

# Test Report # TR 318032 A

**Equipment Under Test:** Vehicle Tag v2

**Test Date(s):** July 9, 10, 12, 13, 16, August 27, September 6, 14 2018

**Prepared for:**  
 Arity 875, LLC  
 Attn: Emad Isaac  
 222 W Merchandise Mart Plaza  
 Chicago, IL 60654

**Report Issued by:**

Signature: *Laura M Zehnder*

Date: 29 October 2018

**Report Reviewed by:** Adam Alger, Quality Manager

Signature: *Adam Alger*

Date: 26 October 2018

**Report Constructed by:** Laura Zehnder, Sr EMC Engineer

Signature: *Laura M Zehnder*

Date: 21 August 2108

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Company: Arity 875, LLC	Page 1 of 30	Name: Vehicle Tag v2
Report: TR 318032 A		Model: ARTST2001
Job: C-2977		Serial: D28 and 21

## 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 .....	20
6 Revision History .....	30

## 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: Arity	Page 3 of 30	Name: Vehicle Tag v2
Report: TR 318032 A		Model: ARTST2001
Job: C-2977		Serial: D28 and 21

## 1 TEST REPORT SUMMARY

During July 9, 10, 12, 13, 16, August 27, September 6, 14, 2018 the Equipment Under Test (EUT), Vehicle Tag v2, as provided by Arity 875, LLC was tested to the following FCC requirements:

FCC	Test Description	Measurement Procedure	Compliant
15.247 (a)(2)	Digital Modulation System 6 dB bandwidth	ANSI C63.10 Section 11.8	Yes
2.1049	Occupied Bandwidth	ANSI C63.10 Section 6.9	Yes
15.247 (b)(3)	Maximum Conducted Output Power	ANSI C63.10 Section 11.9	Yes
15.247 (e)	Digital Modulation System Power Spectral Density	ANSI C63.10 Section 11.10	Yes
15.247 (d)	RF Spurious Emissions in Non-Restricted Frequency Bands	ANSI C63.10 Section 11.11	Yes
15.247 (d)	Spurious Radiated Emissions in Restricted Bands	ANSI C63.10 Section 11.12	Yes
15.247 (d)	Band Edge	ANSI C63.10 Section 11.13	Yes
2.1055 (d)	Frequency Stability	ANSI C63.10 Section 6.8	Yes

Exclusions: *none*

### 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

<b>Company Name</b>	Arity 875, LLC
<b>Contact Person</b>	Emad Isaac
<b>Address</b>	222 W. Merchandise Mart Plaza Chicago, IL 60654

### 2.1 Equipment Under Test (EUT) Information

*The following information has been supplied by the client*

<b>Product Name</b>	Vehicle Tag v2
<b>Model Number</b>	ARTST2001
<b>Serial Number</b>	D28 and 21
<b>FCC ID</b>	2AQQAARTST2001

### 2.2 Product Description

The Arity model ARTST2001 is a battery-powered driving behavior and device presence tracking device that is designed to be fixed inside the passenger area of a vehicle and when enabled, relay information to a mobile phone application over Bluetooth. The ARTST2001 uses a low power accelerometer and real-time clock to capture significant movement events and send the events immediately or at next opportunity to the mobile application.

Antenna is a folded monopole with a peak gain of 2.9 dBi and an efficiency of 73.28%.

### 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

EUT was programmed using LightBlue explorer for Android version 2.6.4.

Channels tested: BLE channels 0 (2402 MHz), 18 (2438 MHz), 39 (2480 MHz)

EUT nominal operating voltage: 1.5 VDC.

### 3 REFERENCES

Publication	Date
FCC Part 15	2018
ANSI C63.10	2013

## 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

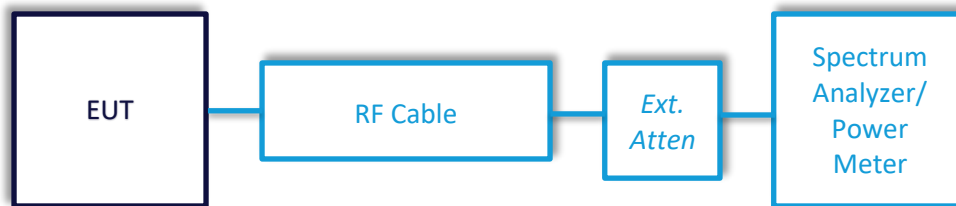
Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	$1 \times 10^{-7}$	$0.55 \times 10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65°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

## 5 TEST DATA

### 5.1 Antenna Port Conducted Emissions

<b>Description of Measurement</b>	<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>
<b>Example Calculations</b>	<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

<b>Operator</b>	Jeysson Gonzalez
<b>QA</b>	Aidi Zainal
<b>Test Date</b>	7/12/2018
<b>Location</b>	Bench
<b>Temp. / R.H.</b>	22.1 deg C/56% RH
<b>Requirement</b>	FCC 15.247
<b>Method</b>	ANSI C63.10

### Test Parameters

<b>Channels</b>	0 (2402 MHz), 18 (2438 MHz), 39 (2480 MHz)
<b>EUT Tx mode</b>	Transmitting modulated carrier.
<b>EUT Power</b>	1.5 VDC

### Instrumentation



Date: 9-May-2018 Test: Final - Conducted RF Job: C-2977  
 PE: Jeysson Gonzalez Customer: Arity Quote: 318032

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960047	Gage - Temp/Humidity	Lufft	5064.34	80206-01	5/19/2018	5/19/2019	Active Calibration
2	EE 960054	Meter - Multi	HP	971A	JP40011152	1/3/2018	1/3/2019	Active Calibration
3	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/25/2018	4/25/2019	Active Calibration
4	AA 960160	Cable	Micro-Coax	UFC142A-0-0720-2002	218652-001	11/15/2017	11/15/2018	Active Verification

### 5.1.1.1 Output Power

Requirement	FCC 15.247(b)(3) and (4)
Method	ANSI C63.10 Section 11.9.1.1
Settings	RBW = 3 MHz VBW= 50 MHz

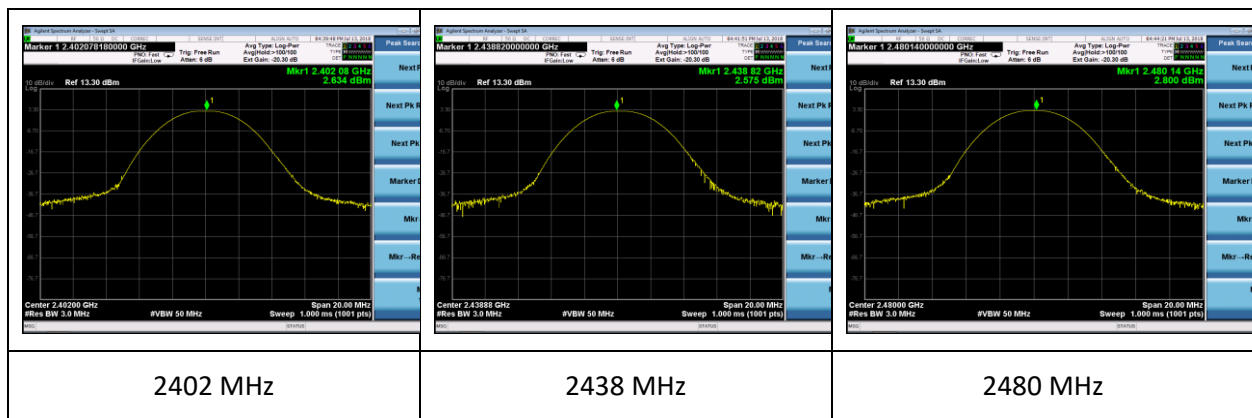
#### Limits:

The maximum peak conducted output power for systems using digital modulation shall not exceed 1W output power.

#### Table

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
2402	3.1	30.0	26.9
2438	3.1	30.0	26.9
2480	3.3	30.0	26.7

#### Plots



### 5.1.1.2 6 dB Occupied Bandwidth and DTS Bandwidth

#### Test Parameters

Requirement	FCC 15.247(a)(2)
Method	ANSI C63.10 Section 11.8.1, Option 1
Settings for 6 dB Bandwidth	RBW = 100 kHz, VBW = 300 kHz, Span = 3 MHz
Settings for 99% Bandwidth	RBW = 30 kHz, VBW = 100 kHz, Span = 5 MHz

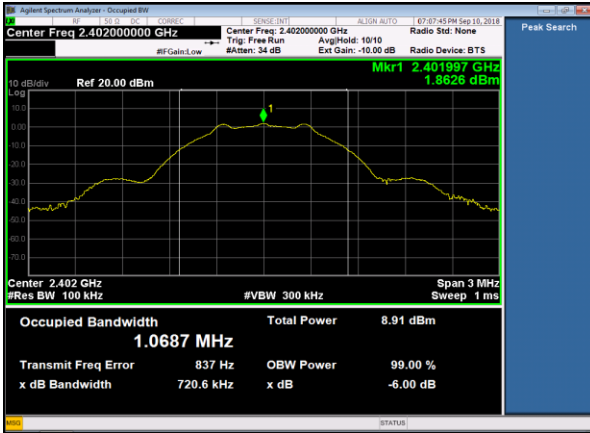
**Limits:** The minimum 6 dB bandwidth shall be at least 500 kHz

#### Table

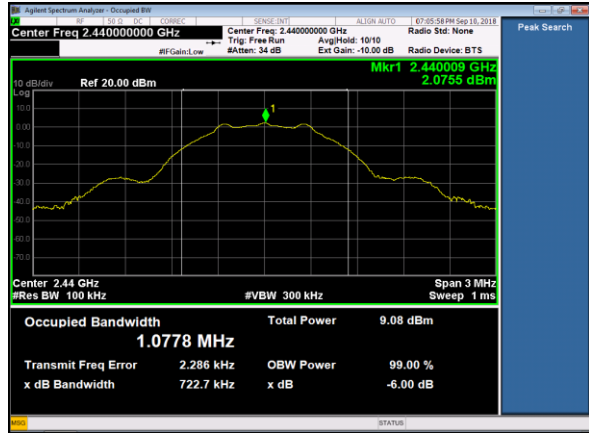
6 dB BW	
Frequency (MHz)	BW (kHz)
2402	720.6
2440	722.7
2480	720.1

## Plots

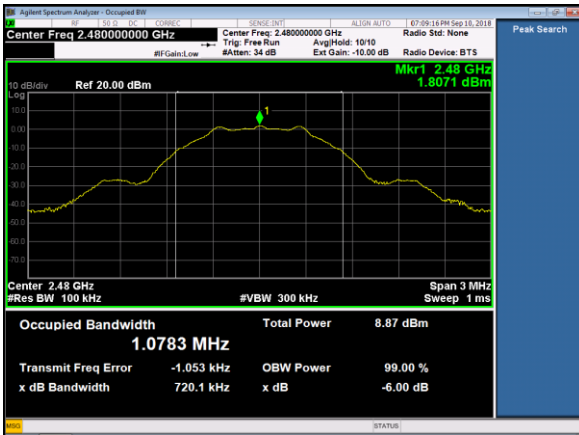
### 2402 MHz



### 2440 MHz



### 2480 MHz

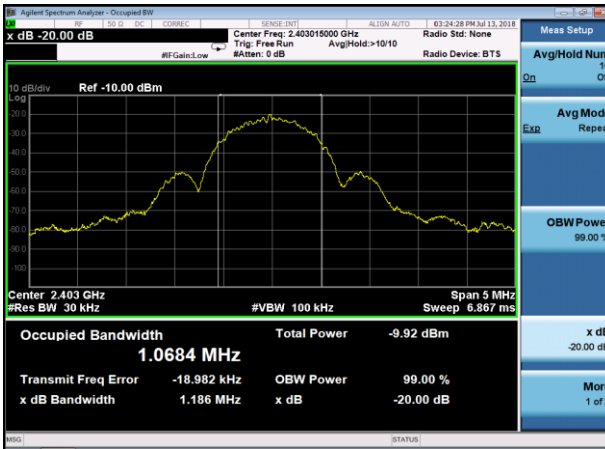


**Table**

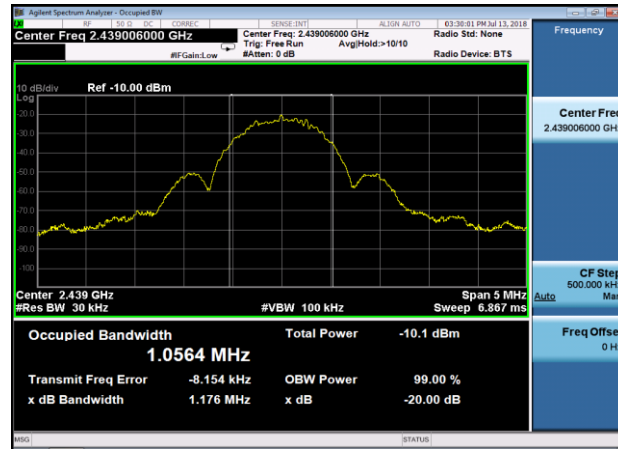
99% Bandwidth	
Channel	Bandwidth (MHz)
0	1.0684
18	1.0564
39	1.0581

**Plots**

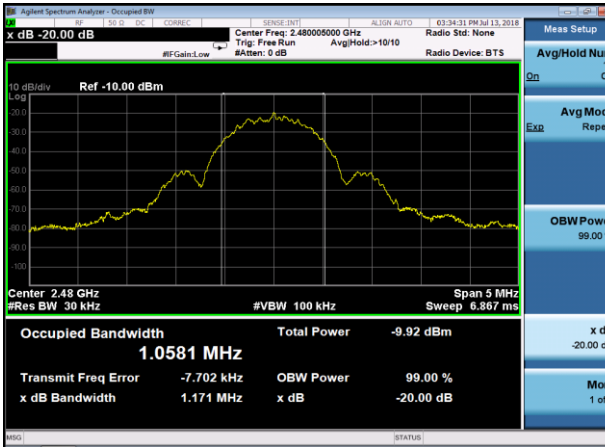
**Channel 0**



**Channel 18**



**Channel 39**



### 5.1.1.3 Power Spectral Density

Requirement	FCC 15.247 (e)
Method	ANSI C63.10 Section 11.10.2
Settings	RBW = 3 kHz VBW= 30 kHz

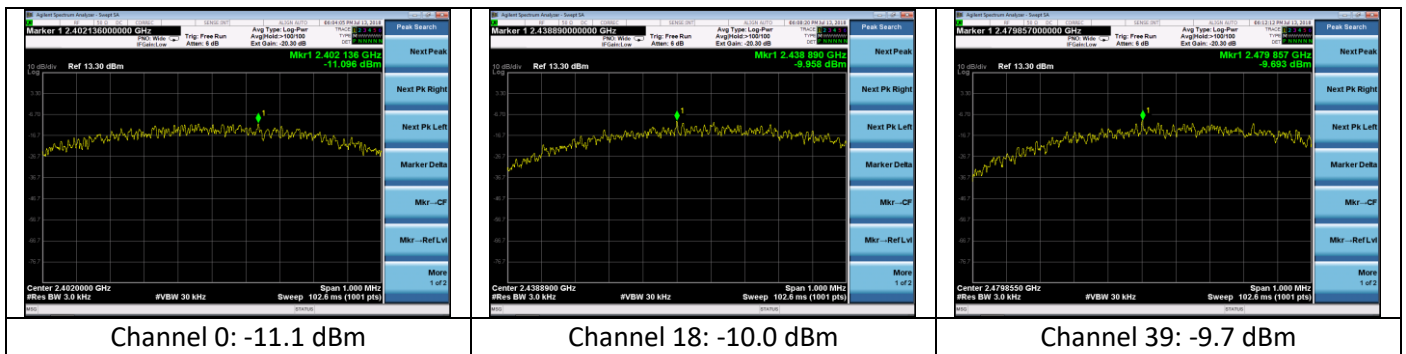
#### Limits:

15.247(e) The power spectral density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Table

PSD					
Channel	Span	DTS Bandwidth (kHz)	Peak 3kHz Reading (dBm)	Limit (dBm)	Limit Margin (dB)
0	1 MHz	597.4	-11.1	8.0	19.1
18	1 MHz	636.7	-10.0	8.0	18.0
39	1 MHz	578.4	-9.7	8.0	17.7

#### Plots



### 5.1.1.4 Spurious Emissions in Non-Restricted Frequency Bands

Requirement	FCC 15.209 and 15.247(d)
Method	ANSI C63.10 Section 11.11
Settings	RBW = 100 kHz VBW= 300 kHz

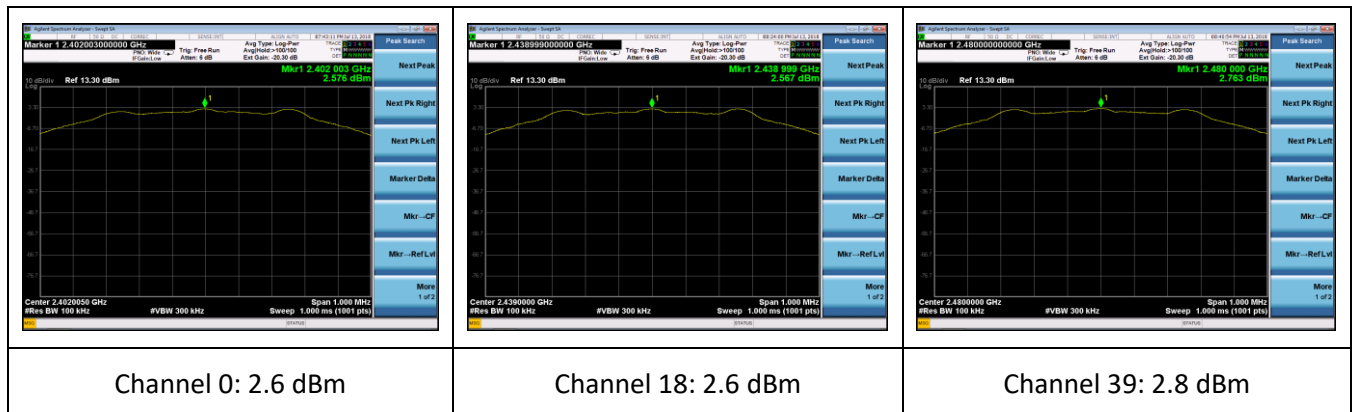
#### Limits:

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

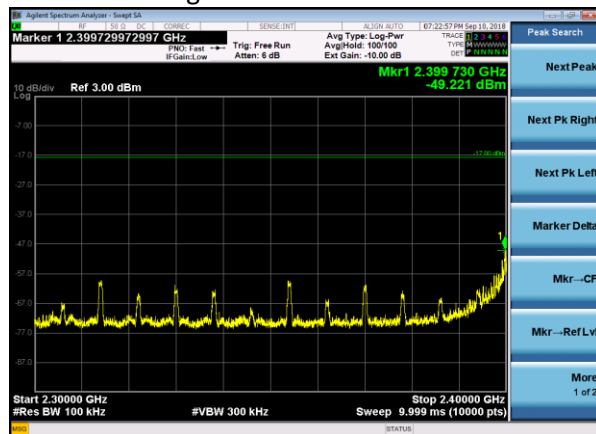
Note: all spurious emissions in plots on page 14 have margins greater than 9 dB (the gain of the highest gain antenna available for the EUT).

#### Plots

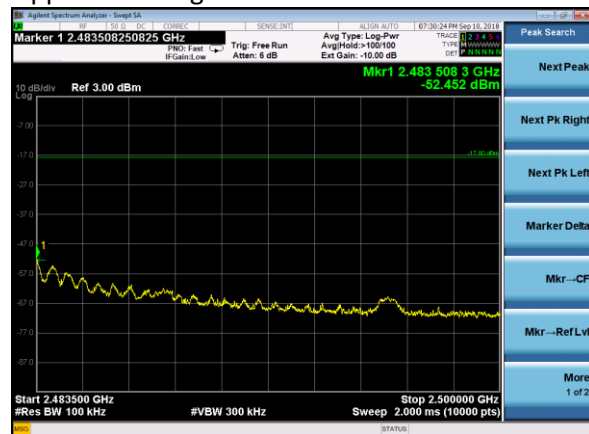
Fundamental emissions reference plots:



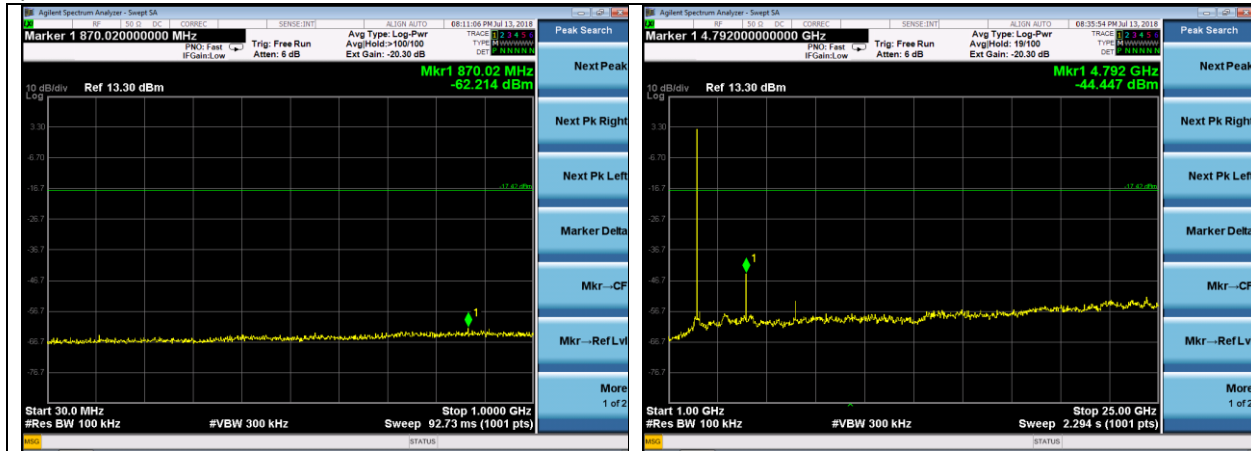
#### Lower Band Edge



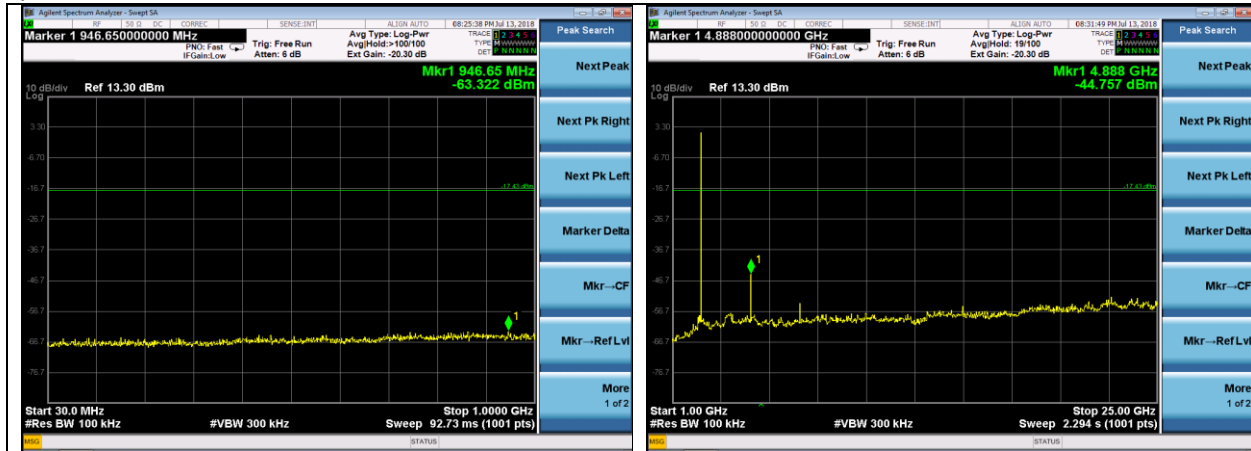
#### Upper Band Edge



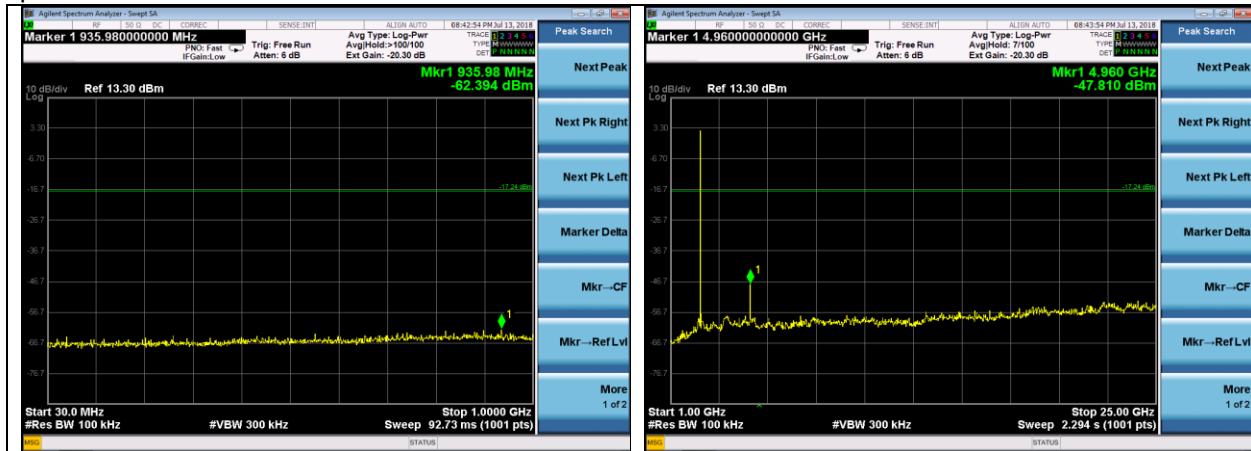
### Spurious Emissions Channel 0



### Spurious Emissions Channel 18



### Spurious Emissions Channel 39





### 5.1.1.5 Frequency Stability

Requirement	FCC 2.1055(d)
Method	ANSI C63.10
Settings	RBW = 300 Hz VBW = 1 kHz
Power	85% nominal voltage (1.275 VDC), 100% nominal voltage (1.5 VDC), 115% nominal voltage (1.725 VDC)

#### Low Channel

Low Channel/1.275 VDC

Temp °C	Frequency (Hz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2401980305	2401980153	2401980118	2401980062	2401980062	2401980305	243
40	2401986275	2401986065	2401986017	2401985927	2401985927	2401986275	348
30	2401993781	2401993552	2401993464	2401993363	2401993363	2401993781	418
20	2402001358	2402001089	2402001089	2402001094	2402001089	2402001358	269
10	2402007970	2402007738	2402007704	2402007702	2402007702	2402007970	268
0	2402012007	2402011920	2402011891	2402011923	2402011891	2402012007	116
-10	2402012333	2402012332	2402012337	2402012329	2402012329	2402012337	8
-20	2402007195	2402007569	2402007562	2402007623	2402007195	2402007623	428
-30	2401996917	2401996904	2401996766	2401996687	2401996687	2401996917	230

Low Channel/1.5 VDC

Temp °C	Frequency (Hz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2401980262	2401980163	2401980117	2401980068	2401980068	2401980262	194
40	2401986200	2401986081	2401986011	2401985933	2401985933	2401986200	267
30	2401993702	2401993564	2401993437	2401993359	2401993359	2401993702	343
20	2402001208	2402001088	2402001086	2402001098	2402001086	2402001208	122
10	2402007889	2402007772	2402007703	2402007704	2402007703	2402007889	186
0	2402011991	2401011929	2402011888	2402011928	2401011929	2402011991	1000062
-10	2402012148	2402012313	2402012336	2402012330	2402012148	2402012336	188
-20	2401006976	2402007606	2402007555	2402007595	2401006976	2402007606	1000630
-30	2401996871	2401996756	2401996661	2401996667	2401996661	2401996871	210

Low Channel/1.725 VDC

Temp °C	Frequency (Hz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2401980230	2401980182	2401980110	2401980081	2401980081	2401980230	149
40	2401986150	2401986098	2401986000	2401985942	2401985942	2401986150	208
30	2401993652	2401993593	2401993428	2401993368	2401993368	2401993652	284
20	2402001137	2402001092	2402001082	2402001093	2402001082	2402001137	55
10	2402007855	2402007780	2402007701	2402007701	2402007701	2402007855	154
0	2402011970	2402011941	2402011886	2402011929	2402011886	2402011970	84
-10	2402012210	2402012297	2402012327	2402012329	2402012210	2402012329	119
-20	2402006528	2402007517	2402007582	2402007620	2402006528	2402007620	1092
-30	2401996746	2401996954	2401996811	2401996731	2401996731	2401996954	223



**Middle Channel**

Mid Channel/1.275 VDC

Temp °C	Frequency (GHz)						
	start up	2 min	5 min	10 min	min	max	delta
50	2438979727	2438979719	2438979709	2438979686	2438979686	2438979727	41
40	2438985792	2438985632	2438985646	2438985642	2438985632	2438985792	160
30	2438992753	2438992777	2438992970	2438993097	2438992753	2438993097	344
20	2439001342	2439001005	2439000991	2439000996	2439000991	2439001342	351
10	2439007905	2439007680	2439007672	2439007684	2439007672	2439007905	233
0	2439012050	2439011957	2439011958	2439011978	2439011957	2439012050	93
-10	2439012407	2439012487	2439012497	2439012498	2439012407	2439012498	91
-20	2439007544	2439007852	2439007810	2439007822	2439007544	2439007852	308
-30	2438995833	2438996531	2438996542	2438996540	2438995833	2438996542	709

Mid Channel/1.5 VDC

Temp °C	Frequency (GHz)						
	start up	2 min	5 min	10 min	min	max	delta
50	2438979727	2438979725	2438979710	2438979691	2438979691	2438979727	36
40	2438985715	2438985627	2438985642	2438985642	2438985627	2438985715	88
30	2438992685	2438992756	2438992986	2438993084	2438992685	2438993084	399
20	2439001180	2439001012	2439000995	2439000998	2439000995	2439001180	185
10	2439007830	2439007674	2439007687	2439007688	2439007674	2439007830	156
0	2439011985	2439011955	2439011960	2439011974	2439011955	2439011985	30
-10	2439012440	2439012490	2439012497	2439012499	2439012440	2439012499	59
-20	2439007674	2439007848	2439007836	2439007819	2439007674	2439007848	174
-30	2438996255	2438996545	2438996574	2438996565	2438996255	2438996574	319

Mid Channel/1.725 VDC

Temp °C	Frequency (GHz)						
	start up	2 min	5 min	10 min	min	max	delta
50	2438979723	2438979725	2438979704	2438979694	2438979694	2438979725	31
40	2438985662	2438985626	2438985645	2438985647	2438985626	2438985662	36
30	2438992661	2438992739	2438992991	2438993068	2438992661	2438993068	407
20	2439001098	2439001031	2439000993	2439000992	2439000992	2439001098	106
10	2439007777	2439007671	2439007682	2439007684	2439007671	2439007777	106
0	2439011966	2439011953	2439011962	2439011975	2439011953	2439011975	22
-10	2439012465	2439012486	2439012500	2439012495	2439012465	2439012500	35
-20	2439007755	2439007878	2439007818	2439007800	2439007755	2439007878	123
-30	2438996434	2438996563	2438996569	2438996577	2438996434	2438996577	143



**High Channel**

High Channel/1.275 VDC

Temp °C	Frequency (GHz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2479979355	2479979329	2479979324	2479979311	2479979311	2479979355	44
40	2479985420	2479985308	2479985328	2479985352	2479985308	2479985420	112
30	2479993289	2479993033	2479993054	2479993065	2479993033	2479993289	256
20	2480001374	2480000938	2480000981	2480001000	2480000938	2480001374	436
10	2480007946	2480007719	2480007725	2480007767	2480007719	2480007946	227
0	2480012281	2480012172	2480012174	2480012172	2480012172	2480012281	109
-10	2480012616	2480012704	2480012698	2480012690	2480012616	2480012704	88
-20	2480007578	2480007958	2480007975	2480007991	2480007578	2480007991	413
-30	2479996302	2479996645	2479996588	2479996591	2479996302	2479996645	343

High Channel/1.5 VDC

Temp °C	Frequency (GHz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2479979335	2479979328	2479979320	2479979315	2479979315	2479979335	20
40	2479985343	2479985299	2479985340	2479985362	2479985299	2479985362	63
30	2479993137	2479993032	2479993046	2479993062	2479993032	2479993137	105
20	2480001222	2480000990	2480000989	2480000993	2480000989	2480001222	233
10	2480007824	2480007712	2480007727	2480007768	2480007712	2480007824	112
0	2480012227	2480012174	2480012178	2480012179	2480012174	2480012227	53
-10	2480012648	2480012701	2480012699	2480012687	2480012648	2480012701	53
-20	2480007762	2480007965	2480007945	2480007977	2480007762	2480007977	215
-30	2479996377	2479996679	2479996641	2479996525	2479996377	2479996679	302

High Channel/1.725 VDC

Temp °C	Frequency (GHz)				min	max	delta
	start up	2 min	5 min	10 min			
50	2479979334	2479979319	2479979318	2479979311	2479979311	2479979334	23
40	2479985308	2479985302	2479985345	2479985365	2479985302	2479985365	63
30	2479993087	2479993032	2479993051	2479993061	2479993032	2479993087	55
20	2480001099	2480001002	2480000998	2480000992	2480000992	2480001099	107
10	2480007774	2480007715	2480007724	2480007774	2480007715	2480007774	59
0	2480012201	2480012178	2480012175	2480012177	2480012175	2480012201	26
-10	2480012676	2480012698	2480012697	2480012695	2480012676	2480012698	22
-20	2480007811	2480007958	2480007918	2480007986	2480007811	2480007986	175
-30	2479996614	2479996652	2479996593	2479996586	2479996586	2479996652	66

## 5.2 Radiated Emissions

<p><b>Description of Measurement</b></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><b>Example Calculations</b></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 – Radiated Spurious Emissions in Restricted and Non-Restricted Bands

<b>Operator</b>	Jeysson Gonzalez
<b>QA</b>	Laura Zehnder
<b>Test Date</b>	7/9, 10, 16/2018 and 8/27/2018
<b>Location</b>	Chamber 3
<b>Temp. / R.H.</b>	72F/61
<b>Requirement</b>	FCC part 15.209
<b>Method</b>	ANSI C63.10

Limits (at 3-meter measurement distance):

Frequency (MHz)	Field Strength (microvolts/meter)	Field Strength (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

#### Test Parameters

<b>Frequency</b>	30-25000 MHz
<b>Distance</b>	3m
<b>RBW</b>	Below 1 GHz: 120 kHz & Above 1 GHz: 1 MHz
<b>VBW</b>	Below 1 GHz: 1.2 MHz & Above 1 GHz: 3 MHz (Peak Measurements), 30 kHz (Video-Averaged Measurements)
<b>EUT Power</b>	1.5 VDC
<b>EUT Channels</b>	Low (2402 MHz), Mid (2438 MHz), High (2480 MHz)
<b>Notes</b>	There were no significant differences in emissions signatures when transmitting on different channels or in different positions (EUT Flat, Vertical, Side). All measurements and plots are from the EUT transmitting on channel 0 in side position, which was determined to be worst case.
<b>Example Calculation</b>	Margin (dB)= QP Limit (dBμV/m) – QP Measurement (dBμV/m) 11.8 (dB)= 40.0 (dBμV/m) – 28.2 (dBμV/m)

**Instrumentation**



Date : 9-May-2018 Test : Final - Harmonics Job : C-2977  
 PE : Jeysson Gonzalez Customer : Arity Quote : 318032

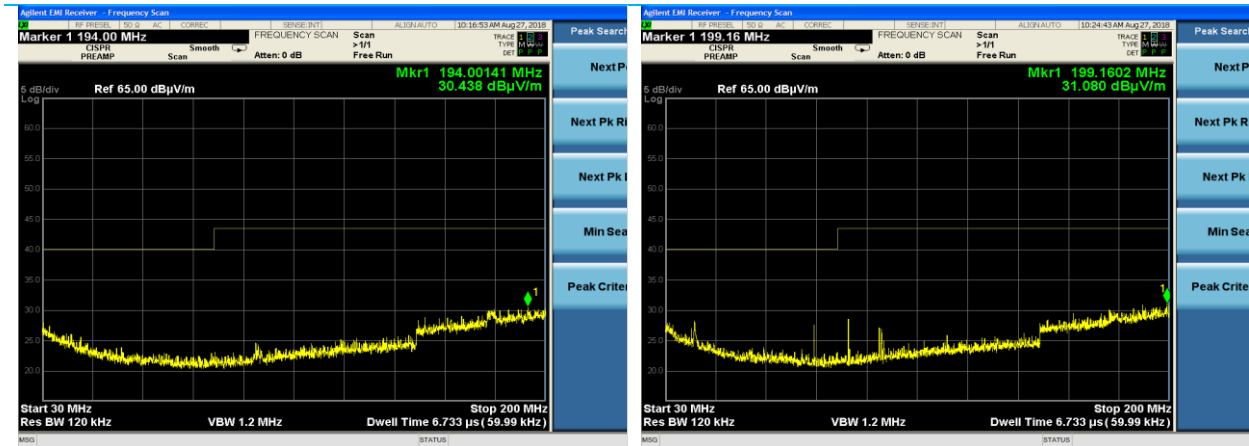
No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	8/30/2017	8/30/2018	Active Calibration
2	EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/24/2018	4/24/2019	Active Calibration
3	AA 960171	Cable	A.H. Systems, Inc.	SAC-26G-6	386	11/15/2017	11/15/2018	Active Verification
4	EE 960160	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	977711030	8/30/2017	8/30/2018	Active Calibration
5	AA 960153	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-04	4/25/2018	4/25/2019	Active Calibration
6	AA 960195	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	557	1/30/2018	1/30/2019	Active Calibration
7	AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	4/20/2018	4/20/2019	Active Calibration

**Table**

Frequency (MHz)	Polarization	EUT Orientation	Angle (deg)	Height (cm)	Quasi Peak reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)
39.96	Vertical	Side	250	100	24.4	40.0	15.6
91.72	Vertical	Side	0	100	24.4	43.5	19.1
156.63	Horizontal	Side	0	100	24.4	43.5	19.1
398.25	Vertical	Top	0	100	22.5	47.0	24.5
398.25	Vertical	Front	0	100	22.6	47.0	24.4
398.25	Horizontal	Front	0	100	22.6	47.0	24.4

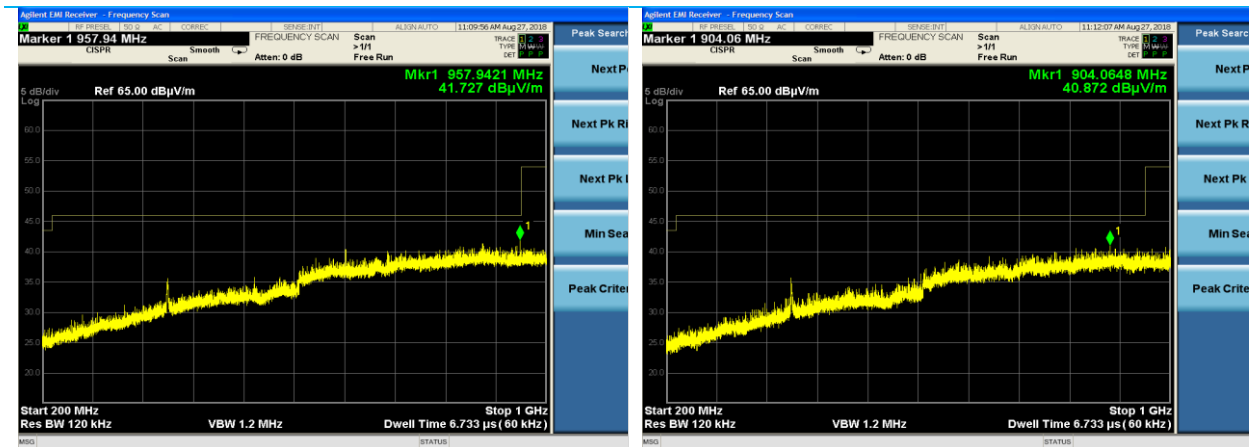
Frequency (GHz)	Polarization	EUT orientation	Angle (deg)	Height (cm)	Peak reading (dBµV/m)	Avg reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)
4.80	Vertical	Front	219	100	44.5	35.6	54.0	18.4
4.80	Vertical	Top	200	100	42.5	36.8	54.0	17.2
4.80	Horizontal	Side	110	100	43.5	39.3	54.0	14.8
4.80	Horizontal	Front	75	100	47.1	36.5	54.0	17.5
7.21	Vertical	Top	311	100	43.6	35.3	54.0	18.7
7.21	Horizontal	Front	258	100	41.2	35.5	54.0	18.5
9.61	Vertical	Side	0	250	43.0	36.9	54.0	17.2

### Plots



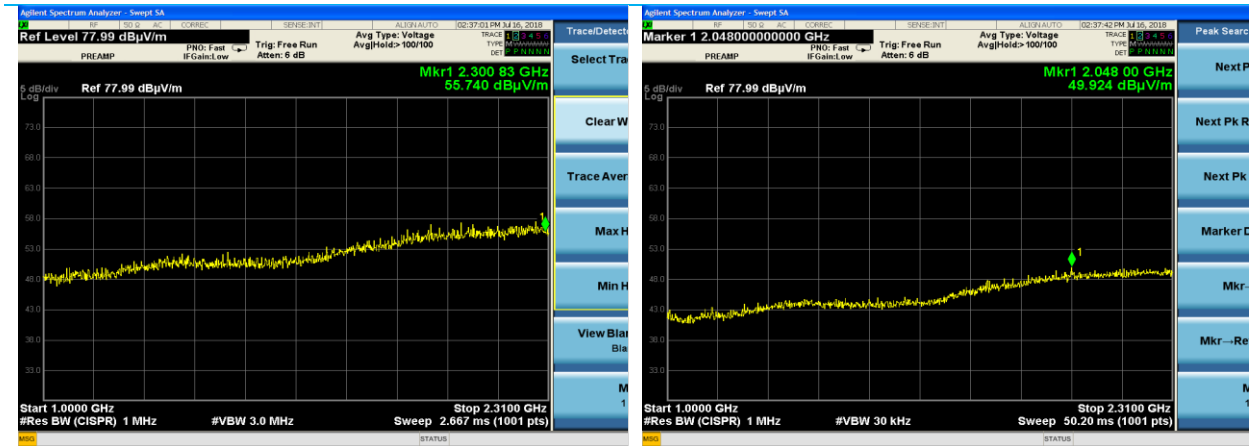
30-200 MHz Horizontal

30-200 MHz Vertical



200-1000 MHz Horizontal

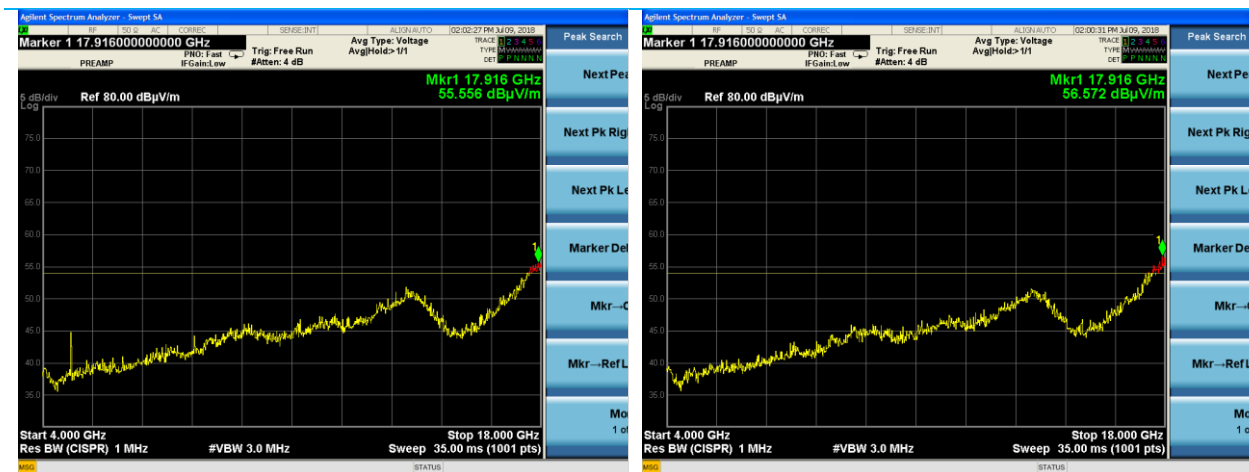
200-1000 MHz Vertical



1-2.310 GHz Horizontal – Full VBW

1-2.310 GHz Horizontal – Reduced VBW

Emissions 2310-2400 GHz reported in Section 5.2.2 Radiated Band Edge.



4-18 GHz Horizontal – Full VBW

4-18 GHz Vertical – Full VBW

Note: 3 MHz VBW for peak measurements is subject to the peak limit of 74 dBμV/m. The limit line shown in the plots above is relevant to the video-averaged measurements, reflected on page 25.

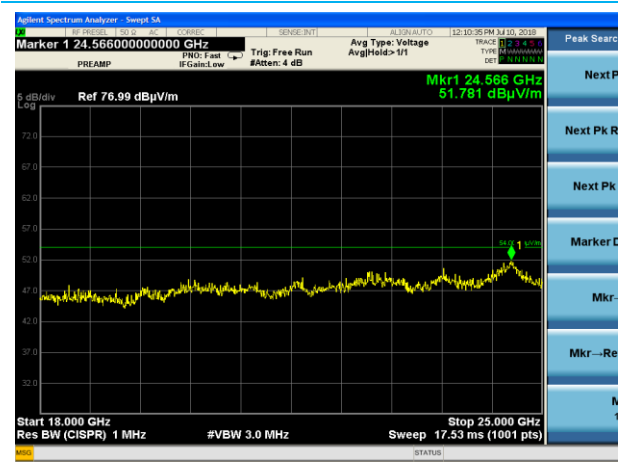




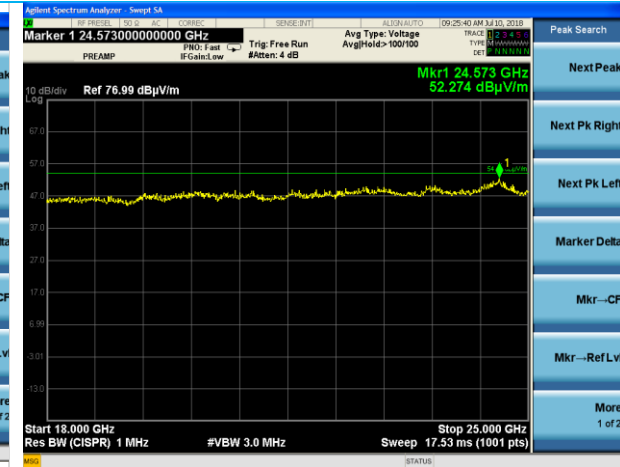
4-18 GHz Horizontal – Reduced VBW



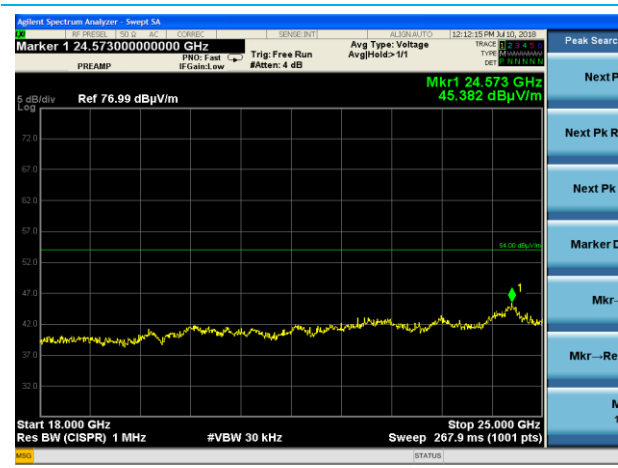
4-18 GHz Vertical – Reduced VBW



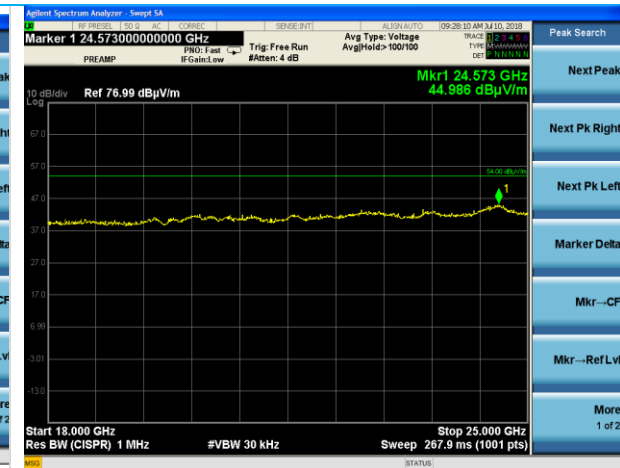
18-25 GHz Horizontal – Full VBW



18-25 GHz Vertical – Full VBW



18-25 GHz Horizontal – Reduced VBW



18-25 GHz Vertical – Reduced VBW

Company: Arity	Page 25 of 30	Name: Vehicle Tag v2
Report: TR 318032 A		Model: ARTST2001
Job: C-2977		Serial: D28 and 21

## 5.2.2 Radiated – Band Edge

<b>Operator</b>	Jeysson Gonzalez
<b>QA</b>	Laura Zehnder
<b>Test Date</b>	9/6 & 14/2018
<b>Location</b>	Chamber 3
<b>Temp. / R.H.</b>	72F/61
<b>Requirement</b>	FCC part 15.209
<b>Method</b>	ANSI C63.10

### Test Parameters

<b>Frequency</b>	2310-2390MHz, 2483.5-4000MHz
<b>Modulation</b>	Tx mod
<b>Channel</b>	Low (2402MHz), High (2480MHz)
<b>RBW</b>	1MHz
<b>VBW</b>	3MHz(Peak), 30kHz(Avg)
<b>EUT power</b>	1.5VDC AAA alkaline battery

### Instrumentation



Date: 9-May-2018 Test: Band Edge Job: C-2977

PE: Jeysson Gonzalez Customer: Arity Quote: 318032

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	8/30/2017	8/30/2018	Active Calibration
2	EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/24/2018	4/24/2019	Active Calibration
3	AA 960171	Cable	A.H. Systems, Inc.	SAC-26G-6	386	1/15/2017	1/15/2018	Active Verification

Company: Arity	Page 26 of 30	Name: Vehicle Tag v2
Report: TR 318032 A		Model: ARTST2001
Job: C-2977		Serial: D28 and 21

Table

Output of Low channel fundamental:

Frequency (GHz)	Polarization	EUT orientation	Angle (deg)	Height (m)	Peak reading (dBμV/m)	Avg reading (dBμV/m)
2.402	V	Front	105	2.84	98.477	95.51
2.402	H	Front	12	1.08	102.62	99.25
2.402	H	Top	175	1.26	103.06	98.86
2.402	V	Top	118	2.81	97.95	93.26
2.402	V	Side	320	1.67	102.45	99.17
2.402	H	Side	250	1.29	102.63	99.66

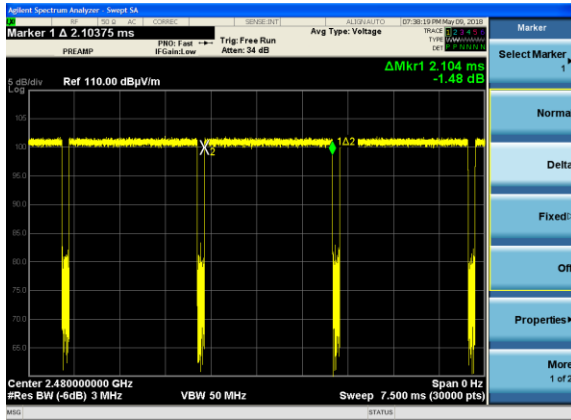
Frequency	Polarization	EUT orientation	Angle (deg)	Height (m)	Peak reading (dBμV/m)	Avg reading (dBμV/m)
2.480	H	Front	24	1.00	102.27	99.09
2.480	H	Top	166	1.24	102.25	98.27
2.480	H	Side	155	200	92.81	88.4

Frequency (MHz)	Peak Measurement (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)
2388.9	53.75	75.0	21.25
2399.9	66.25	83.06	16.81
2483.7	58.02	75.0	16.98

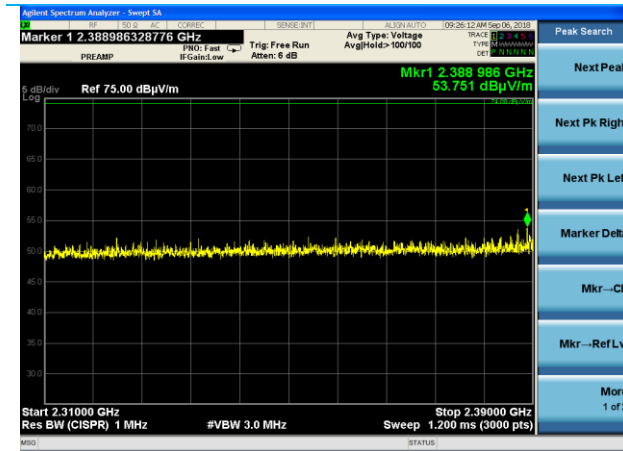
Frequency (MHz)	Average Measurement (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
2387.5	45.0	54.0	9.0
2399.9	48.84	63.03	14.19
2483.9	46.53	54.0	7.47

## Plots

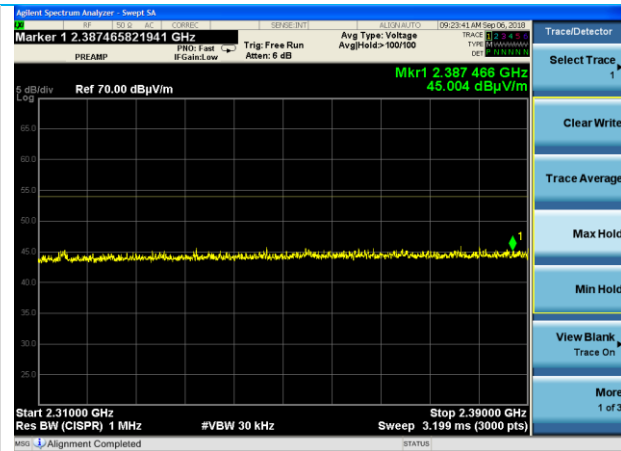
### Duty Cycle:



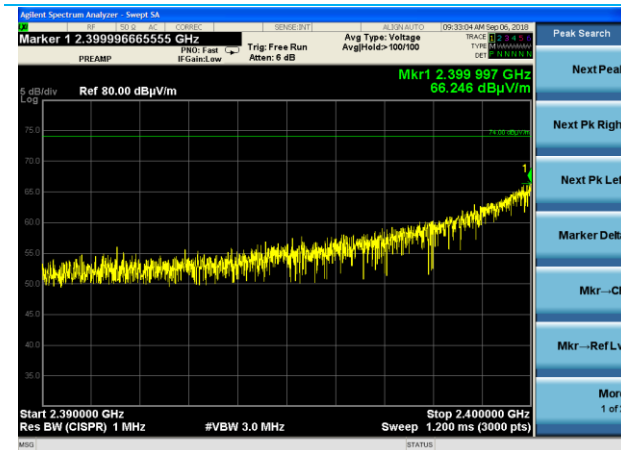
### Lower Band Edge



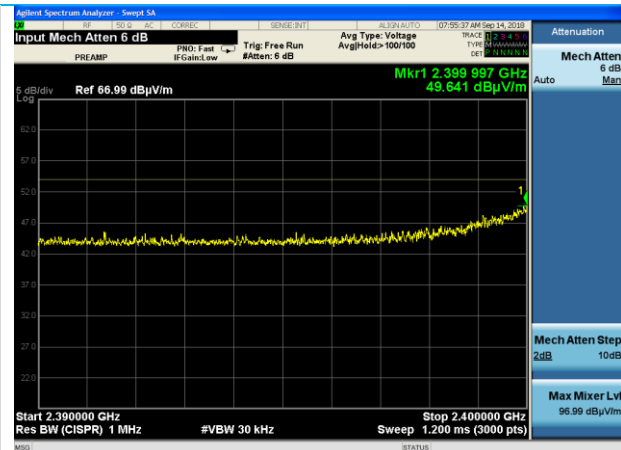
2310 – 2390 MHz Full VBW



2310-2390 MHz Reduced VBW

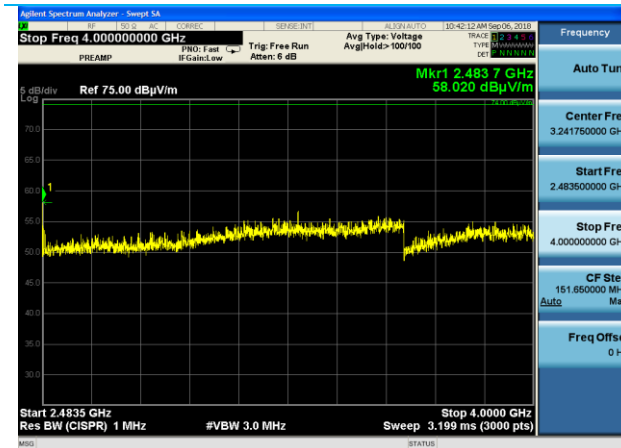


2390-2400 MHz Full VBW



2390-2400 MHz Reduced VBW

### Upper Band Edge



2483.5-4000 MHz Full VBW



2483.5-4000 MHz Reduced VBW

## 6 REVISION HISTORY

Version	Date	Notes	Reference Personnel
0.0	6 September 2018	Release for initial review.	Laura Zehnder
0.1	27 September 2018	Administrative updates, corrected band edge measurements.	Laura Zehnder
0.2	26 October 2018	Added antenna information, clarified band edge measurements.	Laura Zehnder

**END OF REPORT**