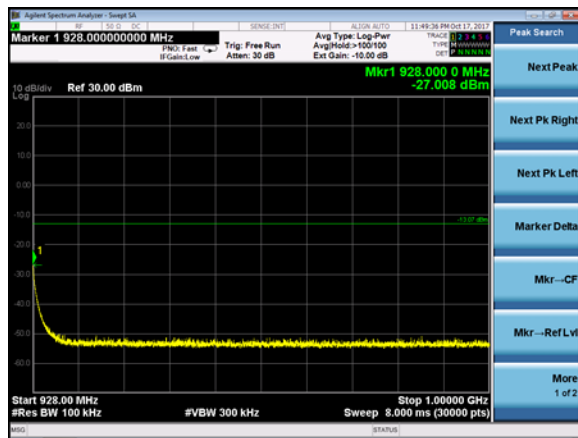
30-1000 MHz (High)



10000-25000 MHz (High)



Lower Band Edge



Upper Band Edge

5.1.4 Antenna Port Conducted Emissions – Power Spectral Density

Operator	Shane Dock
Test Date	10/17/17
Location	Conducted RF Measurement Area
Temp. / R.H.	71 degrees Fahrenheit / 57%
Requirement	15.247 (e)
Method	ANSI C63.10 Section 11.10.2

Limits:

PSD (dBm/3 kHz)
< 8

Test Parameters

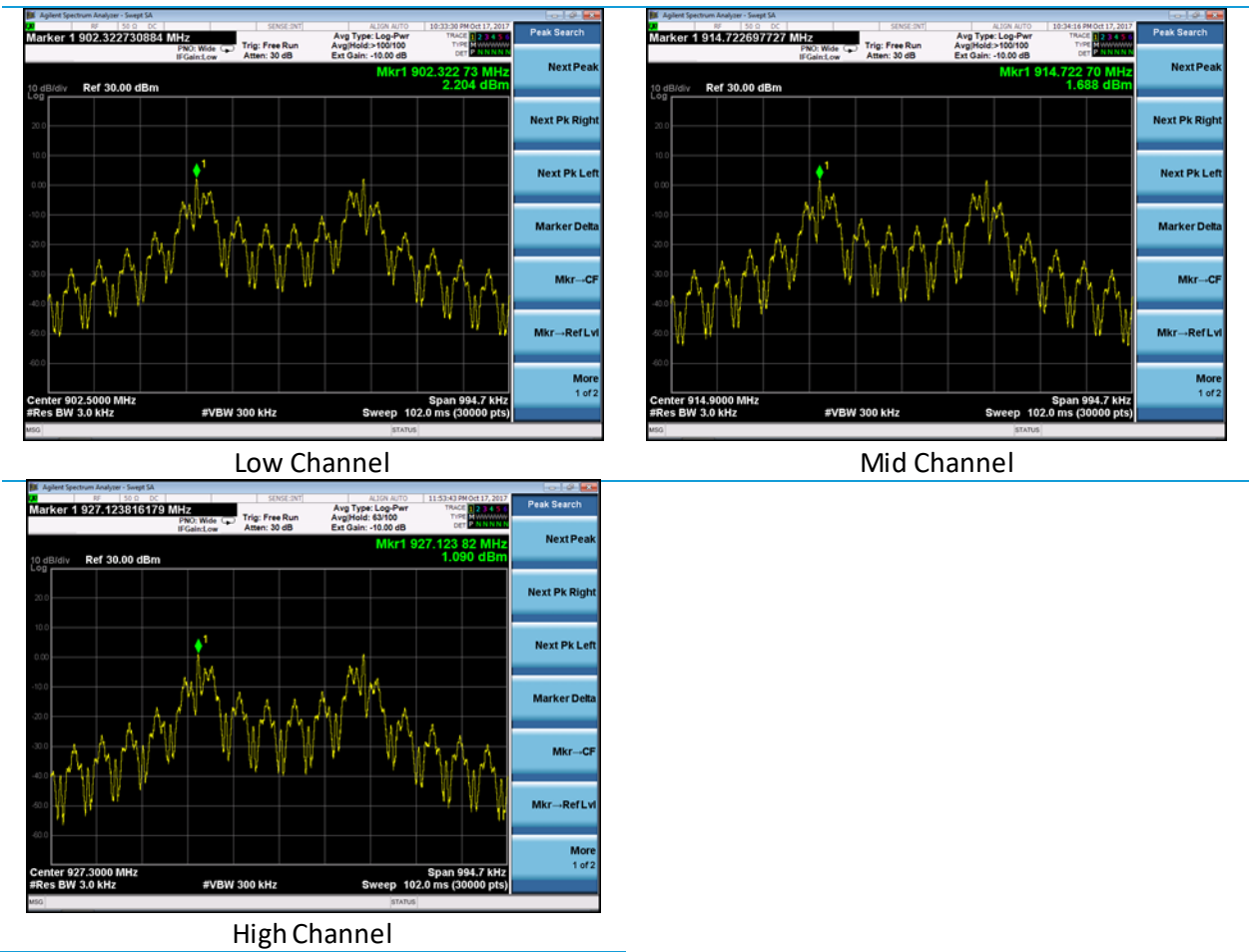
Frequency	902.5 MHz, 914.9 MHz, 927.3 MHz
RBW	3kHz
VBW	300kHz
Trace	Max Hold
Detector	Peak

Table

Channel	Low	Mid	High
PSD (dBm)	2.204	1.688	1.090

Worst Case Margin = 8.000 dBm – (2.204dBm) = 5.796 dB

Plots



5.1.5 Antenna Port Conducted Emissions – Frequency Stability

Operator	Shane Dock
Test Date	10/17/17
Location	Conducted RF Measurement Area
Temp. / R.H.	71 degrees Fahrenheit / 57%
Requirement	FCC: 2.1055 (d) IC: RSS-GEN 6.11
Method	ANSI C63.10 Section 6.8

Test Parameters

Channels	Low, Mid, High
Frequencies (Nominal)	902.5 MHz, 914.9 MHz, 927.3 MHz
Voltages	3.15, 3.70, and 4.20 VDC

Table (Values below listed in Hz at the given voltages)

Channel	3.15 VDC	3.70 VDC	4.20 VDC	Deviation (Hz)
Low Channel	902501892	902503158	902501592	1566
Mid Channel	914901375	914901825	914903708	2333
High Channel	927303675	927301475	927302675	2200

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	10/2/17 – 10/18/17
Location	Chamber 3, Chamber 5
Temp. / R.H.	71/55%
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
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 (Tx signal is continuous)
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. Emissions below 200 MHz are not a function of the EUT.
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 : RE

Job # : C-2757

PE : Shane Dock

Customer : Triax Technologies

Quote #: 317206

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960128	Biconical Antenna	ETS Lindgren	3110B	00062899	4/13/2017	4/13/2018	Active Calibration
2	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	4/17/2017	4/17/2018	Active Calibration
3	EE 960088	EMI Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration
4	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2017	5/12/2018	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	8/30/2017	8/30/2018	Active Calibration
6	AA 960174	Small Horn Antenna	ETS Lindgren	3116C-PA	00206880	5/1/2017	5/1/2018	Active Calibration
7	AA 960171	Cable - low loss 6m	A.H. Systems, Inc	SAC-26G-6	386	3/31/2016	12/11/2017	Active Verification
8	AA 960154	High Pass Filter 2.4 GHz	KWM	HPF-L-14186	7272-02	8/30/2017	8/30/2018	Active Calibration

Table

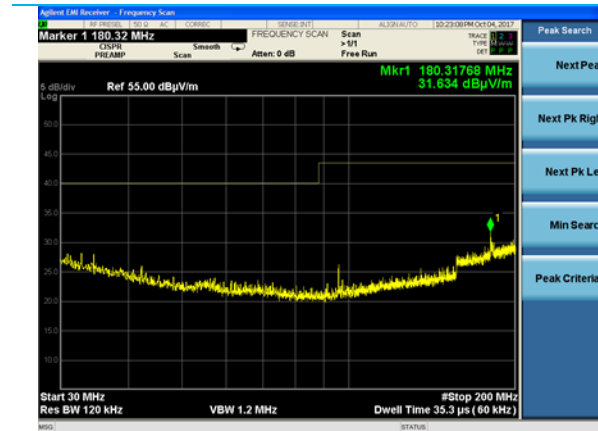
Measurements below 200 MHz are noise floor measurements.

Frequency (MHz)	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Margin (dB)	Antenna Polarity	EUT orientation	Channel
198.68	100.00	0.0	24.4	43.5	19.1	H	V	Low
180.38	100.00	0.0	23.2	43.5	20.3	V	V	Low

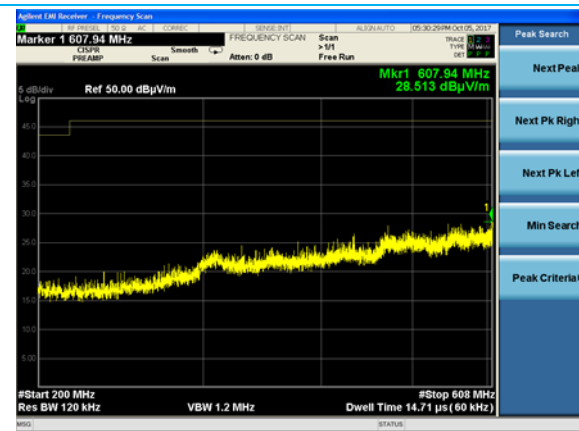
Frequency (MHz)	Height (cm)	Azimuth (degrees)	Peak Reading (dBμV/m)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Avg Margin (dB)	Antenna Polarity	EUT orientation	Channel
2707.5	196.09	129.25	51.2	47.0	54.0	7.0	Vertical	Horizontal	1
2745.0	260.57	60.25	45.6	40.1	54.0	13.9	Vertical	Horizontal	32
3660.0	129.19	343.75	44.6	36.9	54.0	17.1	Vertical	Horizontal	32
2782.0	133.00	181.8	48.5	41.8	54.0	12.2	Vertical	Horizontal	63

Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Avg Margin (dB)	Antenna Polarity	EUT orientation	Channel
4511.6	100.00	326.50	42.0	32.4	54.0	21.6	Vertical	Vertical	1
9023.2	117.57	179.25	47.2	37.7	54.0	16.3	Vertical	Vertical	1
4513.4	114.90	110.50	42.3	33.1	54.0	20.9	Horizontal	Vertical	1
9023.2	150.14	106.00	45.4	35.3	54.0	18.7	Horizontal	Vertical	1
4513.2	241.95	44.25	46.0	38.1	54.0	15.9	Horizontal	Horizontal	1
9023.4	244.33	160.00	47.1	37.5	54.0	16.5	Horizontal	Horizontal	1
4513.4	110.66	66.00	44.0	35.7	54.0	18.3	Vertical	Horizontal	1
4513.4	109.52	84.00	43.5	33.6	54.0	20.4	Vertical	Flat	1
9026.8	100.04	196.25	46.4	35.0	54.0	19.0	Vertical	Flat	1
4575.6	287.33	37.50	44.8	37.0	54.0	17.0	Horizontal	Horizontal	32
9147.2	249.28	167.75	47.0	37.2	54.0	16.8	Horizontal	Horizontal	32
4635.65	297.14	32.75	44.2	35.6	54.0	18.4	Horizontal	Horizontal	63
9271.3	257.57	166.00	47.7	37.0	54.0	17.0	Horizontal	Horizontal	63

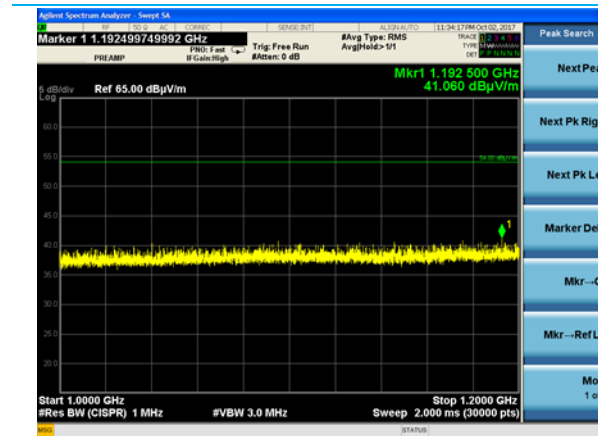
Plots – Spurious Emissions



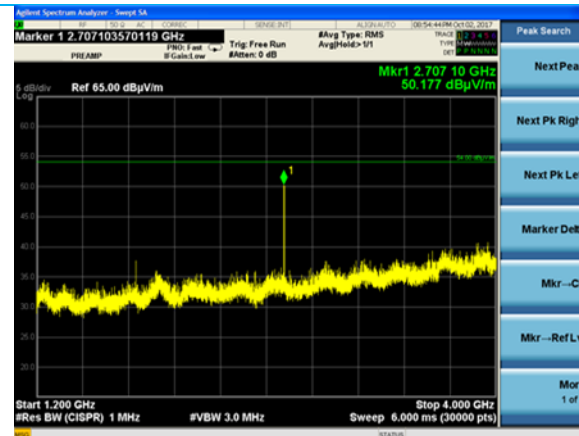
30-200 MHz



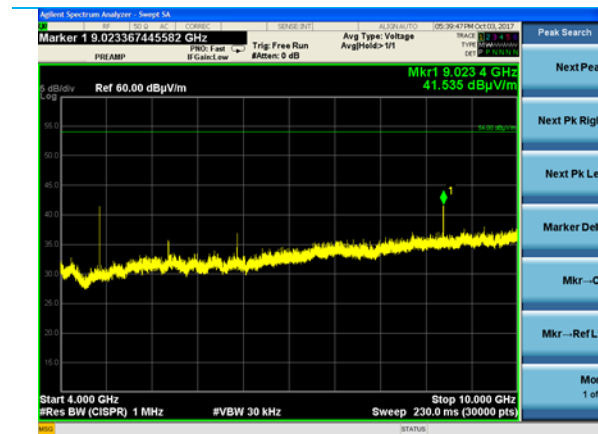
200-608 MHz



1000-1200 MHz



1200-4000 MHz (Reduced BW)



4-10 GHz (Reduced BW)

Plots – Band Edges



6 REVISION HISTORY

Version	Date	Notes	Person
V0	11/14/17	First Draft	Shane Dock
V1	6/6/18	Updated Draft	Shane Dock
V2	8/13/18	Customer Information Added	Shane Dock
V3	8/14/18	Final Draft	Shane Dock
V4	9/18/18	Updated References	Shane Dock

END OF REPORT