

# NORTHWEST EMC

**Uber Technologies Inc.**

**FF01**

**FCC 15.247:2016**

**Bluetooth Low Energy Radio Module**

**Report # SYNA0203.2 Rev 01**



NVLAP Lab Code: 200629-0

*This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America. This Report shall not be reproduced, except in full without written approval of the laboratory.*

# CERTIFICATE OF TEST

Last Date of Test: November 29, 2016  
Uber Technologies Inc.  
Model: FF01

## Radio Equipment Testing

### Standards

Specification	Method
FCC 15.247:2016	ANSI C63.10:2013

### Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Per FCC 15.207 this test is not required for a device intended for use only in a vehicle and which will not be connected to the AC mains.
6.5, 6.6, 11.12.1, 11.13.2	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
11.8.2	Occupied Bandwidth	Yes	Pass	
11.9.1.1	Output Power	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	

### Deviations From Test Standards

None

### Approved By:



Rod Munro, Operations Manager

*Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information.*

# REVISION HISTORY

Revision Number	Description	Date	Page Number
01	Replaced SRE data to include measurements with USB port populated	11/29/16	38-40

# ACCREDITATIONS AND AUTHORIZATIONS

---

## United States

---

**FCC** - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

**A2LA** - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Northwest EMC to certify transmitters to FCC and IC specifications.

**NVLAP** - Each laboratory is accredited by NVLAP to ISO 17025

---

## Canada

---

**ISED** - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with ISED.

---

## European Union

---

**European Commission** – Validated by the European Commission as a Notified Body under the R&TTE Directive.

---

## Australia/New Zealand

---

**ACMA** - Recognized by ACMA as a CAB for the acceptance of test data.

---

## Korea

---

**MSIP / RRA** - Recognized by KCC's RRA as a CAB for the acceptance of test data.

---

## Japan

---

**VCCI** - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

---

## Taiwan

---

**BSMI** – Recognized by BSMI as a CAB for the acceptance of test data.

**NCC** - Recognized by NCC as a CAB for the acceptance of test data.

---

## Singapore

---

**IDA** – Recognized by IDA as a CAB for the acceptance of test data.

---

## Israel

---

**MOC** – Recognized by MOC as a CAB for the acceptance of test data.

---

## Hong Kong

---

**OFCA** – Recognized by OFCA as a CAB for the acceptance of test data.

---

## Vietnam

---

**MIC** – Recognized by MIC as a CAB for the acceptance of test data.

---

## SCOPE

---

For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>  
<http://gsi.nist.gov/global/docs/cabs/designations.html>

# MEASUREMENT UNCERTAINTY

## Measurement Uncertainty

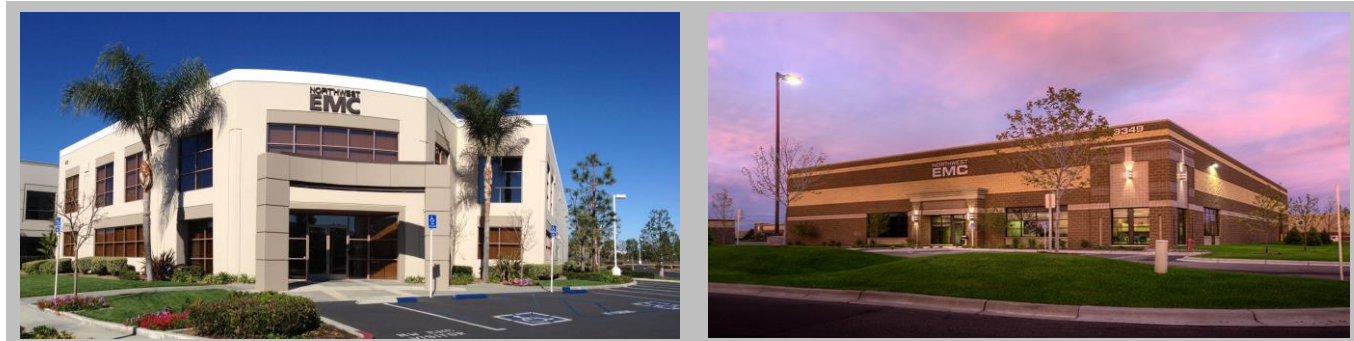
When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty ( $K=2$ ) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

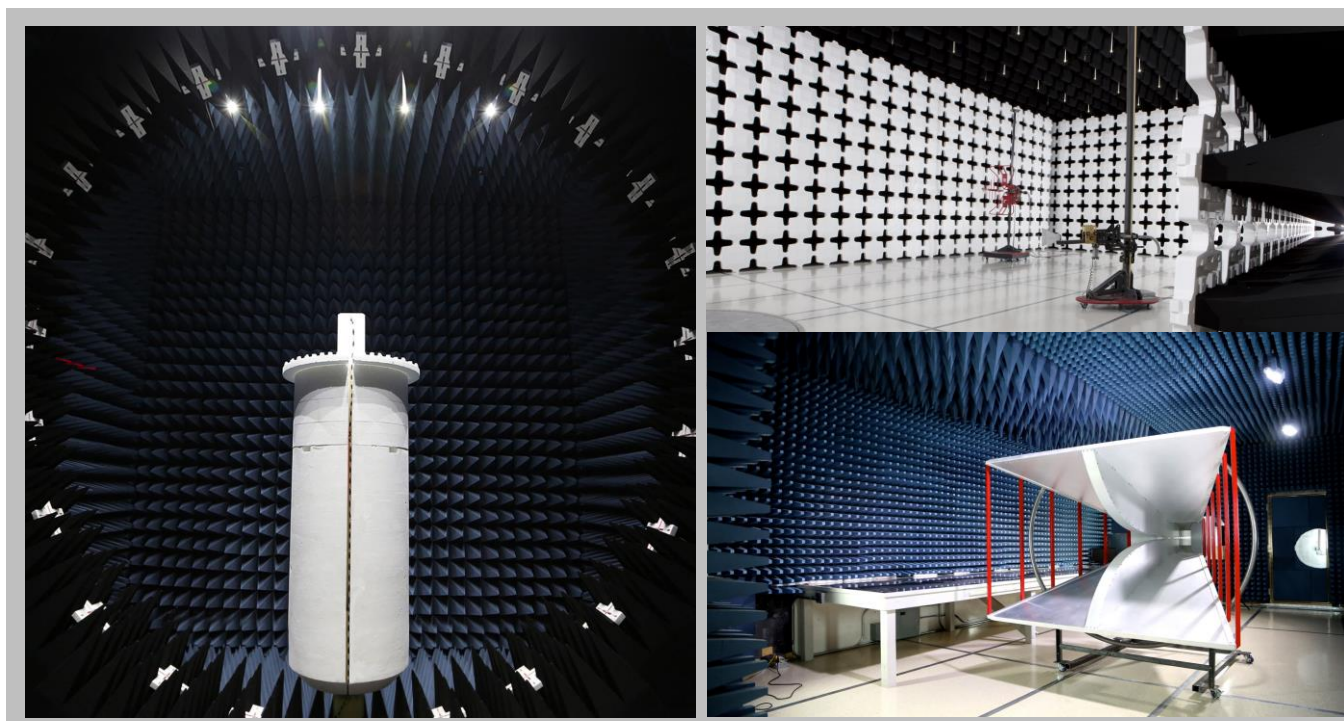
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

<b>Test</b>	<b>+ MU</b>	<b>- MU</b>
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

# FACILITIES

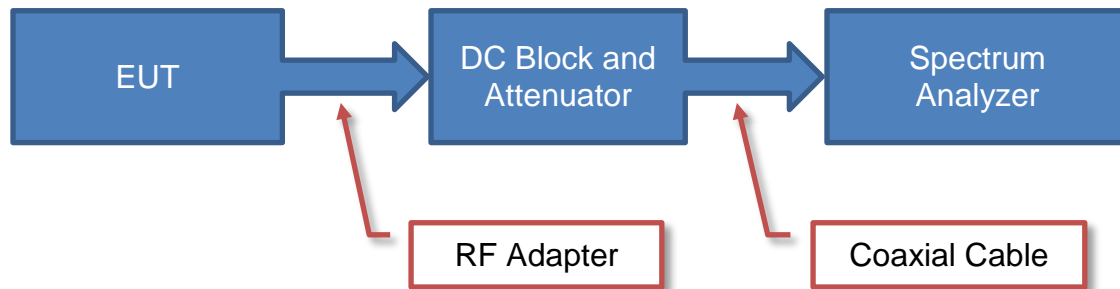


<b>California</b> Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	<b>Minnesota</b> Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	<b>New York</b> Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	<b>Oregon</b> Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	<b>Texas</b> Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	<b>Washington</b> Labs NC01-05 19201 120 <sup>th</sup> Ave NE Bothell, WA 98011 (425)984-6600
<b>NVLAP</b>					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
<b>Innovation, Science and Economic Development Canada</b>					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-2	2834G-1	2834F-1
<b>BSMI</b>					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
<b>VCCI</b>					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
<b>Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA</b>					
US0158	US0175	N/A	US0017	US0191	US0157

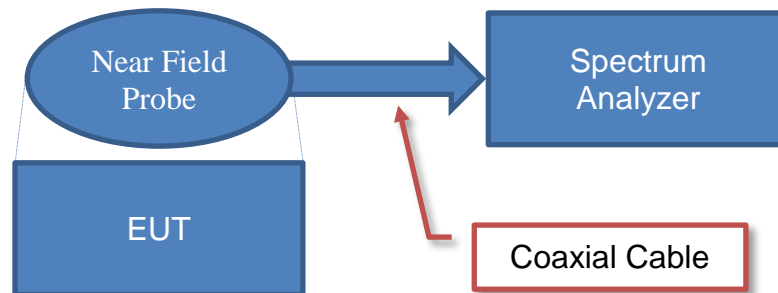


# Test Setup Block Diagrams

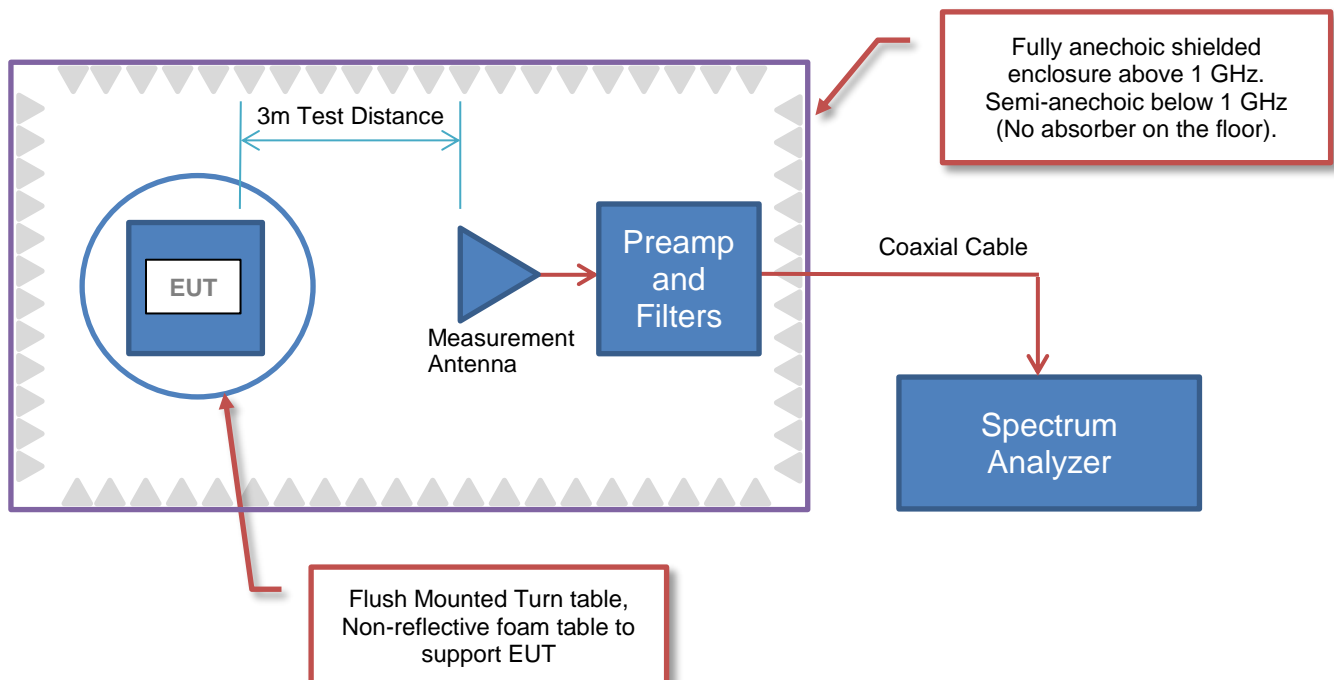
## Antenna Port Conducted Measurements



## Near Field Test Fixture Measurements



## Spurious Radiated Emissions





# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

<b>Company Name:</b>	Uber Technologies Inc.
<b>Address:</b>	1455 Market Street
<b>City, State, Zip:</b>	San Francisco, CA 94103
<b>Test Requested By:</b>	Nikhil Goel of Uber Technologies Inc. and Charles Manry of Synapse Product Development LLC
<b>Model:</b>	FF01
<b>First Date of Test:</b>	November 01, 2016
<b>Last Date of Test:</b>	November 01, 2016
<b>Receipt Date of Samples:</b>	November 29, 2016
<b>Equipment Design Stage:</b>	Production
<b>Equipment Condition:</b>	No Damage
<b>Purchase Authorization:</b>	Verified

## Information Provided by the Party Requesting the Test

### Functional Description of the EUT:

Consumer electronics device that is mounted inside an automobile that displays a logo by using a set of color programmable Light Emitting Diodes (LED), backlighting semi-transparent light diffusing disk. The LED's are controlled via the commands from the User's smartphone running an application. The commands are sent to the device by using the device's Nordic (nFR51822) Bluetooth Low Energy radio (BLE) radio using a customer designed Inverted F Antenna (IFA) as an integrated trace on the PCB.

Normal operation is when the device is powered by its internal battery. It has a USB port that is solely used to charge this battery. No data is passed via the device's USB port as wiring to support that function is not present in the device. The operation and behavior of the device is identical when either powered by its internal battery, or when the device's internal battery is being recharged via the USB port. A 12VDC to USB charger and USB cable are provided with the unit. The provided USB charger accessory is a 12 V input automotive (cigarette lighter) manufactured by Bracketron Incorporated; Model number is BT2-920-3.

### Testing Objective:

To demonstrate compliance of the Bluetooth radio to FCC 15.247 requirements.



# CONFIGURATIONS

## Configuration SYNA0203- 3

Software/Firmware Running during test	
Description	Version
A2 Firmware	None

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LED Display Unit	Uber Technologies Inc.	FF01	A2M12

## Configuration SYNA0209- 5

Software/Firmware Running during test	
Description	Version
EV Firmware	None

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LED Display Unit	Uber Technologies Inc.	FF01	J000045

# MODIFICATIONS

## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	11/1/2016	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
2	11/1/2016	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
3	11/1/2016	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
4	11/1/2016	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
5	11/1/2016	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
6	11/1/2016	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.
7	11/29/2016	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

# DUTY CYCLE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.


There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

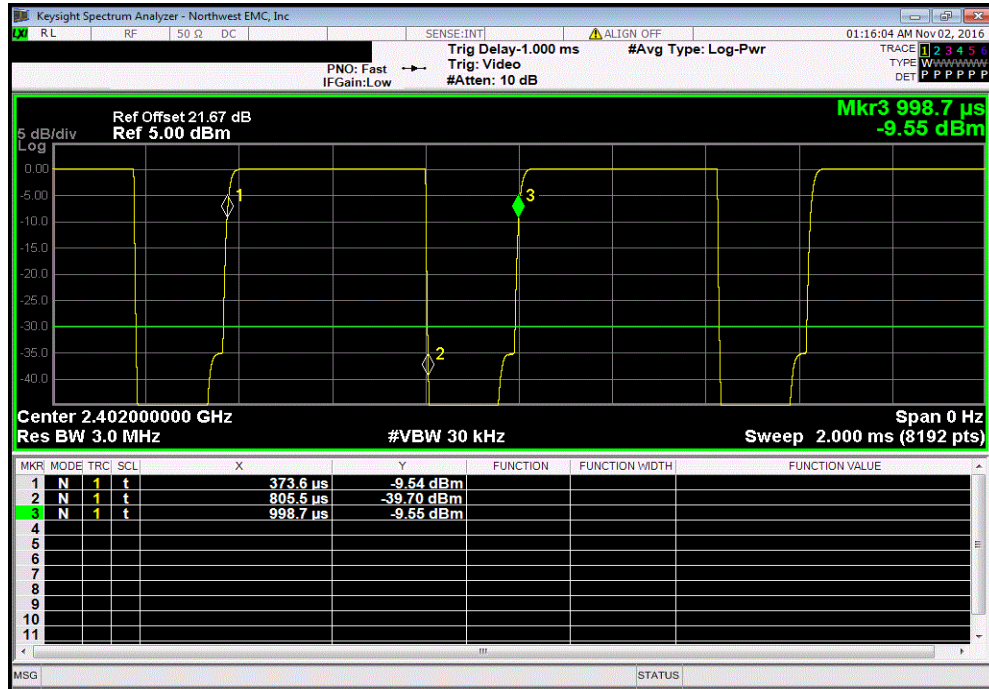
If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

**NORTHWEST  
EMC**

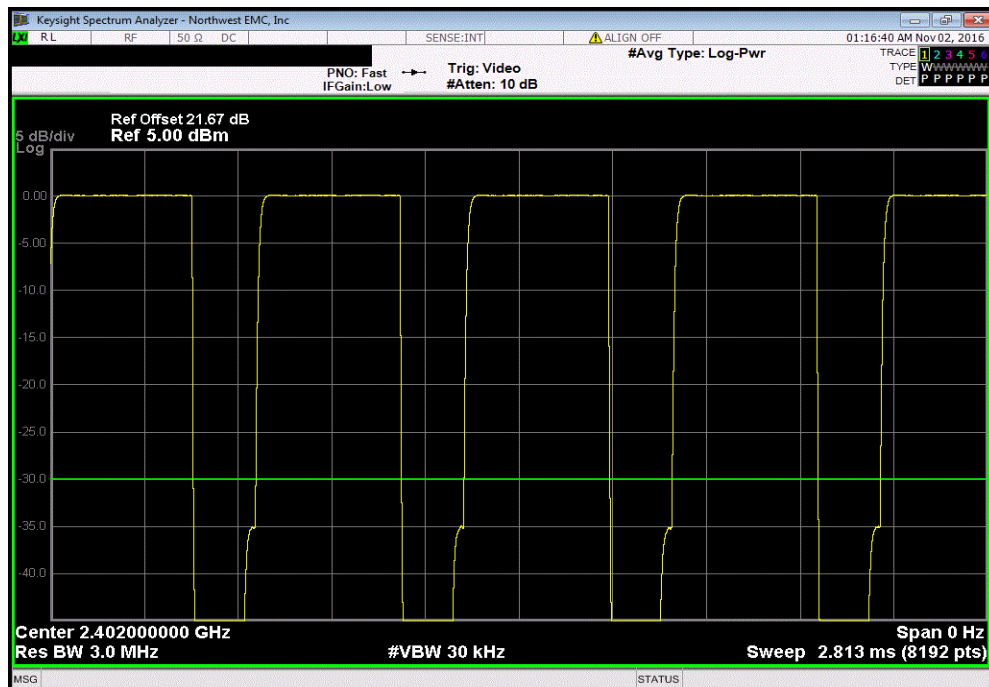
EUT: FF01			Work Order: SYNA0203				
Serial Number: A2M12			Date: 11/01/16				
Customer: Uber Technologies Inc.			Temperature: 21.7 °C				
Attendees: Charles Manry			Humidity: 48.2% RH				
Project: Kitt-A2			Barometric Pres.: 1015 mbar				
Tested by: Matthew Barnes		Power: Battery	Job Site: NC02				
TEST SPECIFICATIONS			Test Method				
FCC 15.247:2016			ANSI C63.10:2013				
COMMENTS							
LED White Level 90%. All LED's on. 0dBm output power.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	3	Signature 					
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
BLE, Low Channel, 2402 MHz		431.9 us	625.1 us	1	69.1	N/A	N/A
BLE, Low Channel, 2402 MHz		N/A	N/A	5	N/A	N/A	N/A
BLE, Mid Channel, 2442 MHz		432.2 us	625.1 us	1	69.1	N/A	N/A
BLE, Mid Channel, 2442 MHz		N/A	N/A	5	N/A	N/A	N/A
BLE, High Channel, 2480 MHz		432.9 us	625.1 us	1	69.3	N/A	N/A
BLE, High Channel, 2480 MHz		N/A	N/A	5	N/A	N/A	N/A

# DUTY CYCLE

BLE, Low Channel, 2402 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
431.9 $\mu$ s	625.1 $\mu$ s	1	69.1	N/A	N/A	

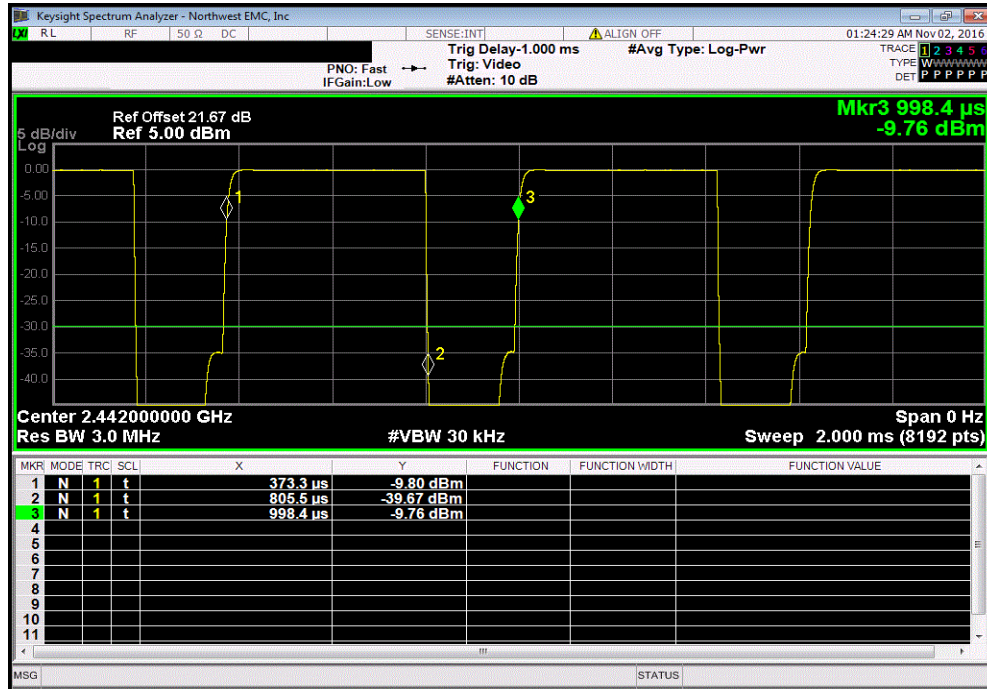


BLE, Low Channel, 2402 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
N/A	N/A	5	N/A	N/A	N/A	

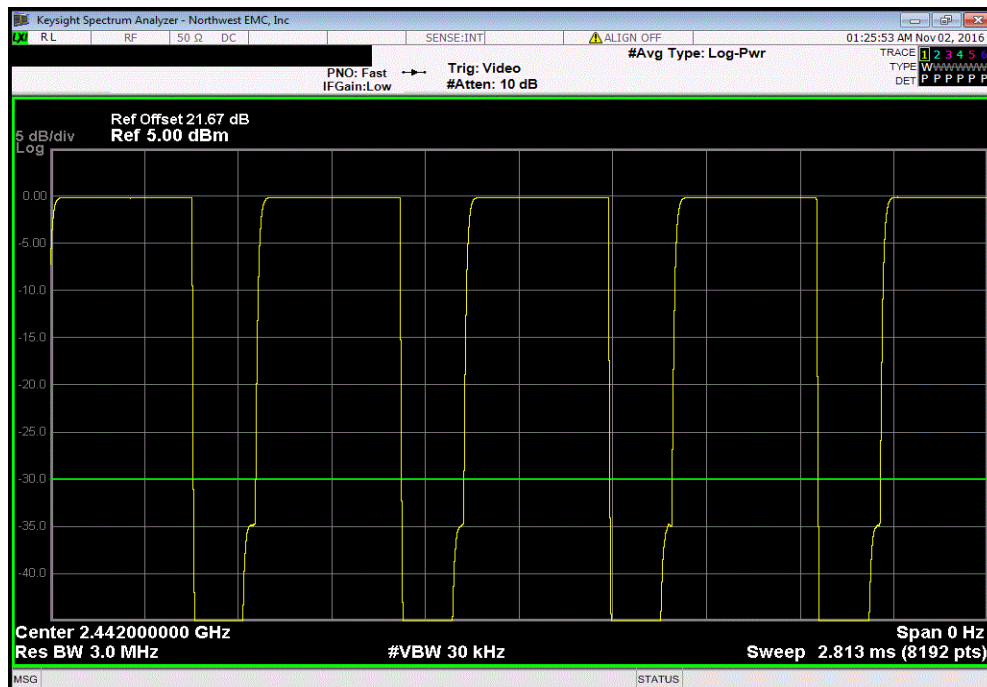


# DUTY CYCLE

BLE, Mid Channel, 2442 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
432.2 $\mu$ s	625.1 $\mu$ s	1	69.1	N/A	N/A	

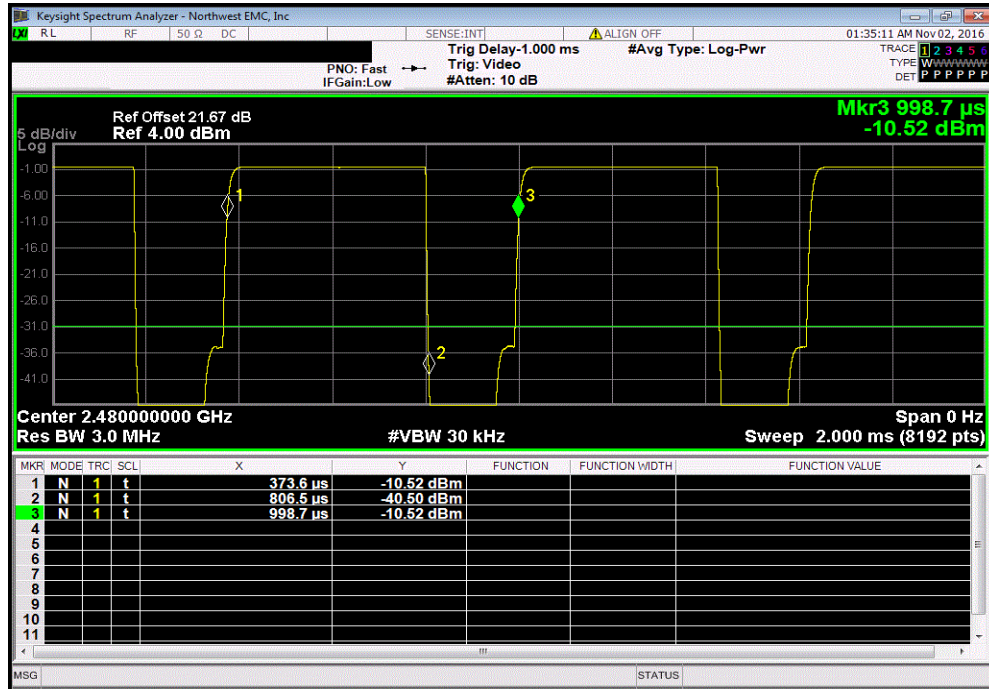


BLE, Mid Channel, 2442 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
N/A	N/A	5	N/A	N/A	N/A	

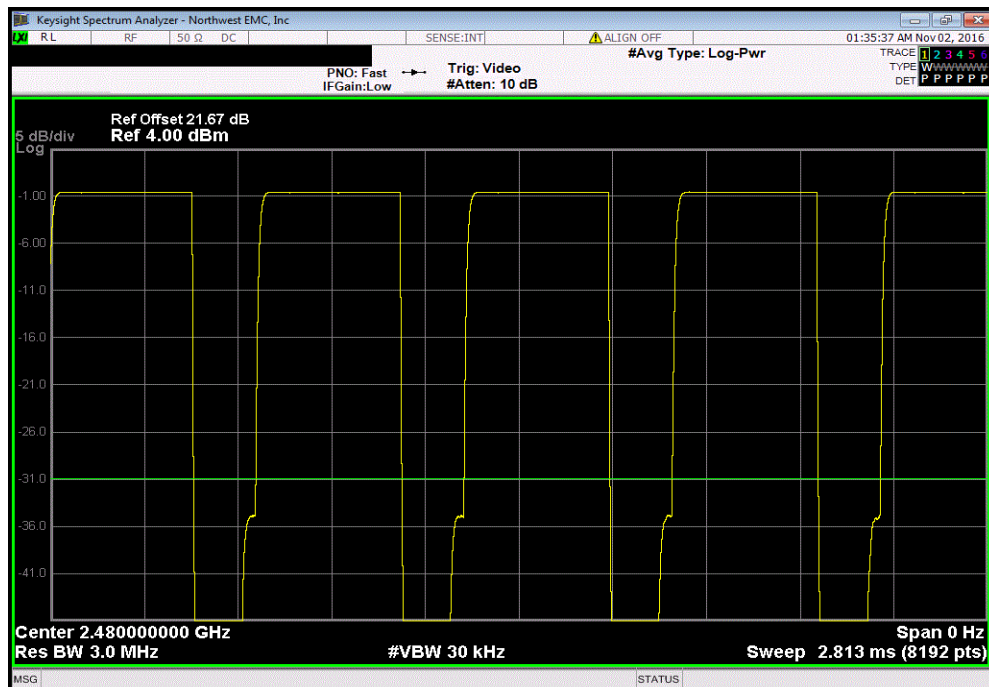


# DUTY CYCLE

BLE, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
432.9 us	625.1 us	1	69.3	N/A	N/A	



BLE, High Channel, 2480 MHz						
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results	
N/A	N/A	5	N/A	N/A	N/A	





# OCCUPIED BANDWIDTH

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT


Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was set to the channels and modes listed in the datasheet.

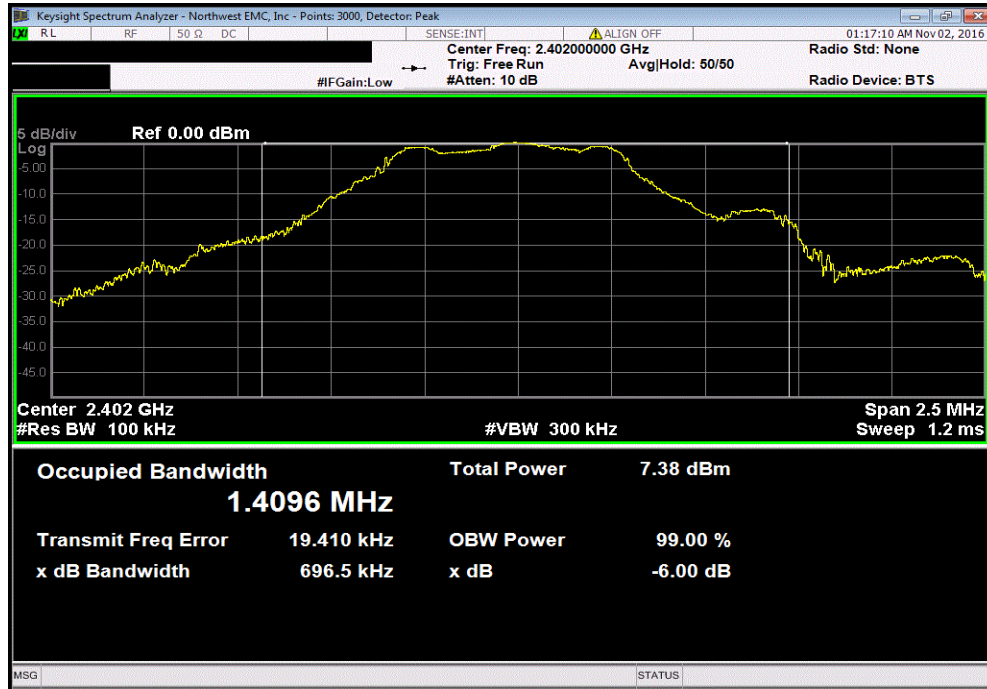
The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.

# OCCUPIED BANDWIDTH

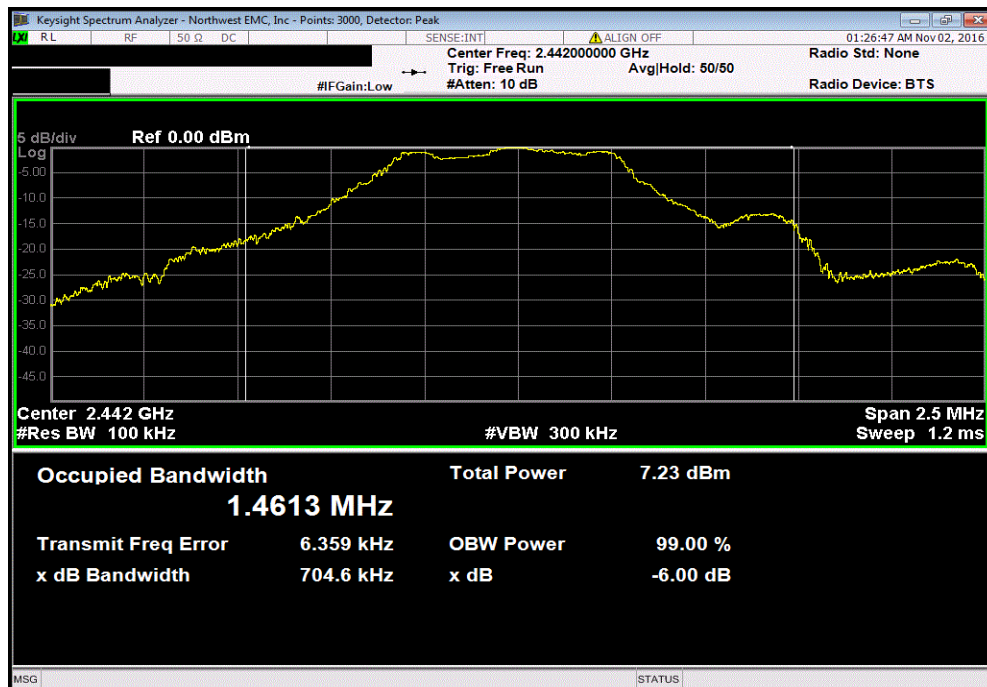
EUT: FF01		Work Order: SYNA0203	
Serial Number: A2M12		Date: 11/01/16	
Customer: Uber Technologies Inc.		Temperature: 21.7 °C	
Attendees: Charles Manry		Humidity: 48.2% RH	
Project: Kitt-A2		Barometric Pres.: 1014 mbar	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
LED White Level 90%. All LED's on. 0dBm output power.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value	Limit (±) Result
BLE, Low Channel, 2402 MHz		696.494 kHz	500 kHz Pass
BLE, Mid Channel, 2442 MHz		704.599 kHz	500 kHz Pass
BLE, High Channel, 2480 MHz		706.074 kHz	500 kHz Pass

# OCCUPIED BANDWIDTH

BLE, Low Channel, 2402 MHz						
				Value	Limit (≥)	Result
				696.494 kHz	500 kHz	Pass

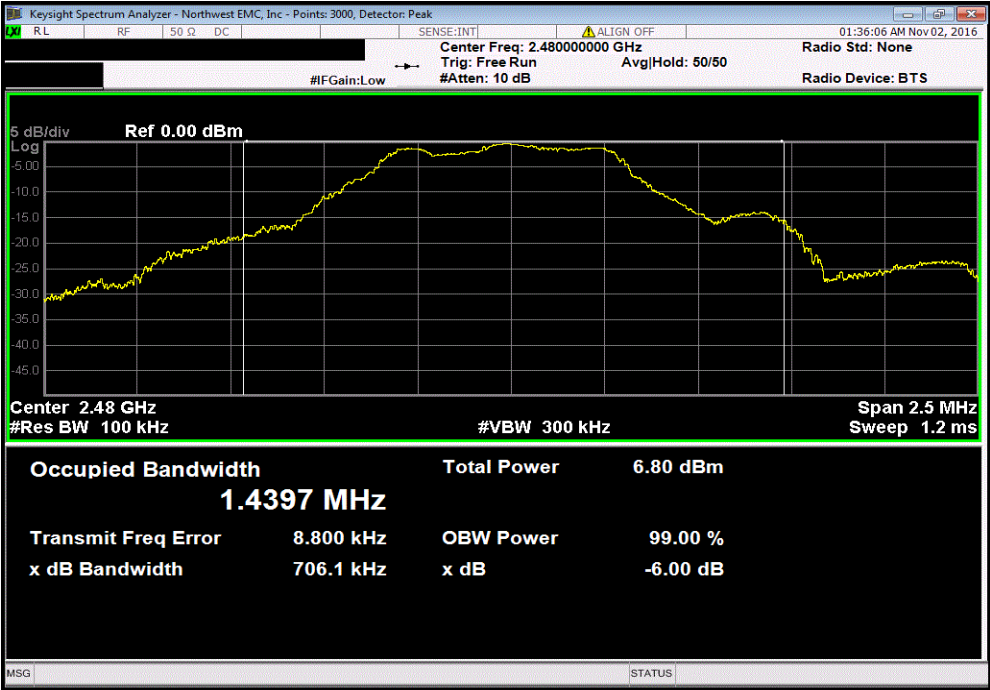


BLE, Mid Channel, 2442 MHz						
				Value	Limit (≥)	Result
				704.599 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

BLE, High Channel, 2480 MHz						
Value				Limit	Result	
				(≥)		
706.074 kHz				500 kHz	Pass	



# OUTPUT POWER

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION


The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio..

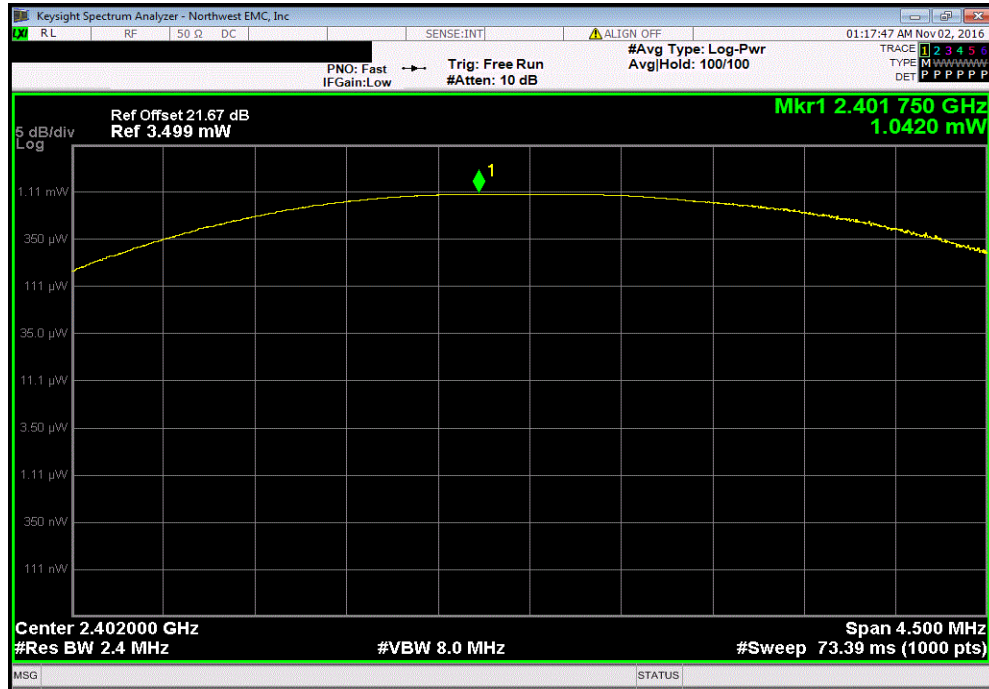
**De Facto EIRP Limit:** The EUT meets the de facto EIRP limit of +36 dBm.

# OUTPUT POWER

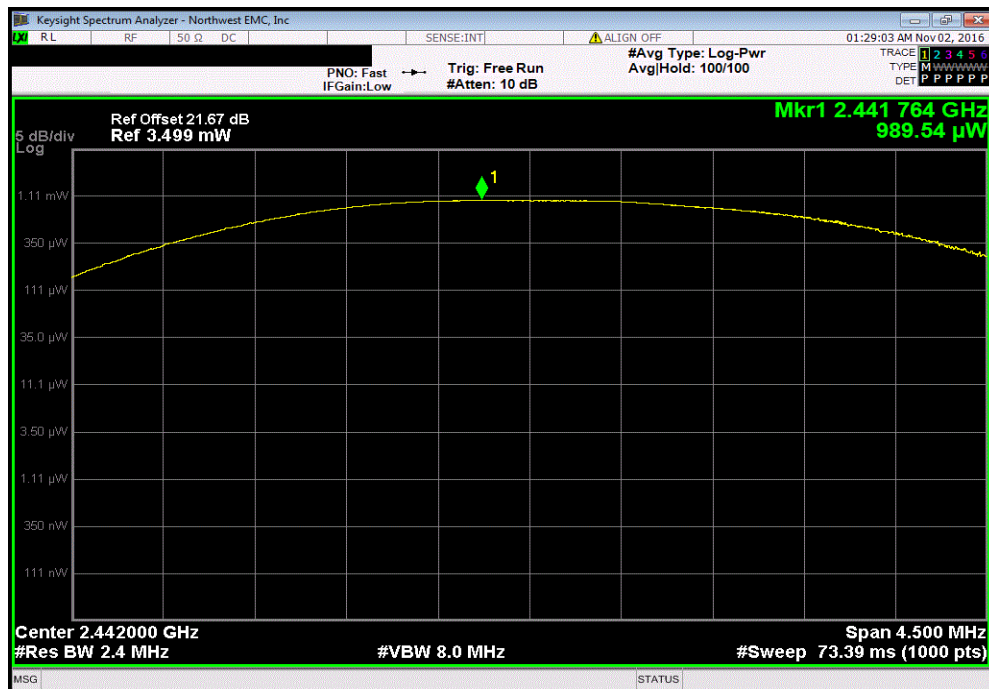
EUT: FF01		Work Order: SYNA0203	
Serial Number: A2M12		Date: 11/01/16	
Customer: Uber Technologies Inc.		Temperature: 21.8 °C	
Attendees: Charles Manry		Humidity: 48% RH	
Project: Kitt-A2		Barometric Pres.: 1015 mbar	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
<b>TEST SPECIFICATIONS</b>			
FCC 15.247:2016		Test Method	
		ANSI C63.10:2013	
<b>COMMENTS</b>			
LED White Level 90%. All LED's on. 0dBm output power.			
<b>DEVIATIONS FROM TEST STANDARD</b>			
None			
Configuration #	3	Signature 	
		Value	Limit (<) Result
BLE, Low Channel, 2402 MHz		1.042 mW	1 W Pass
BLE, Mid Channel, 2442 MHz		989.54 uW	1 W Pass
BLE, High Channel, 2480 MHz		894.4 uW	1 W Pass

# OUTPUT POWER

BLE, Low Channel, 2402 MHz						
				Value	Limit (<)	Result
				1.042 mW	1 W	Pass



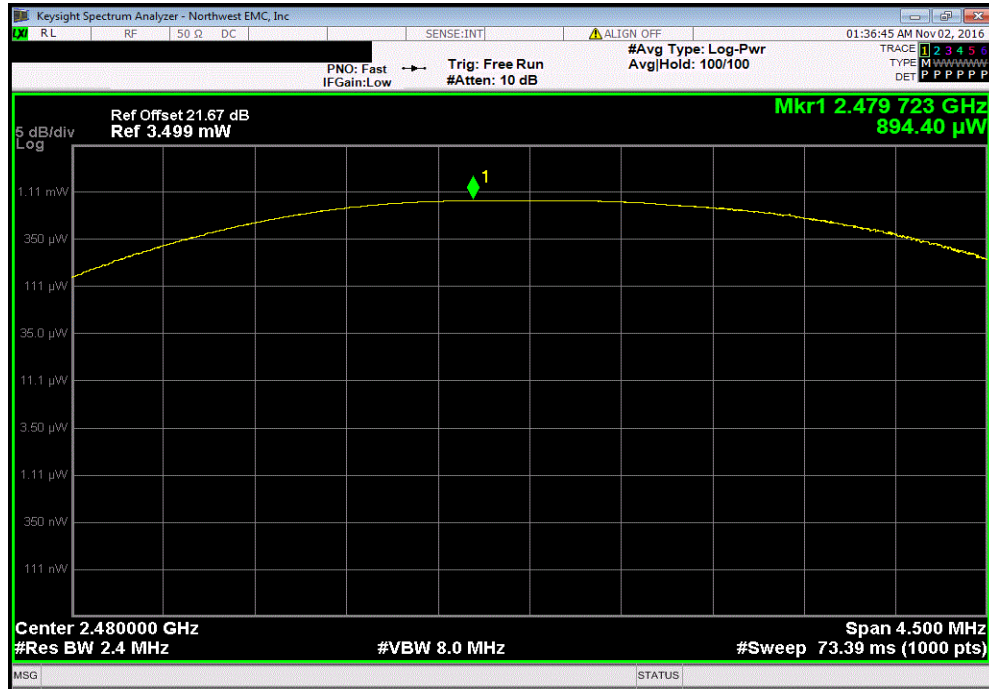
BLE, Mid Channel, 2442 MHz						
				Value	Limit (<)	Result
				989.54 $\mu$ W	1 W	Pass





# OUTPUT POWER

BLE, High Channel, 2480 MHz						
				Value	Limit (<)	Result
				894.4 $\mu$ W	1 W	Pass



# POWER SPECTRAL DENSITY

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION


The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The maximum power spectral density measurements was measured using the channels and modes as called out on the following data sheets.

Per the procedure outlined in ANSI C63.10 the peak power spectral density was measured in a 3 kHz RBW.

# POWER SPECTRAL DENSITY

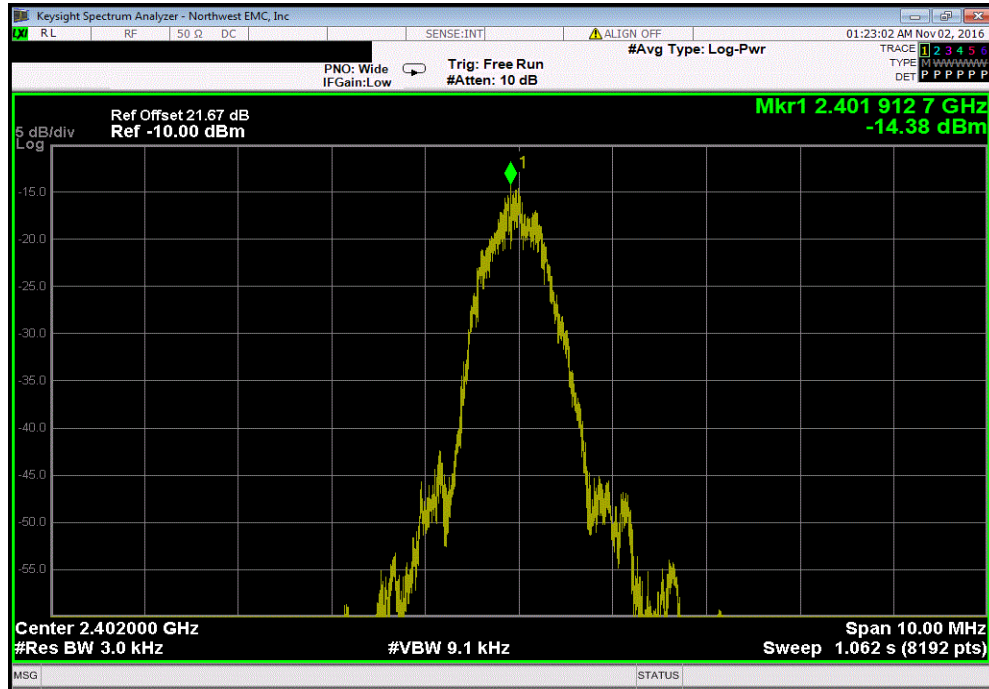


XMR 2016.05.06

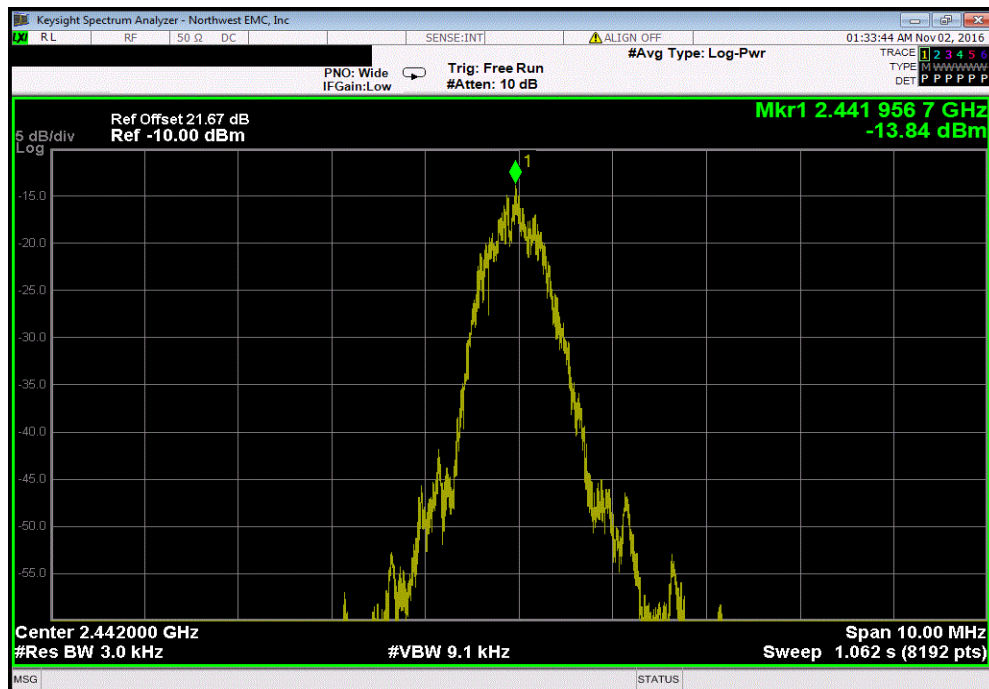
EUT: FF01		Work Order: SYNA0203	
Serial Number: A2M12		Date: 11/01/16	
Customer: Uber Technologies Inc.		Temperature: 21.8 °C	
Attendees: Charles Manry		Humidity: 47.9% RH	
Project: Kitt-A2		Barometric Pres.: 1015 mbar	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS			
FCC 15.247:2016		Test Method	
		ANSI C63.10:2013	
COMMENTS			
LED White Level 90%. All LED's on. 0dBm output power.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value dBm/3kHz	Limit < dBm/3kHz
BLE, Low Channel, 2402 MHz		-14.375	8
BLE, Mid Channel, 2442 MHz		-13.837	8
BLE, High Channel, 2480 MHz		-13.53	8
			Results
			Pass
			Pass
			Pass

# POWER SPECTRAL DENSITY

BLE, Low Channel, 2402 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-14.375	8	Pass

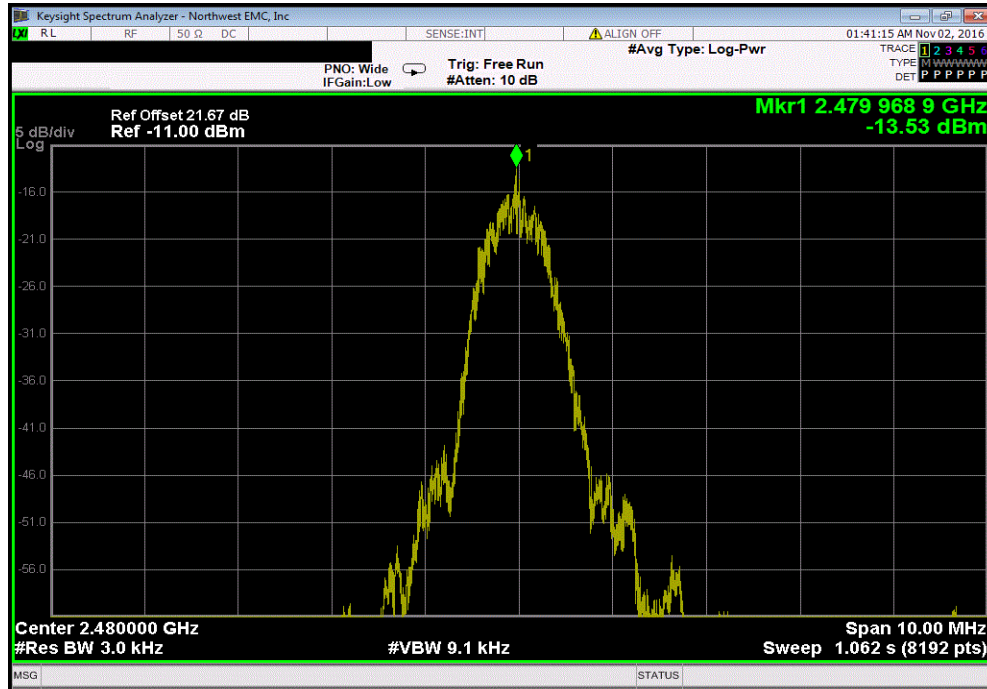


BLE, Mid Channel, 2442 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-13.837	8	Pass



# POWER SPECTRAL DENSITY

BLE, High Channel, 2480 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-13.53	8	Pass



# BAND EDGE COMPLIANCE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION


The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

# BAND EDGE COMPLIANCE



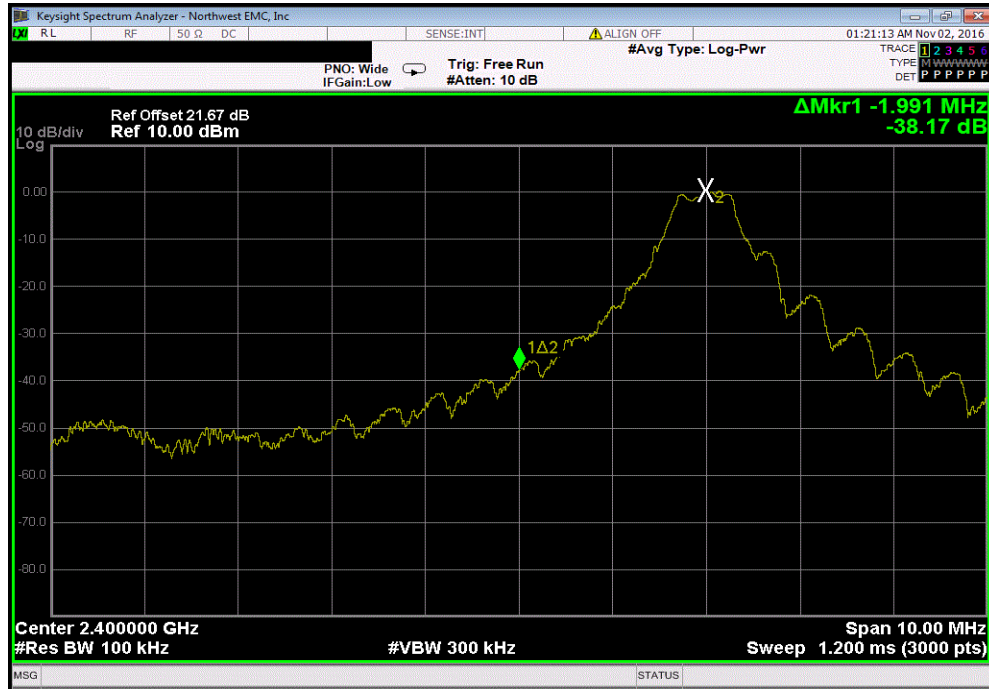
XMR 2016.05.06

EUT: FF01		Work Order: SYNA0203	
Serial Number: A2M12		Date: 11/01/16	
Customer: Uber Technologies Inc.		Temperature: 21.6 °C	
Attendees: Charles Manry		Humidity: 48.3% RH	
Project: Kitt-A2		Barometric Pres.: 1014 mbar	
Tested by: Matthew Barnes	Power: Battery	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
LED White Level 90%. All LED's on. 0dBm output power.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Value (dBc)	Limit ≤ (dBc) Result
BLE, Low Channel, 2402 MHz		-38.17	-20 Pass
BLE, High Channel, 2480 MHz		-34.72	-20 Pass

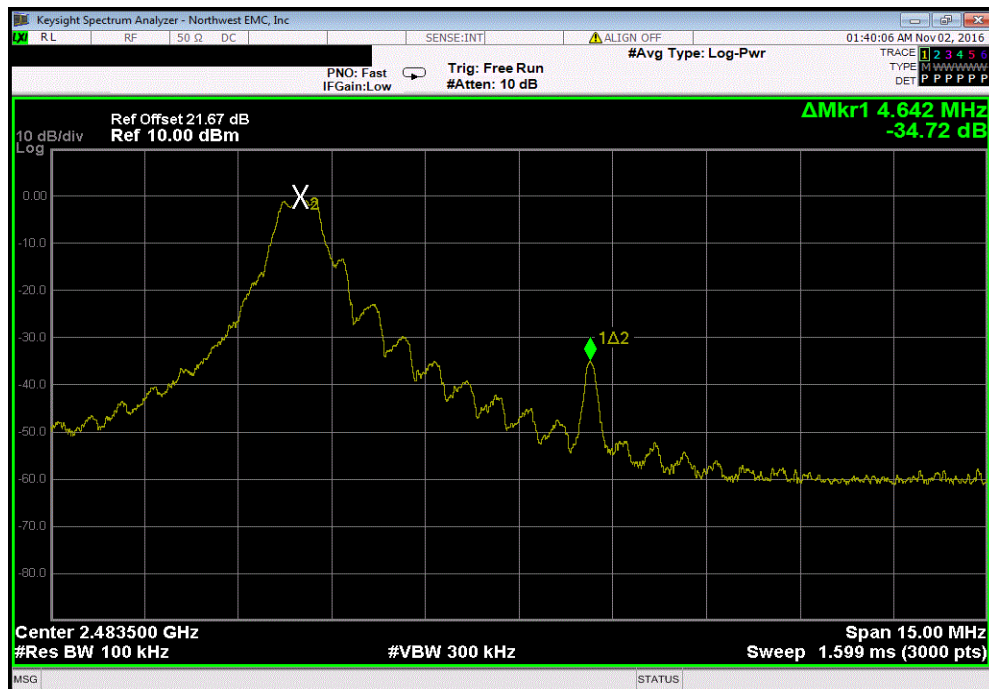


# BAND EDGE COMPLIANCE

BLE, Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-38.17	-20	Pass



BLE, High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-34.72	-20	Pass



# SPURIOUS CONDUCTED EMISSIONS

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.


## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5183A	TIA	4/6/2016	4/6/2018
Cable	Micro-Coax	UFD150A-1-0720-200200	NCS	6/7/2016	6/7/2017
Attenuator	Fairview Microwave	SA4014-20	TKV	3/4/2016	3/4/2017
Block - DC	Fairview Microwave	SD3379	AMU	5/6/2016	5/6/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/8/2016	6/8/2017

## TEST DESCRIPTION

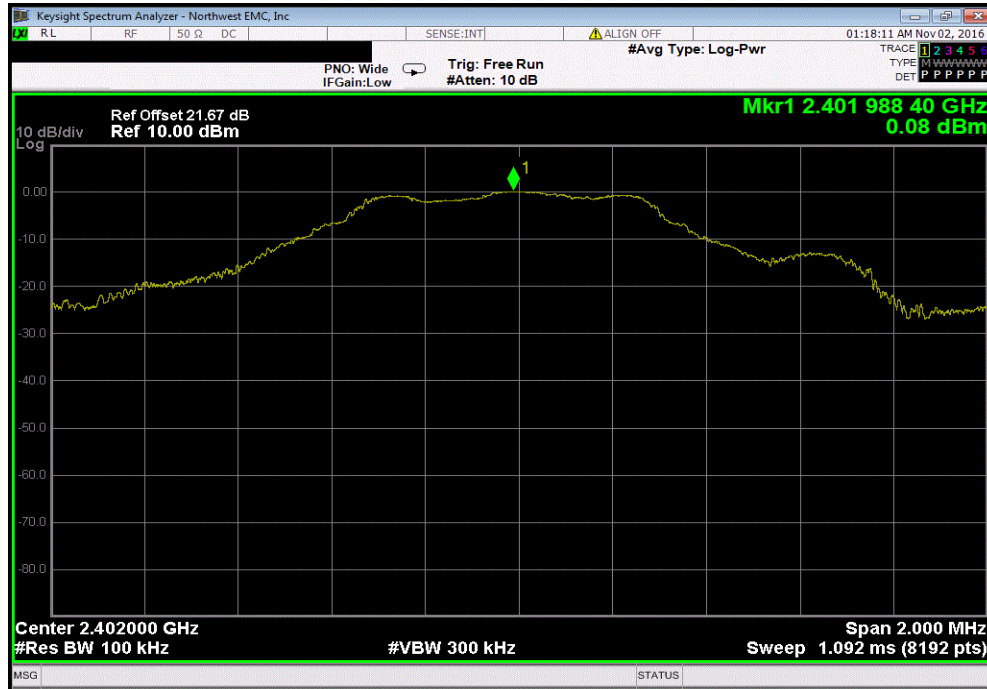
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

# SPURIOUS CONDUCTED EMISSIONS

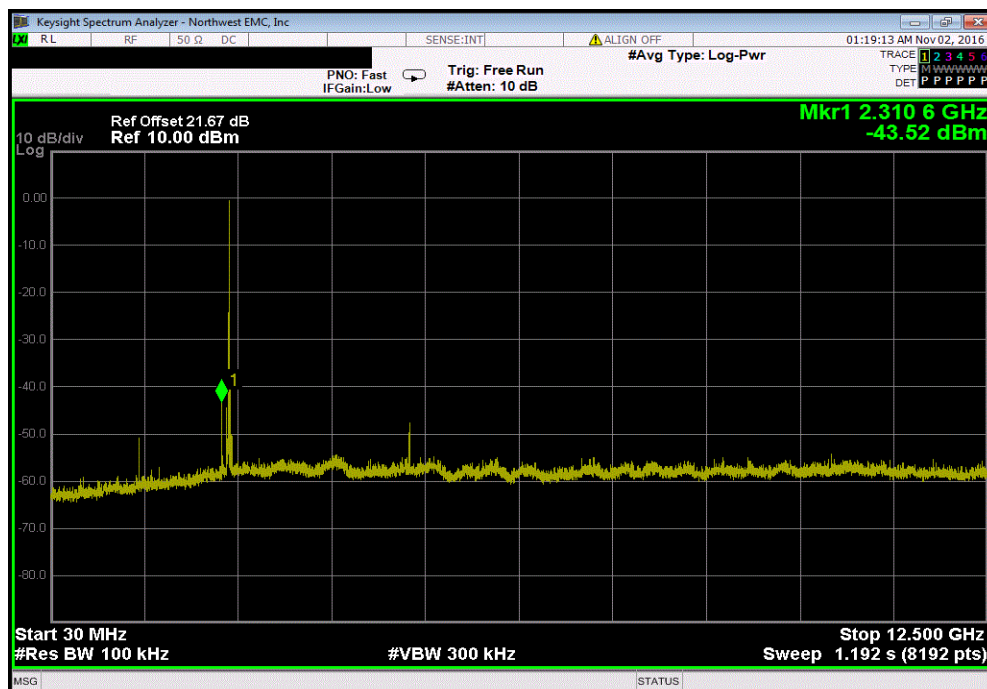
EUT: FF01		Work Order: SYNA0203	
Serial Number: A2M12		Date: 11/01/16	
Customer: Uber Technologies Inc.		Temperature: 21.8 °C	
Attendees: Charles Manry		Humidity: 47.9% RH	
Project: Kitt-A2		Barometric Pres.: 1015 mbar	
Tested by: Matthew Barnes		Power: Battery	
		Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
LED White Level 90%. All LED's on. 0dBm output power.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	3	Signature 	
		Frequency Range	Max Value (dBc)
			Limit ≤ (dBc)
			Result
BLE, Low Channel, 2402 MHz		Fundamental	N/A
BLE, Low Channel, 2402 MHz		30 MHz - 12.5 GHz	-43.6
BLE, Low Channel, 2402 MHz		12.5 GHz - 25 GHz	-51.41
BLE, Mid Channel, 2442 MHz		Fundamental	N/A
BLE, Mid Channel, 2442 MHz		30 MHz - 12.5 GHz	-41.06
BLE, Mid Channel, 2442 MHz		12.5 GHz - 25 GHz	-51.52
BLE, High Channel, 2480 MHz		Fundamental	N/A
BLE, High Channel, 2480 MHz		30 MHz - 12.5 GHz	-44.14
BLE, High Channel, 2480 MHz		12.5 GHz - 25 GHz	-51.15

# SPURIOUS CONDUCTED EMISSIONS

BLE, Low Channel, 2402 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
Fundamental		N/A		N/A	N/A	

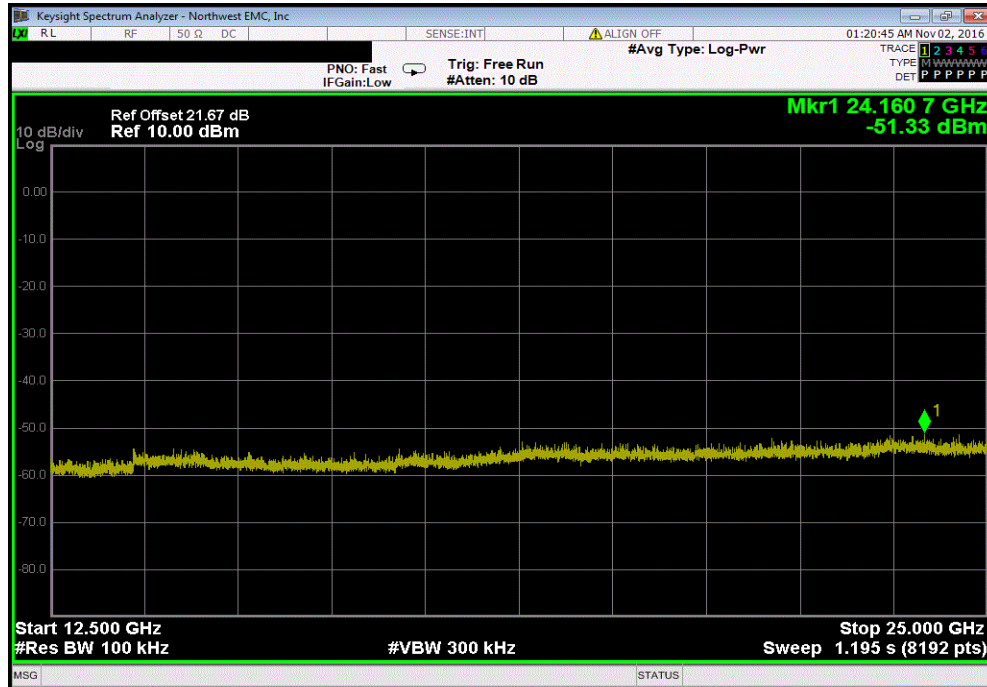


BLE, Low Channel, 2402 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz		-43.6		-20	Pass	

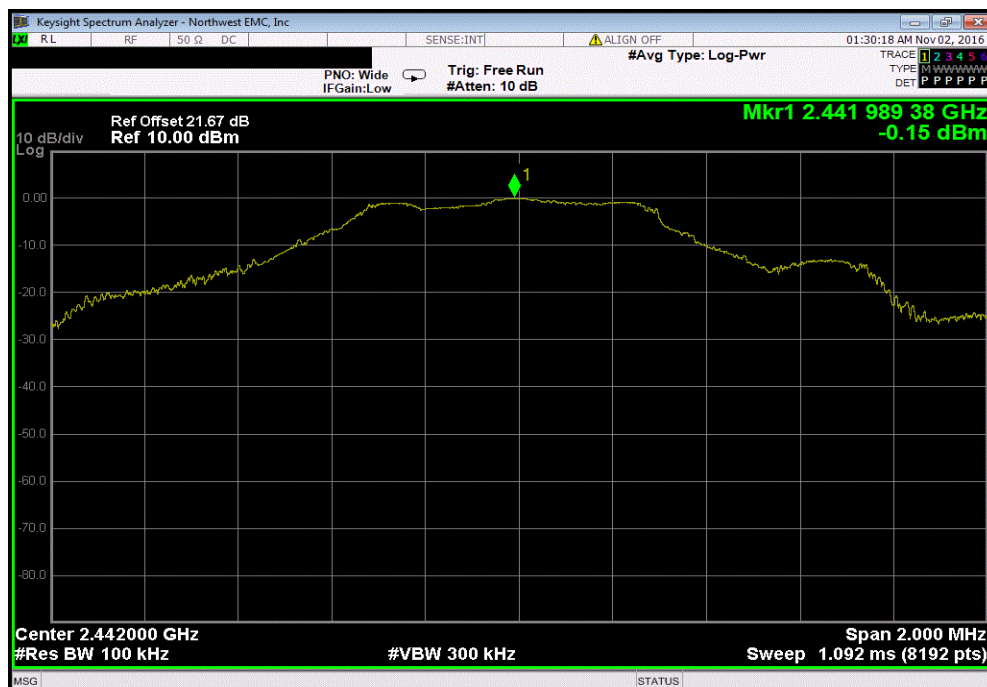


# SPURIOUS CONDUCTED EMISSIONS

BLE, Low Channel, 2402 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-51.41	-20	Pass	

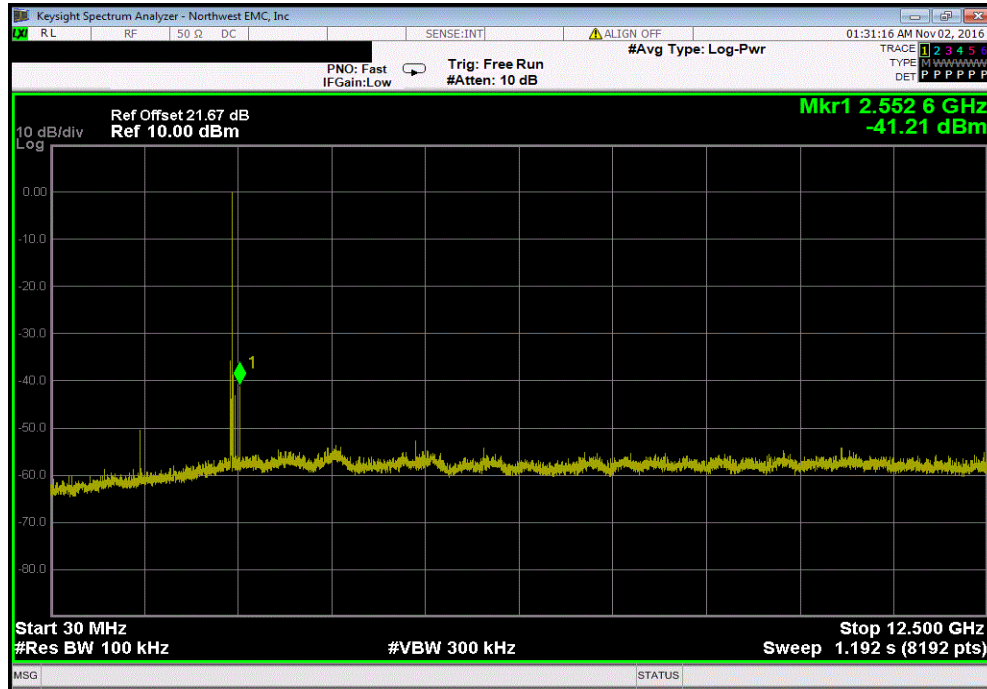


BLE, Mid Channel, 2442 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
Fundamental	N/A	N/A	N/A	

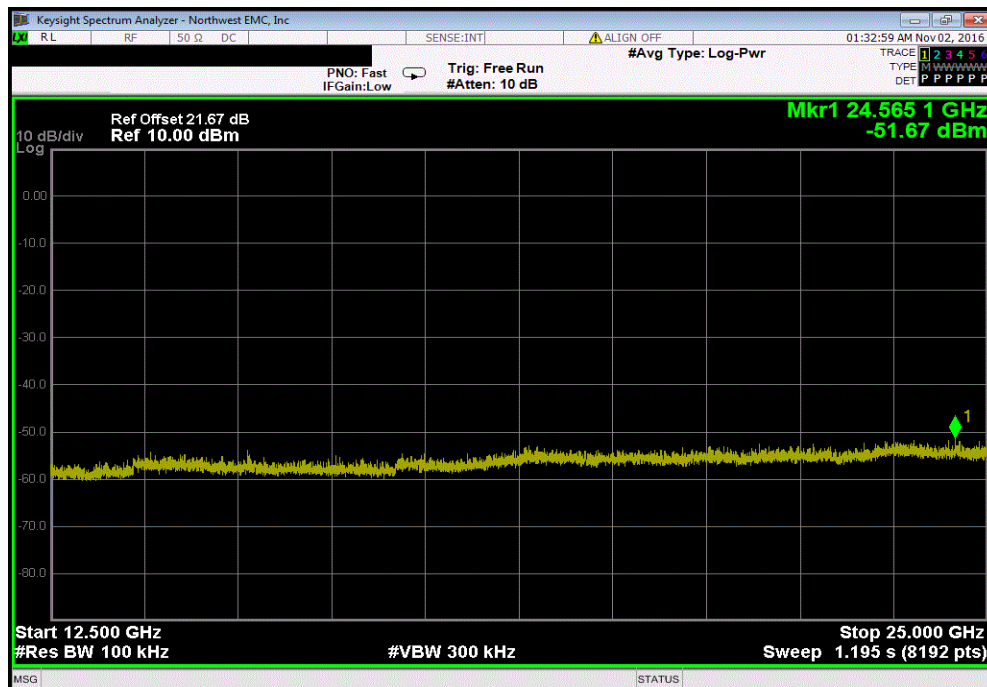


# SPURIOUS CONDUCTED EMISSIONS

BLE, Mid Channel, 2442 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-41.06	-20	Pass	

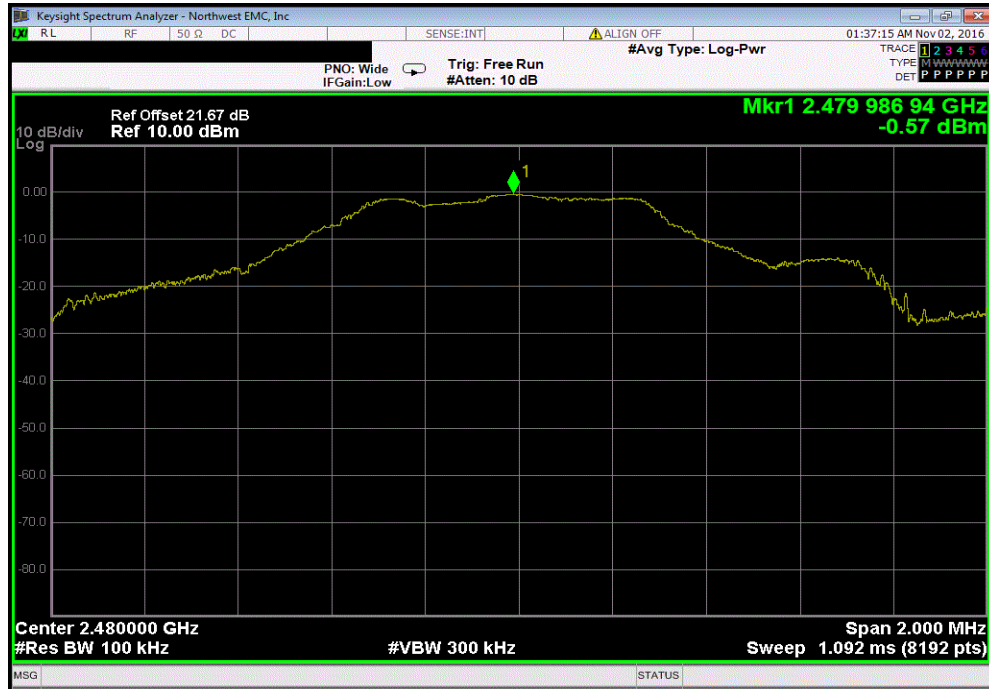


BLE, Mid Channel, 2442 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-51.52	-20	Pass	

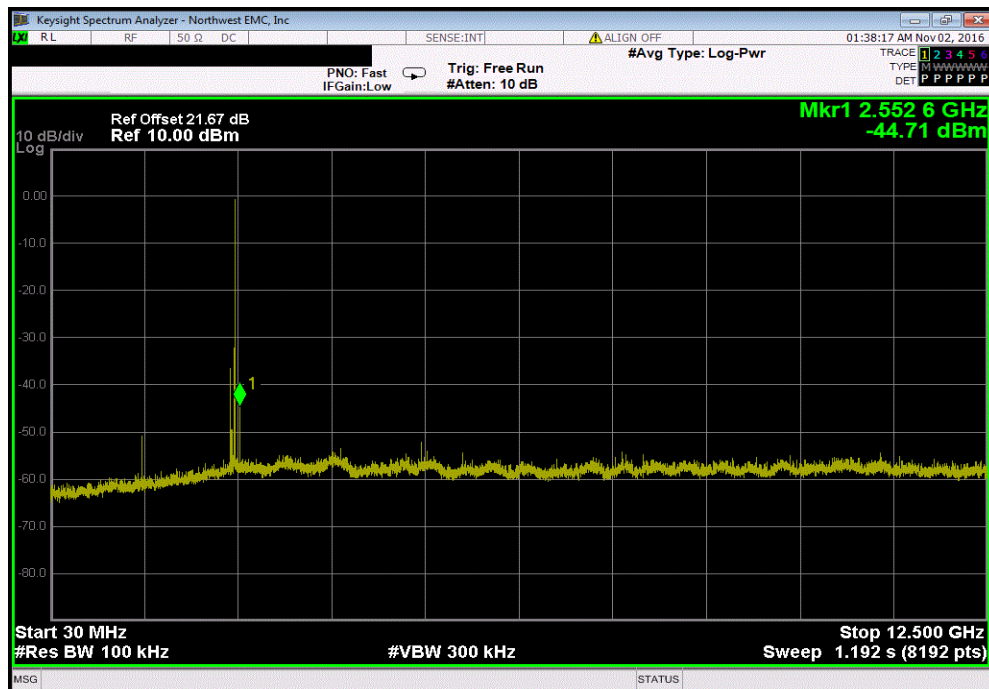


# SPURIOUS CONDUCTED EMISSIONS

BLE, High Channel, 2480 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
Fundamental		N/A		N/A	N/A	



BLE, High Channel, 2480 MHz						
Frequency Range		Max Value (dBc)		Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz		-44.14		-20	Pass	





**NORTHWEST  
EMC**

XMit 2016.05.06

# SPURIOUS RADIATED EMISSIONS

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

## CHANNEL OF OPERATION

Low Channel 0, 2402 MHz  
Middle Channel 20, 2442 MHz  
High Channel 39, 2480 MHz

## POWER SETTINGS INVESTIGATED

Battery only and Charging mode via USB

## CONFIGURATIONS INVESTIGATED

SYNA0209 - 5

## FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26.5 GHz
-----------------	--------	----------------	----------

## SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Cable	ESM Cable Corp.	KMKM-72	EVY	10/17/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AVU	10/17/2016	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AIV	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D00100800-32-13P	AVF	7/11/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVC	3/11/2016	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	0 mo
Attenuator	Coaxicom	3910-20	AXZ	5/18/2016	12 mo
Cable	N/A	Double Ridge Horn Cables	EVB	3/11/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	3/11/2016	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	2/3/2016	24 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFD	5/18/2016	12 mo
Cable	N/A	Bilog Cables	EVA	3/11/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	3/11/2016	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AXR	6/30/2016	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	4/22/2016	12 mo

## TEST DESCRIPTION

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These "pre-scans" are not included in the report. Final measurements on individual emissions were then made.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector  
PK = Peak Detector  
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.


If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

# SPURIOUS RADIATED EMISSIONS

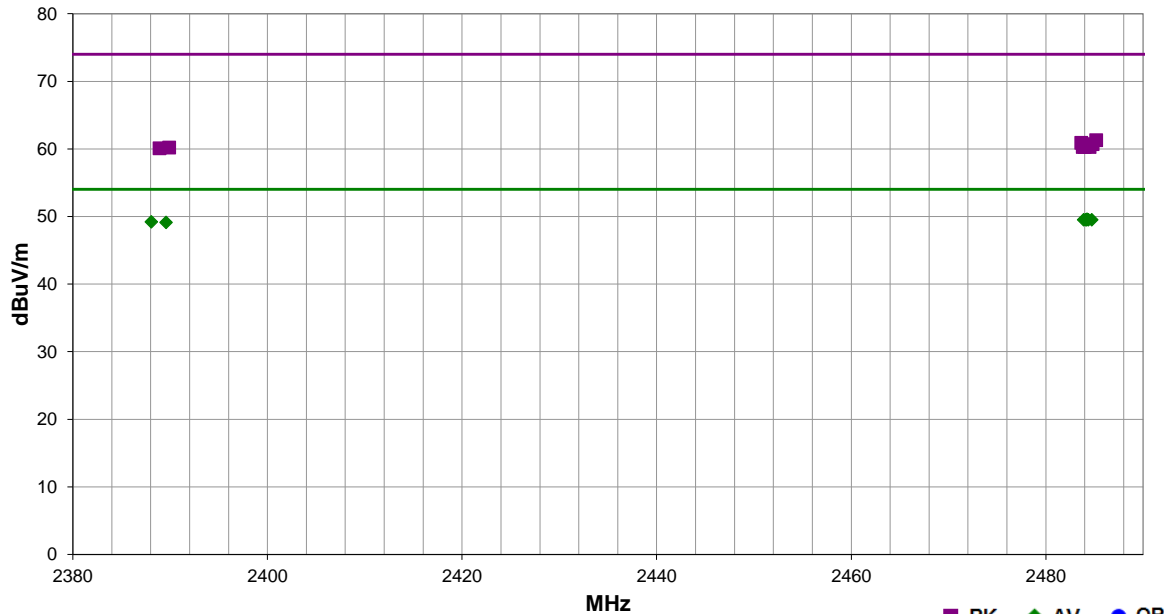


PSA-ESCI 2016.07.22  
EmiRS 2016.08.26

Work Order:	SYNA0209	Date:	11/29/16	
Project:	None	Temperature:	22.1 °C	
Job Site:	EV01	Humidity:	39.7% RH	
Serial Number:	J000045	Barometric Pres.:	1018 mbar	
EUT:	FF01			
Configuration:	5			
Customer:	Uber Technologies, Inc.			
Attendees:	Charles Manry			
EUT Power:	Battery			
Operating Mode:	Transmit, Logo on, white level 90.			
Deviations:	None			
Comments:	See comments for EUT orientation and transmit frequency and channel			


Test Specifications	Test Method
FCC 15.247:2016	ANSI C63.10:2013

Run #	25	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
-------	----	-------------------	---	-------------------	-----------	---------	------

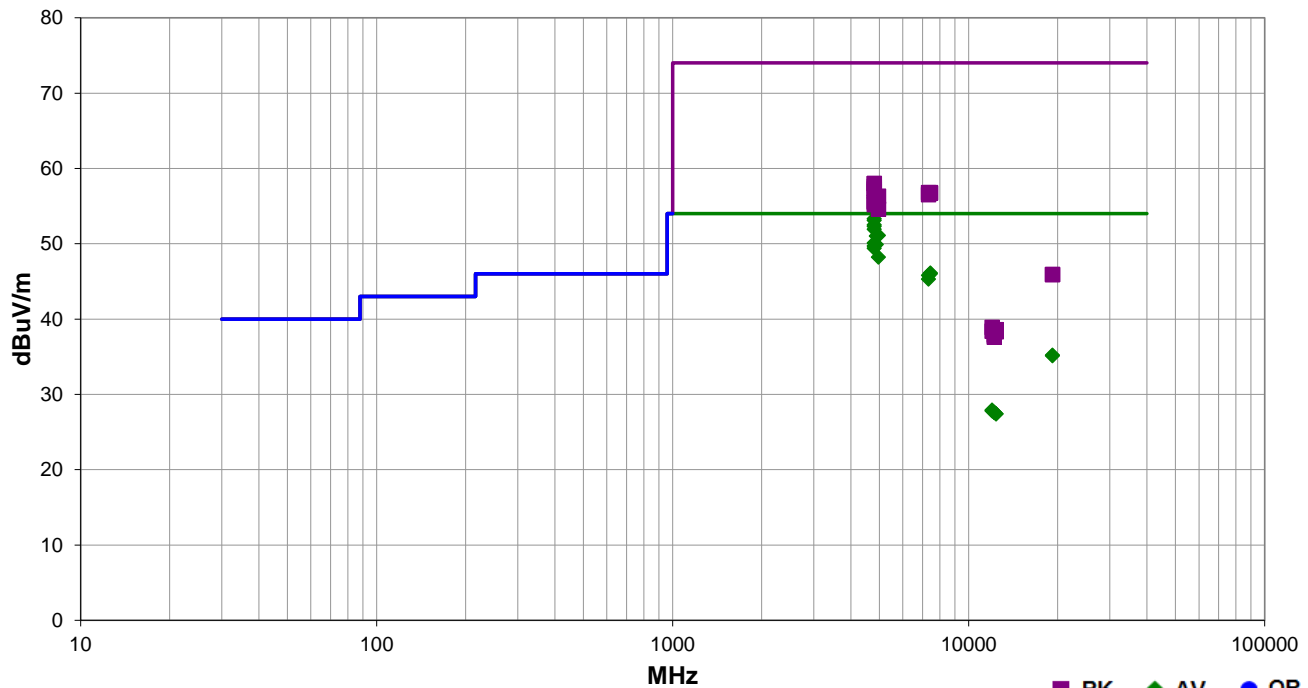


Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
2484.247	30.7	-1.1	1.0	0.0	3.0	20.0	Horz	AV	0.0	49.6	54.0	-4.4
2484.107	30.6	-1.1	3.1	138.0	3.0	20.0	Horz	AV	0.0	49.5	54.0	-4.5
2484.197	30.6	-1.1	1.0	49.0	3.0	20.0	Vert	AV	0.0	49.5	54.0	-4.5
2484.733	30.6	-1.1	3.9	81.0	3.0	20.0	Vert	AV	0.0	49.5	54.0	-4.5
2484.377	30.6	-1.1	1.7	194.0	3.0	20.0	Horz	AV	0.0	49.5	54.0	-4.5
2483.887	30.6	-1.1	1.0	280.0	3.0	20.0	Vert	AV	0.0	49.5	54.0	-4.5
2388.067	30.8	-1.6	3.7	311.0	3.0	20.0	Vert	AV	0.0	49.2	54.0	-4.8
2389.593	30.7	-1.6	1.0	149.0	3.0	20.0	Horz	AV	0.0	49.1	54.0	-4.9
2485.177	42.4	-1.1	1.7	194.0	3.0	20.0	Horz	PK	0.0	61.3	74.0	-12.7
2483.647	42.0	-1.1	3.1	138.0	3.0	20.0	Horz	PK	0.0	60.9	74.0	-13.1
2484.793	41.8	-1.1	1.0	0.0	3.0	20.0	Horz	PK	0.0	60.7	74.0	-13.3
2483.797	41.4	-1.1	1.0	49.0	3.0	20.0	Vert	PK	0.0	60.3	74.0	-13.7
2484.490	41.4	-1.1	3.9	81.0	3.0	20.0	Vert	PK	0.0	60.3	74.0	-13.7
2483.990	41.4	-1.1	1.0	280.0	3.0	20.0	Vert	PK	0.0	60.3	74.0	-13.7
2389.900	41.8	-1.6	1.0	149.0	3.0	20.0	Horz	PK	0.0	60.2	74.0	-13.8
2388.907	41.7	-1.6	3.7	311.0	3.0	20.0	Vert	PK	0.0	60.1	74.0	-13.9

# SPURIOUS RADIATED EMISSIONS

Work Order:	SYNA0209	Date:	11/29/16		
Project:	None	Temperature:	22.1 °C		
Job Site:	EV01	Humidity:	39.7% RH		
Serial Number:	J000045	Barometric Pres.:	1018 mbar	Tested by:	Jeff Alcock and Rod Pelouin
EUT:	FF01				
Configuration:	5				
Customer:	Uber Technologies, Inc.				
Attendees:	Charles Manry				
EUT Power:	Battery				
Operating Mode:	Logo on, white level 90, Transmit				
Deviations:	None				
Comments:	See comments for Transmit channel, frequency and EUT orientation. Charging via USB investigated in worst case orientation.				

Test Specifications					Test Method		
FCC 15.247:2016					ANSI C63.10:2013		
Run #	30	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4803.980	44.3	9.0	3.5	302.0	3.0	0.0	Vert	AV	0.0	53.3	54.0	-0.7
4803.980	44.1	9.0	3.0	249.0	3.0	0.0	Horz	AV	0.0	53.1	54.0	-0.9
4803.890	43.5	9.0	2.6	344.0	3.0	0.0	Horz	AV	0.0	52.5	54.0	-1.5
4803.905	43.3	9.0	1.2	194.0	3.0	0.0	Horz	AV	0.0	52.3	54.0	-1.7
4803.960	42.9	9.0	2.4	105.0	3.0	0.0	Vert	AV	0.0	51.9	54.0	-2.1
4959.950	41.7	9.4	3.5	141.0	3.0	0.0	Vert	AV	0.0	51.1	54.0	-2.9
4883.925	41.8	9.2	3.6	314.0	3.0	0.0	Vert	AV	0.0	51.0	54.0	-3.0
4803.960	41.1	9.0	1.0	247.0	3.0	0.0	Vert	AV	0.0	50.1	54.0	-3.9
4883.970	40.7	9.2	3.1	53.0	3.0	0.0	Horz	AV	0.0	49.9	54.0	-4.1
4804.025	40.7	9.0	1.0	139.0	3.0	0.0	Vert	AV	0.0	49.7	54.0	-4.3