

Test Report # 317206 A

Equipment Under Test: Spot-r Clip

Test Date(s): 10/3/17 – 10/12/17

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

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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

1 TEST REPORT SUMMARY

During **10/3/17 – 10/12/17** 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 3 channels at one set power. Unit tested in Vertical, Horizontal and Flat Orientations. Unit programmed with a serial connection (via a terminal connection program like PuTTY).

Low – 2402 MHz

Mid – 2440 MHz

High – 2480 MHz

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

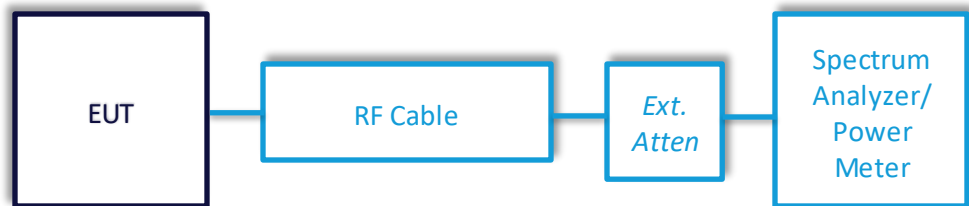
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
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	10/12/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 59%
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	2402, 2440, 2480 MHz
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Tables

Channel	Low	Mid	High
6dB BW (kHz)	689.0	681.9	678.6
99% BW (kHz)	1059.1	1057.3	1058.3

Instrumentation

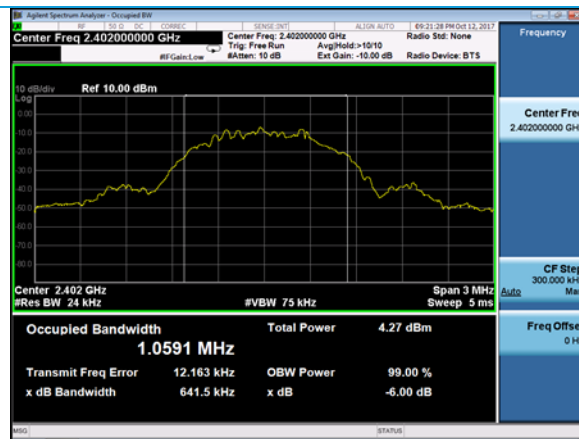


Date : 18-Jul-2017 Test : Conducted RF Testing Job # : C-2757
PE: Shane Dock Customer : Triax Technologies Quote #: 317206

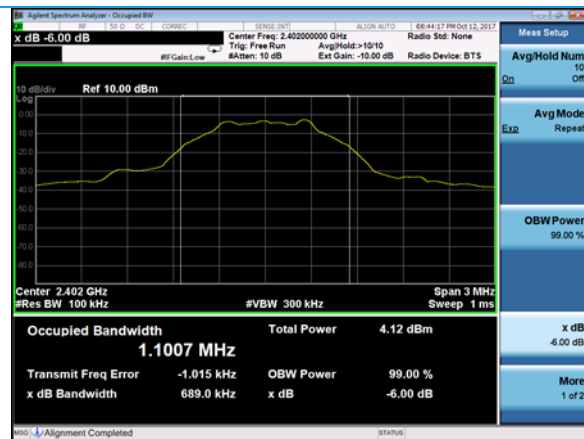
No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/29/2016	12/31/2017	Active Calibration

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Report: 317206 A		Model: CL-2
Job: C-2757		Serial: See Section 2.1

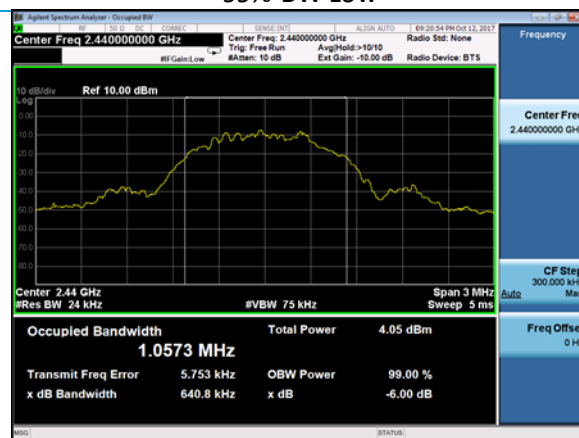
Plots



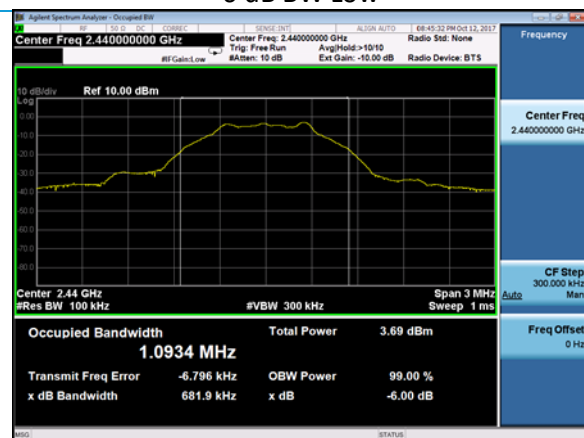
99% BW Low



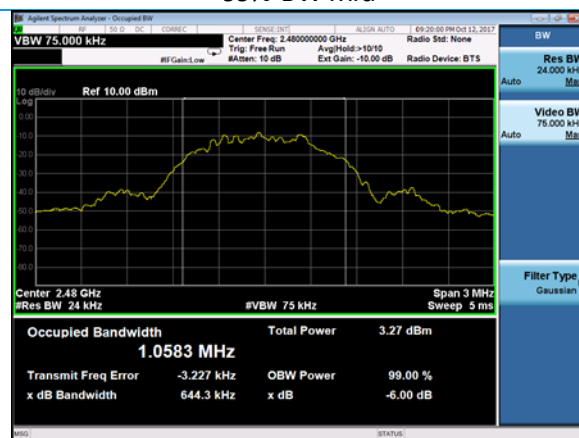
6 dB BW Low



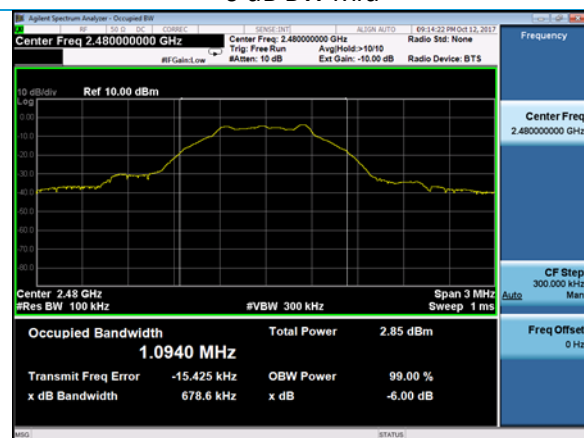
99% BW Mid



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	10/12/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 59% RH
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

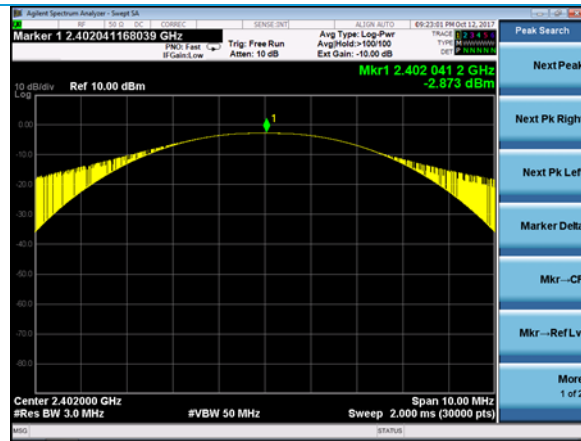
Frequency	2402, 2440, 2480 MHz
RBW	3 MHz

Table

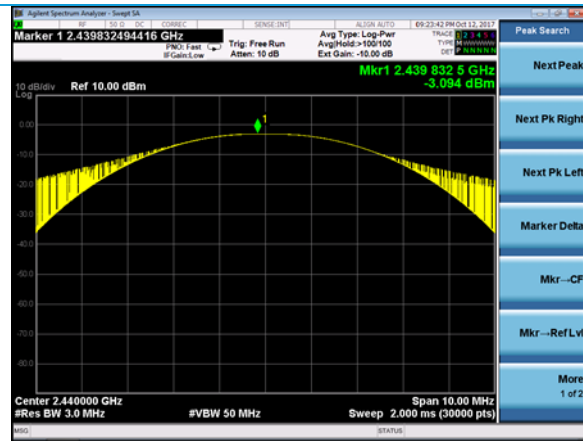
Channel	Low	Mid	High
Pout Conducted (dBm)	-2.873	-3.094	-3.935

Worst Case Margin = 30.000 dBm – (-2.873 dBm) = 32.873 dB

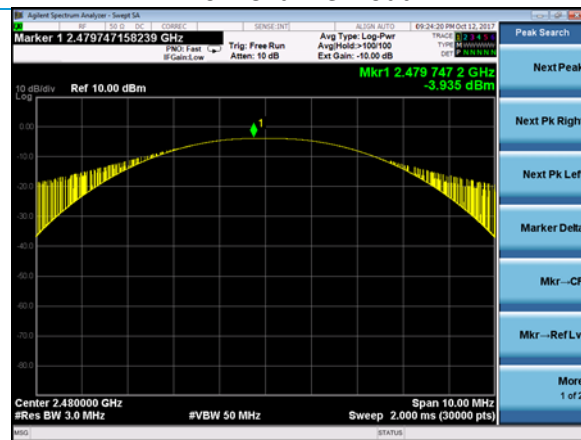
Plots



Low Channel Pout



Mid Channel Pout



High Channel Pout

5.1.3 Antenna Port Conducted Emissions – RF Spurious Emissions

Operator	Shane Dock
Test Date	10/12/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70/59%
Requirement	FCC: 15.247 (d) IC: RSS-247 5.5
Method	ANSI C63.10 section 11.11

Limits:

RF Spurious Limit

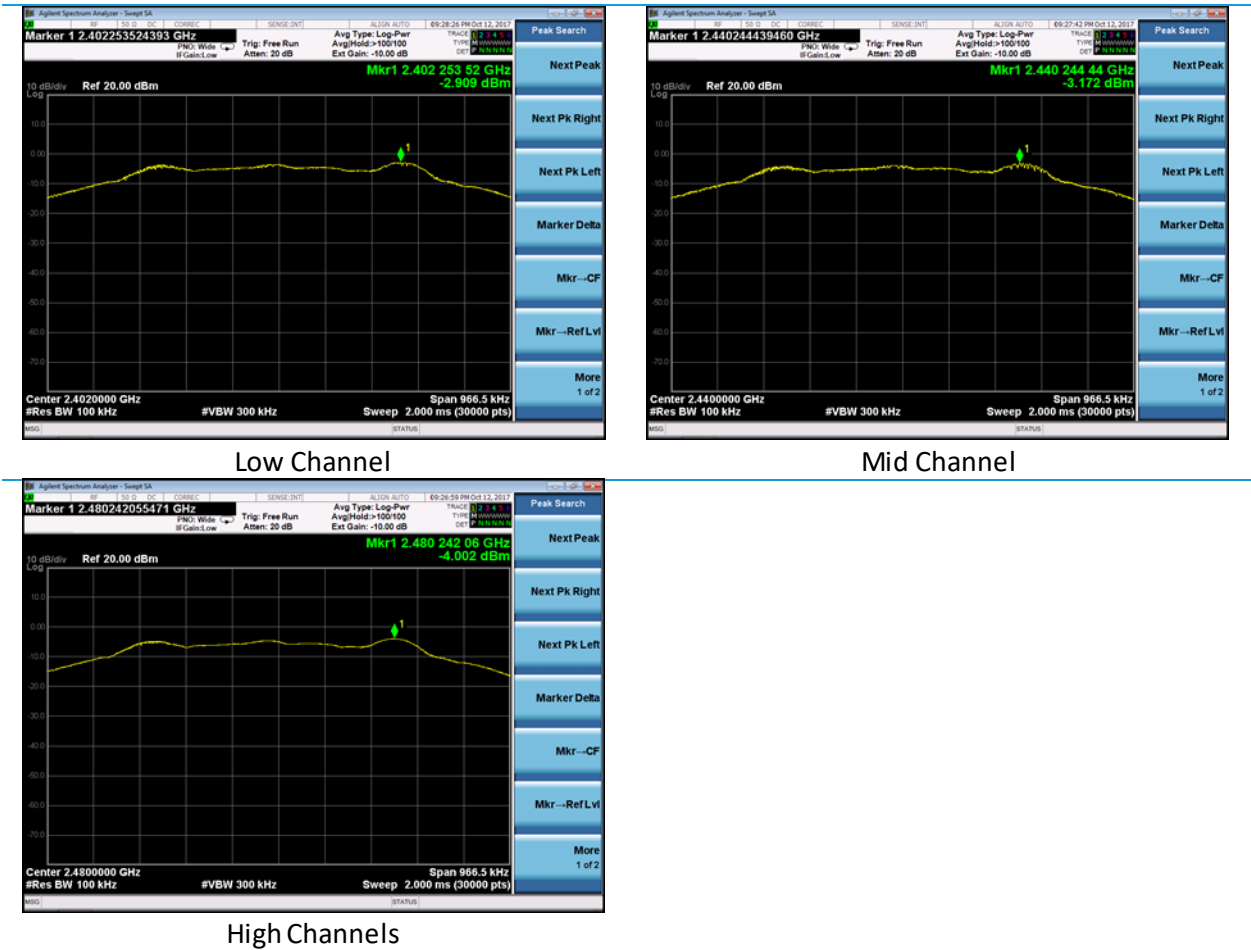
20 dBc

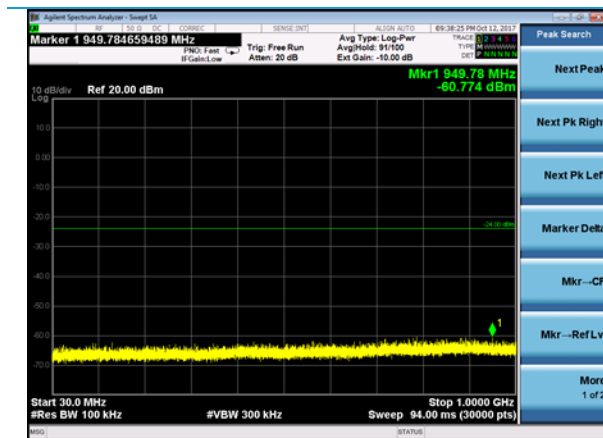
Test Parameters

Frequency	30-25000 MHz
Settings	2402, 2440, 2480 MHz Channels
RBW	100k
VBW	300k
Trace	Max Hold
Detector	Peak
Note	All emissions are >15 dB below the limit.

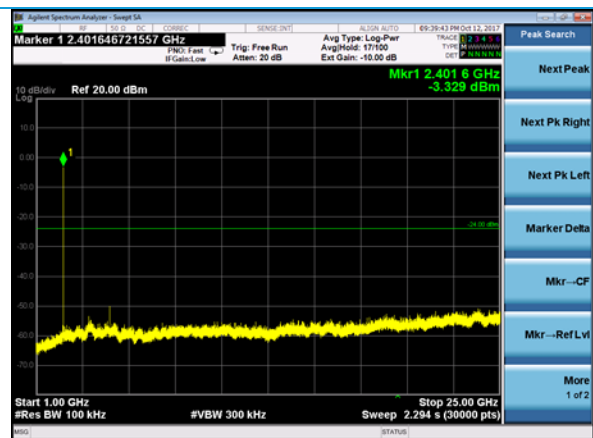
Plots

Reference Levels (Worst-Case Shown)

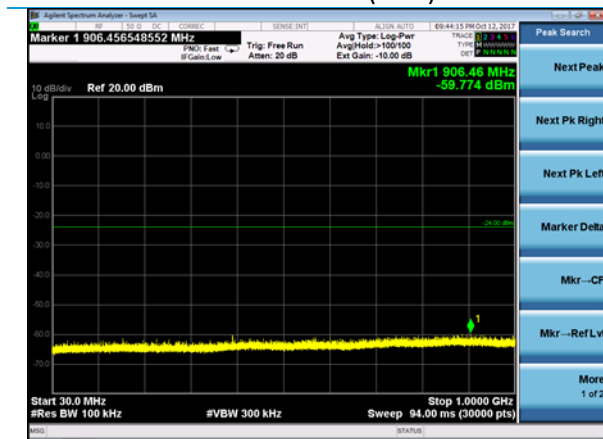




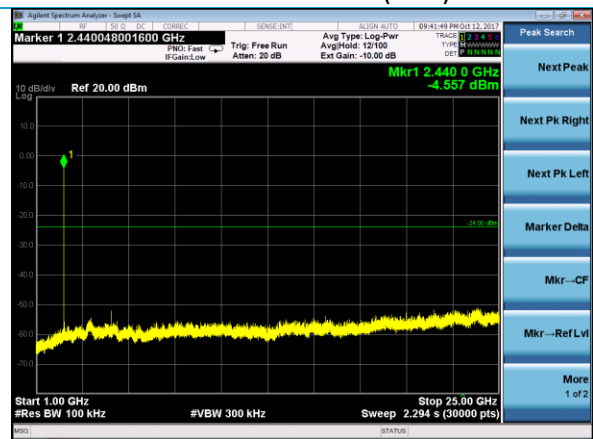
30-1000 MHz (Low)



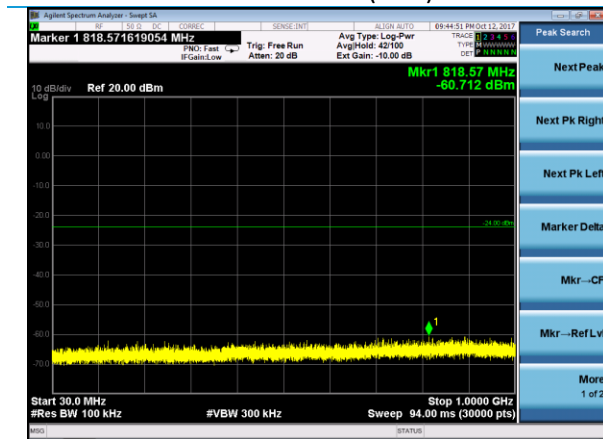
10000-25000 MHz (Low)



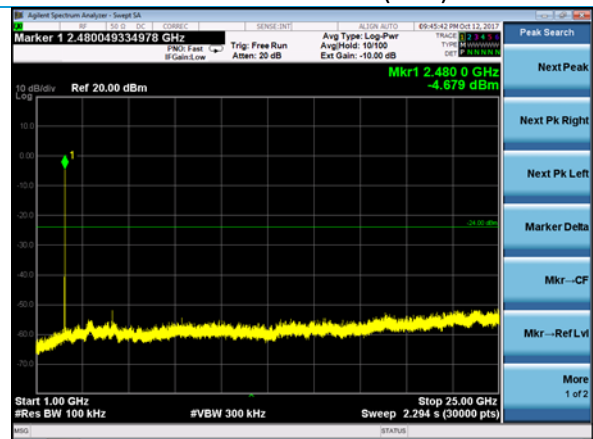
30-1000 MHz (Mid)



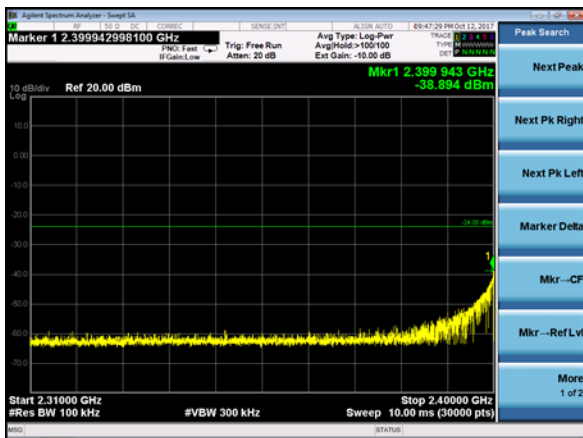
10000-25000 MHz (Mid)



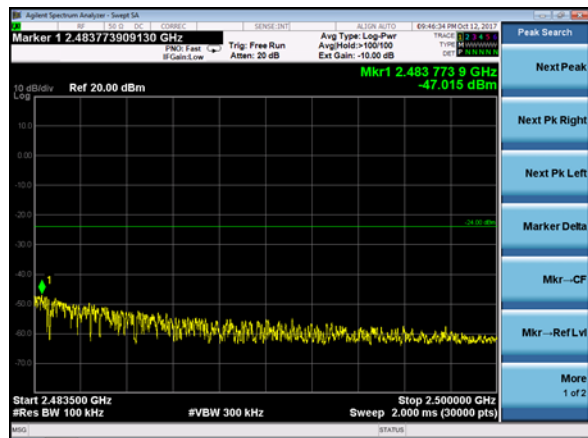
30-1000 MHz (High)



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	10/12/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70/59%
Requirement	FCC: 15.247 (e) IC: RSS-247 5.2 (b)
Method	ANSI C63.10 Section 11.10.2

Limits:

PSD (dBm/3 kHz)
< 8

Test Parameters

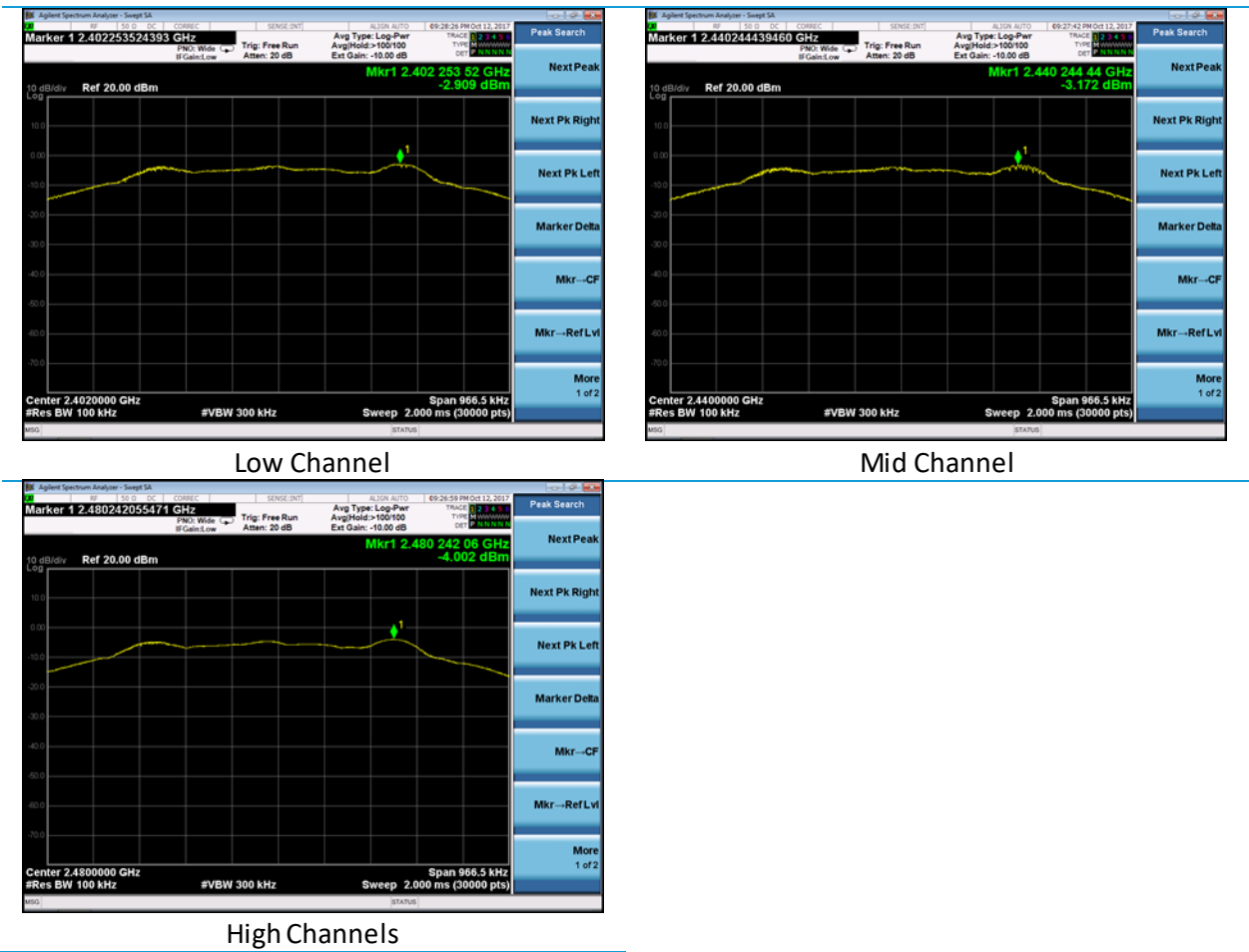
Frequency	2402, 2440, 2480 MHz
RBW	100kHz
VBW	300kHz
Trace	Max Hold
Detector	Peak

Table

Channel	Low	Mid	High
PSD (dBm)	-2.909	-3.172	-4.002

Worst Case Margin = 8.000 dBm – (-2.909dBm) = 10.909 dBm

Plots



5.1.5 Antenna Port Conducted Emissions – Frequency Stability

Operator	Shane Dock
Test Date	10/12/17
Location	Conducted measurement area
Temp. / R.H.	70/59
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)	2402, 2440, 2480 MHz
Voltages	3.15, 3.70, 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	2402253710	2402255780	2402254580	2070
Mid	2440244370	2440245240	2440244240	1000
High	2480234710	2480235970	2480237170	2460

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	10/3/17 – 10/4/17
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 (μV/m)	100	150	200	500
Field Strength (dBμV/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 = 1 kHz for Average measurements (2.127 ms on time)
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. BLE emissions below 1 GHz are not a function of the EUT.
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 = 33.20 dBμV/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	EM Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration
4	EE 960085	EM 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	HFF-L-14186	7272-02	8/30/2017	8/30/2018	Active Calibration

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Name: Spot-r Clip

Model: CL-2

Serial: See Section 2.1

Table

Measurements below 1 GHz are noise floor measurements.

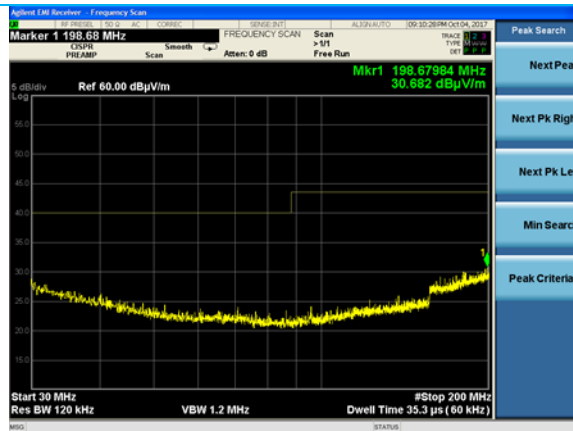
Frequency (MHz)	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)	Antenna Polarity	EUT orientation	Channel
198.68	100.00	0.0	24.4	43.5	19.1	H	V	Low
180.38	100.00	0.0	23.2	43.5	20.3	V	V	Low
970.60	100.00	0.0	28.6	54.0	25.4	H	V	Low
998.74	100.00	0.0	29.3	54.0	24.7	V	V	Low

Frequency (MHz)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Avg Margin (dB)
2387.6	36.4	54.0	17.6
2483.9	38.2	54.0	15.8

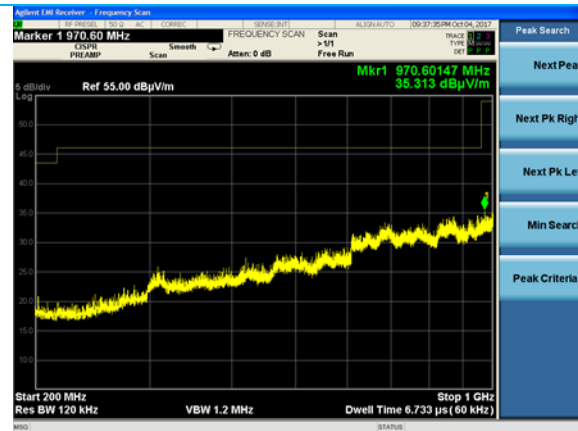
Frequency (MHz)	Peak Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)
2389.4	55.0	74.0	19.0
2483.7	69.1	74.0	4.9

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
4804.05	100.00	248.50	46.7	40.7	54.0	13.3	H	F	Low
4804.09	149.38	118.75	42.7	33.9	54.0	20.1	V	F	Low
4804.07	277.19	274.50	46.5	39.7	54.0	14.3	V	V	Low
4803.96	107.19	176.75	45.9	39.1	54.0	14.9	H	V	Low
4804.06	100.00	33.75	45.9	39.0	54.0	15.0	H	H	Low
4804.01	100.09	155.75	46.5	40.2	54.0	13.8	V	H	Low
4880.16	100.00	354.75	43.9	35.3	54.0	18.7	H	F	Mid
4959.98	104.61	248.25	47.4	41.4	54.0	12.6	H	F	High

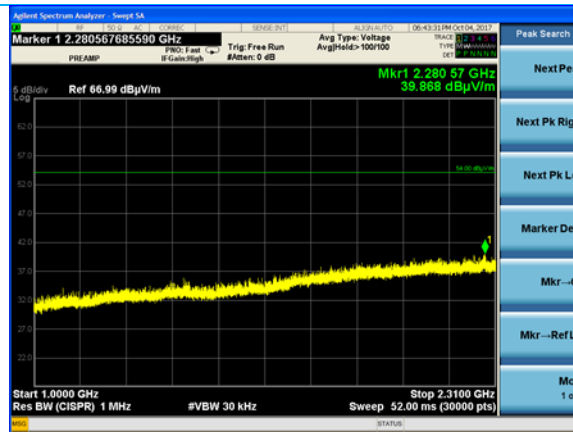
Plots – Spurious Emissions



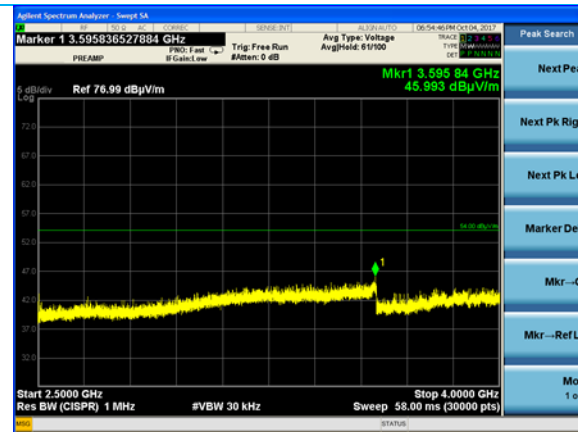
30-200 MHz



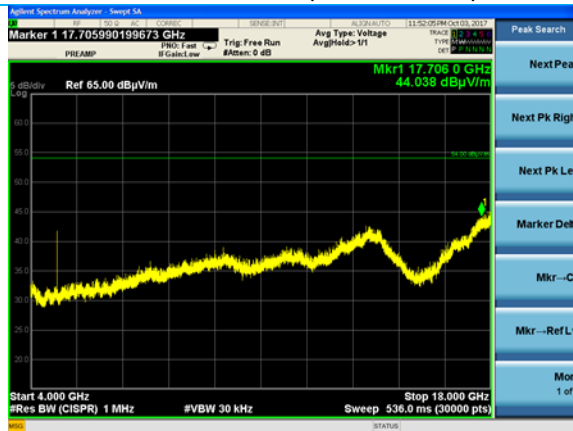
200-1000 MHz



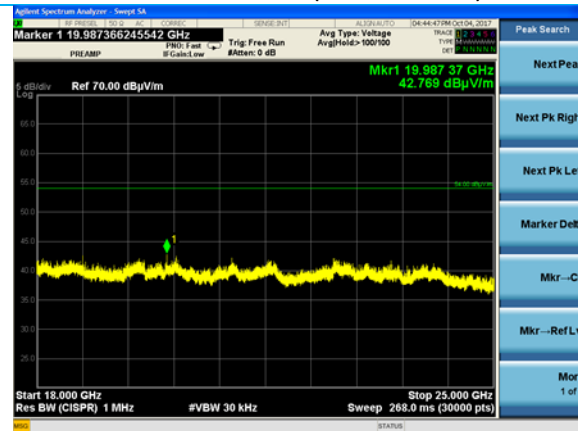
1000-2310 MHz (Reduced BW)



2500-4000 MHz (Reduced BW)

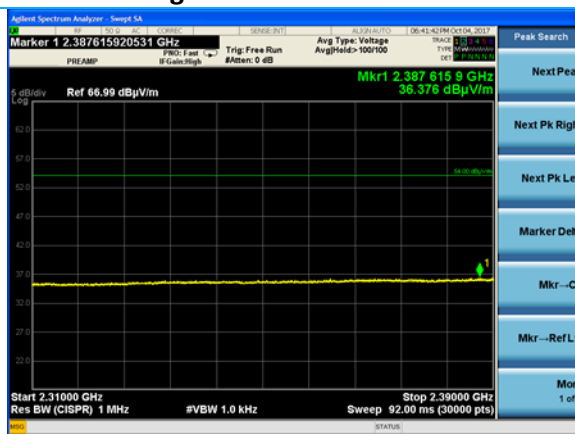


4-18 GHz (Reduced BW)

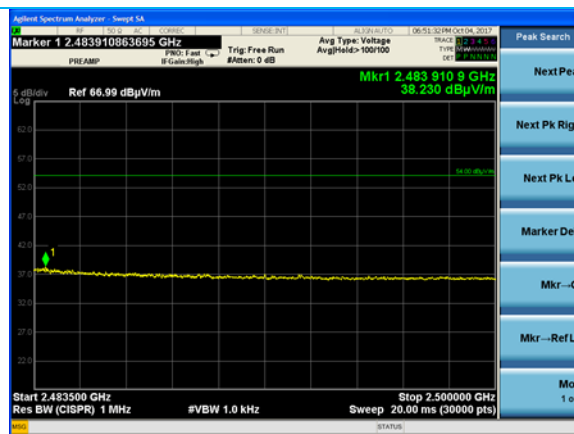


18-25 GHz (Reduced BW)

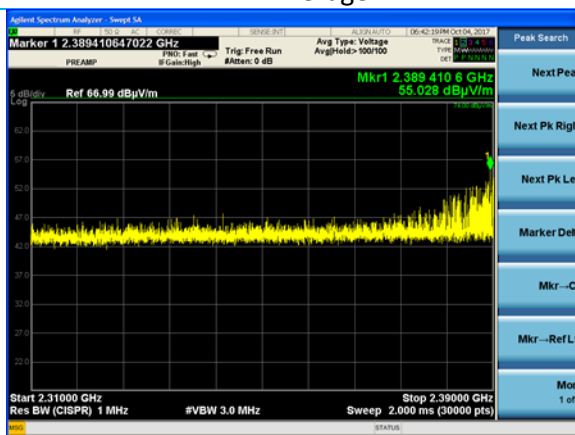
Plots – Band Edges



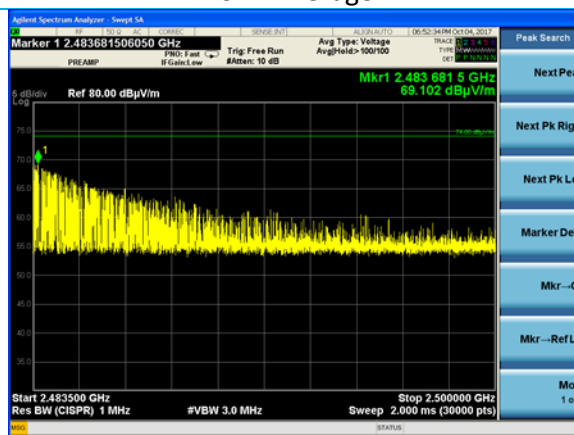
LBE Average



UBE Average



LBE Peak



UBE Peak

6 REVISION HISTORY

Version	Date	Notes	Person
0	11/14/17	First Draft	Shane Dock
1	6/6/18	Updated Draft	Shane Dock
2	8/13/18	Customer Info Added	Shane Dock
3	8/14/18	Final Draft	Shane Dock
4	9/18/18	Updated References	Shane Dock

END OF REPORT