



**Starkey Laboratories, Inc.**

**BTE 13**

**FCC 15.247:2018**  
**Bluetooth Low Energy Radio**  
**Report # STAK0123**



**NVLAP**<sup>®</sup>  
TESTING

NVLAP LAB CODE: 200881-0



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# CERTIFICATE OF TEST



Last Date of Test: June 13, 2018  
Starkey Laboratories, Inc.  
Model: BTE 13

## Radio Equipment Testing

### Standards

Specification	Method
FCC 15.247:2018	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.
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	
11.12.1, 11.13.2, 6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	

### Deviations From Test Standards

None

### Approved By:

Matt Nuernberg, 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 Element 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** – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

## Australia/New Zealand

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

## Korea

**MSIT / 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:

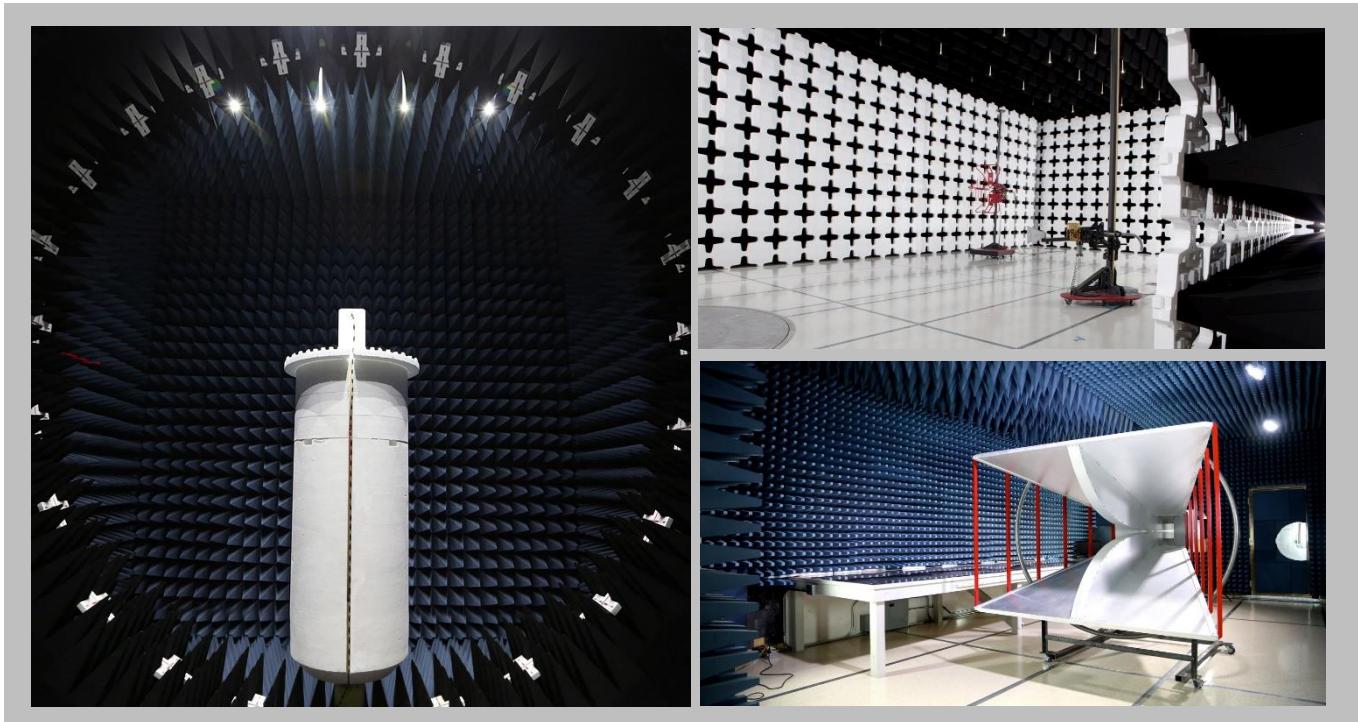
<http://portlandcustomer.element.com/ts/scope/scope.htm>

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

# FACILITIES



California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 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 6775 NE Evergreen Pkwy #400 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, 2834E-3	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.

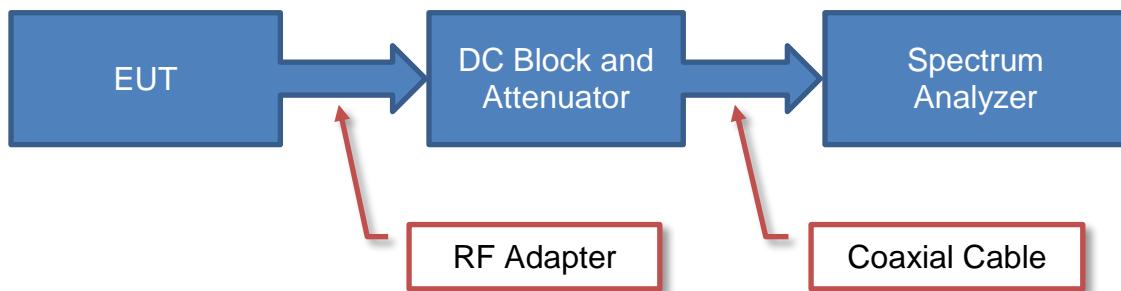
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

# Test Setup Block Diagrams

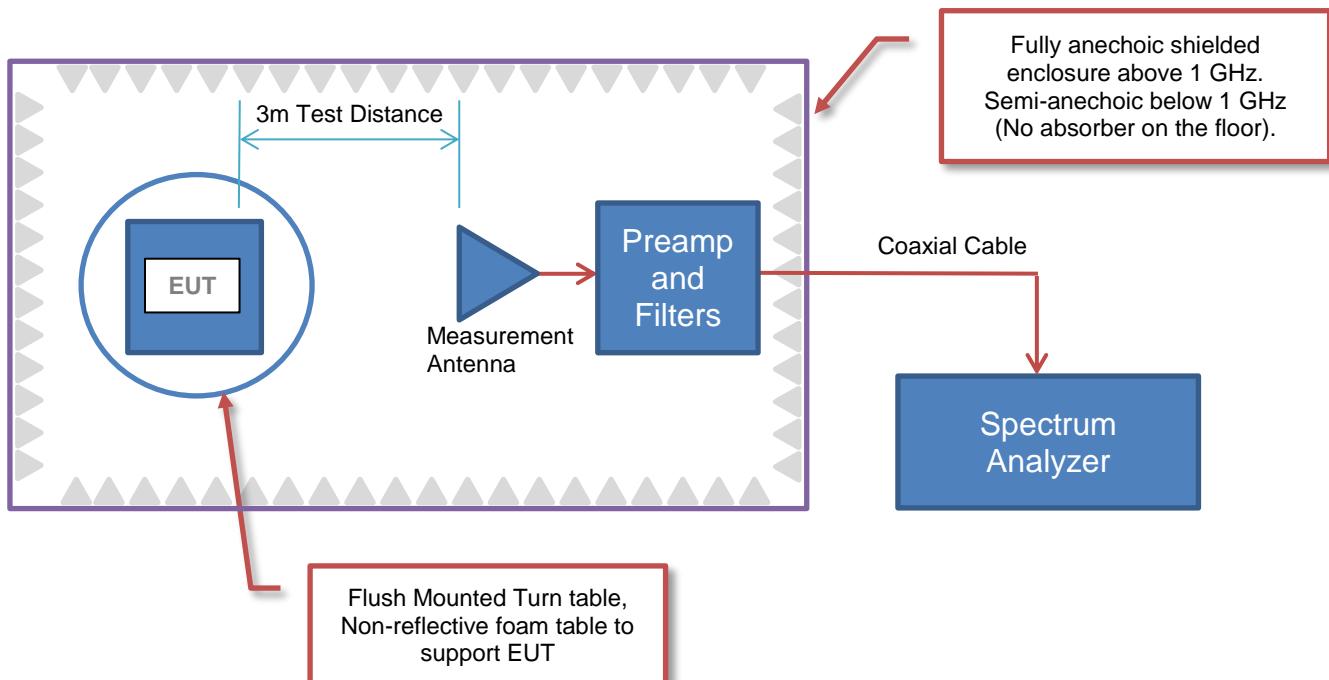
## Antenna Port Conducted Measurements



## Near Field Test Fixture Measurements



## Spurious Radiated Emissions



# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

<b>Company Name:</b>	Starkey Laboratories, Inc.
<b>Address:</b>	6600 Washington Ave. SO.
<b>City, State, Zip:</b>	Eden Prairie, MN 55344
<b>Test Requested By:</b>	Bill Mitchell
<b>Model:</b>	BTE 13
<b>First Date of Test:</b>	June 11, 2018
<b>Last Date of Test:</b>	June 13, 2018
<b>Receipt Date of Samples:</b>	June 11, 2018
<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:

Bluetooth Low Energy radio with 1 antenna type and 1 antenna port.

### Testing Objective:

To demonstrate compliance of the Bluetooth Low Energy radio to FCC 15.247 requirements for operation in the 2.4 GHz band.

# CONFIGURATIONS

## Configuration STAK0123- 1

Software/Firmware Running during test	
Description	Version
WEST	3.9.2.0

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Hearing Aid	Starkey Laboratories, Inc.	BTE13	180913776

## Configuration STAK0123- 3

Software/Firmware Running during test	
Description	Version
Kiwi Test Software	2.26.0.0
WEST	3.9.2.0

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Hearing Aid	Starkey Laboratories, Inc.	BTE13	180913778

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Power Supply (Laptop)	Lenovo	ADLX90NCT2A	11S45N0311Z1ZLZ633M0T4
Bluetooth Dongle	Anatel	BLE0112	Unknown
Laptop	Lenovo	ThinkPad T430	11306
Bluetooth Dongle Dock	TruLink	None	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
AC Cable (Laptop)	No	1.0m	No	AC Mains	Power Supply (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	Power Supply (Laptop)	Laptop
USB Cable (Bluetooth Dongle Dock)	No	1.8m	No	Laptop	Bluetooth Dongle Dock

# MODIFICATIONS

## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	6/11/2018	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	6/13/2018	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	6/13/2018	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	6/13/2018	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	6/13/2018	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	6/13/2018	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	6/13/2018	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

# DUTY CYCLE



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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.

# DUTY CYCLE



TbTx 2017.12.14

XMi 2017.12.13

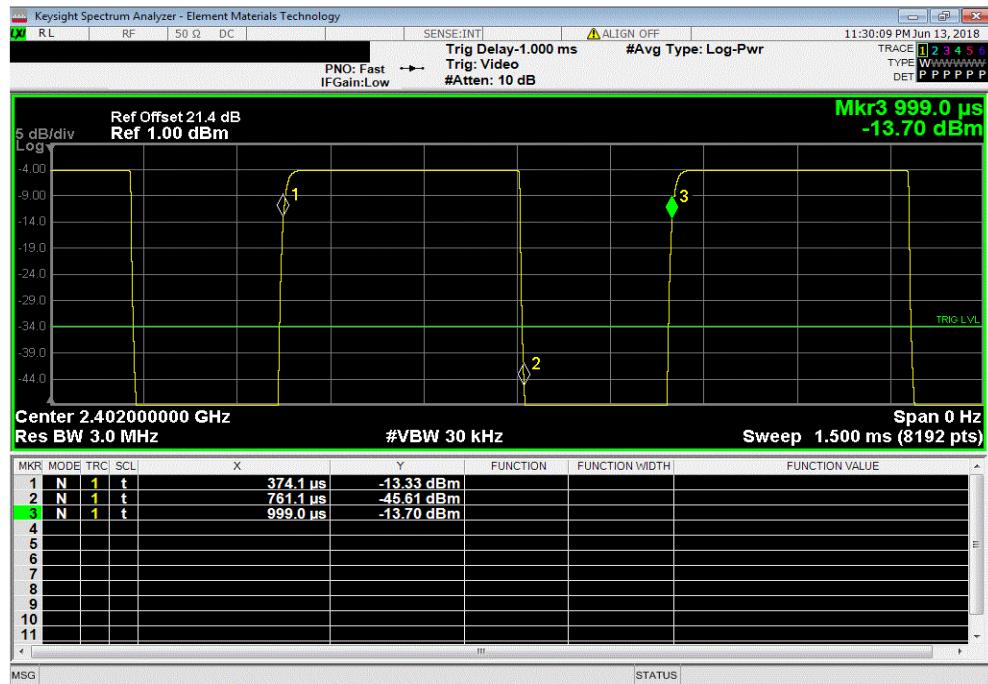
EUT:	BTE 13		Work Order:	STAK0123	
Serial Number:	180913778		Date:	13-Jun-18	
Customer:	Starkey Laboratories, Inc.		Temperature:	22.1 °C	
Attendees:	Charlie Esch		Humidity:	53.2% RH	
Project:	None		Barometric Pres.:	1020 mbar	
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2018			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature	<i>Dustin Sparks</i>		
			Pulse Width	Period	Number of Pulses
BLE/GFSK Low Channel, 2402 MHz			387 us	624.9 us	1
BLE/GFSK Low Channel, 2402 MHz			N/A	N/A	5
BLE/GFSK Mid Channel, 2442 MHz			387.8 us	624.9 us	1
BLE/GFSK Mid Channel, 2442 MHz			N/A	N/A	5
BLE/GFSK High Channel, 2480 MHz			387.5 us	625.1 us	1
BLE/GFSK High Channel, 2480 MHz			N/A	N/A	5
					Value (%)
					Limit (%)
					Results

# DUTY CYCLE



TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	387 us	624.9 us	1	61.9	N/A	N/A



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

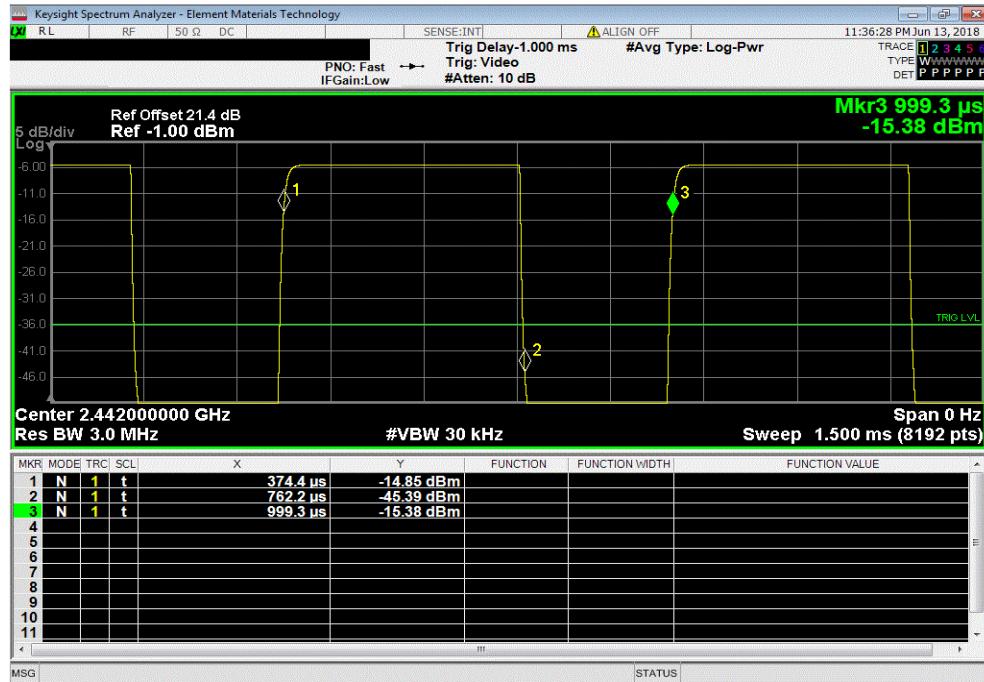


# DUTY CYCLE

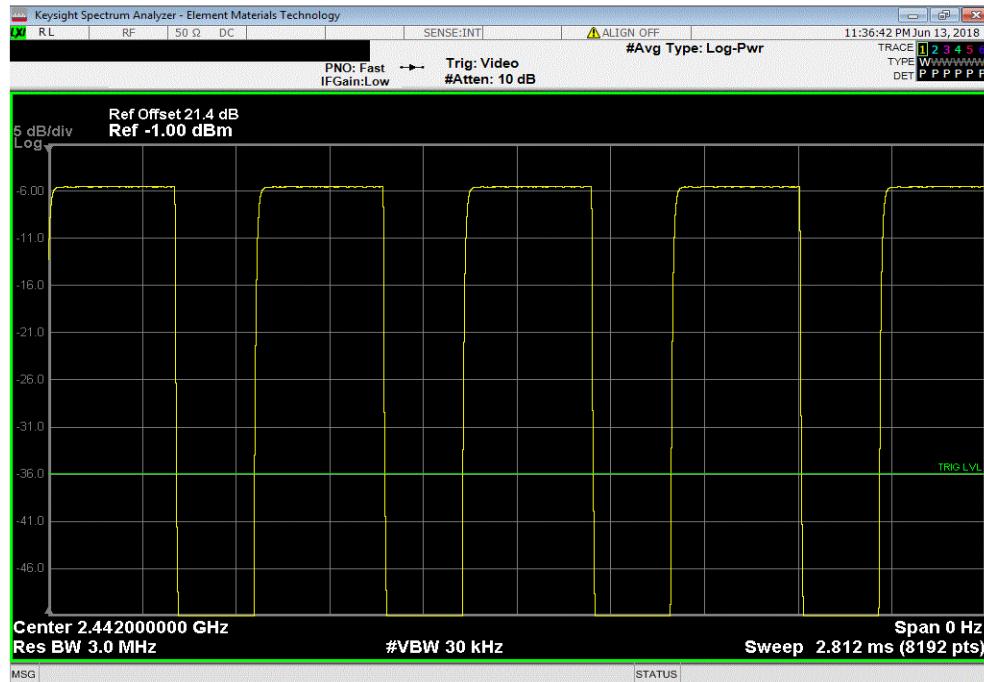


TbTx 2017.12.14 XM1 2017.12.13

BLE/GFSK Mid Channel, 2442 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
387.8 us	624.9 us	1	62.1	N/A	N/A



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

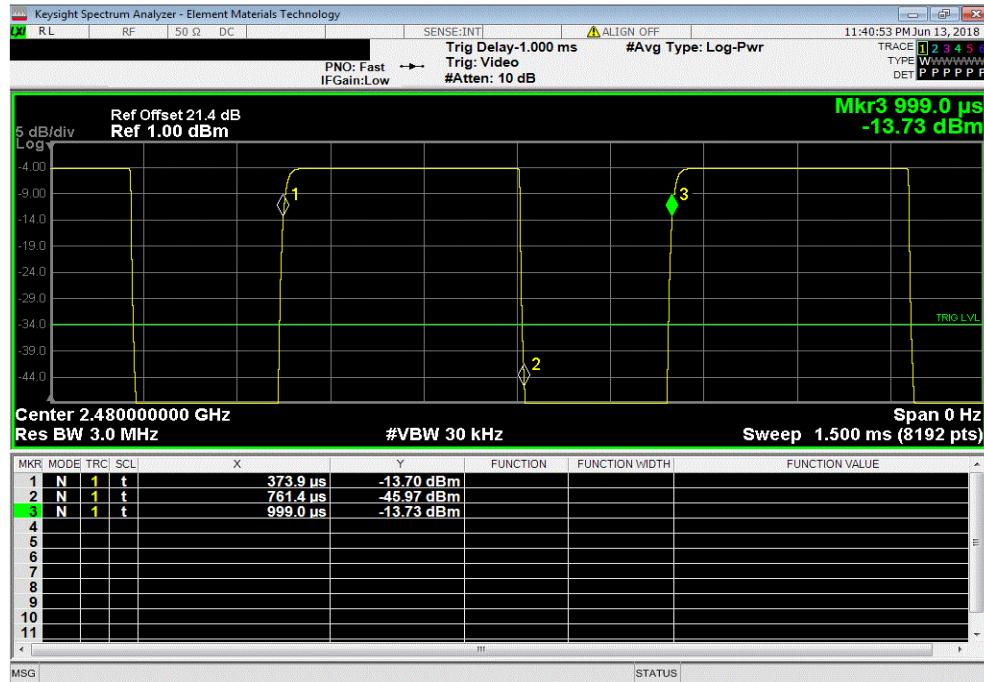


# DUTY CYCLE

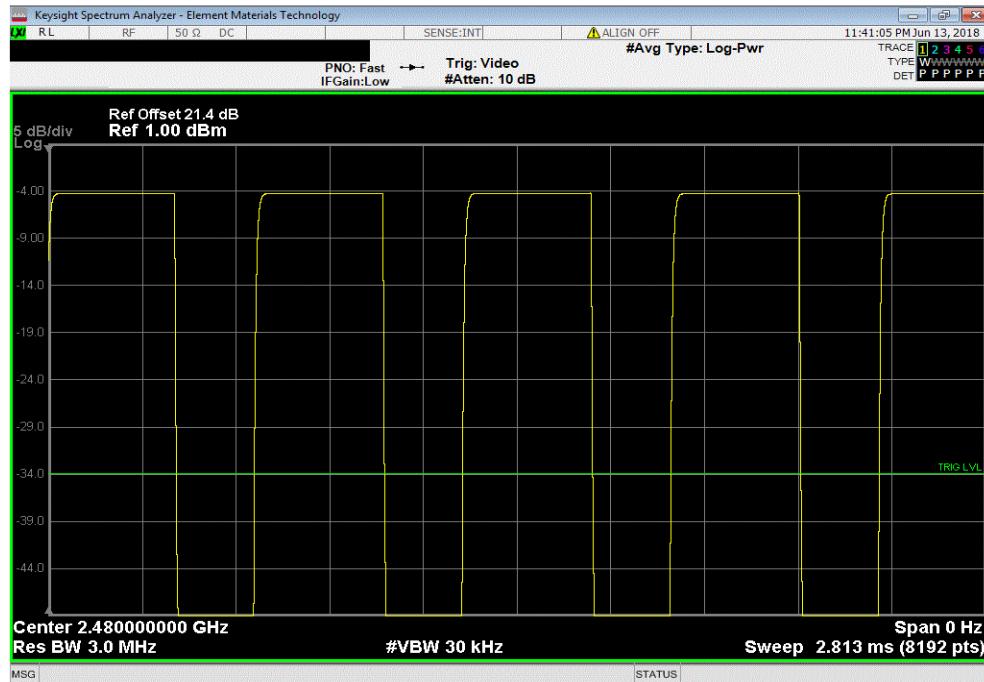


TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK High Channel, 2480 MHz					
Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
387.5 us	625.1 us	1	62	N/A	N/A



BLE/GFSK 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



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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



TbitTx 2017.12.14

XMI 2017.12.13

EUT:	BTE 13		Work Order:	STAK0123	
Serial Number:	180913778		Date:	13-Jun-18	
Customer:	Starkey Laboratories, Inc.		Temperature:	22 °C	
Attendees:	Charlie Esch		Humidity:	53.9% RH	
Project:	None		Barometric Pres.:	1020 mbar	
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2018			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature			
			Value	Limit (±)	Result
			736.374 kHz	500 kHz	Pass
			737.046 kHz	500 kHz	Pass
			747.224 kHz	500 kHz	Pass

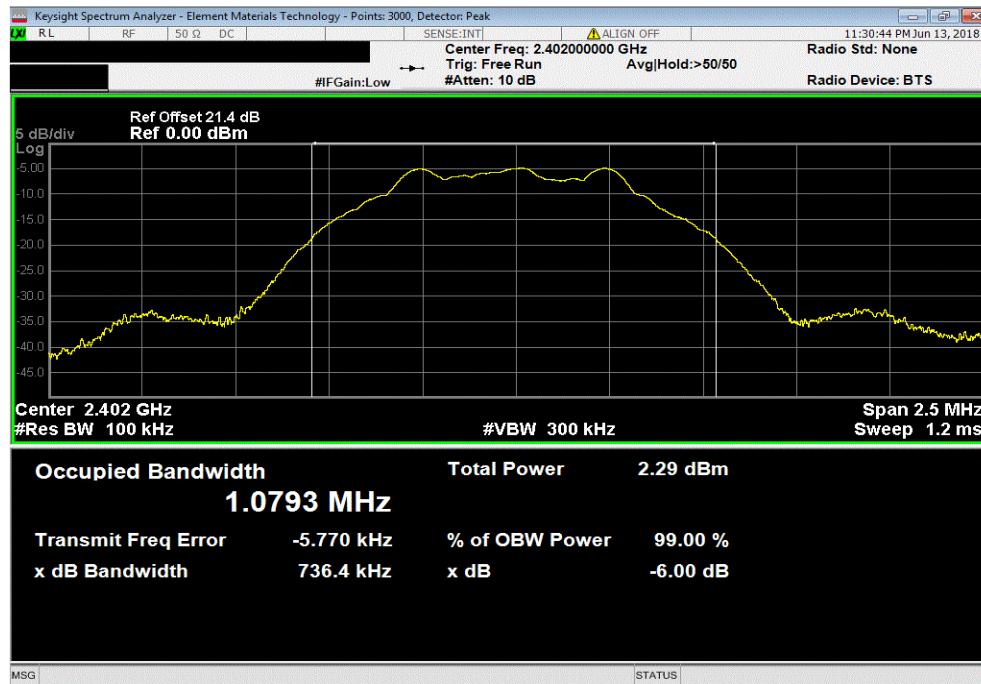
BLE/GFSK Low Channel, 2402 MHz  
 BLE/GFSK Mid Channel, 2442 MHz  
 BLE/GFSK High Channel, 2480 MHz

# OCCUPIED BANDWIDTH

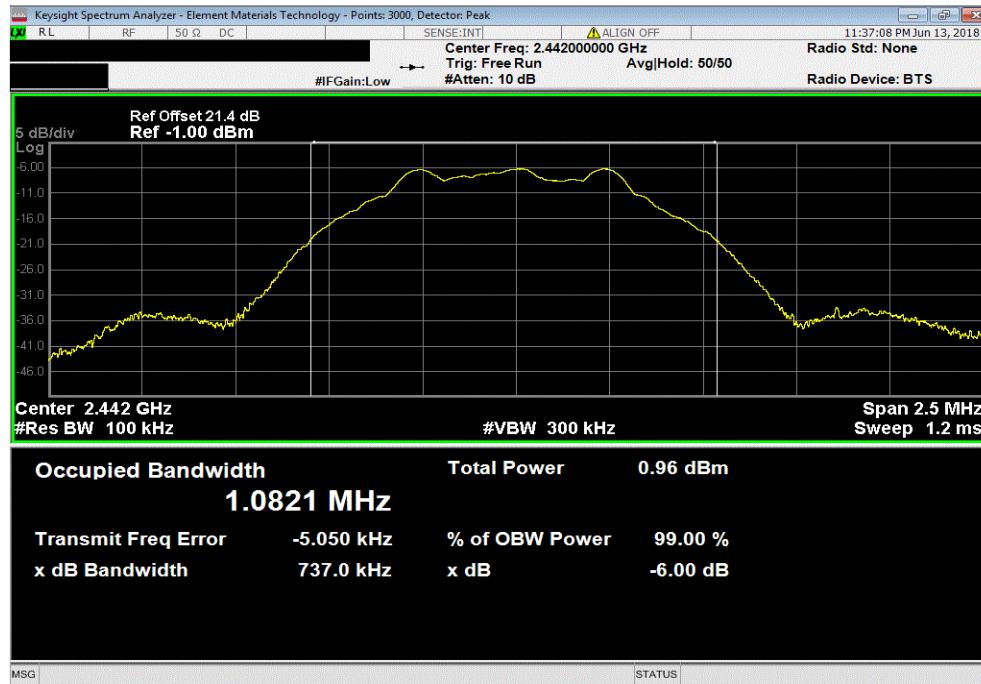


TbTx 2017.12.14 XM1 2017.12.13

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



BLE/GFSK Mid Channel, 2442 MHz			Value	Limit (≥)	Result
			737.046 kHz	500 kHz	Pass



# OCCUPIED BANDWIDTH



TbTx 2017.12.14 XMII 2017.12.13



# OUTPUT POWER



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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



TbitTx 2017.12.14

XMI 2017.12.13

EUT:	BTE 13		Work Order:	STAK0123	
Serial Number:	180913778		Date:	13-Jun-18	
Customer:	Starkey Laboratories, Inc.		Temperature:	22 °C	
Attendees:	Charlie Esch		Humidity:	53.5% RH	
Project:	None		Barometric Pres.:	1020 mbar	
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2018			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature			
			Value	Limit (±)	Result
			389.28 uW	1 W	Pass
			287.62 uW	1 W	Pass
			388.44 uW	1 W	Pass

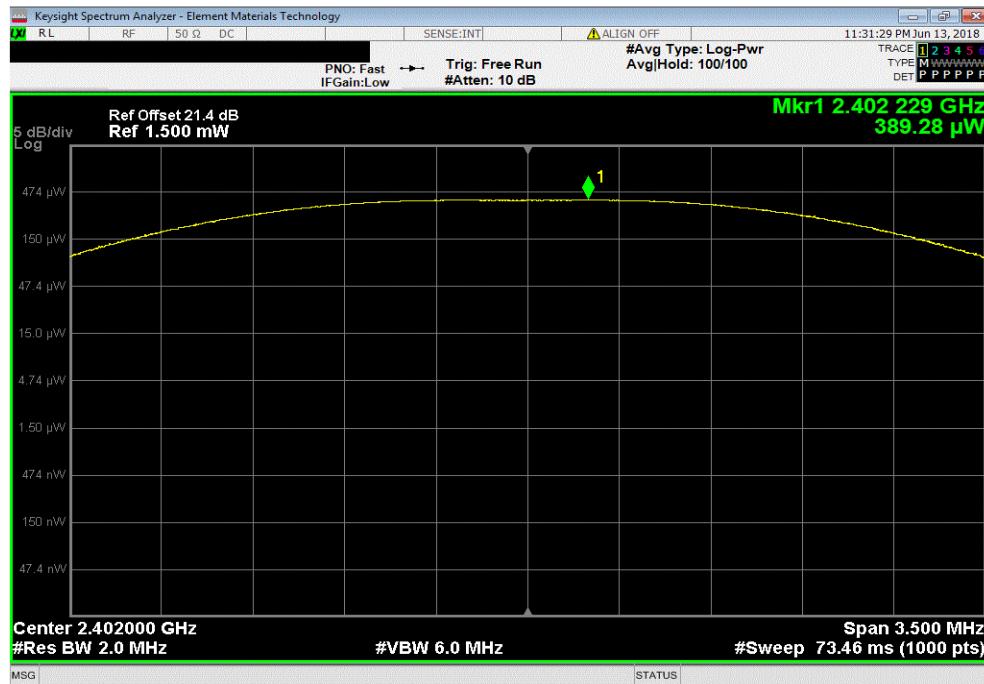
BLE/GFSK Low Channel, 2402 MHz  
BLE/GFSK Mid Channel, 2442 MHz  
BLE/GFSK High Channel, 2480 MHz

# OUTPUT POWER

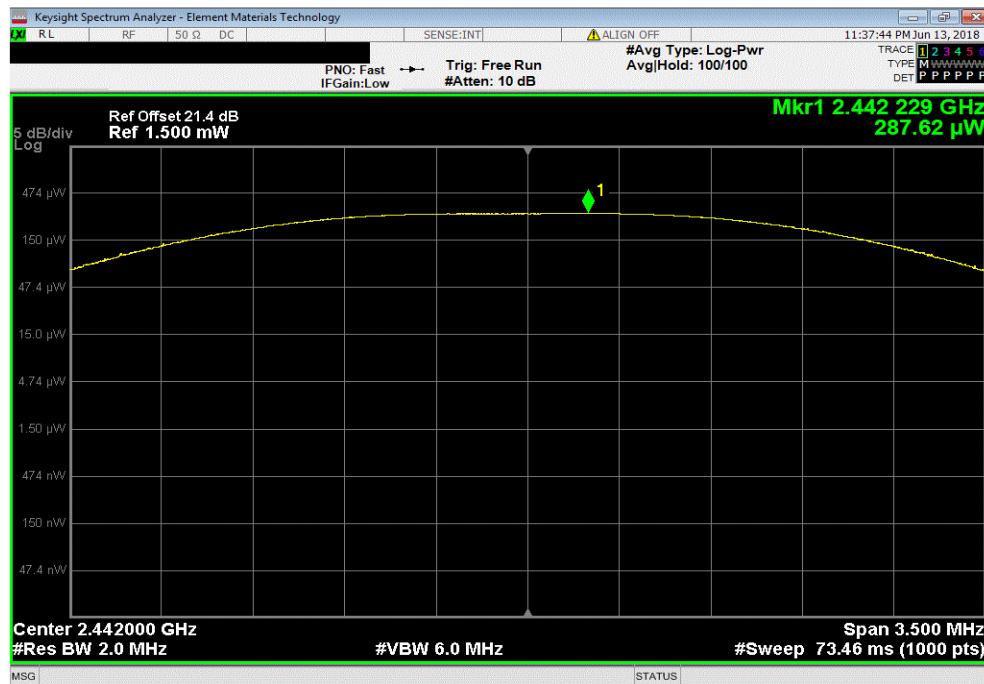


TbTx 2017.12.14 XM1 2017.12.13

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



BLE/GFSK Mid Channel, 2442 MHz			Value	Limit (<)	Result
			287.62 uW	1 W	Pass

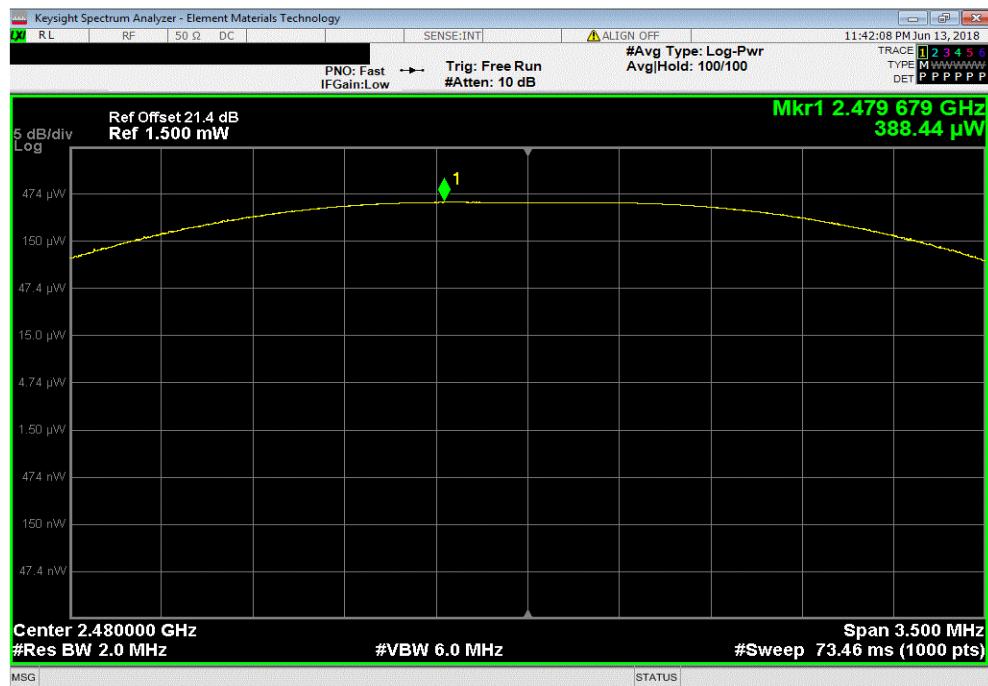


# OUTPUT POWER



TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK High Channel, 2480 MHz			Value	Limit (<)	Result
			388.44 uW	1 W	Pass



# POWER SPECTRAL DENSITY



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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



TbitTx 2017.12.14

XMI 2017.12.13

EUT:	BTE 13		Work Order:	STAK0123	
Serial Number:	180913778		Date:	13-Jun-18	
Customer:	Starkey Laboratories, Inc.		Temperature:	22 °C	
Attendees:	Charlie Esch		Humidity:	53.4% RH	
Project:	None		Barometric Pres.:	1020 mbar	
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2018			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature			
			Value	Limit	Results
			dBm/3kHz	< dBm/3kHz	
			-19.522	8	Pass
			-20.842	8	Pass
			-19.544	8	Pass

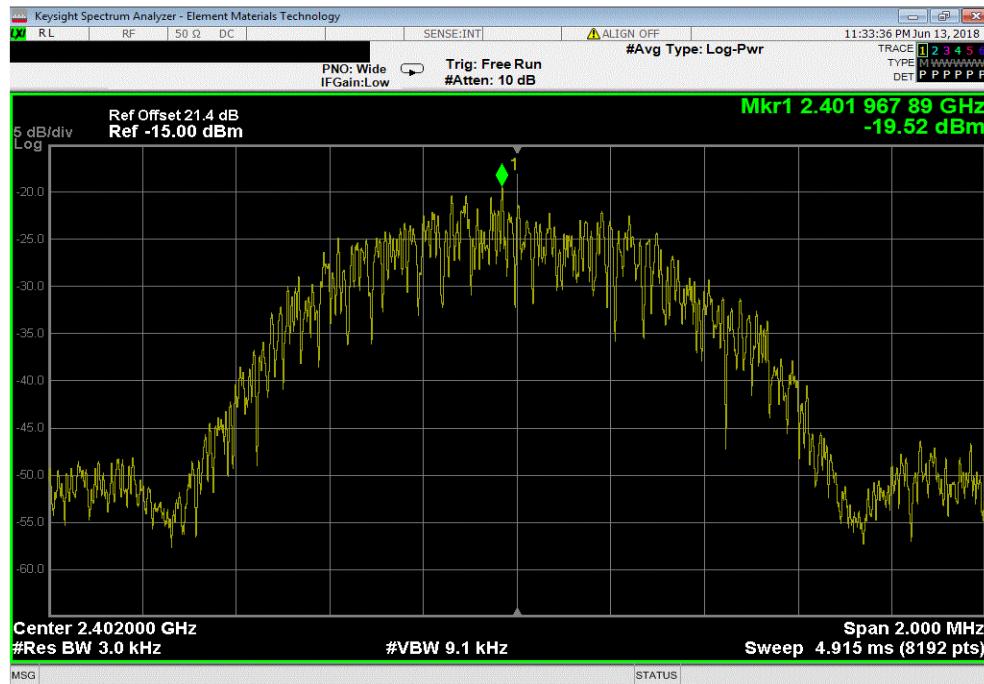
BLE/GFSK Low Channel, 2402 MHz  
BLE/GFSK Mid Channel, 2442 MHz  
BLE/GFSK High Channel, 2480 MHz

# POWER SPECTRAL DENSITY

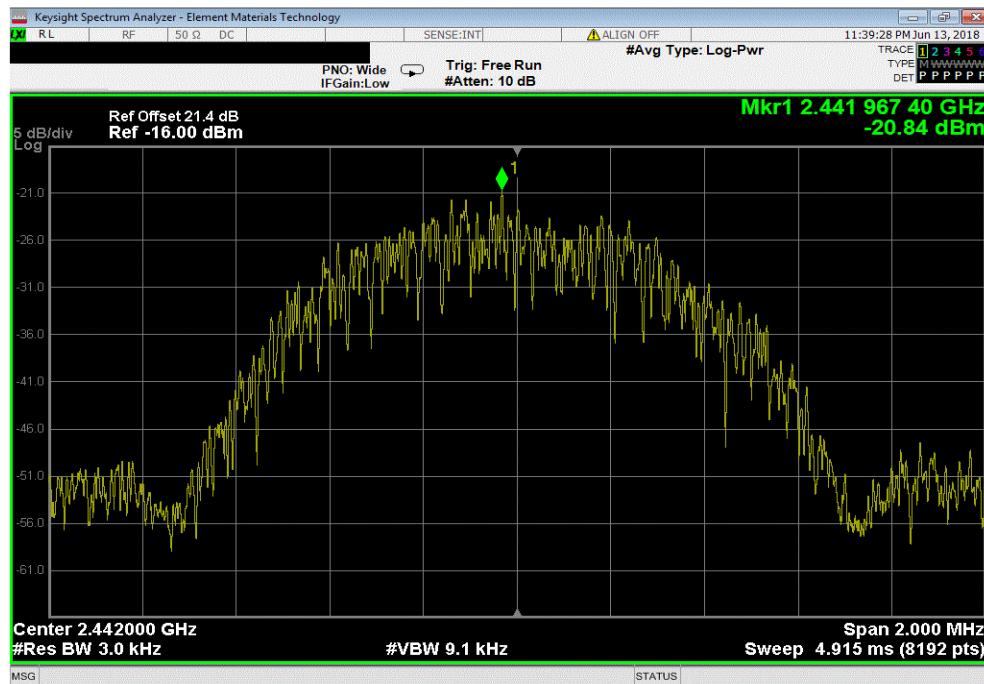


TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK Low Channel, 2402 MHz				Value	Limit	Results
				dBm/3kHz	< dBm/3kHz	
				-19.522	8	Pass



BLE/GFSK Mid Channel, 2442 MHz				Value	Limit	Results
				dBm/3kHz	< dBm/3kHz	
				-20.842	8	Pass

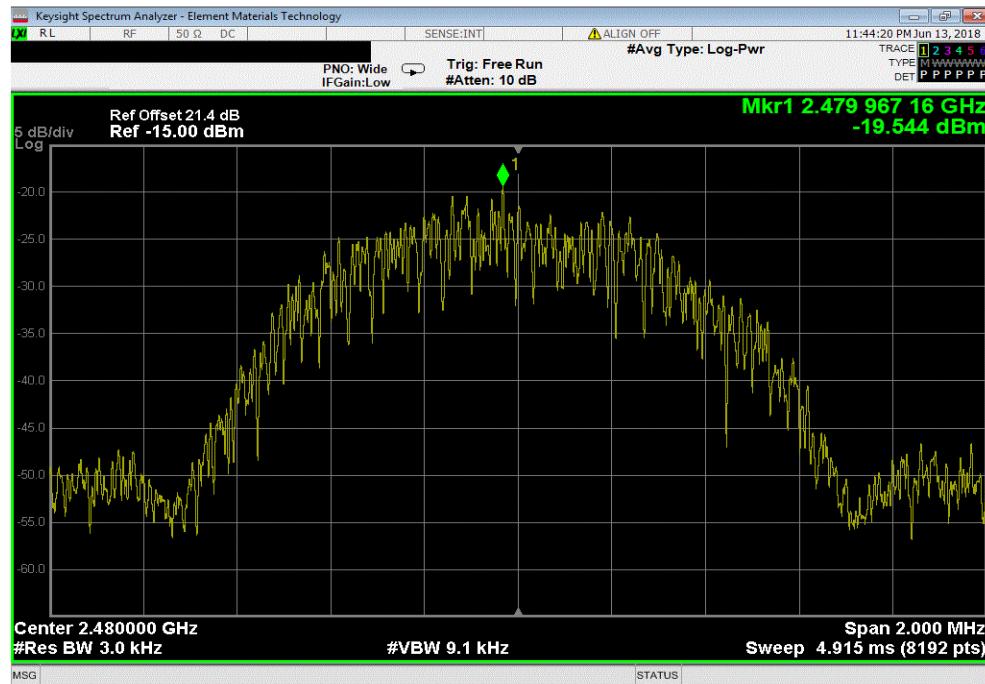


# POWER SPECTRAL DENSITY



TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK High Channel, 2480 MHz				Value	Limit	Results
				dBm/3kHz	< dBm/3kHz	
				-19.544	8	Pass



# BAND EDGE COMPLIANCE



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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



TbTx 2017.12.14

XMi 2017.12.13

EUT:	BTE 13		Work Order:	STAK0123	
Serial Number:	180913778		Date:	13-Jun-18	
Customer:	Starkey Laboratories, Inc.		Temperature:	21.9 °C	
Attendees:	Charlie Esch		Humidity:	54.2% RH	
Project:	None		Barometric Pres.:	1020 mbar	
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08
TEST SPECIFICATIONS			Test Method		
FCC 15.247:2018			ANSI C63.10:2013		
COMMENTS					
None					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	3	Signature	<i>Dustin Sparks</i>	Value (dBc)	Limit ≤ (dBc)
			-34.52	-20	Pass
			-43.72	-20	Pass
BLE/GFSK Low Channel, 2402 MHz					
BLE/GFSK High Channel, 2480 MHz					

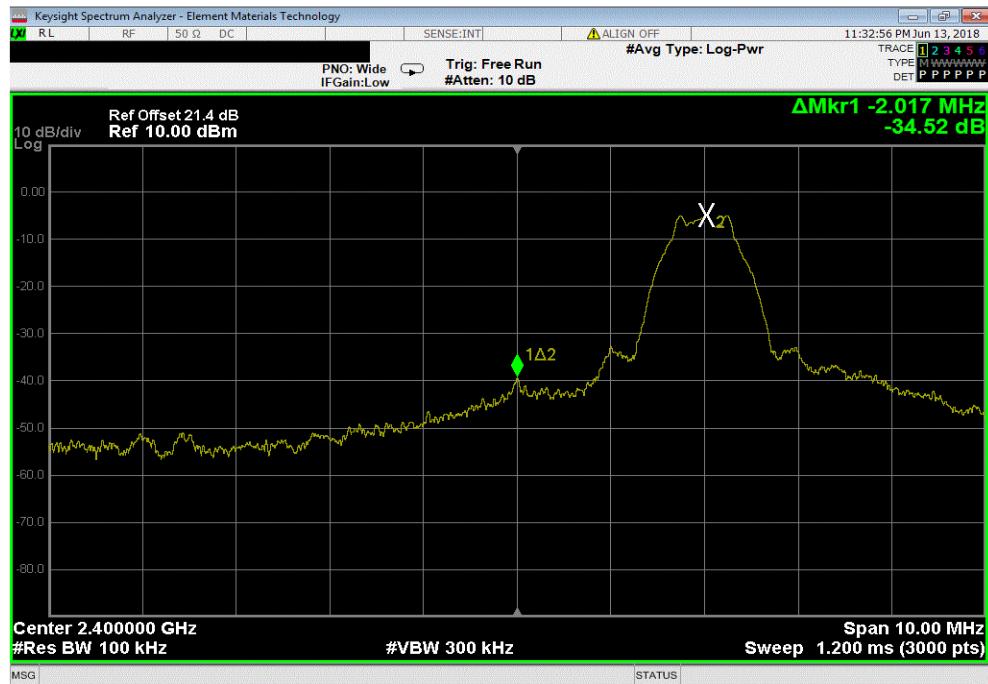
## **BAND EDGE COMPLIANCE**



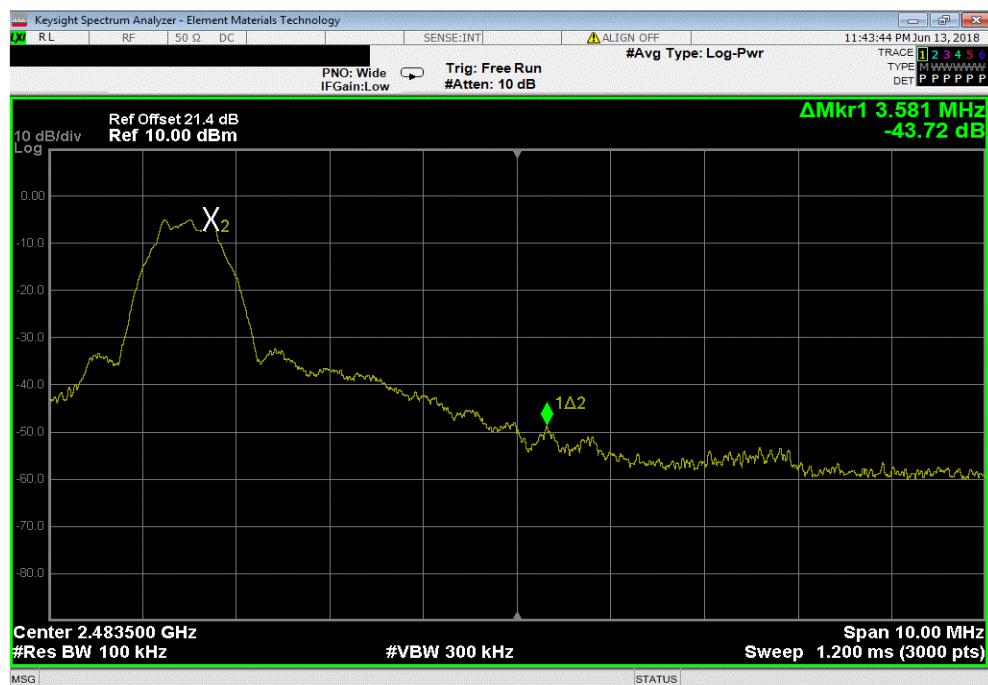
TbtTx 2017.12.14

Xmit 2017.12.13

BLE/GFSK Low Channel, 2402 MHz						
		Value (dBc)	Limit ≤ (dBc)	Result		
		-34.52	-20	Pass		



BLE/GFSK High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-43.72	-20	Pass



# SPURIOUS CONDUCTED EMISSIONS



XMit 2017.12.13

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	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-17	19-Dec-18

## 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



Tbitx 2017.12.14

XMI 2017.12.13

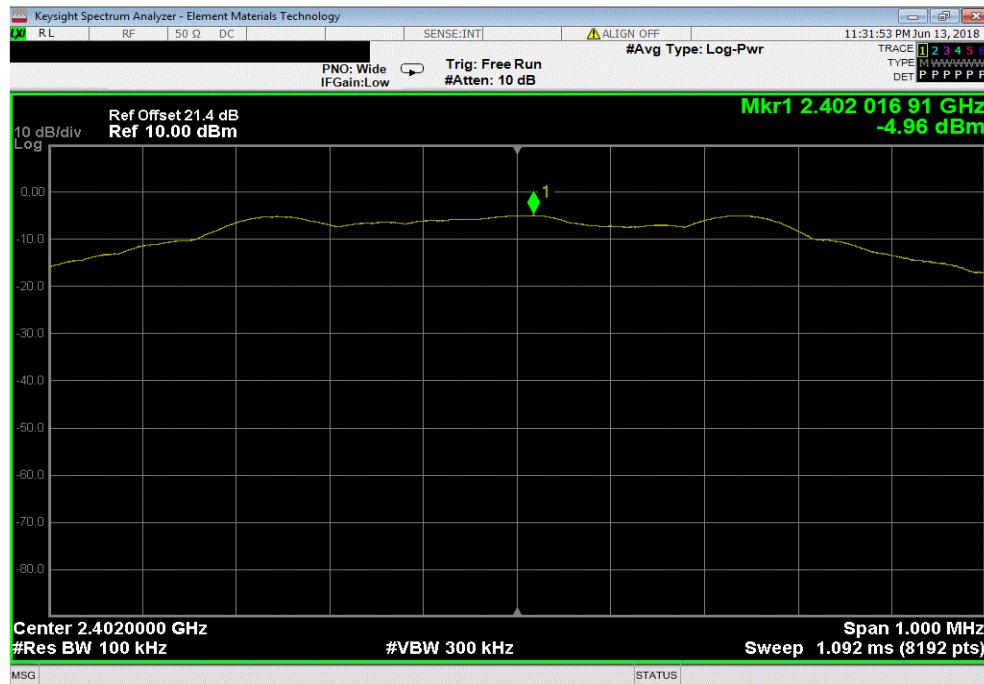
EUT:	BTE 13		Work Order:	STAK0123		
Serial Number:	180913778		Date:	13-Jun-18		
Customer:	Starkey Laboratories, Inc.		Temperature:	22 °C		
Attendees:	Charlie Esch		Humidity:	53.3% RH		
Project:	None		Barometric Pres.:	1020 mbar		
Tested by:	Dustin Sparks	Power:	Battery	Job Site:	MN08	
TEST SPECIFICATIONS		Test Method				
FCC 15.247:2018		ANSI C63.10:2013				
COMMENTS						
None						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	3	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	-46.09	-20	Pass
BLE/GFSK Low Channel, 2402 MHz			12.5 GHz - 25 GHz	-46.09	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz			Fundamental	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz			30 MHz - 12.5 GHz	-46.8	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz			12.5 GHz - 25 GHz	-44.96	-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	-48.37	-20	Pass
BLE/GFSK High Channel, 2480 MHz			12.5 GHz - 25 GHz	-45.05	-20	Pass

# SPURIOUS CONDUCTED EMISSIONS

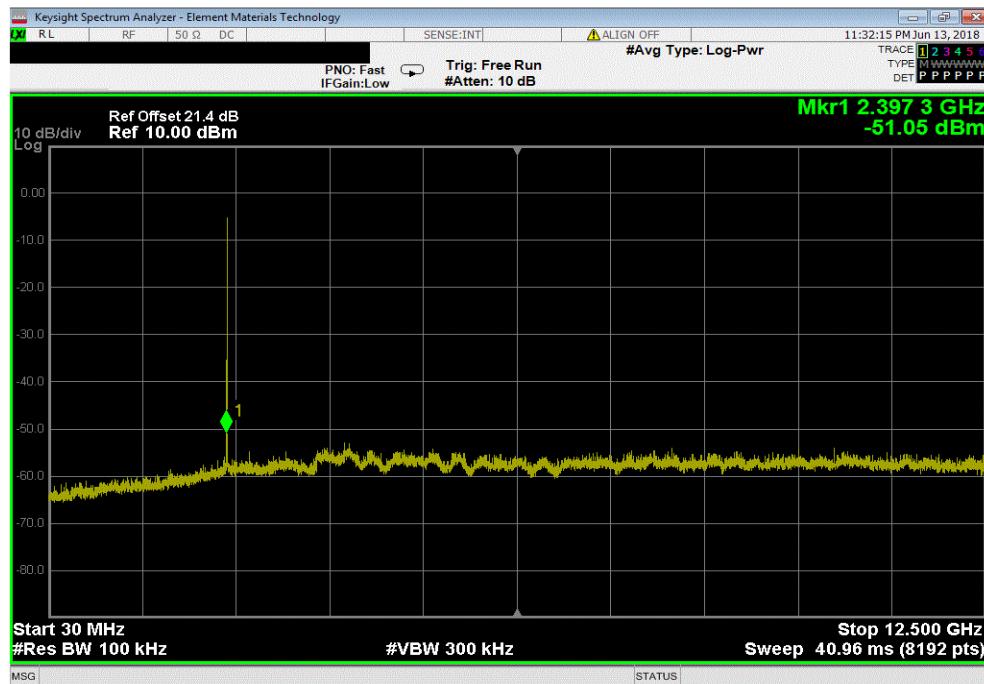


TbTx 2017-12-14 XM1 2017-12-13

Frequency Range		Max Value (dBc)	Limit $\leq$ (dBc)	Result
Fundamental		N/A	N/A	N/A



Frequency Range		Max Value (dBc)	Limit $\leq$ (dBc)	Result
30 MHz - 12.5 GHz		-46.09	-20	Pass

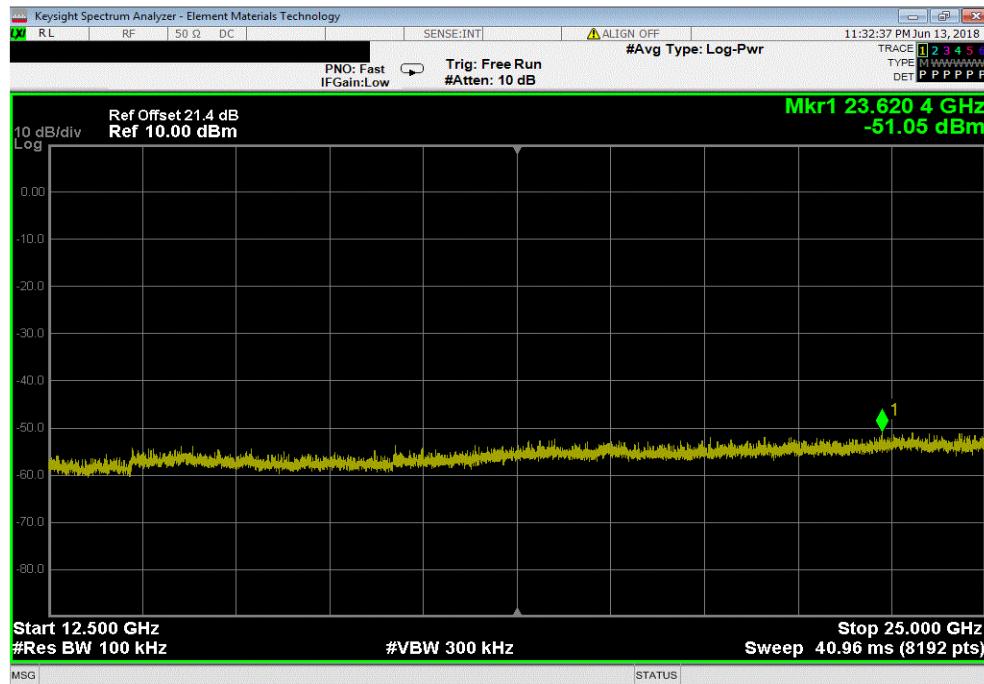


# SPURIOUS CONDUCTED EMISSIONS

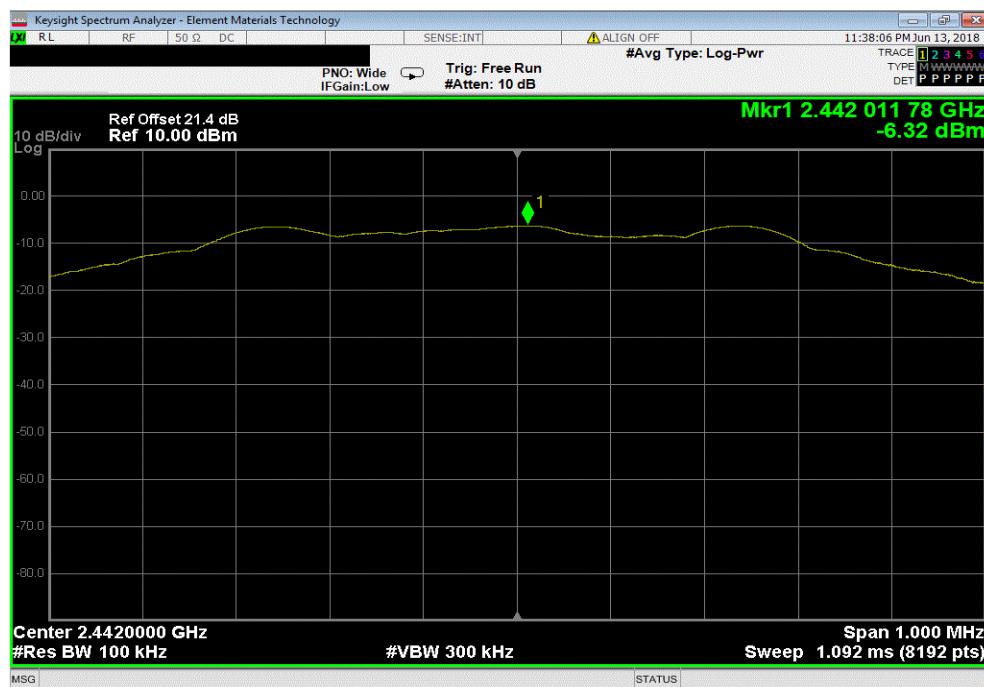


TbTx 2017.12.14 XM1 2017.12.13

Frequency Range		Max Value (dBc)	Limit $\leq$ (dBc)	Result
12.5 GHz - 25 GHz		-46.09	-20	Pass



Frequency Range		Max Value (dBc)	Limit $\leq$ (dBc)	Result
Fundamental		N/A	N/A	N/A

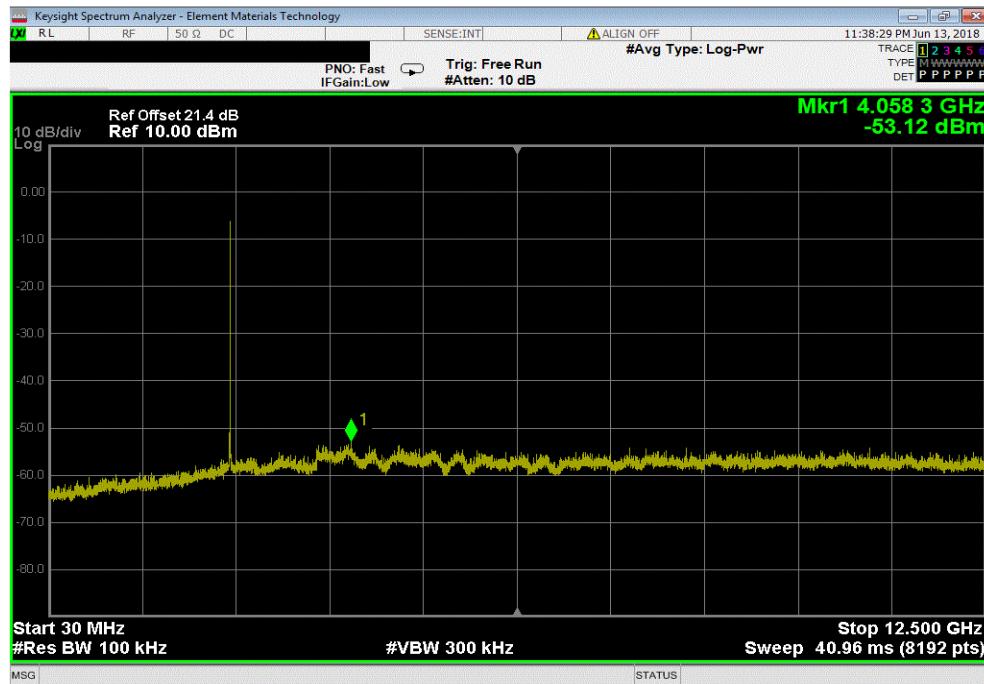


# SPURIOUS CONDUCTED EMISSIONS

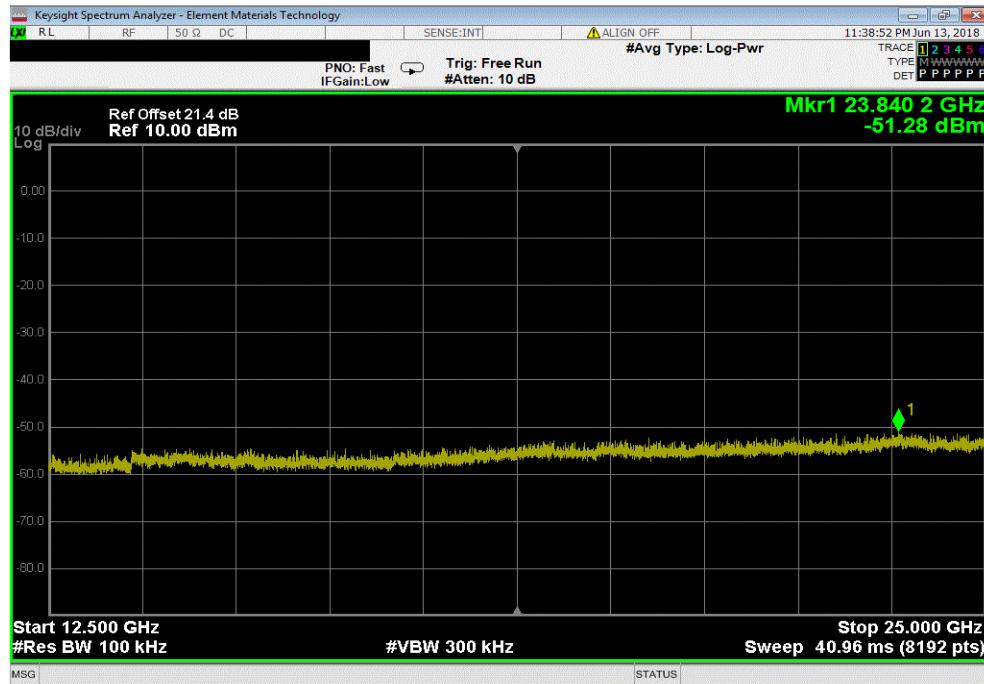


TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK Mid Channel, 2442 MHz			
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result
30 MHz - 12.5 GHz	-46.8	-20	Pass



BLE/GFSK Mid Channel, 2442 MHz			
Frequency Range	Max Value (dBc)	Limit $\leq$ (dBc)	Result
12.5 GHz - 25 GHz	-44.96	-20	Pass

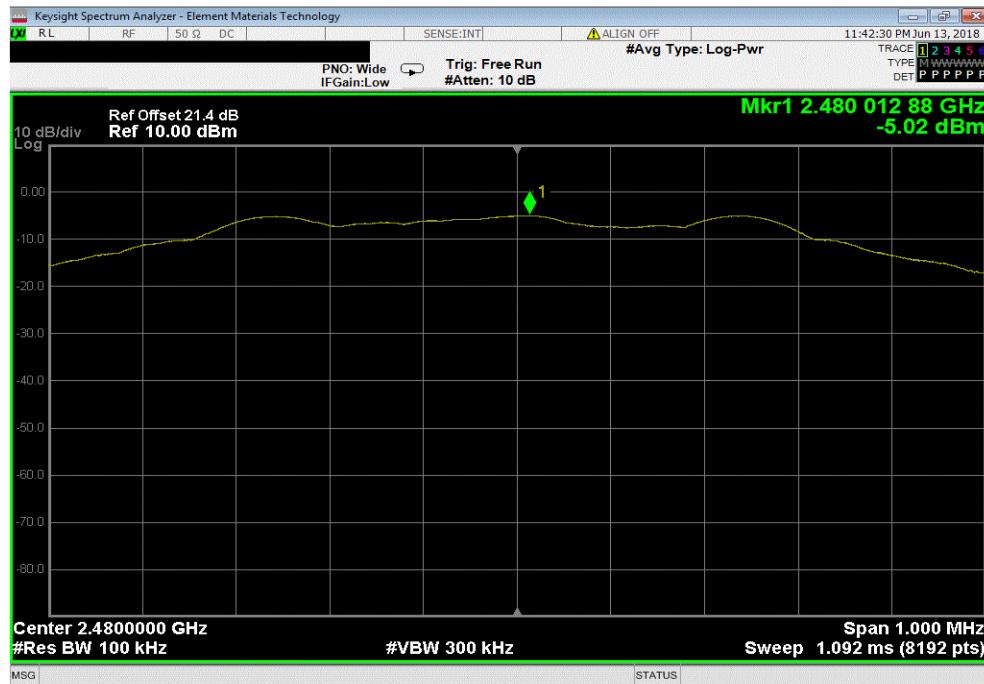


# SPURIOUS CONDUCTED EMISSIONS

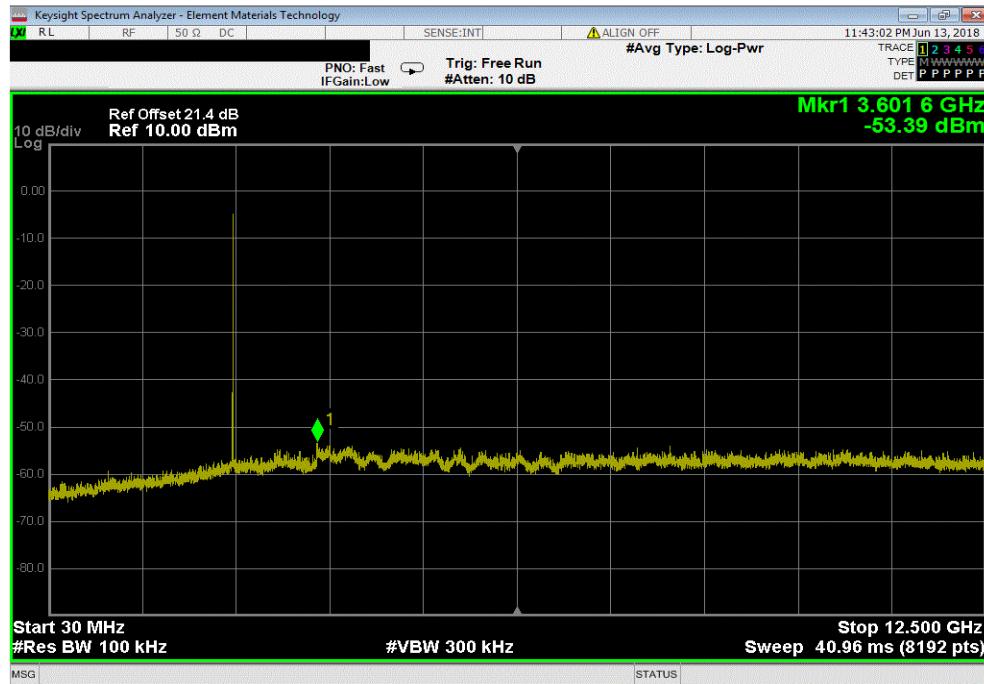


TbTx 2017.12.14 XM1 2017.12.13

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	-48.37	-20	Pass		

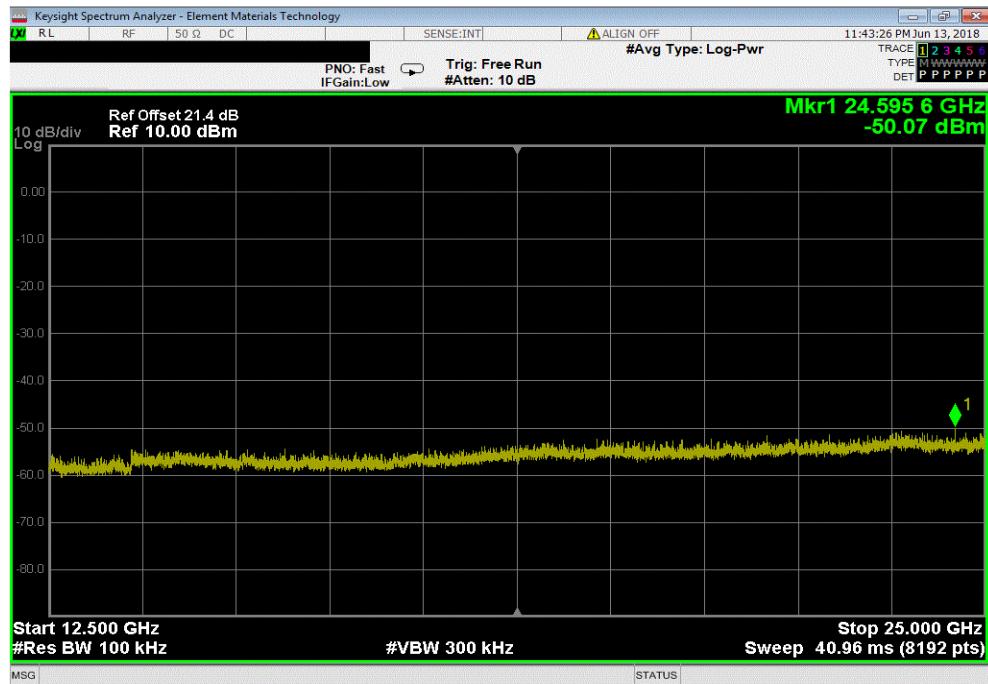


# SPURIOUS CONDUCTED EMISSIONS



TbTx 2017.12.14 XMII 2017.12.13

BLE/GFSK High Channel, 2480 MHz			
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	-45.05	-20	Pass



# SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2018.05.04

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

Transmitting at 2402 MHz Channel 0, 2440 MHz Channel 20, 2480 MHz Channel 39

## POWER SETTINGS INVESTIGATED

Battery

## CONFIGURATIONS INVESTIGATED

STAK0123 - 1

## FREQUENCY RANGE INVESTIGATED

Start Frequency | 30 MHz | Stop Frequency | 26000 MHz

## 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
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	12-Sep-2017	12 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2-Aug-2017	12 mo
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	13-Feb-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	0 mo
Filter - High Pass	Micro-Tronics	HPM50111	LFN	20-Sep-2017	12 mo
Attenuator	Fairview Microwave	SA18E-20	TWZ	20-Sep-2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	13-Feb-2018	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cab	MNI	21-Nov-2017	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJA	23-Jun-2016	24 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	9-Nov-2017	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	9-Nov-2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	13-Feb-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	13-Jul-2018	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AYD	25-Jan-2018	24 mo

## MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

## TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

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 and included in this test report.

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.

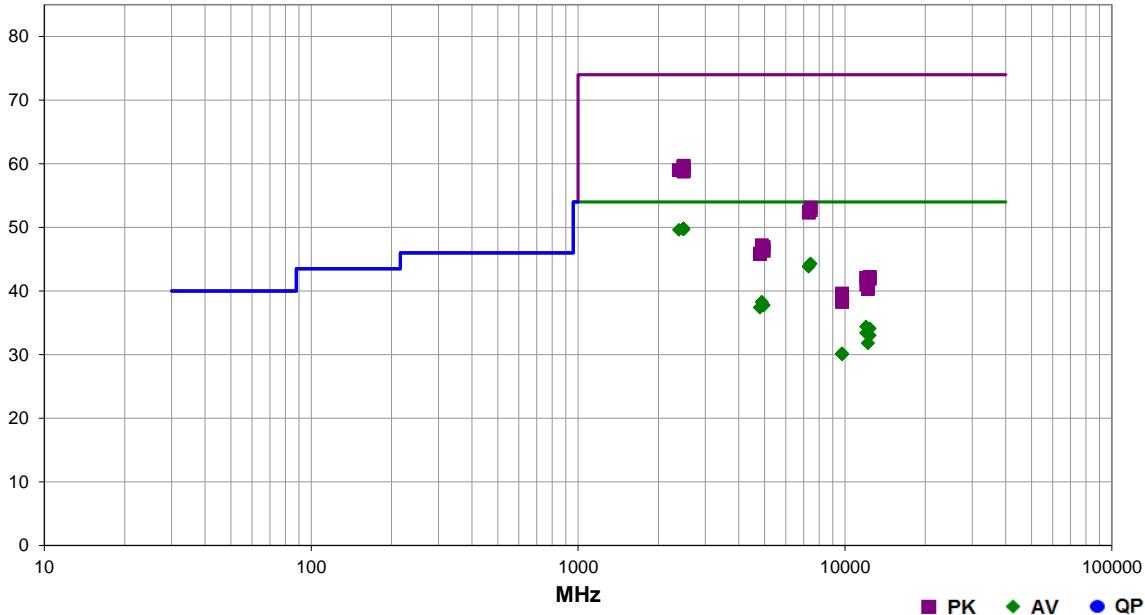
# SPURIOUS RADIATED EMISSIONS



Work Order:	STAK0123	Date:	11-Jun-2018	EmiR5 2018.05.07	PSA-ESCI 2018.05.04
Project:	None	Temperature:	21.6 °C		
Job Site:	MN05	Humidity:	59.9% RH		
Serial Number:	180913776	Barometric Pres.:	1013 mbar	Tested by:	Chris Patterson, Dustin Sparks
EUT:	BTE 13				
Configuration:	1				
Customer:	Starkey Laboratories, Inc.				
Attendees:	Charlie Esch				
EUT Power:	Battery				
Operating Mode:	Transmitting at 2402 MHz Channel 0, 2440 MHz Channel 20, 2480 MHz Channel 39				
Deviations:	None				
Comments:	2.1 dB duty cycle correction factor (calculated from a 62% duty cycle using the formula $10 * \log [1/x]$ ) added to the average readings.				

Test Specifications	Test Method
FCC 15.247:2018	ANSI C63.10:2013

Run #	20	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2485.167	32.2	-4.5	1.0	347.0	2.1	20.0	Horz	AV	0.0	49.8	54.0	-4.2	EUT On Side, Ch. 39
2483.725	32.2	-4.5	1.0	120.1	2.1	20.0	Horz	AV	0.0	49.8	54.0	-4.2	EUT Horz, Ch. 39
2483.650	32.2	-4.5	1.0	78.0	2.1	20.0	Vert	AV	0.0	49.8	54.0	-4.2	EUT On Side, Ch. 39
2484.158	32.1	-4.5	1.5	308.9	2.1	20.0	Vert	AV	0.0	49.7	54.0	-4.3	EUT Vert, Ch. 39
2484.267	32.1	-4.5	1.0	247.9	2.1	20.0	Vert	AV	0.0	49.7	54.0	-4.3	EUT Horz, Ch. 39
2483.750	32.1	-4.5	1.6	224.1	2.1	20.0	Horz	AV	0.0	49.7	54.0	-4.3	EUT Vert, Ch. 39
2389.558	31.9	-4.4	1.0	106.1	2.1	20.0	Horz	AV	0.0	49.6	54.0	-4.4	EUT Vert, Ch. 0
7439.075	31.3	10.9	1.0	322.9	2.1	0.0	Vert	AV	0.0	44.3	54.0	-9.7	EUT Horz, Ch. 39
7439.167	31.3	10.9	1.0	199.1	2.1	0.0	Horz	AV	0.0	44.3	54.0	-9.7	EUT Vert, Ch. 39
7317.583	31.3	10.5	1.6	162.0	2.1	0.0	Vert	AV	0.0	43.9	54.0	-10.1	EUT Horz, Ch. 20
7318.275	31.2	10.5	2.9	350.0	2.1	0.0	Horz	AV	0.0	43.8	54.0	-10.2	EUT Vert, Ch. 20
2486.883	44.2	-4.5	1.0	78.0	0.0	20.0	Vert	PK	0.0	59.7	74.0	-14.3	EUT On Side, Ch. 39
2483.608	44.1	-4.5	1.0	120.1	0.0	20.0	Horz	PK	0.0	59.6	74.0	-14.4	EUT Horz, Ch. 39
2485.133	44.0	-4.5	1.6	224.1	0.0	20.0	Horz	PK	0.0	59.5	74.0	-14.5	EUT On Side, Ch. 39
2485.167	43.5	-4.5	1.0	347.0	0.0	20.0	Horz	PK	0.0	59.0	74.0	-15.0	EUT Vert, Ch. 39
2385.483	43.3	-4.3	1.0	106.1	0.0	20.0	Horz	PK	0.0	59.0	74.0	-15.0	EUT Vert, Ch. 0
2485.908	43.3	-4.5	1.5	308.9	0.0	20.0	Vert	PK	0.0	58.8	74.0	-15.2	EUT Vert, Ch. 39
2483.692	43.3	-4.5	1.0	247.9	0.0	20.0	Vert	PK	0.0	58.8	74.0	-15.2	EUT Horz, Ch. 39
4881.892	30.8	5.4	1.0	212.0	2.1	0.0	Horz	AV	0.0	38.3	54.0	-15.7	EUT Vert, Ch. 20
4879.542	30.8	5.3	2.5	310.0	2.1	0.0	Vert	AV	0.0	38.2	54.0	-15.8	EUT Horz, Ch. 20