

# NORTHWEST EMC

**RevFire**  
**T2**  
**FCC 15.247:2016**  
**Bluetooth Low Energy Radio**

**Report # REVF0001.1**



NVLAP Lab Code: 201049-0

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# CERTIFICATE OF TEST

Last Date of Test: December 19, 2016

RevFire  
Model: T2

## Radio Equipment Testing

### Standards

Specification	Method
FCC 15.247:2016	ANSI C63.10:2013, KDB 558074

### Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT.
6.5, 6.6, 11.12.1, 11.13.2,	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	N/A	Characterization of radio operation.
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:



Jeremiah Darden, 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
00	None		

# 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:

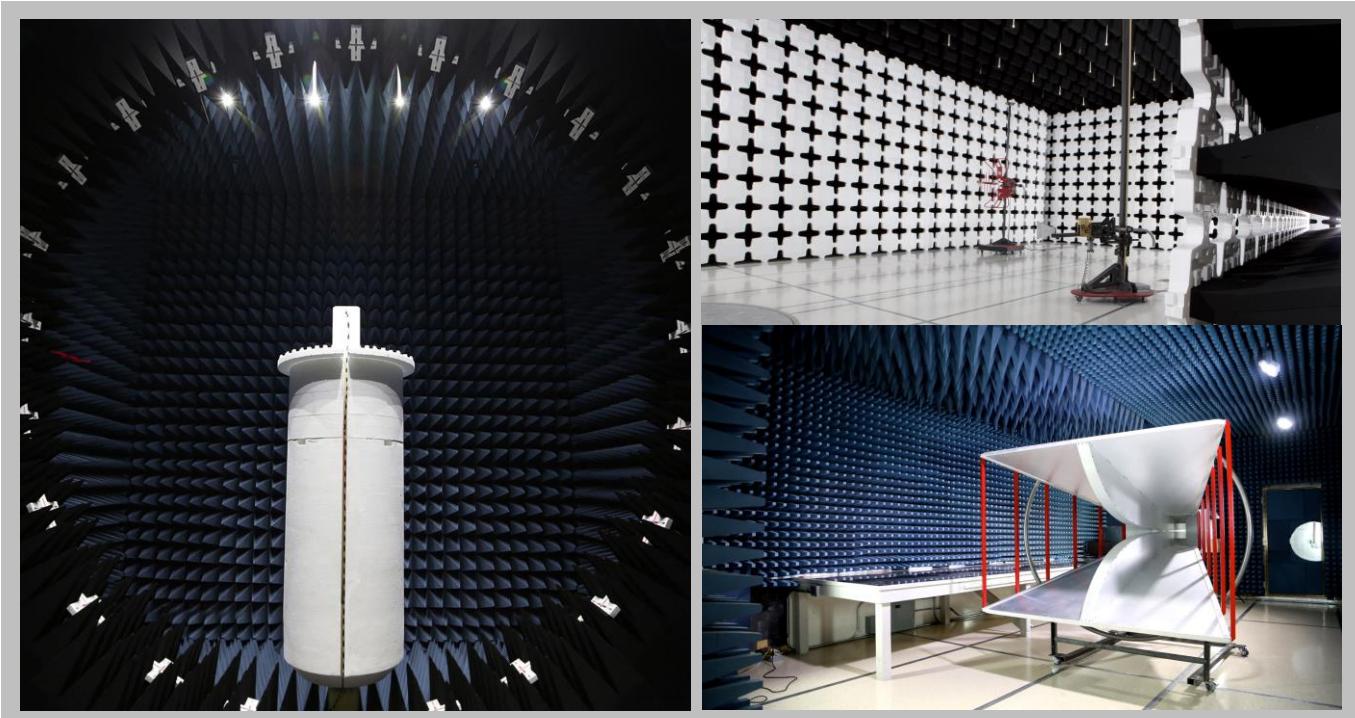
<http://www.nwemc.com/accreditations/>

<http://gsi.nist.gov/global/docs/cabs/designations.html>

# FACILITIES



California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	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/RRA, MIC, MOC, NCC, OFCA</b>					
US0158	US0175	N/A	US0017	US0191	US0157



# 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.

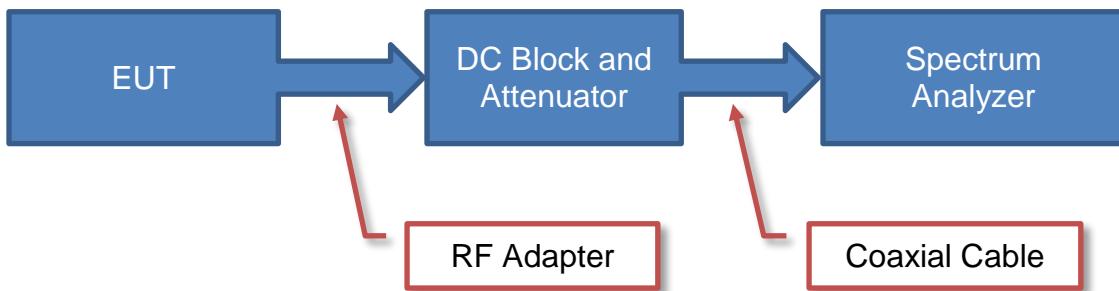
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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.

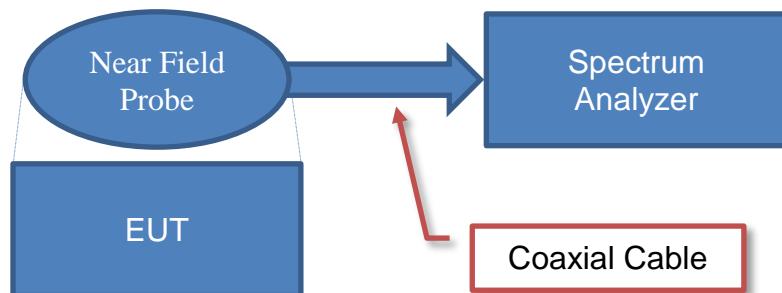
Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	4.9 dB	-4.9 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

# Test Setup Block Diagrams

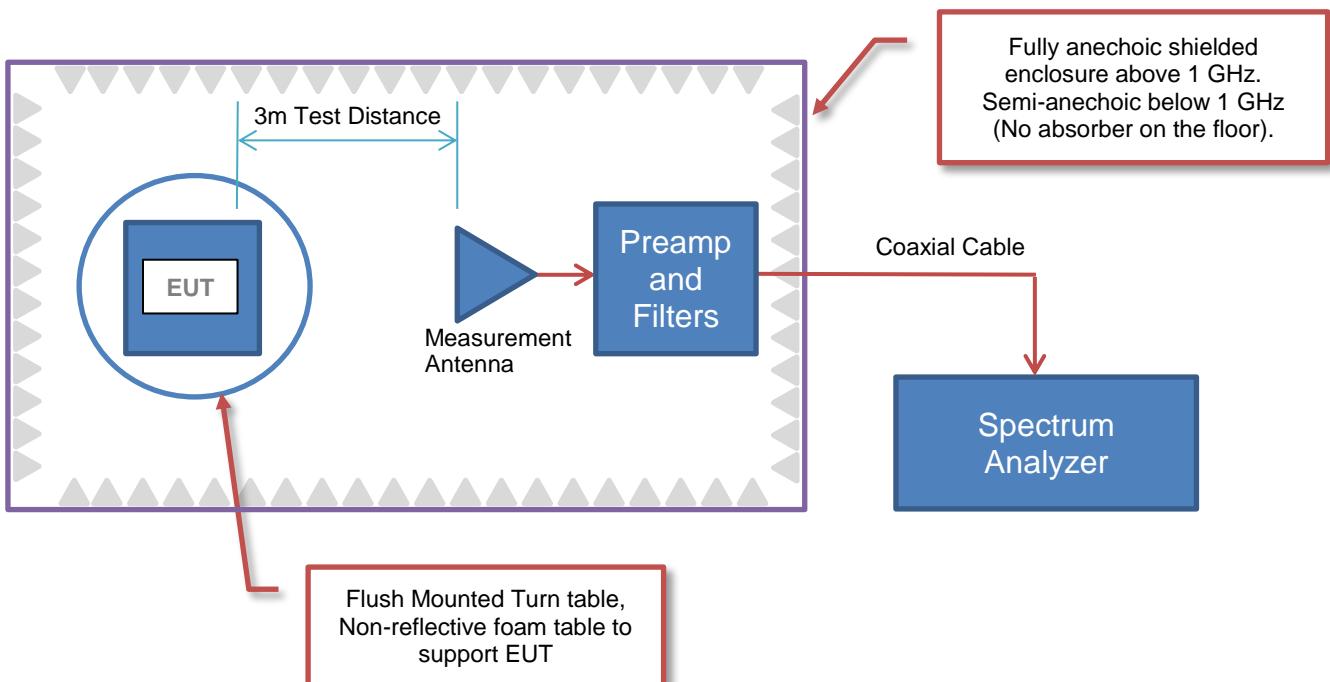
## Antenna Port Conducted Measurements



## Near Field Test Fixture Measurements



## Spurious Radiated Emissions



# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

<b>Company Name:</b>	RevFire
<b>Address:</b>	2143 Willow Creek Dr
<b>City, State, Zip:</b>	Boulder, CO 80301
<b>Test Requested By:</b>	Dave Marinelli
<b>Model:</b>	T2
<b>First Date of Test:</b>	December 16, 2016
<b>Last Date of Test:</b>	December 19, 2016
<b>Receipt Date of Samples:</b>	December 16, 2016
<b>Equipment Design Stage:</b>	Prototype
<b>Equipment Condition:</b>	No Damage
<b>Purchase Authorization:</b>	Verified

## Information Provided by the Party Requesting the Test

<b>Functional Description of the EUT:</b>
The device is a spherical core located at the center of a ball that measures and reports pitch speed and spin to an iPhone via the Bluetooth. It is used for pitcher training. The device is wholly contained in the center of the ball with no external wires or parts, and survives on one coin cell battery for its entire useful life.
<b>Testing Objective:</b>
To demonstrate compliance of the Bluetooth Low Energy radio to FCC 15.247 requirements.

# CONFIGURATIONS

## Configuration REV0001- 1

<b>Software/Firmware Running during test</b>	
<b>Description</b>	<b>Version</b>
FCC Test App	5_1A FCC

<b>EUT</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>
Bluetooth Module (Radiated)	RevFire	T2	3

<b>Peripherals in test setup boundary</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>
Battery Pack	RevFire	None	None
Coin Cell Battery x2	Panasonic	CR2032	None

<b>Remote Equipment Outside of Test Setup Boundary</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>
iPhone	Apple	iPhone 5	F73LGCLNFFHG

<b>Cables</b>					
<b>Cable Type</b>	<b>Shield</b>	<b>Length (m)</b>	<b>Ferrite</b>	<b>Connection 1</b>	<b>Connection 2</b>
DC Power	No	0.25m	No	Bluetooth Module (Radiated)	Coin Cell Battery x2

# CONFIGURATIONS

## Configuration REV0001- 2

<b>Software/Firmware Running during test</b>	
<b>Description</b>	<b>Version</b>
FCC Test App	5_1A FCC

<b>EUT</b>				
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>	
Bluetooth Module (Direct Connect)	RevFire	T2	3	

<b>Peripherals in test setup boundary</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>
Battery Pack	RevFire	None	None
Coin Cell Battery x2	Panasonic	CR2032	None

<b>Remote Equipment Outside of Test Setup Boundary</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model/Part Number</b>	<b>Serial Number</b>
iPhone	Apple	iPhone 5	F73LGCLNFFHG

<b>Cables</b>					
<b>Cable Type</b>	<b>Shield</b>	<b>Length (m)</b>	<b>Ferrite</b>	<b>Connection 1</b>	<b>Connection 2</b>
DC Power	No	0.25m	No	Bluetooth Module (Direct Connect)	Coin Cell Battery x2

# MODIFICATIONS

## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	12/16/2016	Spurious Radiated Emissions	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	12/19/2016	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	12/19/2016	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	12/19/2016	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	12/19/2016	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	12/19/2016	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

# 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.

## **MODES OF OPERATION**

Continuously Transmitting at Low Channel 2402 MHz, High Channel 2480 MHz

Continuously Transmitting at Low Channel 2402 MHz, Mid Channel 2440 MHz, High Channel 2480 MHz

## **POWER SETTINGS INVESTIGATED**

Battery

## **CONFIGURATIONS INVESTIGATED**

REVF0001 - 1

## **FREQUENCY RANGE INVESTIGATED**

Start Frequency	30 MHz	Stop Frequency	26500 MHz
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## **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
Attenuator	Weinschel Corp	4H-20	AWB	3/9/2016	12 mo
Filter - High Pass	Micro-Tronics	HPM50111	HGC	3/4/2016	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	HHV	8/5/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	JSDWK42-18004000-60-5P	PAM	11/18/2016	12 mo
Antenna - Double Ridge	A.H. Systems, Inc.	SAS-574	AXW	8/5/2016	24 mo
Cable	Northwest EMC	18-40GHz	TXE	11/18/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	PAL	10/12/2016	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AJG	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	PAK	10/18/2016	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AJF	NCR	0 mo
Cable	Northwest EMC	8-18GHz	TXD	5/31/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	5/31/2016	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJN	9/15/2016	24 mo
Cable	Northwest EMC	1-8.2 GHz	TXC	5/31/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1551	PAH	11/9/2016	12 mo
Antenna - Biconilog	ETS Lindgren	3143B	AYF	4/13/2016	24 mo
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	11/9/2016	12 mo
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	10/4/2016	12 mo

## **TEST DESCRIPTION**

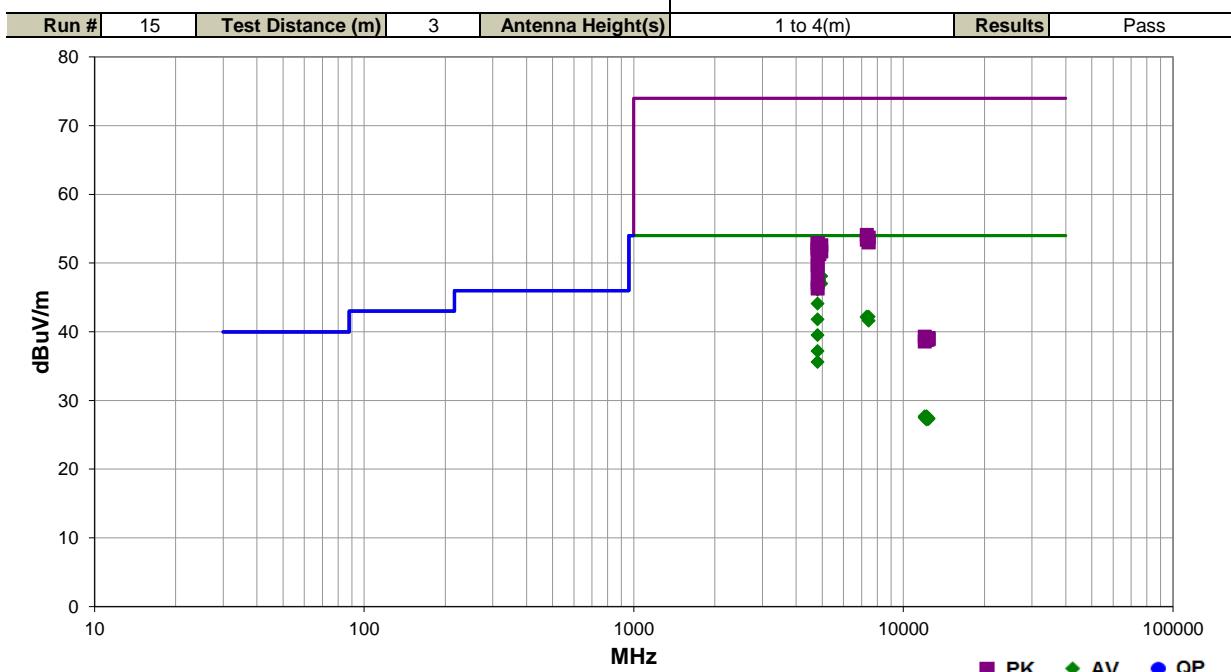
The highest gain of each type of antenna to be used with the EUT was tested. The EUT was configured for low, mid, and high band transmit frequencies. For each configuration, the spectrum was scanned throughout the specified range. In addition, measurements were made in the restricted bands to verify compliance. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and the EUT antenna in three orthogonal axis, and adjusting measurement antenna height and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

# SPURIOUS RADIATED EMISSIONS

NORTHWEST  
EMC  
PSA-ESCI 2016.09.30.1  
EmiR5 2016.08.26

Work Order:	REVFO001	Date:	12/16/16	
Project:	None	Temperature:	21.7 °C	
Job Site:	TX02	Humidity:	31.2% RH	
Serial Number:	1	Barometric Pres.:	1017 mbar	Tested by: Jonathan Kiefer
EUT:	T2			
Configuration:	1			
Customer:	RevFire			
Attendees:	David Marinelli			
EUT Power:	Battery			
Operating Mode:	Continuously Transmitting at Low Channel 2402 MHz, Mid Channel 2440 MHz, High Channel 2480 MHz			
Deviations:	None			
Comments:	Harmonics.			

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



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)	Comments
4957.983	41.7	6.4	1.2	243.9	3.0	0.0	Vert	AV	0.0	48.1	54.0	-5.9	High Ch, EUT Vertical
4806.008	41.3	6.2	1.4	117.0	3.0	0.0	Vert	AV	0.0	47.5	54.0	-6.5	Low Ch, EUT Vertical
4881.992	41.1	6.4	1.6	90.0	3.0	0.0	Vert	AV	0.0	47.5	54.0	-6.5	Mid Ch, EUT Vertical
4806.000	40.8	6.2	1.2	183.9	3.0	0.0	Horz	AV	0.0	47.0	54.0	-7.0	Low Ch, EUT On Side
4882.008	40.6	6.4	1.5	0.0	3.0	0.0	Horz	AV	0.0	47.0	54.0	-7.0	Mid Ch, EUT On Side
4958.008	40.6	6.4	1.2	207.0	3.0	0.0	Horz	AV	0.0	47.0	54.0	-7.0	High Ch, EUT On Side
4806.000	40.6	6.2	1.3	165.9	3.0	0.0	Horz	AV	0.0	46.8	54.0	-7.2	Low Ch, EUT Horizontal
4806.008	39.9	6.2	1.0	222.0	3.0	0.0	Vert	AV	0.0	46.1	54.0	-7.9	Low Ch, EUT Vertical
4806.000	37.9	6.2	1.1	248.0	3.0	0.0	Vert	AV	0.0	44.1	54.0	-9.9	Low Ch, EUT On Side
7319.358	28.6	13.6	1.2	63.0	3.0	0.0	Horz	AV	0.0	42.2	54.0	-11.8	Mid Ch, EUT On Side
7439.425	28.6	13.6	1.2	196.9	3.0	0.0	Vert	AV	0.0	42.2	54.0	-11.8	High Ch, EUT Vertical
7317.708	28.5	13.6	1.2	235.0	3.0	0.0	Vert	AV	0.0	42.1	54.0	-11.9	Mid Ch, EUT Vertical
4805.992	35.6	6.2	1.2	171.9	3.0	0.0	Horz	AV	0.0	41.8	54.0	-12.2	Low Ch, EUT Vertical
7440.758	28.0	13.6	1.2	198.0	3.0	0.0	Horz	AV	0.0	41.6	54.0	-12.4	High Ch, EUT On Side
4806.017	33.3	6.2	1.2	219.9	3.0	0.0	Vert	AV	0.0	39.5	54.0	-14.5	Low Ch, EUT Horizontal
4804.353	31.0	6.2	1.2	246.0	3.0	0.0	Vert	AV	0.0	37.2	54.0	-16.8	Low Ch, EUT Vertical
4804.383	29.4	6.2	3.6	355.0	3.0	0.0	Horz	AV	0.0	35.6	54.0	-18.4	Low Ch, EUT On Side
7319.583	40.5	13.6	1.2	63.0	3.0	0.0	Horz	PK	0.0	54.1	74.0	-19.9	Mid Ch, EUT On Side

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)	Comments
7438.708	40.1	13.6	1.2	196.9	3.0	0.0	Vert	PK	0.0	53.7	74.0	-20.3	High Ch, EUT Vertical
7318.225	39.8	13.6	1.2	235.0	3.0	0.0	Vert	PK	0.0	53.4	74.0	-20.6	Mid Ch, EUT Vertical
7440.917	39.4	13.6	1.2	198.0	3.0	0.0	Horz	PK	0.0	53.0	74.0	-21.0	High Ch, EUT On Side
4805.925	46.7	6.2	1.3	165.9	3.0	0.0	Horz	PK	0.0	52.9	74.0	-21.1	Low Ch, EUT Horizontal
4806.017	46.7	6.2	1.2	183.9	3.0	0.0	Horz	PK	0.0	52.9	74.0	-21.1	Low Ch, EUT On Side
4957.950	46.2	6.4	1.2	243.9	3.0	0.0	Vert	PK	0.0	52.6	74.0	-21.4	High Ch, EUT Vertical
4805.908	46.0	6.2	1.4	117.0	3.0	0.0	Vert	PK	0.0	52.2	74.0	-21.8	Low Ch, EUT Vertical
4806.050	45.7	6.2	1.0	222.0	3.0	0.0	Vert	PK	0.0	51.9	74.0	-22.1	Low Ch, EUT Vertical
4957.950	45.3	6.4	1.2	207.0	3.0	0.0	Horz	PK	0.0	51.7	74.0	-22.3	High Ch, EUT On Side
4881.967	45.3	6.4	1.6	90.0	3.0	0.0	Vert	PK	0.0	51.7	74.0	-22.3	Mid Ch, EUT Vertical
4881.917	44.9	6.4	1.5	0.0	3.0	0.0	Horz	PK	0.0	51.3	74.0	-22.7	Mid Ch, EUT On Side
4806.192	44.9	6.2	1.1	248.0	3.0	0.0	Vert	PK	0.0	51.1	74.0	-22.9	Low Ch, EUT On Side
4806.108	43.5	6.2	1.2	171.9	3.0	0.0	Horz	PK	0.0	49.7	74.0	-24.3	Low Ch, EUT Vertical
4806.025	42.9	6.2	1.2	219.9	3.0	0.0	Vert	PK	0.0	49.1	74.0	-24.9	Low Ch, EUT Horizontal
12201.190	29.7	-2.0	1.2	298.9	3.0	0.0	Horz	AV	0.0	27.7	54.0	-26.3	Mid Ch, EUT On Side
12008.760	30.0	-2.3	3.9	358.9	3.0	0.0	Vert	AV	0.0	27.7	54.0	-26.3	Low Ch, EUT Vertical
12008.520	29.8	-2.3	1.1	68.0	3.0	0.0	Horz	AV	0.0	27.5	54.0	-26.5	Low Ch, EUT On Side
12398.040	28.5	-1.1	1.2	247.0	3.0	0.0	Horz	AV	0.0	27.4	54.0	-26.6	High Ch, EUT On Side
12399.010	28.4	-1.1	1.2	78.0	3.0	0.0	Vert	AV	0.0	27.3	54.0	-26.7	High Ch, EUT Vertical
4803.935	41.0	6.2	1.2	246.0	3.0	0.0	Vert	PK	0.0	47.2	74.0	-26.8	Low Ch, EUT Vertical
12201.080	29.2	-2.0	1.2	192.0	3.0	0.0	Vert	AV	0.0	27.2	54.0	-26.8	Mid Ch, EUT Vertical
4803.573	40.1	6.2	3.6	355.0	3.0	0.0	Horz	PK	0.0	46.3	74.0	-27.7	Low Ch, EUT On Side
12010.780	41.6	-2.3	3.9	358.9	3.0	0.0	Vert	PK	0.0	39.3	74.0	-34.7	Low Ch, EUT Vertical
12399.450	40.2	-1.1	1.2	247.0	3.0	0.0	Horz	PK	0.0	39.1	74.0	-34.9	High Ch, EUT On Side
12202.280	41.0	-2.0	1.2	192.0	3.0	0.0	Vert	PK	0.0	39.0	74.0	-35.0	Mid Ch, EUT Vertical
12398.900	40.0	-1.1	1.2	78.0	3.0	0.0	Vert	PK	0.0	38.9	74.0	-35.1	High Ch, EUT Vertical
12201.310	40.8	-2.0	1.2	298.9	3.0	0.0	Horz	PK	0.0	38.8	74.0	-35.2	Mid Ch, EUT On Side
12009.430	40.9	-2.3	1.1	68.0	3.0	0.0	Horz	PK	0.0	38.6	74.0	-35.4	Low Ch, EUT On Side

# SPURIOUS RADIATED EMISSIONS

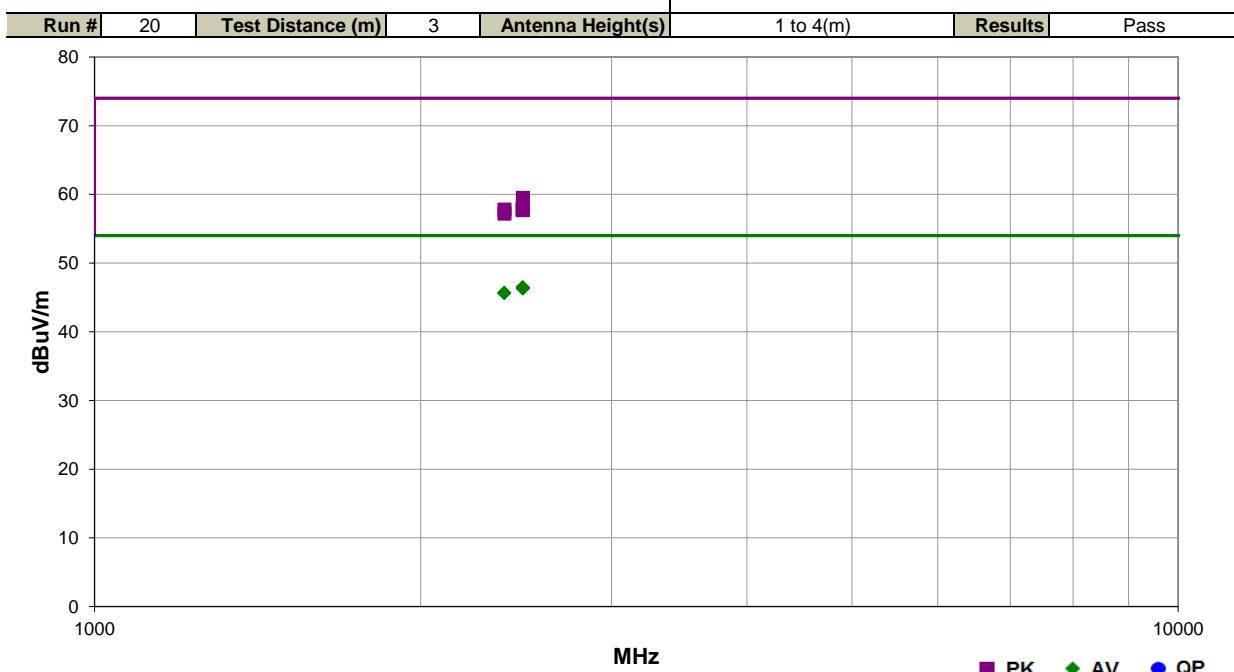
**NORTHWEST  
EMC**

PSA-ESCI 2016.09.30.1

EmiR5 2016.08.26

Work Order:	REVFO001	Date:	12/16/16	
Project:	None	Temperature:	21.7 °C	
Job Site:	TX02	Humidity:	31.2% RH	
Serial Number:	1	Barometric Pres.:	1017 mbar	
EUT:	T2			
Configuration:	1			
Customer:	RevFire			
Attendees:	David Marinelli			
EUT Power:	Battery			
Operating Mode:	Continuously Transmitting at Low Channel 2402 MHz, High Channel 2480 MHz			
Deviations:	None			
Comments:	Restricted bands near band edges			

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



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)	Comments
2484.377	31.2	-4.7	1.2	309.9	3.0	20.0	Horz	AV	0.0	46.5	54.0	-7.5	High Ch, EUT Vertical
2485.187	31.1	-4.7	1.2	349.0	3.0	20.0	Vert	AV	0.0	46.4	54.0	-7.6	High Ch, EUT Horizontal
2484.847	31.1	-4.7	1.2	352.9	3.0	20.0	Horz	AV	0.0	46.4	54.0	-7.6	High Ch, EUT On Side
2484.873	31.1	-4.7	1.6	168.0	3.0	20.0	Vert	AV	0.0	46.4	54.0	-7.6	High Ch, EUT On Side
2485.103	31.0	-4.7	1.2	290.0	3.0	20.0	Vert	AV	0.0	46.3	54.0	-7.7	High Ch, EUT Vertical
2485.227	31.0	-4.7	1.2	298.9	3.0	20.0	Horz	AV	0.0	46.3	54.0	-7.7	High Ch, EUT Horizontal
2388.400	31.1	-5.4	1.2	3.9	3.0	20.0	Horz	AV	0.0	45.7	54.0	-8.3	Low Ch, EUT Vertical
2388.427	31.0	-5.4	1.2	297.0	3.0	20.0	Vert	AV	0.0	45.6	54.0	-8.4	Low Ch, EUT Horizontal
2485.297	44.2	-4.7	1.2	309.9	3.0	20.0	Horz	PK	0.0	59.5	74.0	-14.5	High Ch, EUT Vertical
2485.087	43.7	-4.7	1.6	168.0	3.0	20.0	Vert	PK	0.0	59.0	74.0	-15.0	High Ch, EUT On Side
2484.770	43.0	-4.7	1.2	290.0	3.0	20.0	Vert	PK	0.0	58.3	74.0	-15.7	High Ch, EUT Vertical
2484.547	42.6	-4.7	1.2	349.0	3.0	20.0	Vert	PK	0.0	57.9	74.0	-16.1	High Ch, EUT Horizontal
2484.353	42.5	-4.7	1.2	298.9	3.0	20.0	Horz	PK	0.0	57.8	74.0	-16.2	High Ch, EUT Horizontal
2389.870	43.2	-5.4	1.2	297.0	3.0	20.0	Vert	PK	0.0	57.8	74.0	-16.2	Low Ch, EUT Horizontal
2484.173	42.4	-4.7	1.2	352.9	3.0	20.0	Horz	PK	0.0	57.7	74.0	-16.3	High Ch, EUT On Side
2389.510	42.6	-5.4	1.2	3.9	3.0	20.0	Horz	PK	0.0	57.2	74.0	-16.8	Low Ch, EUT Vertical

## **DUTY CYCLE**

### **TEST DESCRIPTION**

---

The Duty Cycle (x) were measured for each of the EUT operating modes. 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.

The EUT operates at 100% Duty Cycle.

# 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
Cable	Fairview Microwave	SCK0963-60	TXF	11/18/2016	11/18/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	3/15/2016	3/15/2017

## 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.

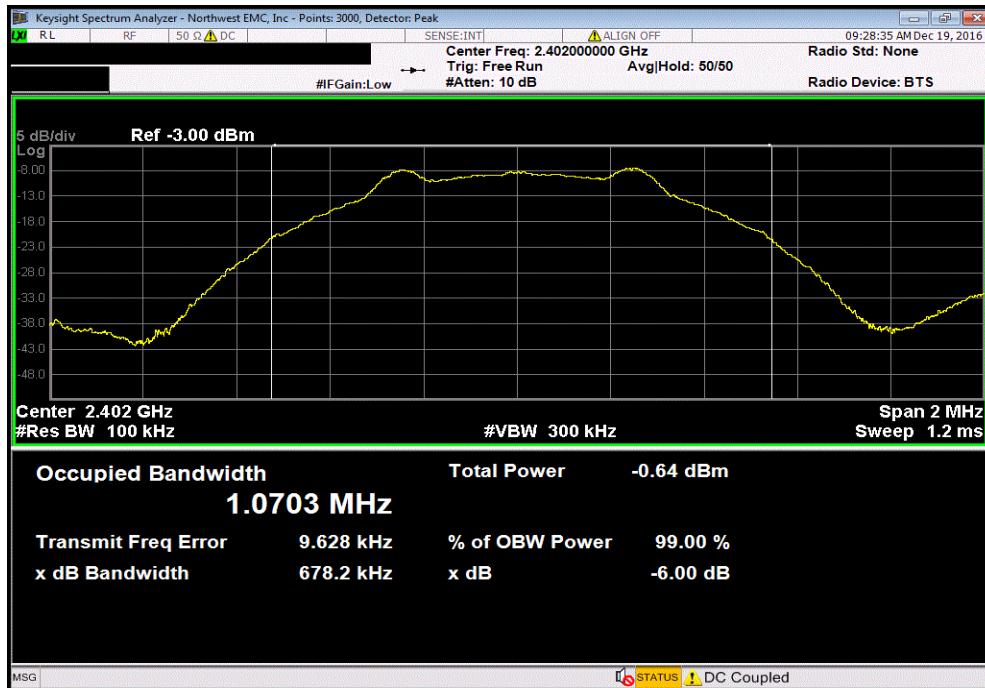
# OCCUPIED BANDWIDTH

EUT:	T2		Work Order:	REVFO001	
Serial Number:	3		Date:	12/19/16	
Customer:	RevFire		Temperature:	21.6 °C	
Attendees:	David Marinelli		Humidity:	16.5% RH	
Project:	None		Barometric Pres.:	1044 mbar	
Tested by:	Jonathan Kiefer	Power:	Battery	Job Site:	TX09
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2016			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	2	Signature	 <i>Jonathan Kiefer</i>		
			Value	Limit (±)	Result
			678.239 kHz	500 kHz	Pass
			677.461 kHz	500 kHz	Pass
			675.382 kHz	500 kHz	Pass

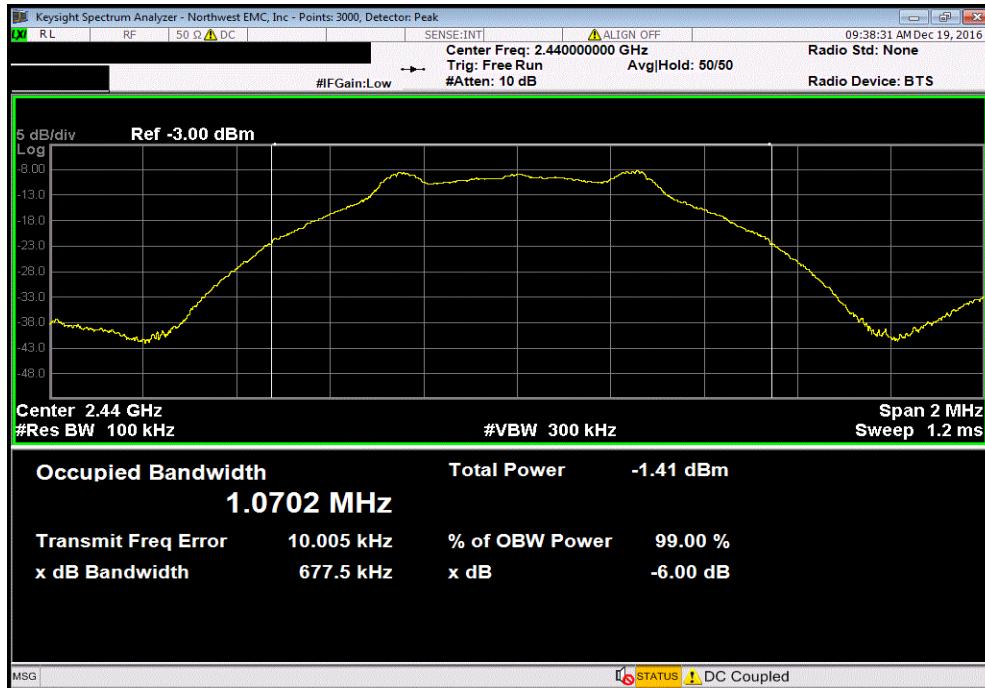
BLE/GFSK Low Channel, 2402 MHz  
BLE/GFSK Mid Channel, 2440 MHz  
BLE/GFSK High Channel, 2480 MHz

# OCCUPIED BANDWIDTH

BLE/GFSK Low Channel, 2402 MHz			Value	Limit	Result
			(≥)		
			678.239 kHz	500 kHz	Pass

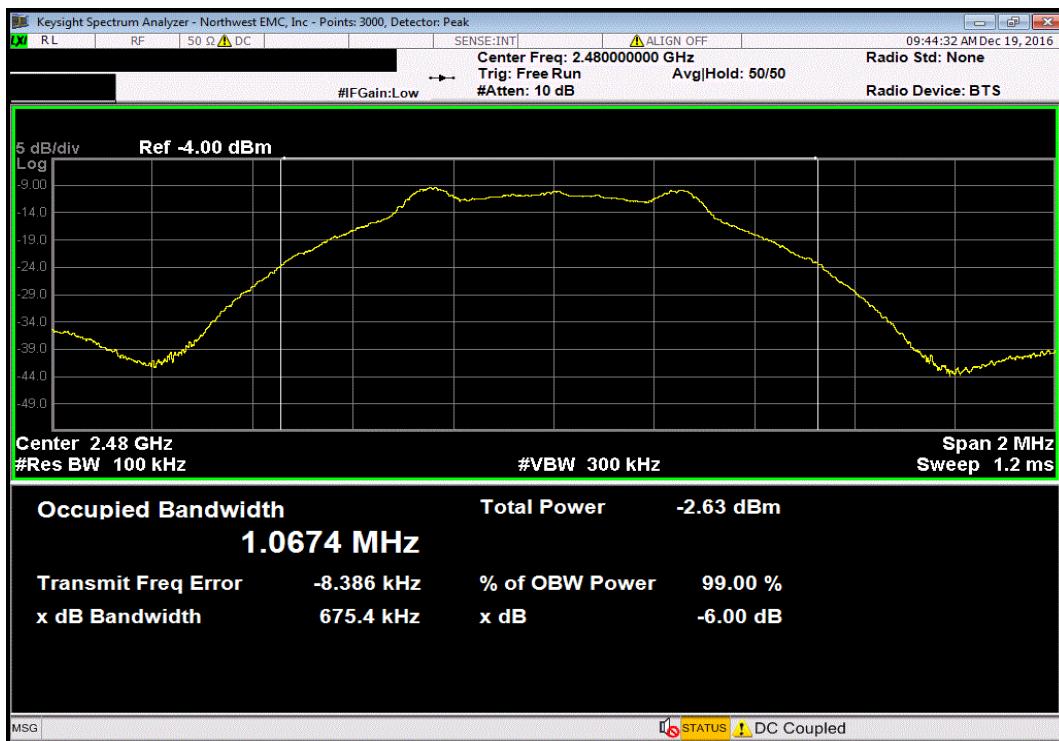


BLE/GFSK Mid Channel, 2440 MHz			Value	Limit	Result
			(≥)		
			677.461 kHz	500 kHz	Pass



# OCCUPIED BANDWIDTH

BLE/GFSK High Channel, 2480 MHz				Value	Limit	Result
				( $\geq$ )		
				675.382 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
Cable	Fairview Microwave	SCK0963-60	TXF	11/18/2016	11/18/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	3/15/2016	3/15/2017

## 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) was measured.

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.

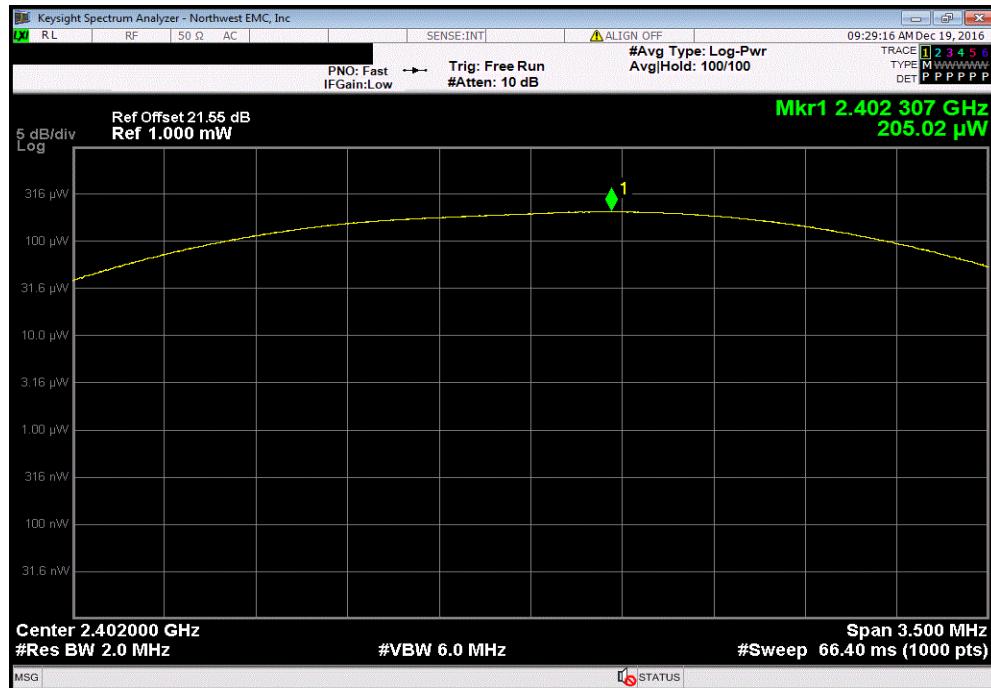
# OUTPUT POWER

EUT:	T2		Work Order:	REVF0001
Serial Number:	3		Date:	12/19/16
Customer:	RevFire		Temperature:	21.6 °C
Attendees:	David Marinelli		Humidity:	16.4% RH
Project:	None		Barometric Pres.:	1044 mbar
Tested by:	Jonathan Kiefer	Power:	Battery	Job Site: TX09
TEST SPECIFICATIONS			Test Method	
FCC 15.247:2016			ANSI C63.10:2013	
COMMENTS				
None				
DEVIATIONS FROM TEST STANDARD				
None				
Configuration #	2	Signature	 <i>Jonathan Kiefer</i>	
			Value	Limit (±)
			205.02 uW	1 W
			171.49 uW	1 W
			127.97 uW	1 W
			Pass	
			Pass	
			Pass	

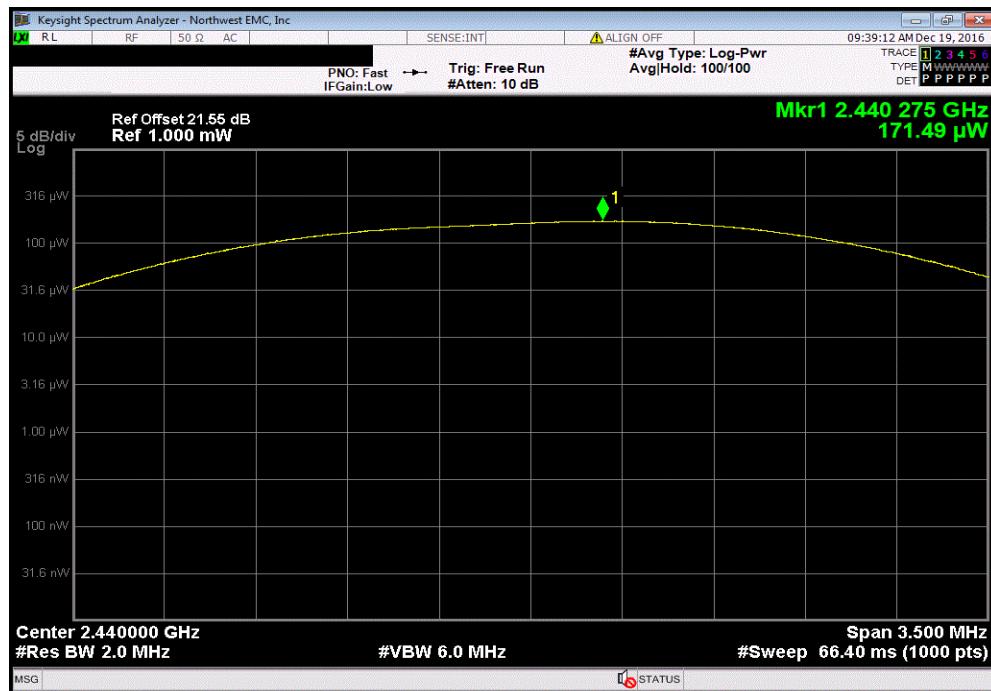
BLE/GFSK Low Channel, 2402 MHz  
BLE/GFSK Mid Channel, 2440 MHz  
BLE/GFSK High Channel, 2480 MHz

# OUTPUT POWER

BLE/GFSK Low Channel, 2402 MHz			Value	Limit (<)	Result
			205.02 uW	1 W	Pass

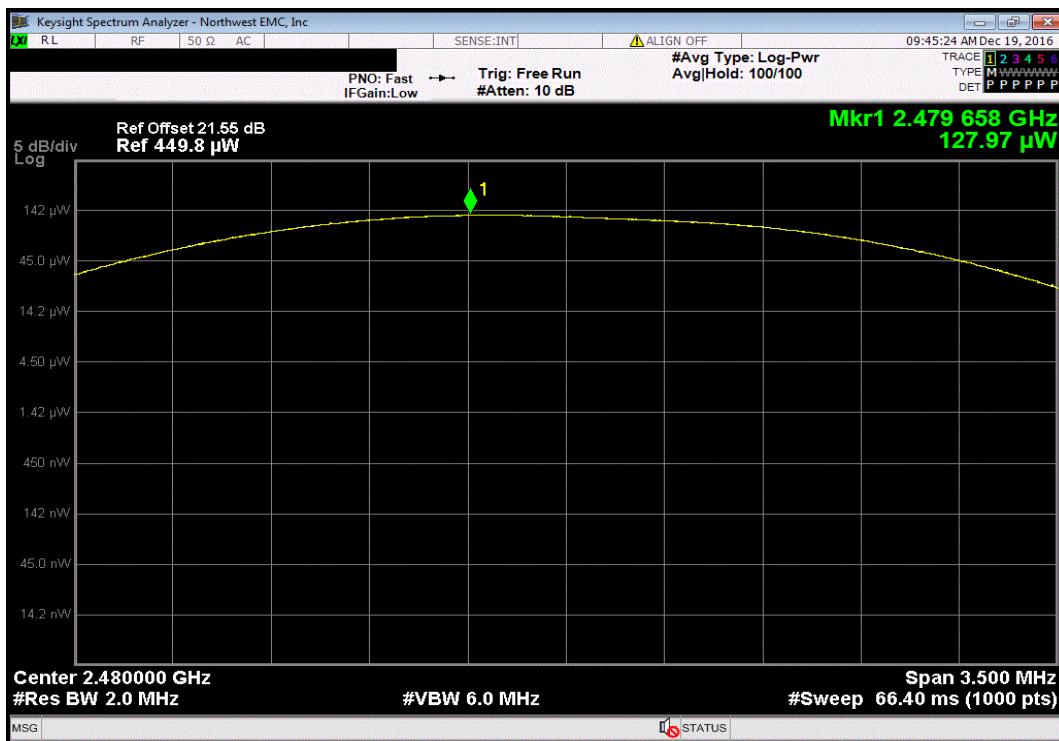


BLE/GFSK Mid Channel, 2440 MHz			Value	Limit (<)	Result
			171.49 uW	1 W	Pass



# OUTPUT POWER

BLE/GFSK High Channel, 2480 MHz				Value	Limit	Result
				(≤)		
				127.97 $\mu$ 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
Cable	Fairview Microwave	SCK0963-60	TXF	11/18/2016	11/18/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	3/15/2016	3/15/2017

## 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

**NORTHWEST  
EMC**

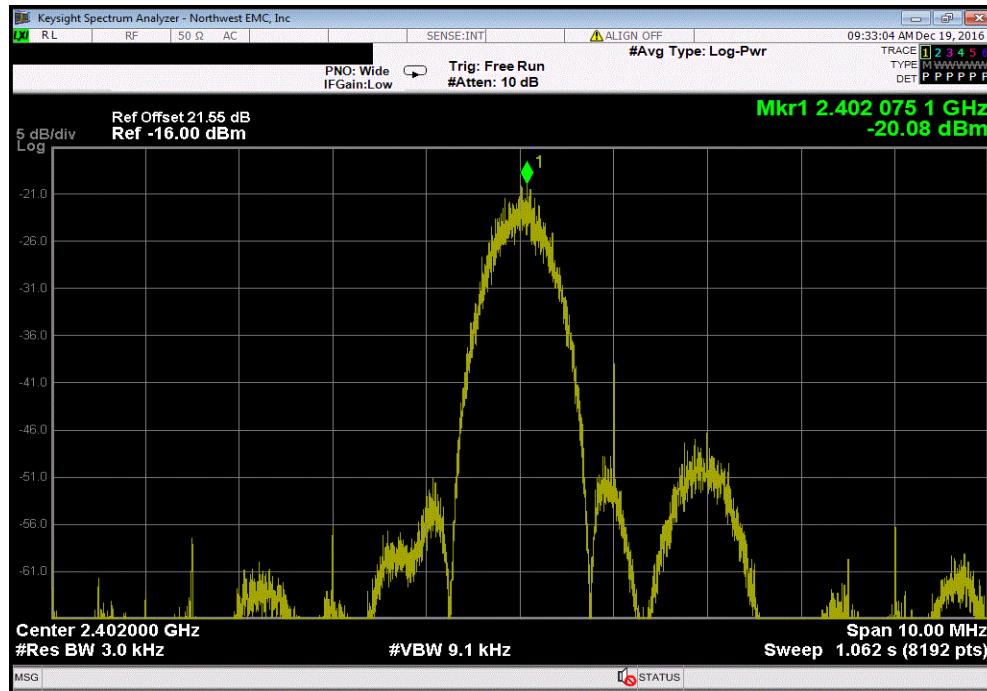
XMit 2016.09.29

NweTx 2016.09.14.2

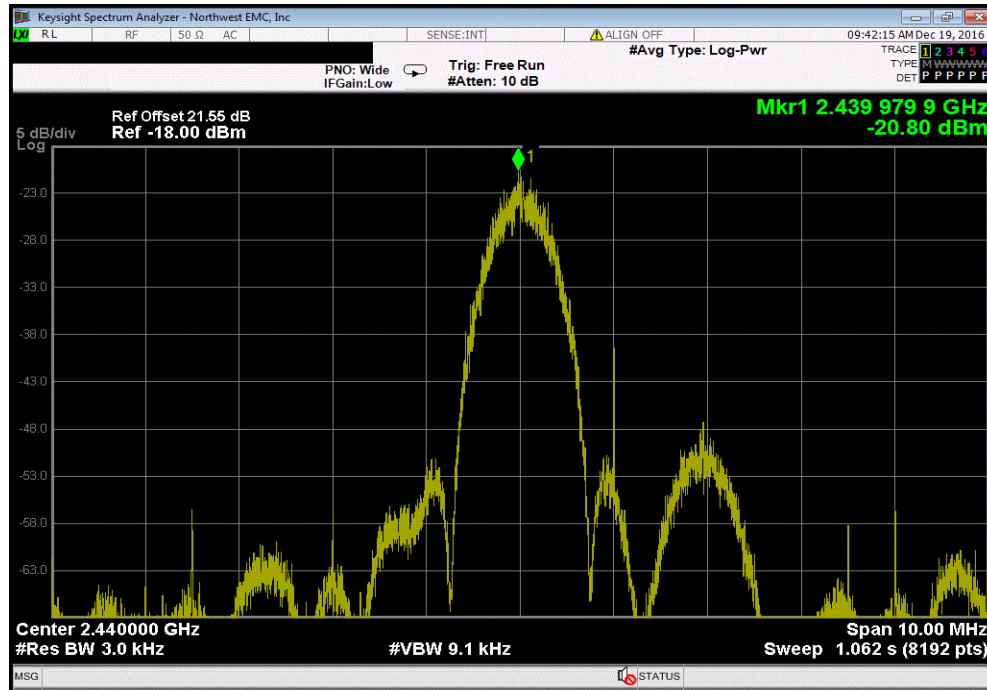
EUT: T2		Work Order: REVFO001																
Serial Number: 3		Date: 12/19/16																
Customer: RevFire		Temperature: 21.6 °C																
Attendees: David Marinelli		Humidity: 16.4% RH																
Project: None		Barometric Pres.: 1044 mbar																
Tested by: Jonathan Kiefer	Power: Battery	Job Site: TX09																
TEST SPECIFICATIONS																		
FCC 15.247:2016		Test Method																
		ANSI C63.10:2013																
COMMENTS																		
None																		
DEVIATIONS FROM TEST STANDARD																		
None																		
Configuration #	2	Signature																
Signature		Jonathan Kiefer																
<table border="1"> <thead> <tr> <th>Value</th> <th>Limit</th> <th></th> </tr> <tr> <th>dBm/3kHz</th> <th>&lt; dBm/3kHz</th> <th>Results</th> </tr> </thead> <tbody> <tr> <td>-20.08</td> <td>8</td> <td>Pass</td> </tr> <tr> <td>-20.797</td> <td>8</td> <td>Pass</td> </tr> <tr> <td>22.306</td> <td>9</td> <td>Pass</td> </tr> </tbody> </table>				Value	Limit		dBm/3kHz	< dBm/3kHz	Results	-20.08	8	Pass	-20.797	8	Pass	22.306	9	Pass
Value	Limit																	
dBm/3kHz	< dBm/3kHz	Results																
-20.08	8	Pass																
-20.797	8	Pass																
22.306	9	Pass																
BLE/GFSK Low Channel, 2402 MHz																		
BLE/GFSK Mid Channel, 2440 MHz																		
BLE/GFSK High Channel, 2480 MHz																		

# POWER SPECTRAL DENSITY

BLE/GFSK Low Channel, 2402 MHz					
	Value	Limit			Results
	dBm/3kHz	< dBm/3kHz			
	-20.08	8			Pass

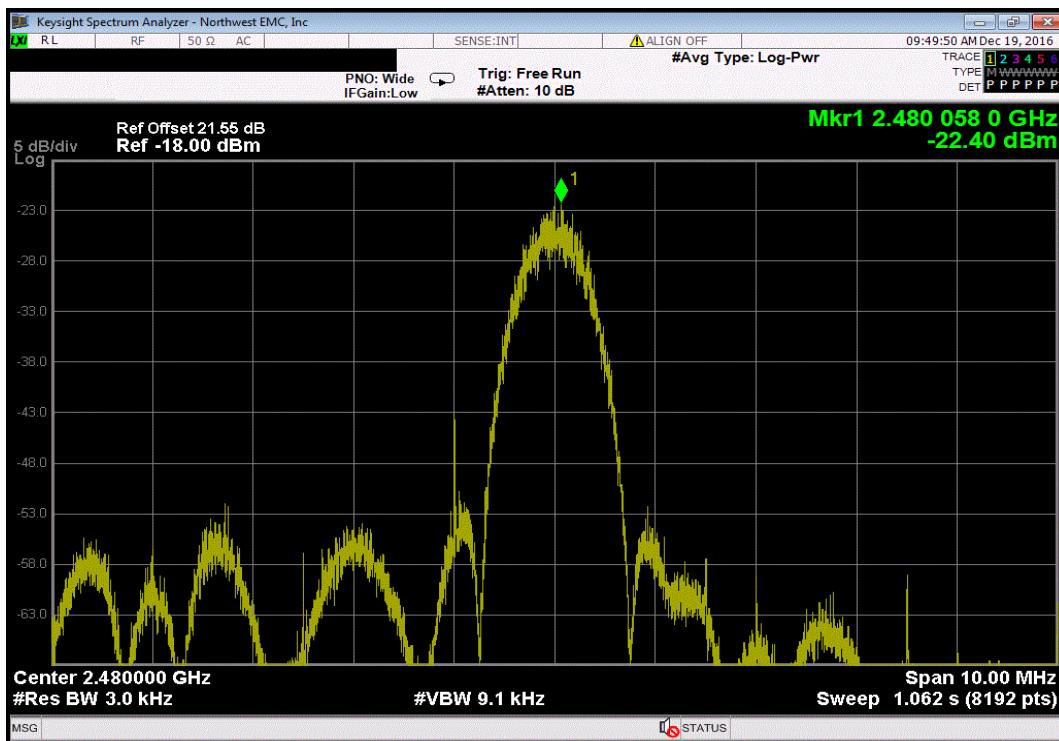


BLE/GFSK Mid Channel, 2440 MHz					
	Value	Limit			Results
	dBm/3kHz	< dBm/3kHz			
	-20.797	8			Pass



# POWER SPECTRAL DENSITY

BLE/GFSK High Channel, 2480 MHz						
	Value	Limit	Results			
	dBm/3kHz	< dBm/3kHz				
	-22.396	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
Cable	Fairview Microwave	SCK0963-60	TXF	11/18/2016	11/18/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	3/15/2016	3/15/2017

## 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.

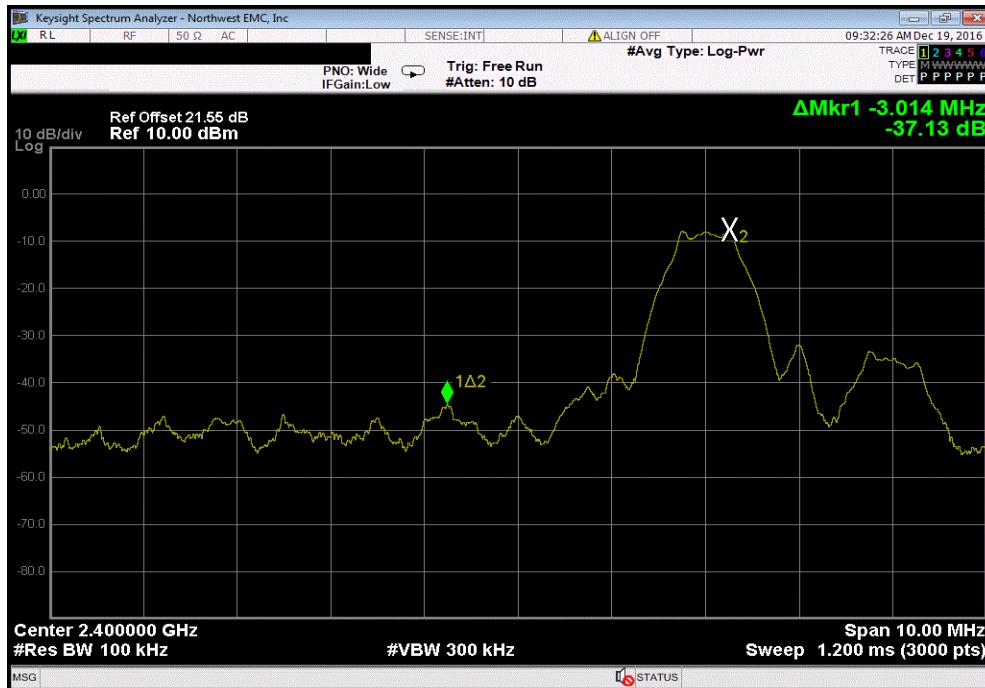
The spectrum was scanned below the lower band edge and above the higher band edge.

# BAND EDGE COMPLIANCE

EUT:	T2		Work Order:	REVF0001	
Serial Number:	3		Date:	12/19/16	
Customer:	RevFire		Temperature:	21.5 °C	
Attendees:	David Marinelli		Humidity:	16.5% RH	
Project:	None		Barometric Pres.:	1044 mbar	
Tested by:	Jonathan Kiefer	Power:	Battery	Job Site:	TX09
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2016			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	2	Signature			
			Value (dBc)	Limit ≤ (dBc)	Result
			-37.13	-20	Pass
			-39.56	-20	Pass
BLE/GFSK Low Channel, 2402 MHz					
BLE/GFSK High Channel, 2480 MHz					

# BAND EDGE COMPLIANCE

BLE/GFSK Low Channel, 2402 MHz			
	Value (dBc)	Limit $\leq$ (dBc)	Result
	-37.13	-20	Pass



BLE/GFSK High Channel, 2480 MHz			
	Value (dBc)	Limit $\leq$ (dBc)	Result
	-39.56	-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
Cable	Fairview Microwave	SCK0963-60	TXF	11/18/2016	11/18/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	3/15/2016	3/15/2017

## TEST DESCRIPTION

---

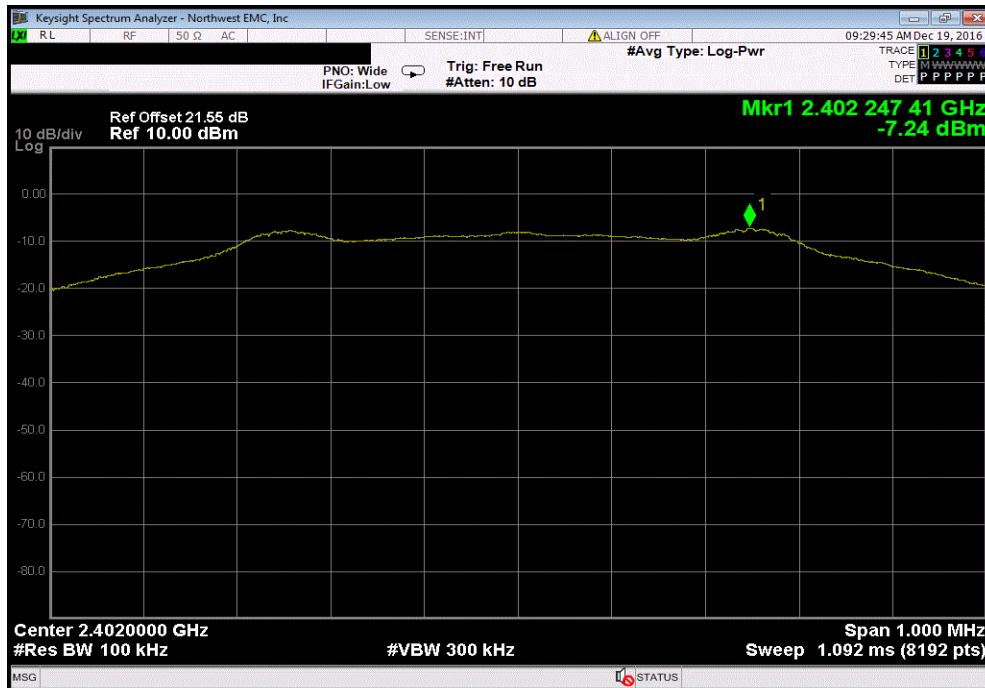
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each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

# SPURIOUS CONDUCTED EMISSIONS

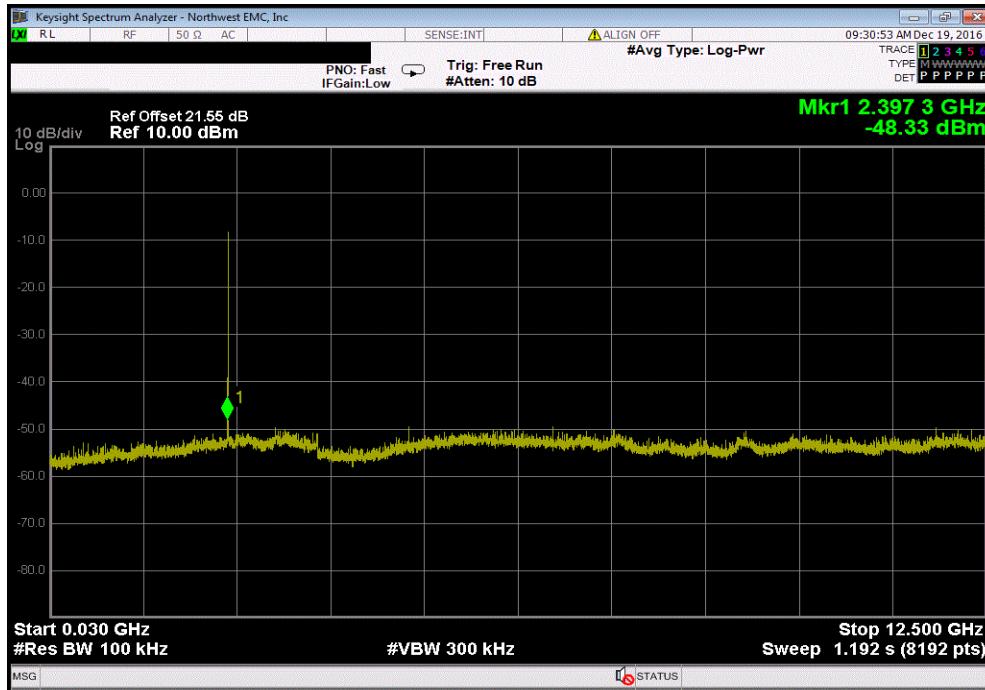
EUT:	T2		Work Order:	REVFO001		
Serial Number:	3		Date:	12/19/16		
Customer:	RevFire		Temperature:	21.6 °C		
Attendees:	David Marinelli		Humidity:	16.7% RH		
Project:	None		Barometric Pres.:	1044 mbar		
Tested by:	Jonathan Kiefer	Power:	Battery	Job Site:	TX09	
TEST SPECIFICATIONS		Test Method				
FCC 15.247:2016		ANSI C63.10:2013				
COMMENTS						
None						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	2	Signature	Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz			Fundamental	N/A	N/A	N/A
BLE/GFSK Low Channel, 2402 MHz			30 MHz - 12.5 GHz	-41.09	-20	Pass
BLE/GFSK Low Channel, 2402 MHz			12.5 GHz - 25 GHz	-32.16	-20	Pass
BLE/GFSK Mid Channel, 2440 MHz			Fundamental	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2440 MHz			30 MHz - 12.5 GHz	-41.77	-20	Pass
BLE/GFSK Mid Channel, 2440 MHz			12.5 GHz - 25 GHz	-31.53	-20	Pass
BLE/GFSK High Channel, 2480 MHz			Fundamental	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz			30 MHz - 12.5 GHz	-40.65	-20	Pass
BLE/GFSK High Channel, 2480 MHz			12.5 GHz - 25 GHz	-30.22	-20	Pass

# SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK Low Channel, 2402 MHz					
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result		
Fundamental	N/A	N/A	N/A		

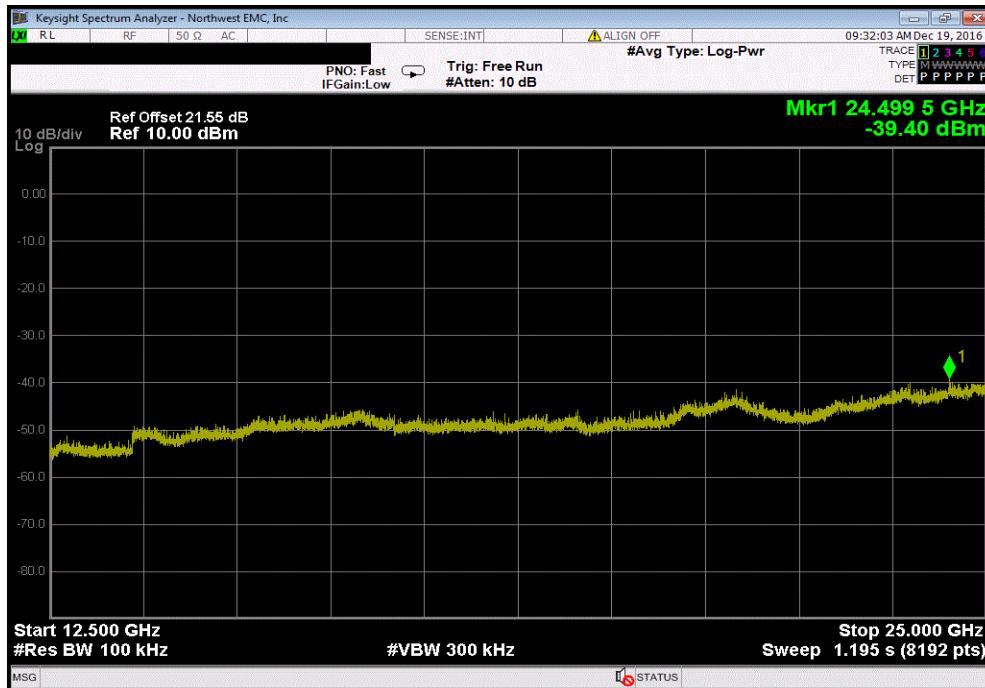


BLE/GFSK Low Channel, 2402 MHz					
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result		
30 MHz - 12.5 GHz	-41.09	-20	Pass		

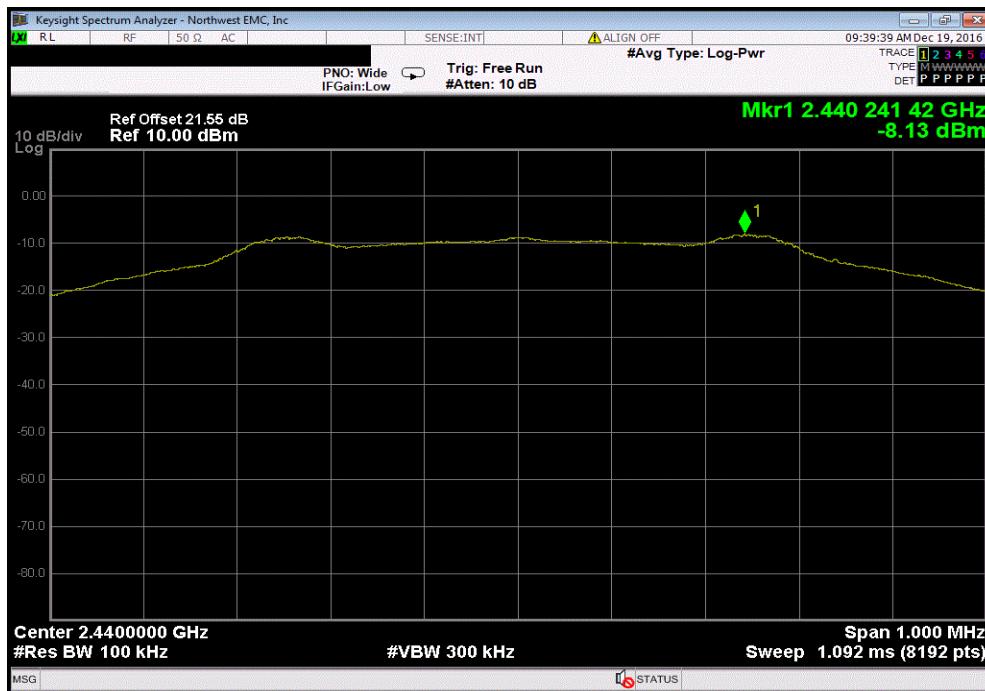


# SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK Low Channel, 2402 MHz			
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	-32.16	-20	Pass

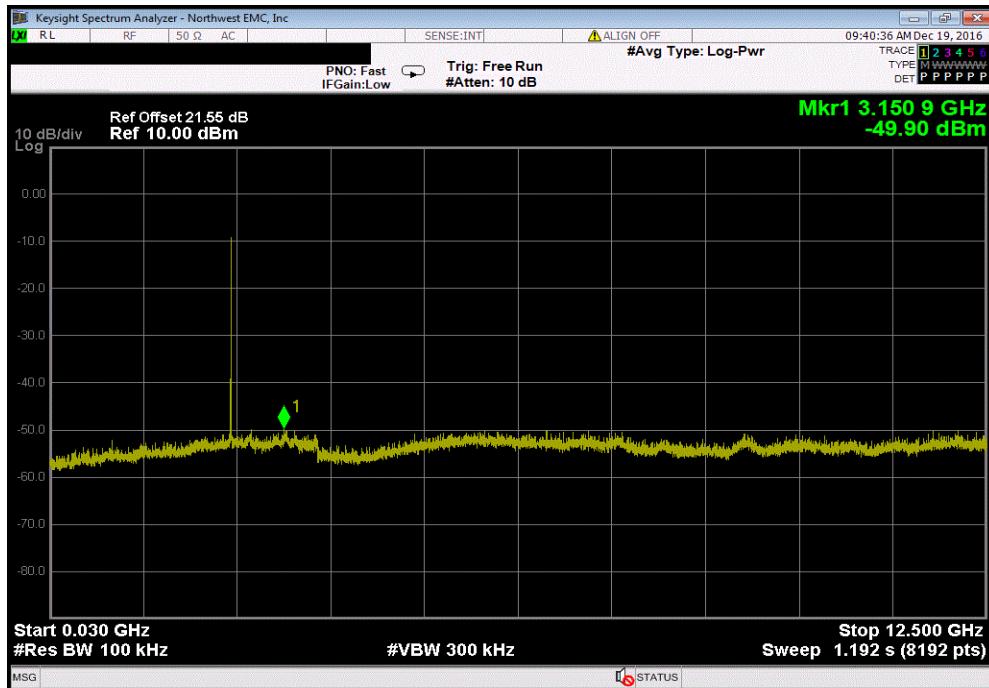


BLE/GFSK Mid Channel, 2440 MHz			
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental	N/A	N/A	N/A

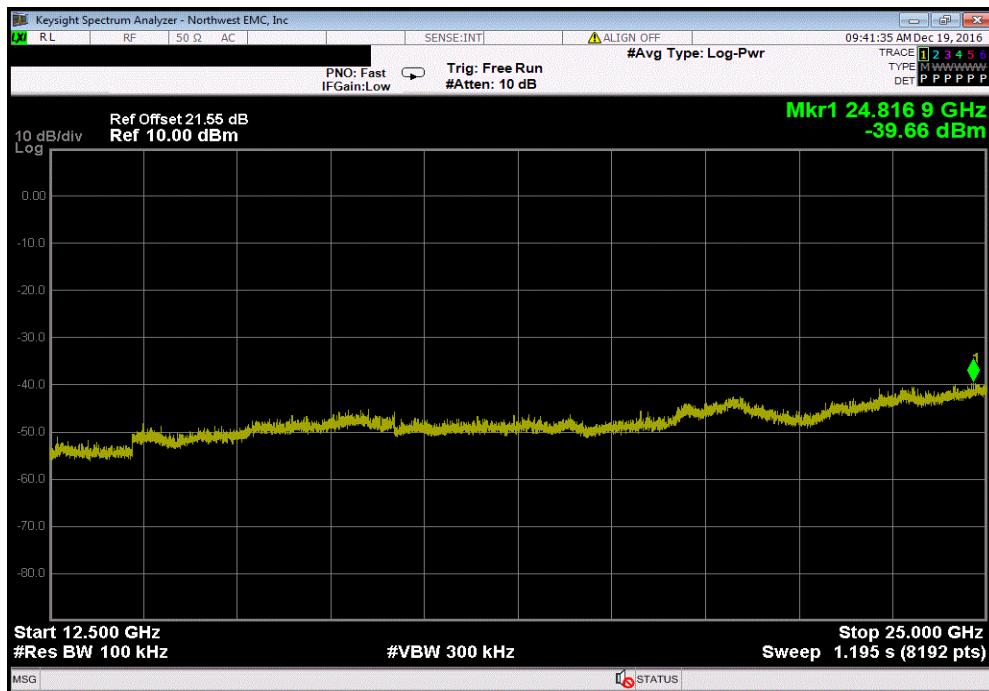


# SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK Mid Channel, 2440 MHz			
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result
30 MHz - 12.5 GHz	-41.77	-20	Pass

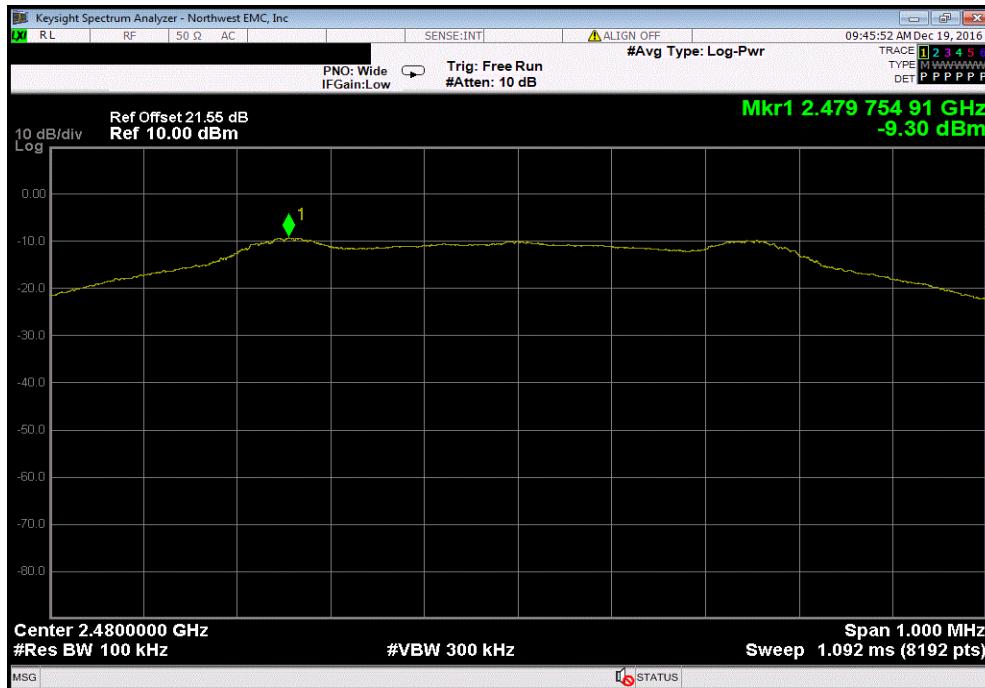


BLE/GFSK Mid Channel, 2440 MHz			
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result
12.5 GHz - 25 GHz	-31.53	-20	Pass

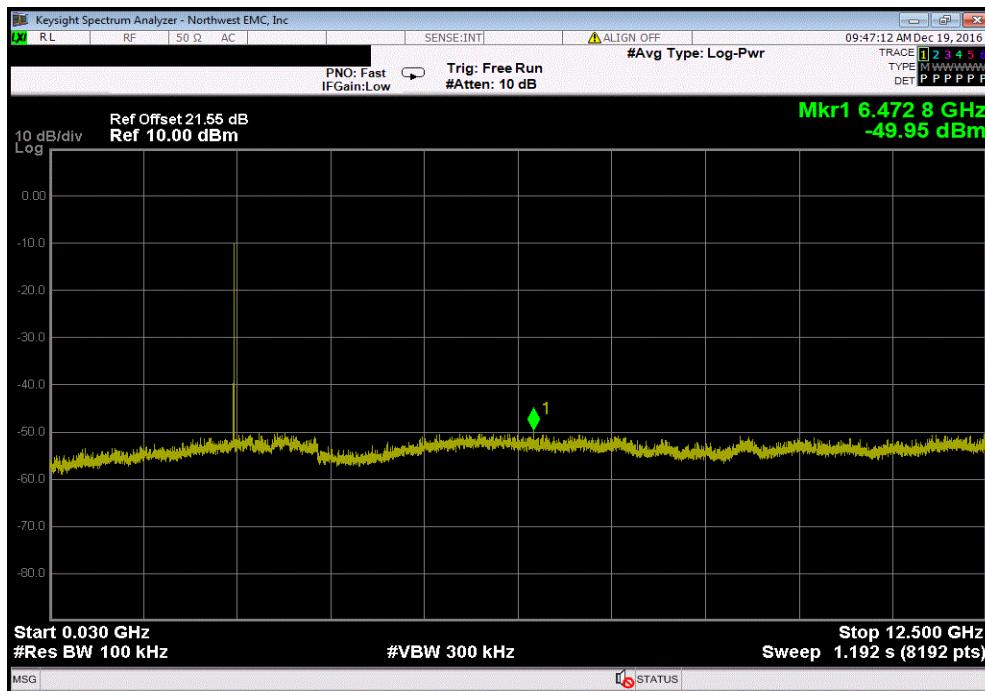


# SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK High Channel, 2480 MHz					
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result		
Fundamental	N/A	N/A	N/A		



BLE/GFSK High Channel, 2480 MHz					
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result		
30 MHz - 12.5 GHz	-40.65	-20	Pass		



# SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK High Channel, 2480 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-30.22	-20	Pass	

