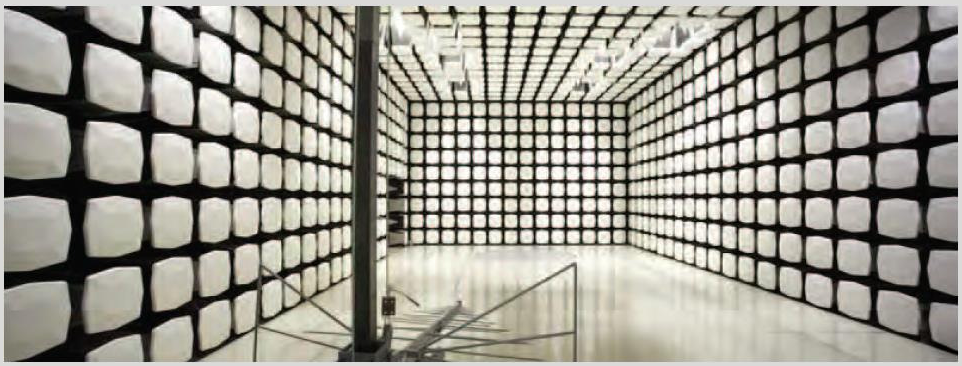
Starkey Laboratories, Inc.

TruLink Remote Model 600

FCC 15.247:2017

Bluetooth Low Energy Radio

Report # STAK0086.1



NVLAP Lab Code: 200881-0

CERTIFICATE OF TEST

Last Date of Test: March 21, 2017
Starkey Laboratories, Inc.
Model: TruLink Remote Model 600

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2017	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:

Dean Ghizzone, General 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

2017.1.25

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 – 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.

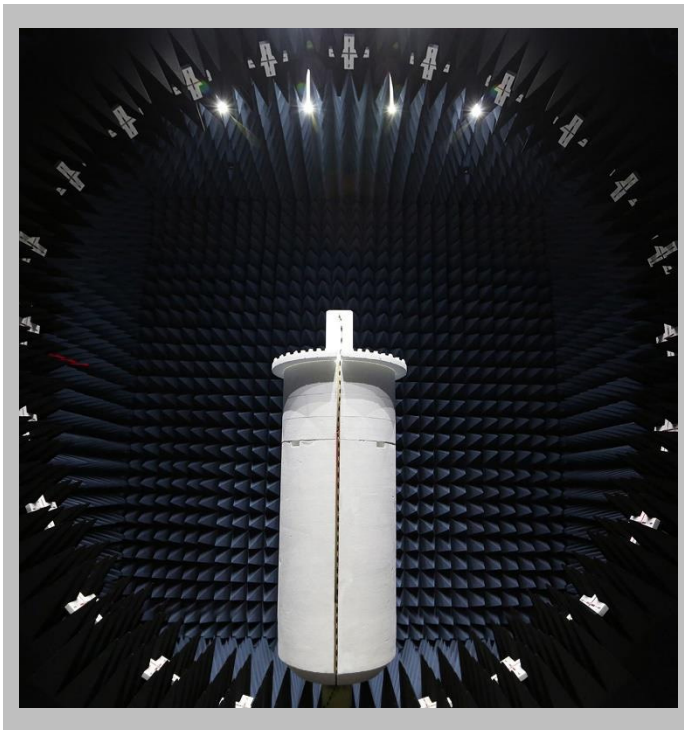
SCOPE

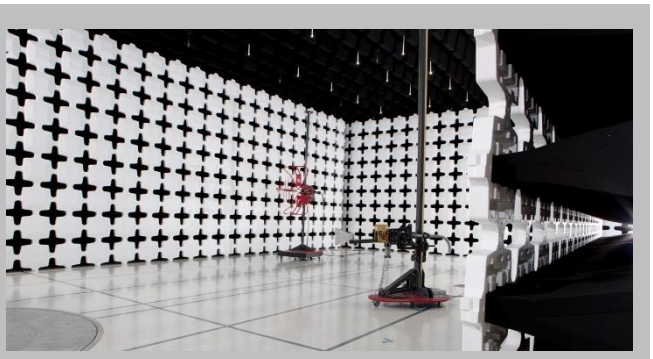
For details on the Scopes of our Accreditations, please visit:
http://portlandcustomer.element.com/ts/scope/scope.htm
http://gsi.nist.gov/global/docs/cabs/designations.html

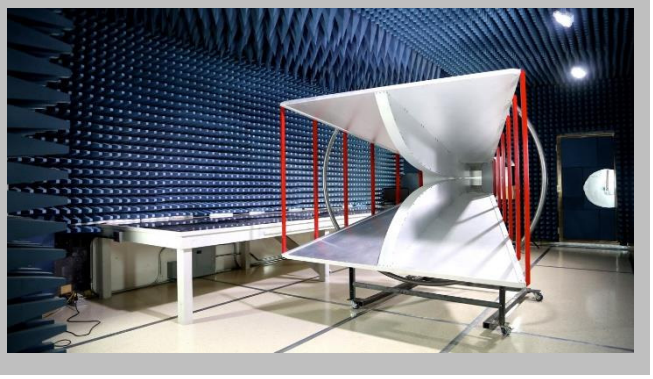
FACILITIES

2017.3.2

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 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP					
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
Innovation, Science and Economic Development Canada					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-*2*	2834G-1	2834F-1
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

WTD.2016.12.19

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 WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. 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.

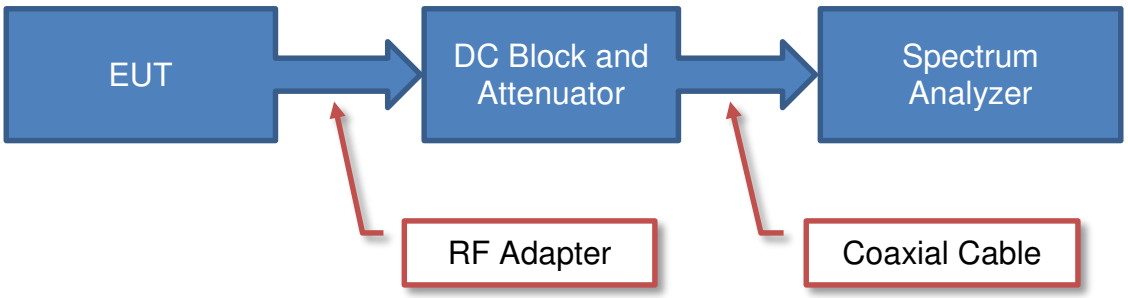
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

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

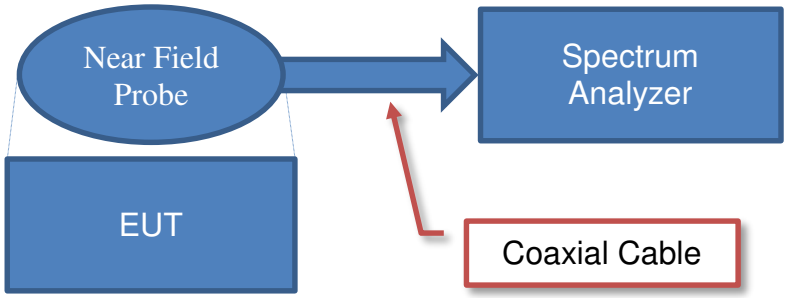
]

Test Setup Block Diagrams

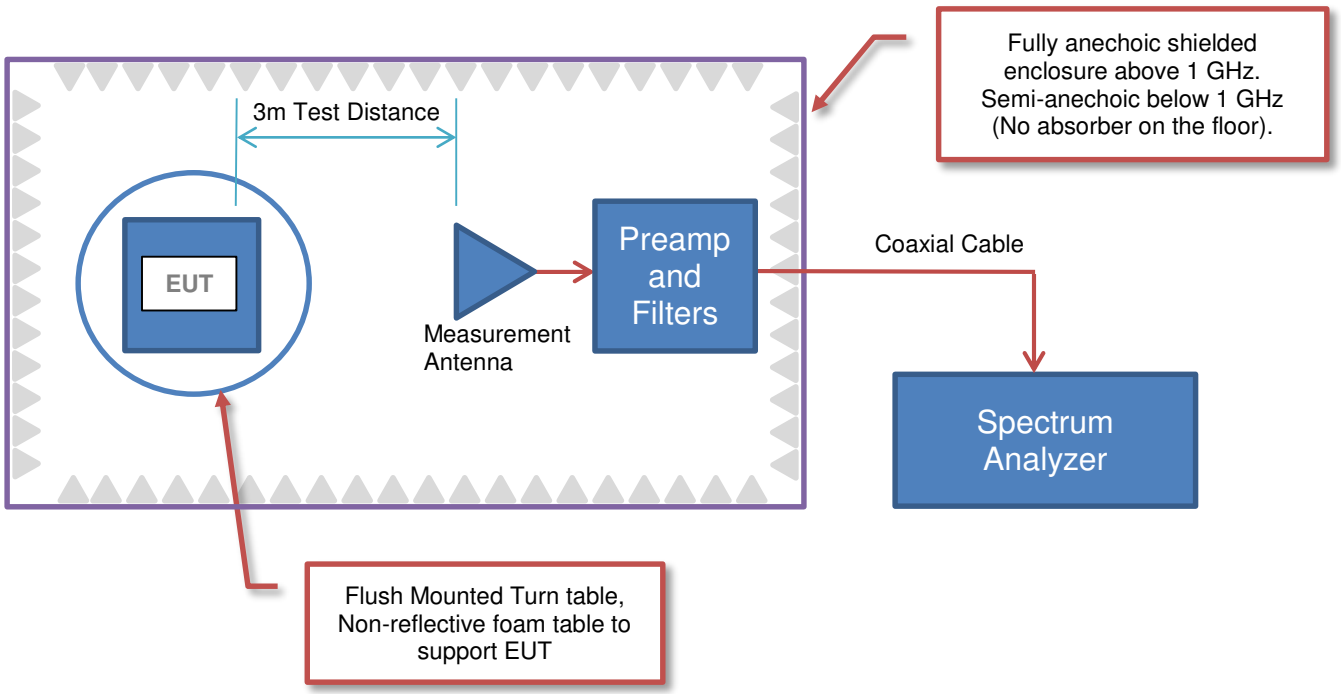
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Starkey Laboratories, Inc.
Address:	6600 Washington Ave. SO.
City, State, Zip:	Eden Prairie, MN 55344
Test Requested By:	Bill Mitchell
Model:	TruLink Remote Model 600
First Date of Test:	March 16, 2017
Last Date of Test:	March 21, 2017
Receipt Date of Samples:	March 13, 2017
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
The TruLink Remote operates in the 2.4 - 2.4835 GHz band and uses the Bluetooth® Low Energy protocol to communicate with the hearing aids. The remote is paired with the hearing aid using the Bluetooth Low Energy protocol. The remote can be paired with either a left or a right hearing aid or both a left and a right binaural pair of hearing aids.

Testing Objective:
To demonstrate compliance of the Bluetooth Low Energy radio to FCC 15.247 requirements.

CONFIGURATIONS

Configuration STAK0086- 2

Software/Firmware Running during test	
Description	**Version**
Firmware Direct_Test_Mode_PCA10040_S132	pca10040_s132.hex

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TruLink Remote Model 600	Starkey Laboratories, Inc.	60019-002	N170742842

Configuration STAK0086- 3

Software/Firmware Running during test	
Description	**Version**
Firmware Direct_Test_Mode_PCA10040_S132	pca10040_s132.hex

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TruLink Remote Model 600	Starkey Laboratories, Inc.	60019-002	N170742842

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Power Cable for Conducted Unit	No	0.9m	No	TruLink Remote Model 600	TQK

MODIFICATIONS

2017-1-25

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	3/16/2017	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.
2	3/16/2017	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.
3	3/16/2017	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.
4	3/16/2017	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.
5	3/16/2017	Spurious Conducted 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.
6	3/17/2017	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.
7	3/21/2017	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

XMit 2017.01.26

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
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	10/17/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. For transmitters which are not operated at a continuous transmission of 100% duty cycle, a duty cycle correction must be measured and calculated to add to the data taken in other tests in this report.

The observed duty cycle is expressed in terms of a percentage and is calculated as:

Duty Cycle = (Tx on / (Tx on + Tx off))

For adding into the calculations required in the specific tests the observed duty cycle is converted to a value in dB as follows:

Duty Cycle Correction = 10 Log (1 / Duty Cycle)

The observed duty cycle was measured for each data rate(s) listed on the datasheet.

DUTY CYCLE

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			**Work Order:**	STAK0086
Serial Number:	N170742842			**Date:**	03/17/17
Customer:	Starkey Laboratories, Inc.			**Temperature:**	21.8 °C
Attendees:	Charlie Esch			**Humidity:**	24.5% RH
Project:	None			**Barometric Pres.:**	1016 mbar
Tested by:	Trevor Buls, Kyle McMullan	**Power:**	3VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

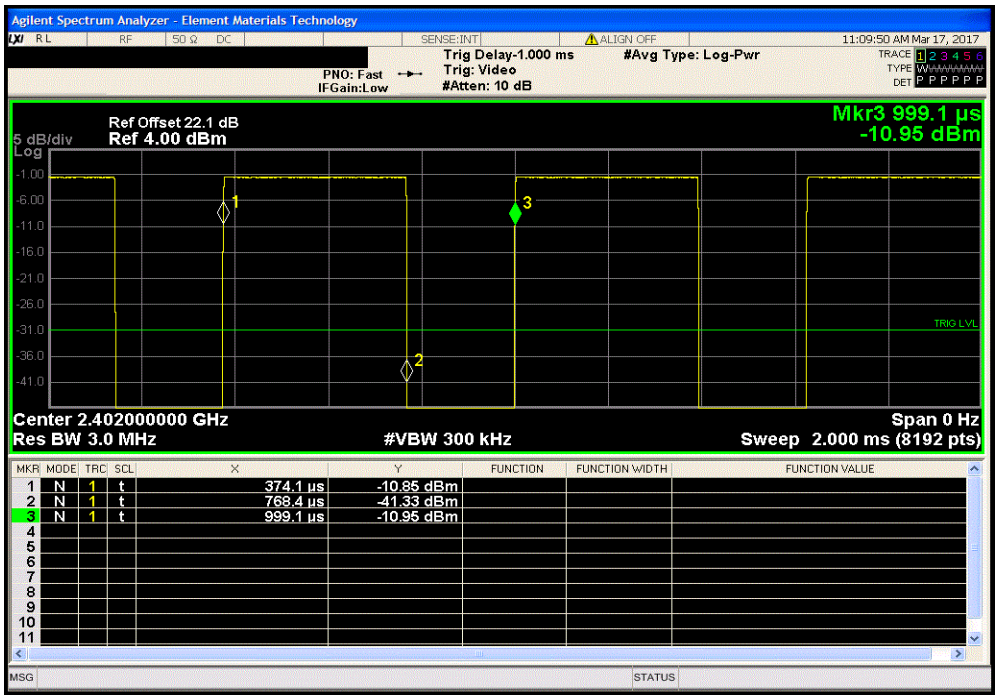
Configuration #	3	Signature	Trevor Buls

	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
Normal Voltage						
BLE/GFSK Low Channel, 2402 MHz	394.3 us	625 us	1	63.1	N/A	N/A
BLE/GFSK Low Channel, 2402 MHz	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2440 MHz	394.3 us	625.1 us	1	63.1	N/A	N/A
BLE/GFSK Mid Channel, 2440 MHz	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	394.1 us	625.1 us	1	63	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	N/A	N/A	5	N/A	N/A	N/A

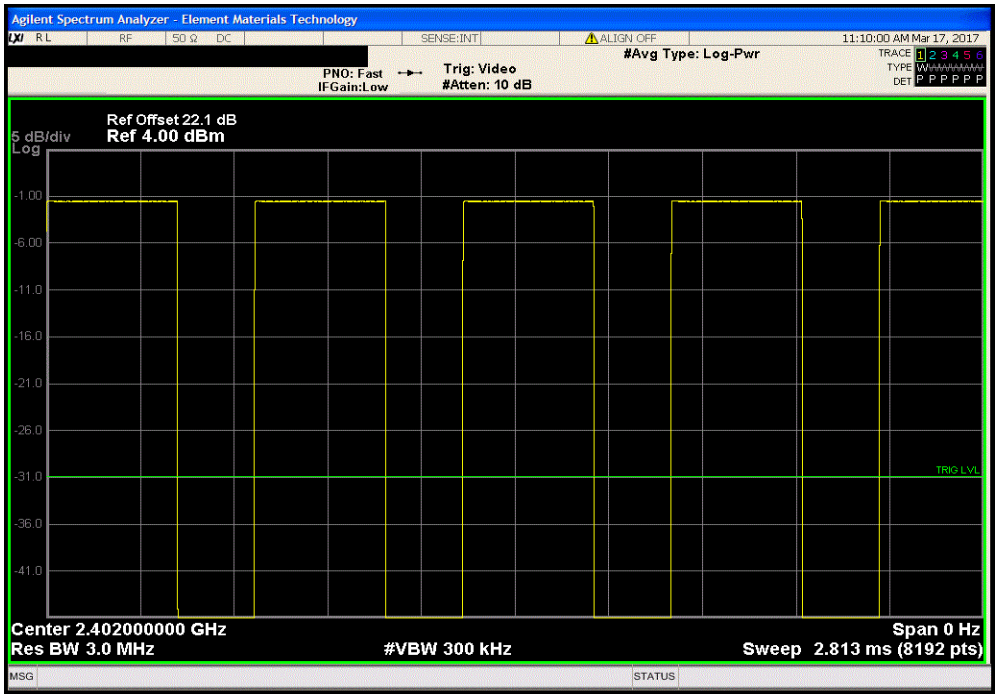
DUTY CYCLE

TbtTx 2017.01.27 XMit 2017.01.26

Normal Voltage, BLE/GFSK Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	394.3 us	625 us	1	63.1	N/A	N/A



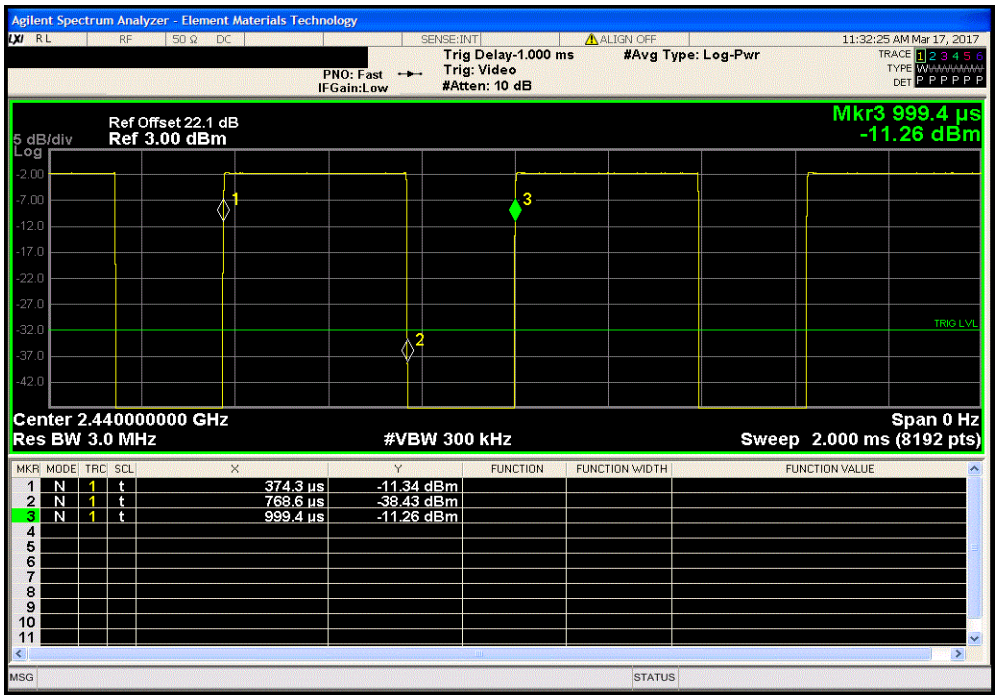
Normal Voltage, BLE/GFSK Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



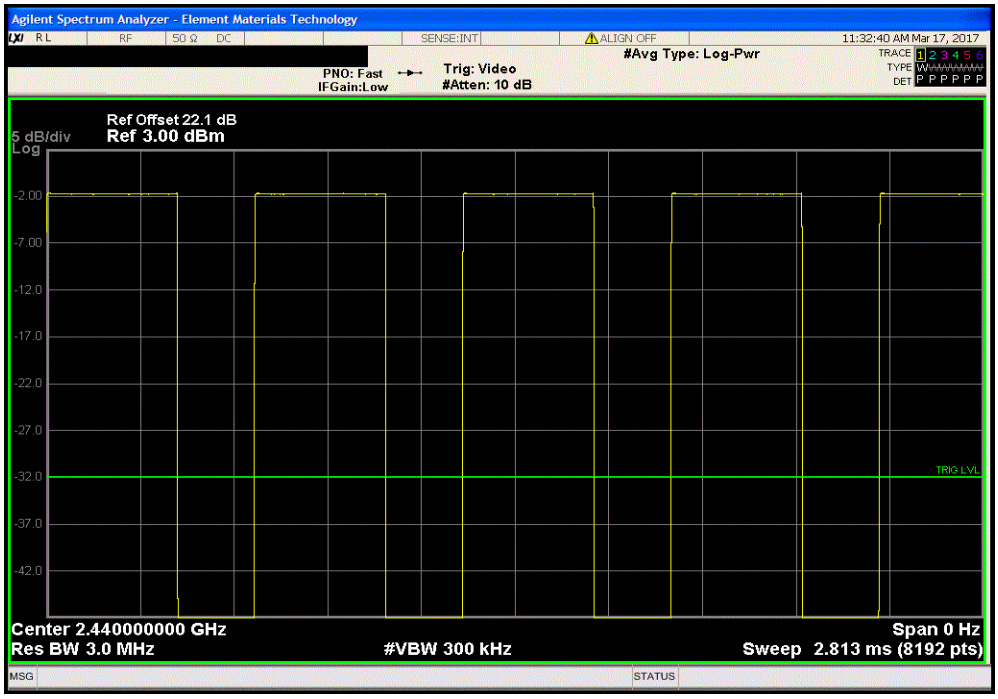
DUTY CYCLE

TbtTx 2017.01.27 XMit 2017.01.26

Normal Voltage, BLE/GFSK Mid Channel, 2440 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	394.3 us	625.1 us	1	63.1	N/A	N/A



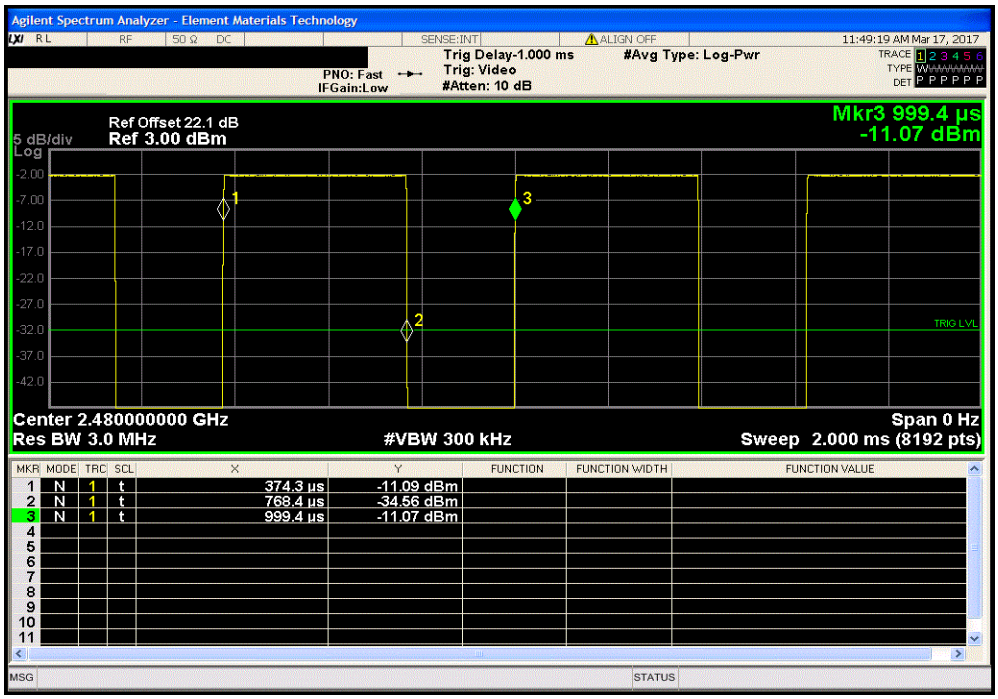
Normal Voltage, BLE/GFSK Mid Channel, 2440 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



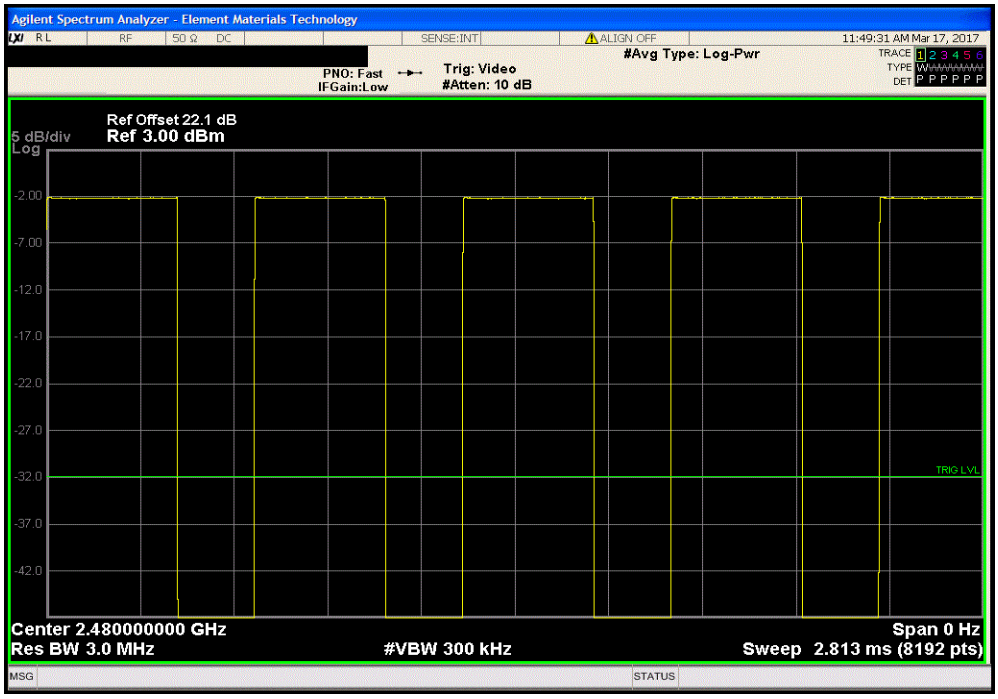
DUTY CYCLE

TbtTx 2017.01.27 XMit 2017.01.26

Normal Voltage, BLE/GFSK High Channel, 2480 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	394.1 us	625.1 us	1	63	N/A	N/A



Normal Voltage, 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 2017.01.26

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
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	10/17/2017
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

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

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			**Work Order:**	STAK0086
Serial Number:	N170742842			**Date:**	03/16/17
Customer:	Starkey Laboratories, Inc.			**Temperature:**	21.4 °C
Attendees:	Charlie Esch			**Humidity:**	16.9% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Trevor Buls, Kyle McMullan	**Power:**	3VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

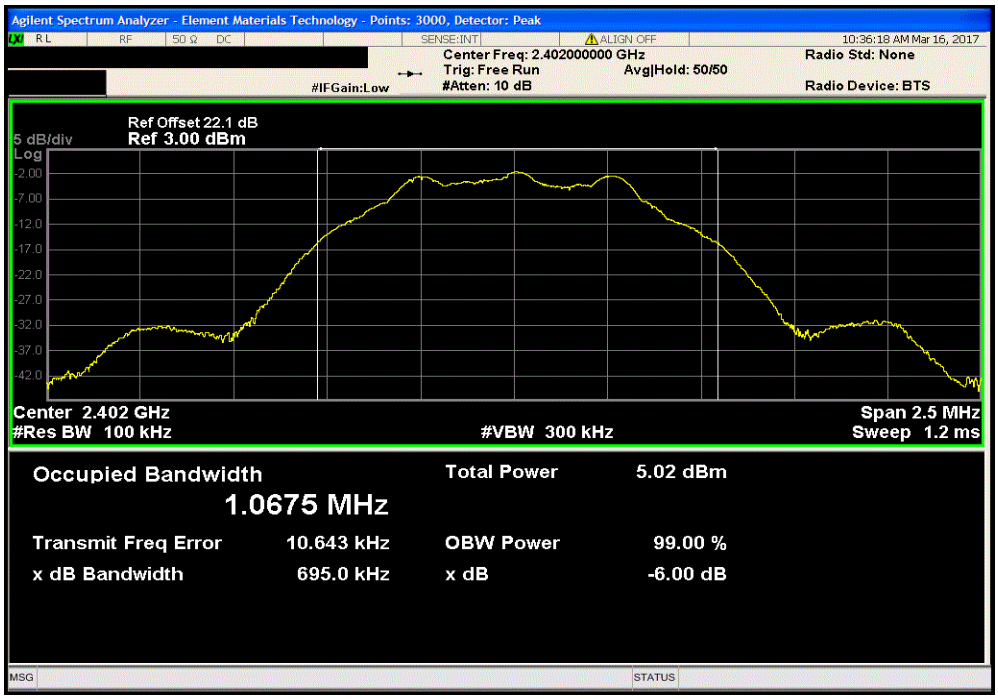
Configuration #	3	Signature	Trevor Buls

	Value	Limit (≥)	Result
BLE/GFSK Low Channel, 2402 MHz	695.007 kHz	500 kHz	Pass
BLE/GFSK Mid Channel, 2440 MHz	686.267 kHz	500 kHz	Pass
BLE/GFSK High Channel, 2480 MHz	697.114 kHz	500 kHz	Pass

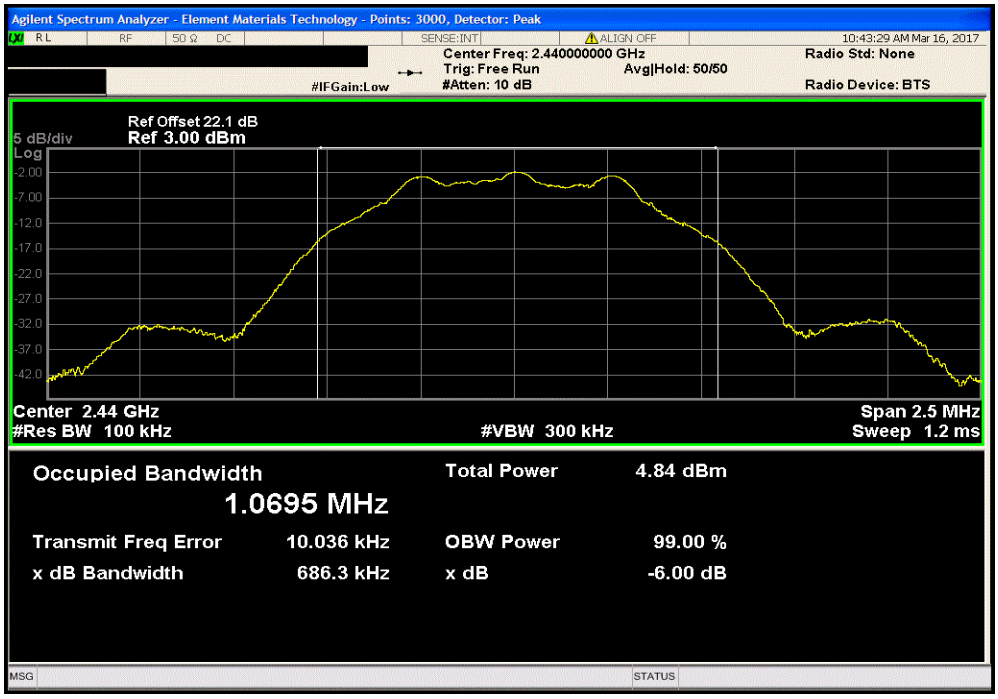
OCCUPIED BANDWIDTH

TbtTx 2017.01.27 XMit 2017.01.26

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



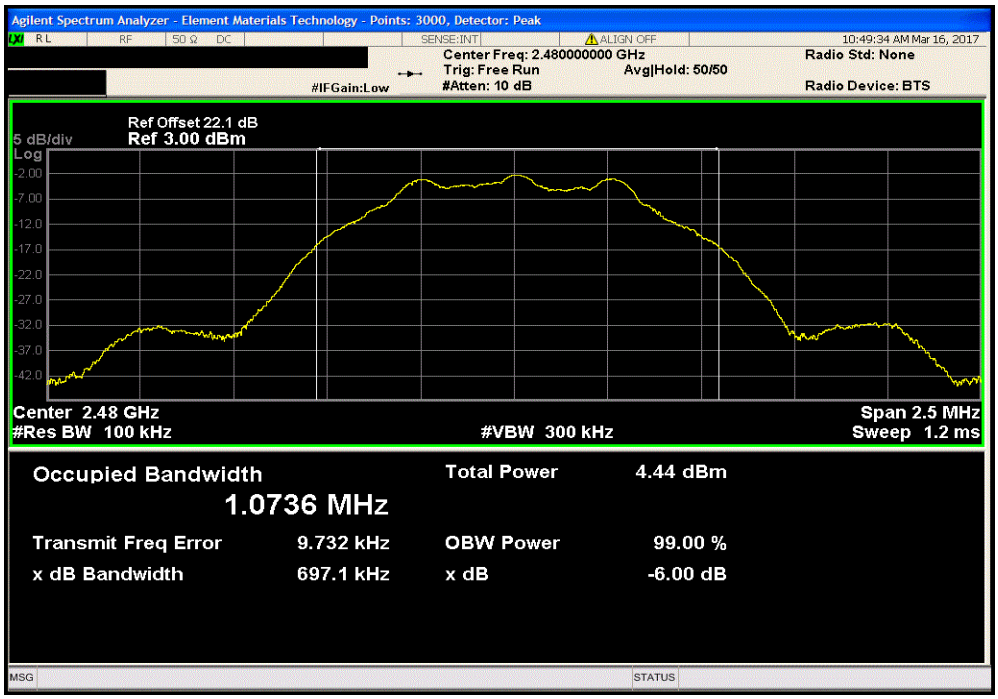
BLE/GFSK Mid Channel, 2440 MHz						
				Value	Limit (≥)	Result
				686.267 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

TbtTx 2017.01.27 XMit 2017.01.26

BLE/GFSK High Channel, 2480 MHz						
				Value	Limit (≥)	Result
				697.114 kHz	500 kHz	Pass



OUTPUT POWER

XMit 2017.01.26

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
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	10/17/2017
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

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

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			**Work Order:**	STAK0086
Serial Number:	N170742842			**Date:**	03/16/17
Customer:	Starkey Laboratories, Inc.			**Temperature:**	21.4 °C
Attendees:	Charlie Esch			**Humidity:**	16.9% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Trevor Buls, Kyle McMullan	**Power:**	3VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

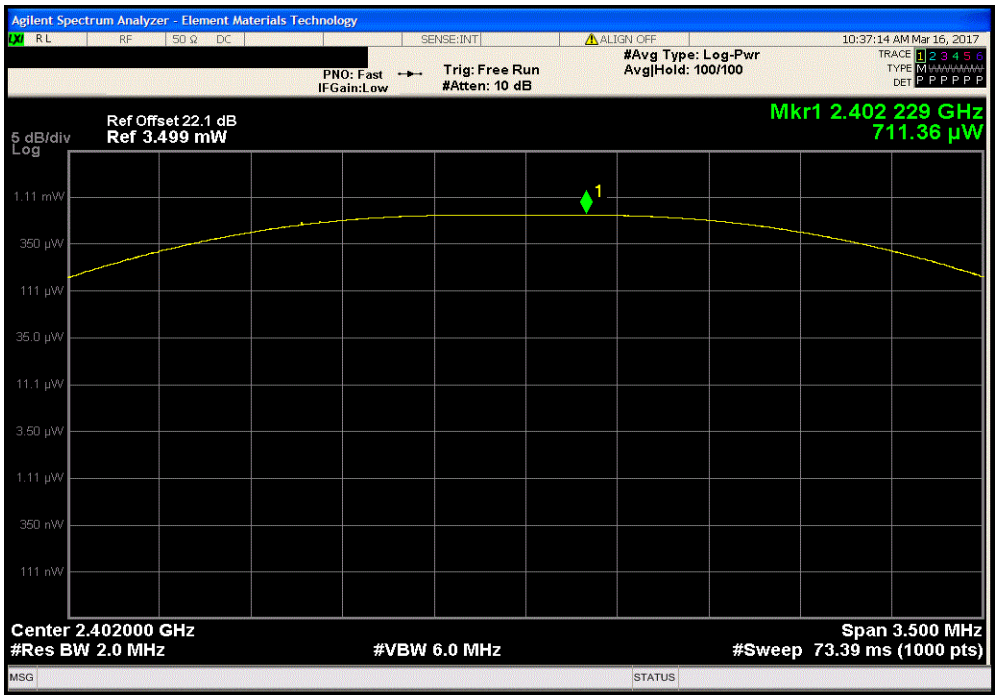
Configuration #	3	Signature	Trevor Buls

	Value	Limit (<)	Result
BLE/GFSK Low Channel, 2402 MHz	711.36 uW	1 W	Pass
BLE/GFSK Mid Channel, 2440 MHz	680.36 uW	1 W	Pass
BLE/GFSK High Channel, 2480 MHz	621.14 uW	1 W	Pass

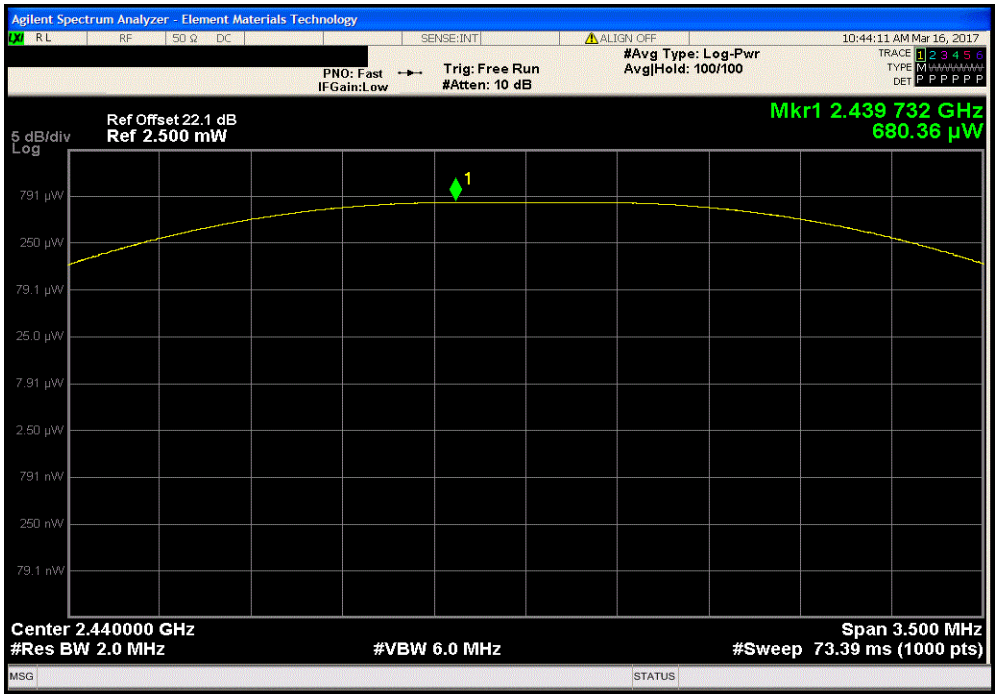
OUTPUT POWER

TbtTx 2017.01.27 XMit 2017.01.26

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

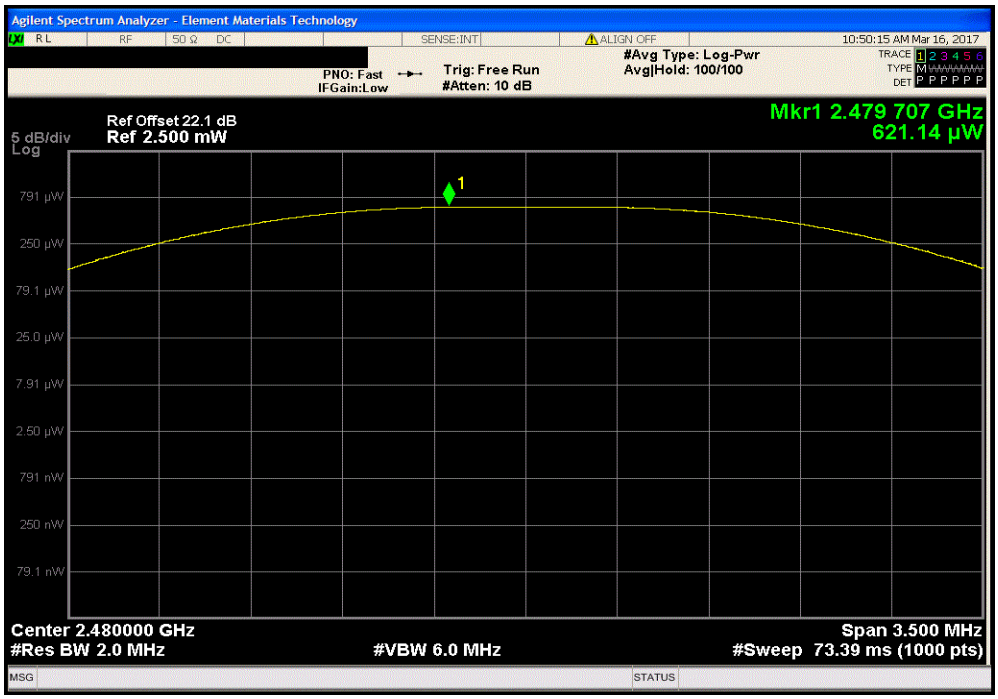


BLE/GFSK Mid Channel, 2440 MHz						
				Value	Limit (<)	Result
				680.36 uW	1 W	Pass



OUTPUT POWER

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



POWER SPECTRAL DENSITY

XMit 2017.01.26

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
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	10/17/2017
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

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

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			Work Order:	STAK0086
Serial Number:	N170742842			Date:	03/16/17
Customer:	Starkey Laboratories, Inc.			Temperature:	21.4 °C
Attendees:	Charlie Esch			Humidity:	16.8% RH
Project:	None			Barometric Pres.:	1024 mbar
Tested by:	Trevor Buls, Kyle McMullan	Power:	3VDC	Job Site:	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

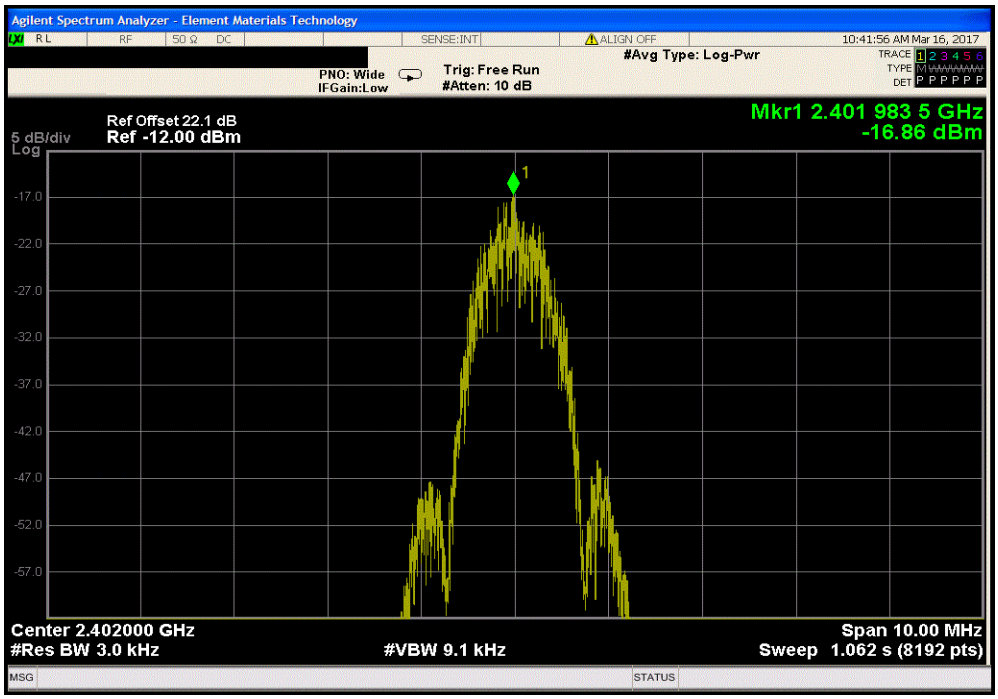
Configuration #	3	Signature	Trevor Buls

	Value dBm/3kHz	Limit < dBm/3kHz	Results
BLE/GFSK Low Channel, 2402 MHz	-16.859	8	Pass
BLE/GFSK Mid Channel, 2440 MHz	-17.038	8	Pass
BLE/GFSK High Channel, 2480 MHz	-17.52	8	Pass

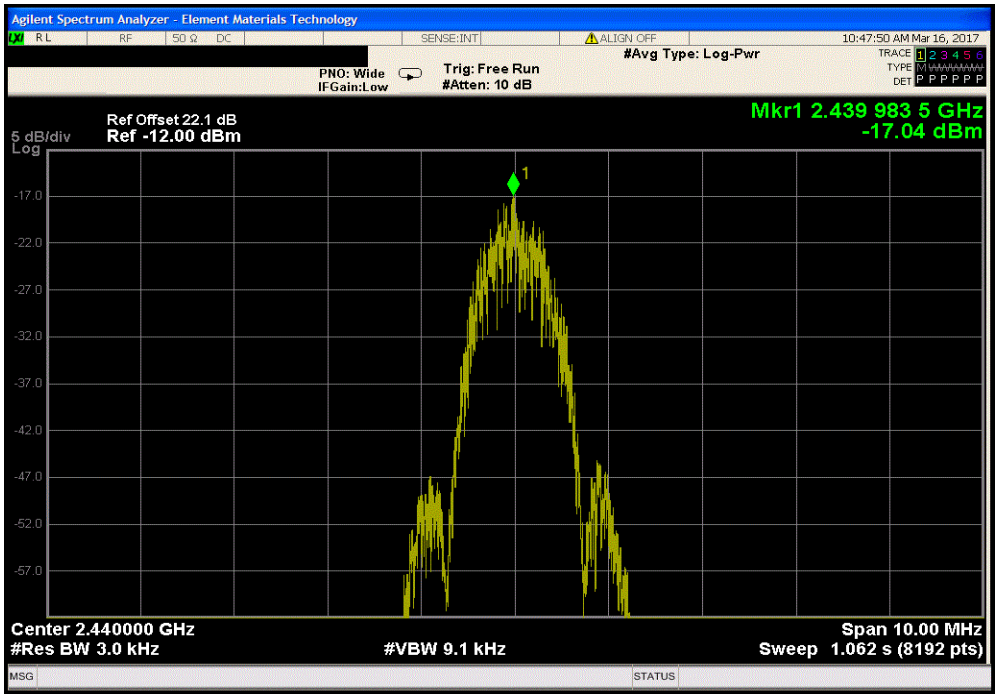
POWER SPECTRAL DENSITY

TbtTx 2017.01.27 XMit 2017.01.26

BLE/GFSK Low Channel, 2402 MHz							
					Value dBm/3kHz	Limit < dBm/3kHz	Results
					-16.859	8	Pass

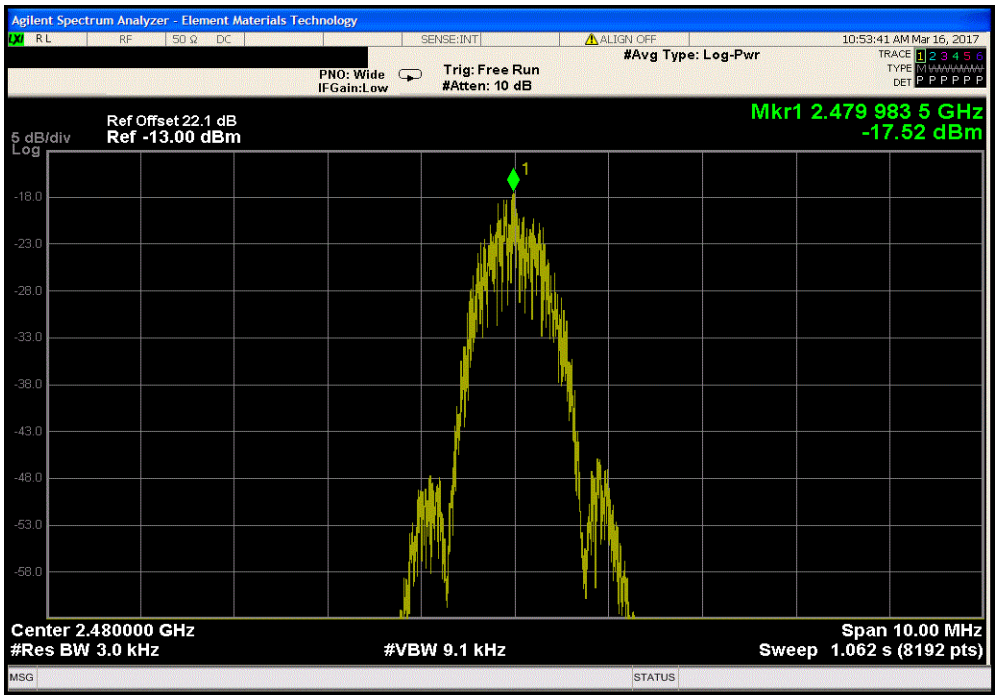


BLE/GFSK Mid Channel, 2440 MHz							
					Value dBm/3kHz	Limit < dBm/3kHz	Results
					-17.038	8	Pass



POWER SPECTRAL DENSITY

BLE/GFSK High Channel, 2480 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-17.52	8	Pass



BAND EDGE COMPLIANCE

XMit 2017.01.26

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	TIK	10/17/2014	10/17/2017
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

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

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			Work Order:	STAK0086
Serial Number:	N170742842			Date:	03/16/17
Customer:	Starkey Laboratories, Inc.			Temperature:	21.3 °C
Attendees:	Charlie Esch			Humidity:	16.9% RH
Project:	None			Barometric Pres.:	1024 mbar
Tested by:	Trevor Buls, Kyle McMullan	Power:	3VDC	Job Site:	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

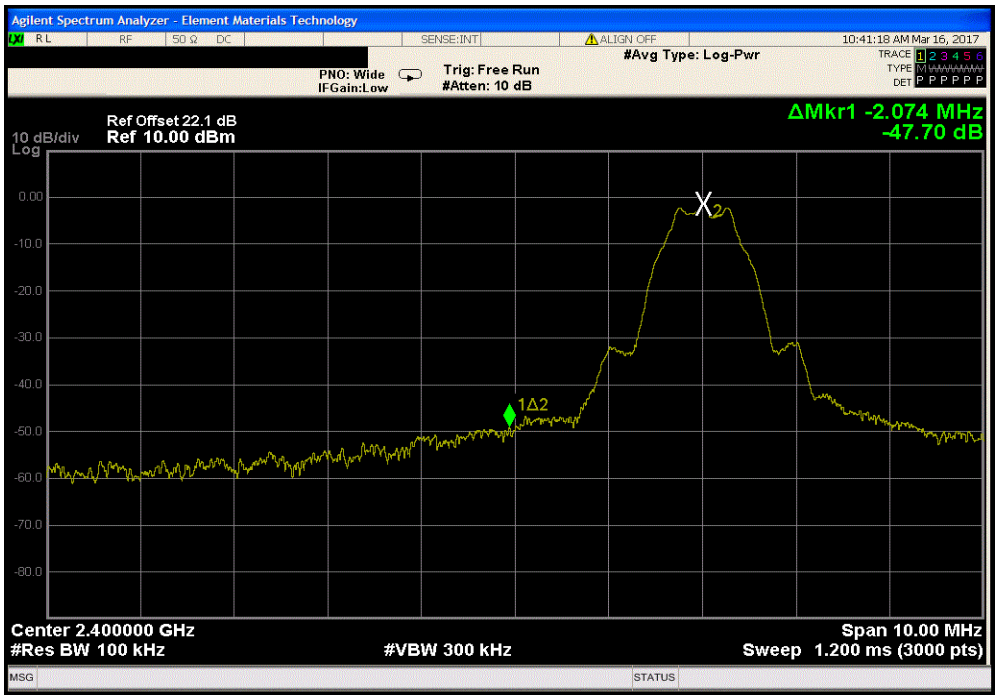
Configuration #	3	Signature	Trevor Buls

	Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	-47.7	-20	Pass
BLE/GFSK High Channel, 2480 MHz	-50.28	-20	Pass

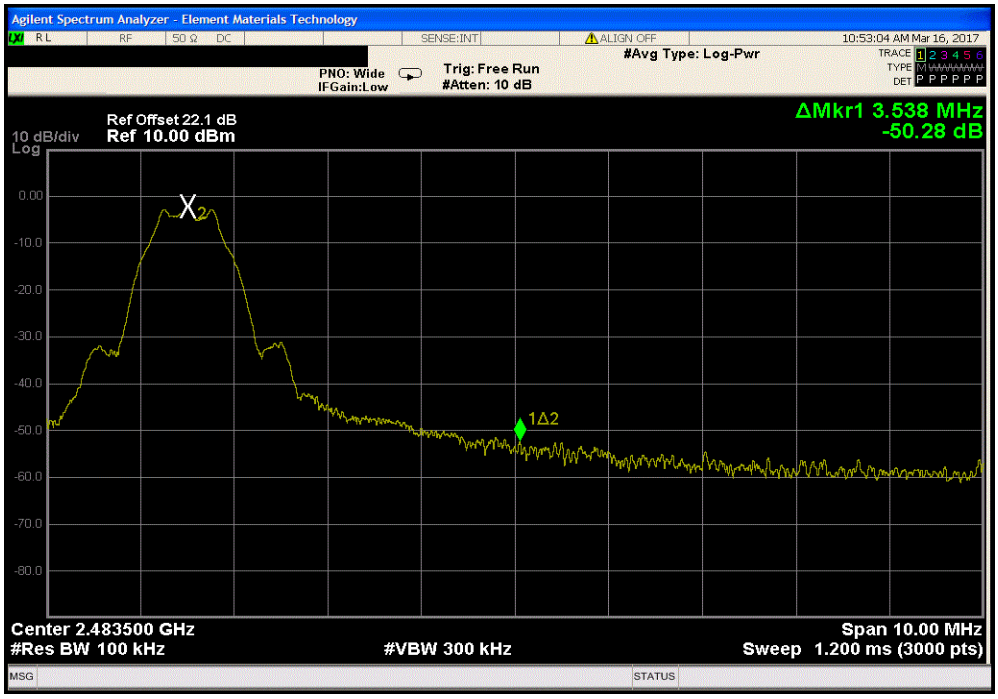
BAND EDGE COMPLIANCE

TbtTx 2017.01.27 XMit 2017.01.26

BLE/GFSK Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-47.7	-20	Pass



BLE/GFSK High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-50.28	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

XMit 2017.01.26

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
Power Supply - DC	EZ Digital Co., Ltd.	GP-4030D	TQK	NCR	NCR
Meter - Multimeter	Fluke	114	MMU	6/30/2014	6/30/2017
Generator - Signal	Agilent	N5183A	TIK	10/17/2014	10/17/2017
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	9/15/2016	9/15/2017
Block - DC	Fairview Microwave	SD3379	AMI	9/15/2016	9/15/2017
Attenuator	S.M. Electronics	SA26B-20	RFW	2/14/2017	2/14/2018
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	1/6/2017	1/6/2018

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

TbtTx 2017.01.27 XMit 2017.01.26

EUT:	TruLink Remote Model 600			**Work Order:**	STAK0086
Serial Number:	N170742842			**Date:**	03/16/17
Customer:	Starkey Laboratories, Inc.			**Temperature:**	21.5 °C
Attendees:	Charlie Esch			**Humidity:**	16.8% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Trevor Buls, Kyle McMullan	**Power:**	3VDC	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2017	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

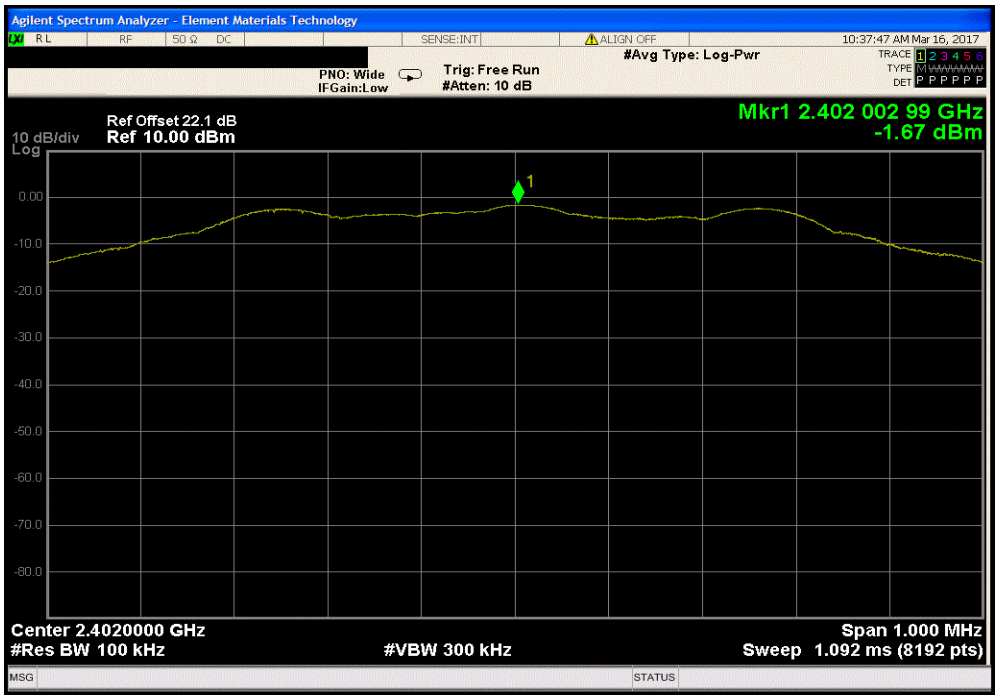
Configuration #	3	Signature	Trevor Buls

	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	-50.99	-20	Pass
BLE/GFSK Low Channel, 2402 MHz	12.5 GHz - 25 GHz	-49.44	-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	-50.35	-20	Pass
BLE/GFSK Mid Channel, 2440 MHz	12.5 GHz - 25 GHz	-48.96	-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	-49.98	-20	Pass
BLE/GFSK High Channel, 2480 MHz	12.5 GHz - 25 GHz	-48.66	-20	Pass

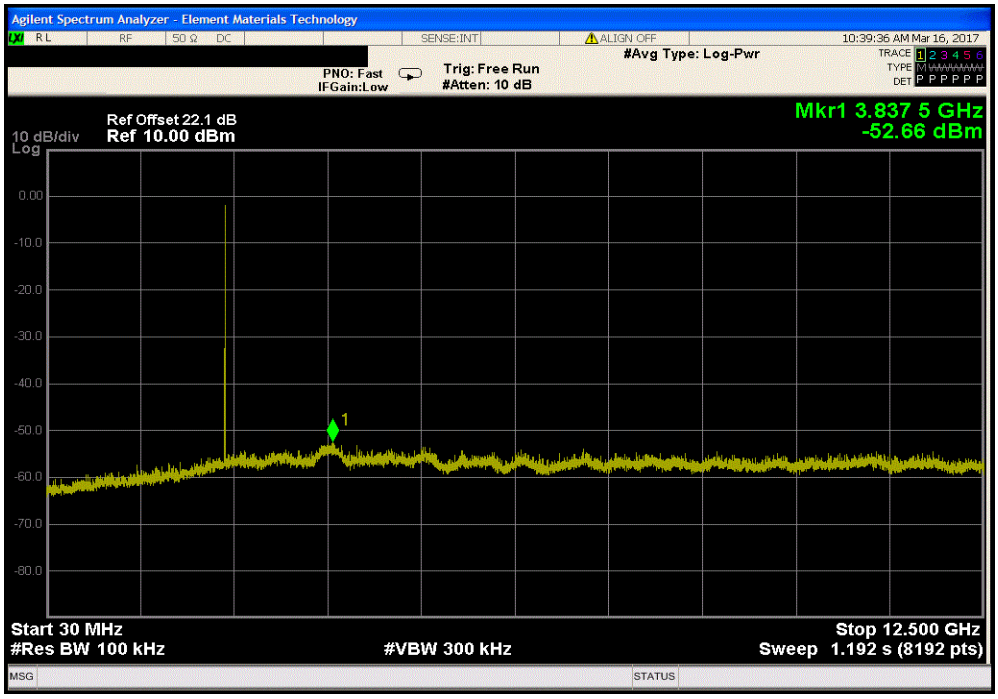
SPURIOUS CONDUCTED EMISSIONS

TbtTx 2017.01.27 XMit 2017.01.26

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



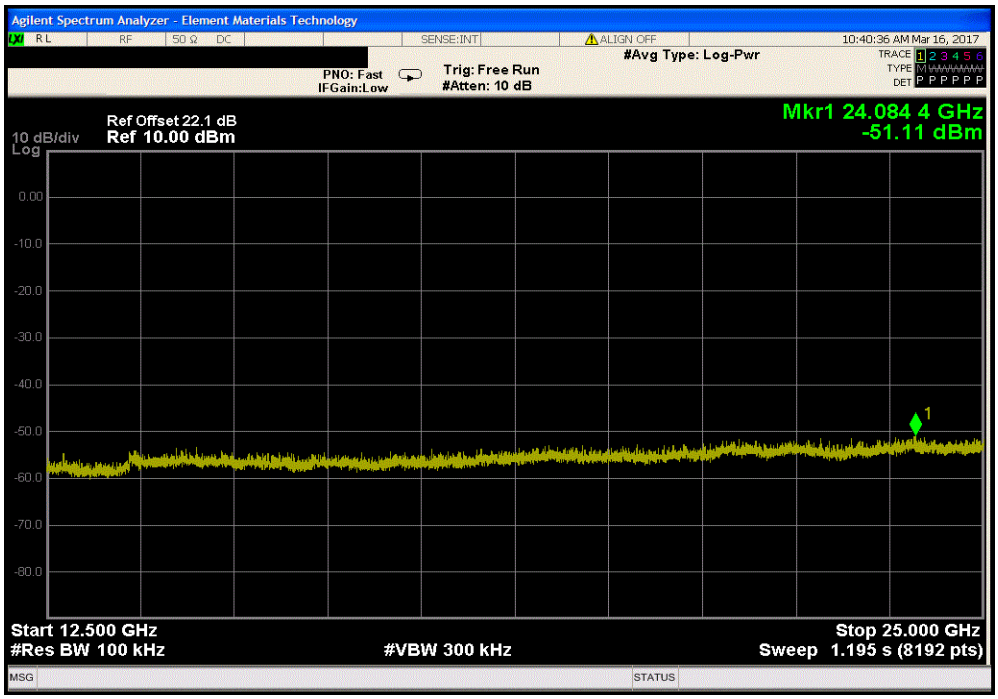
BLE/GFSK Low Channel, 2402 MHz					
Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz			-50.99	-20	Pass



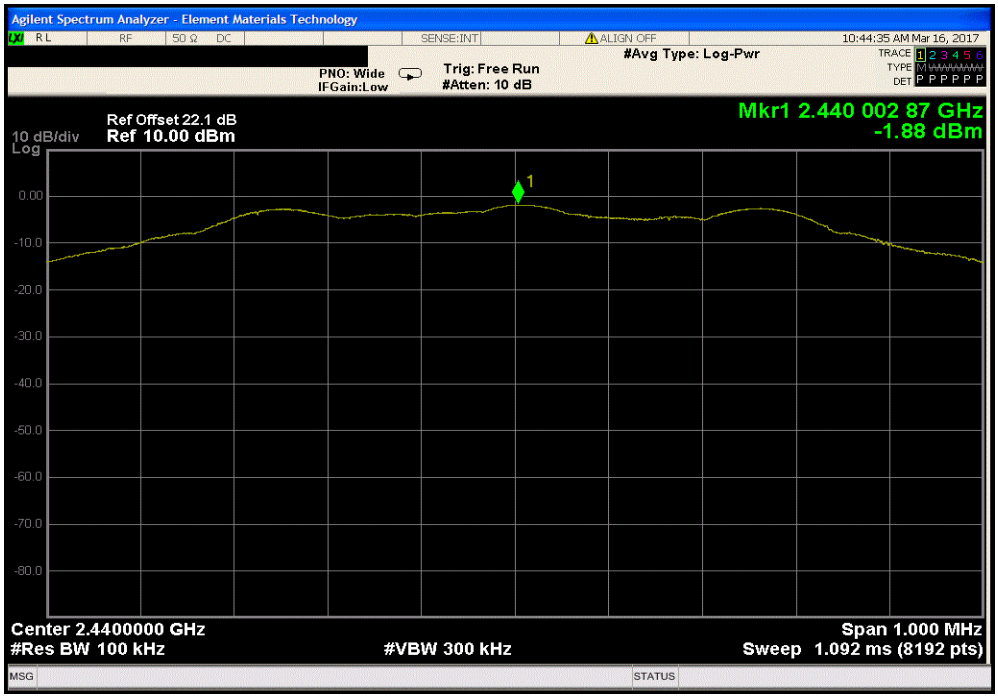
SPURIOUS CONDUCTED EMISSIONS

TbtTx 2017.01.27 XMit 2017.01.26

BLE/GFSK Low Channel, 2402 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz		-49.44	-20	Pass



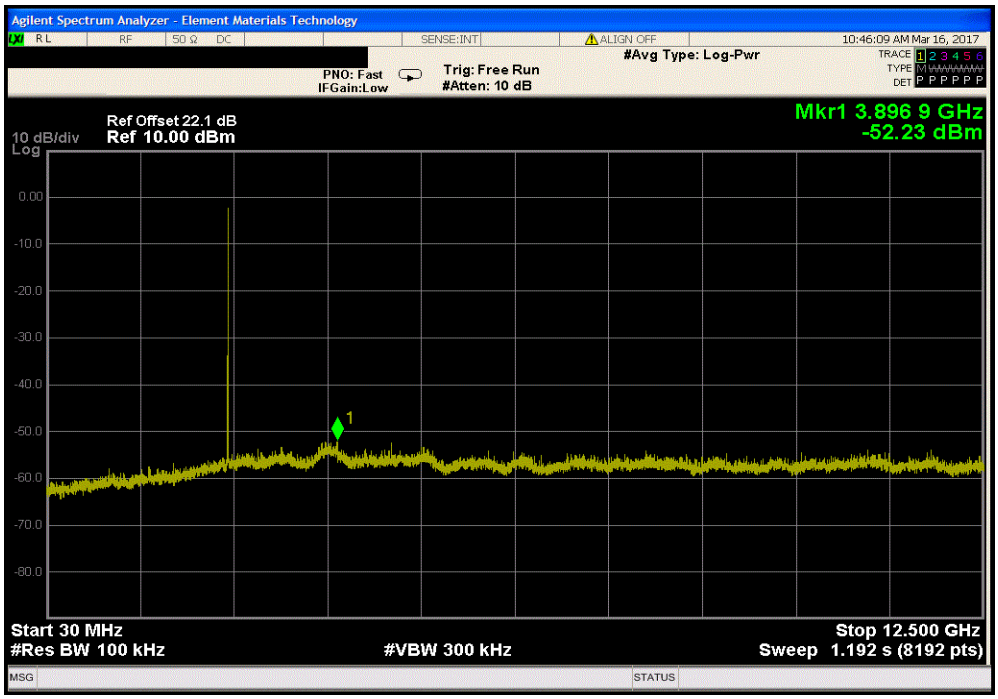
BLE/GFSK Mid Channel, 2440 MHz						
	Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental			N/A	N/A	N/A



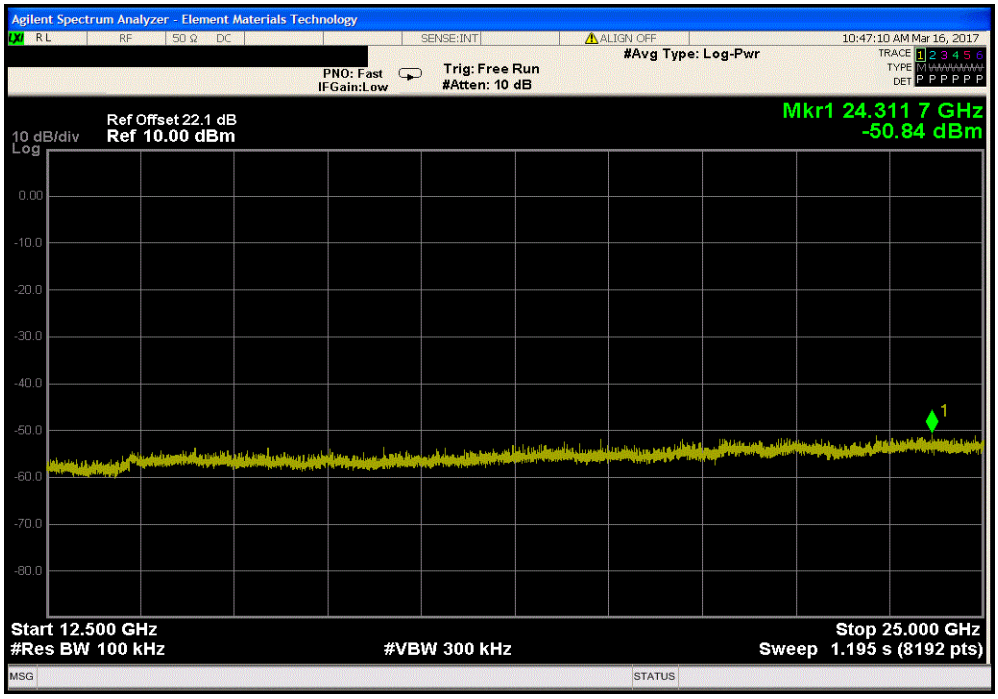
SPURIOUS CONDUCTED EMISSIONS

TbtTx 2017.01.27 XMit 2017.01.26

BLE/GFSK Mid Channel, 2440 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz		-50.35	-20	Pass



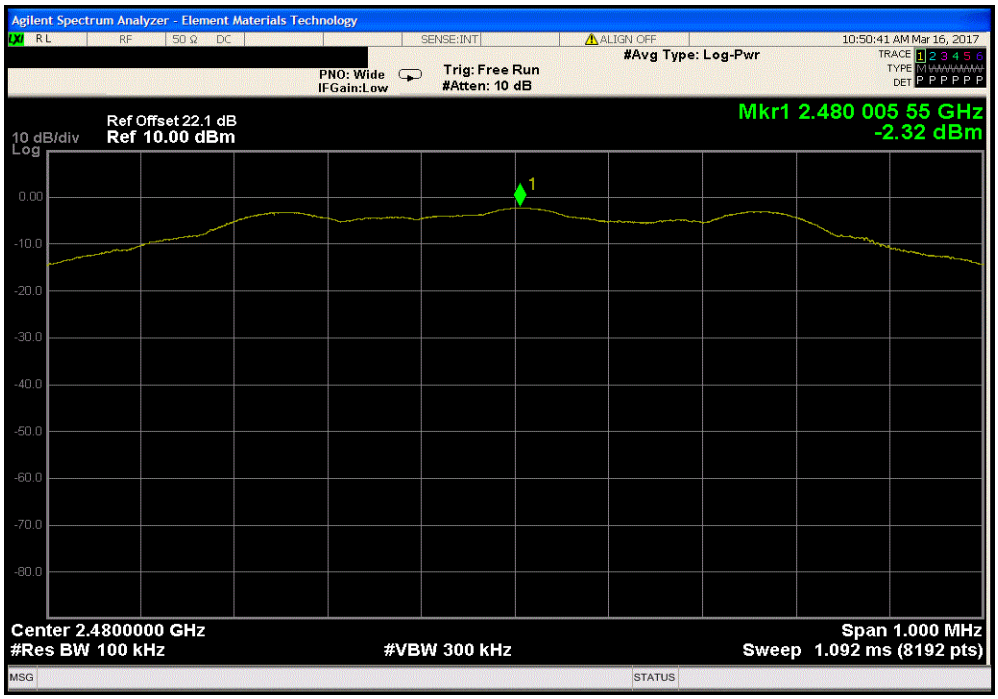
BLE/GFSK Mid Channel, 2440 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz		-48.96	-20	Pass



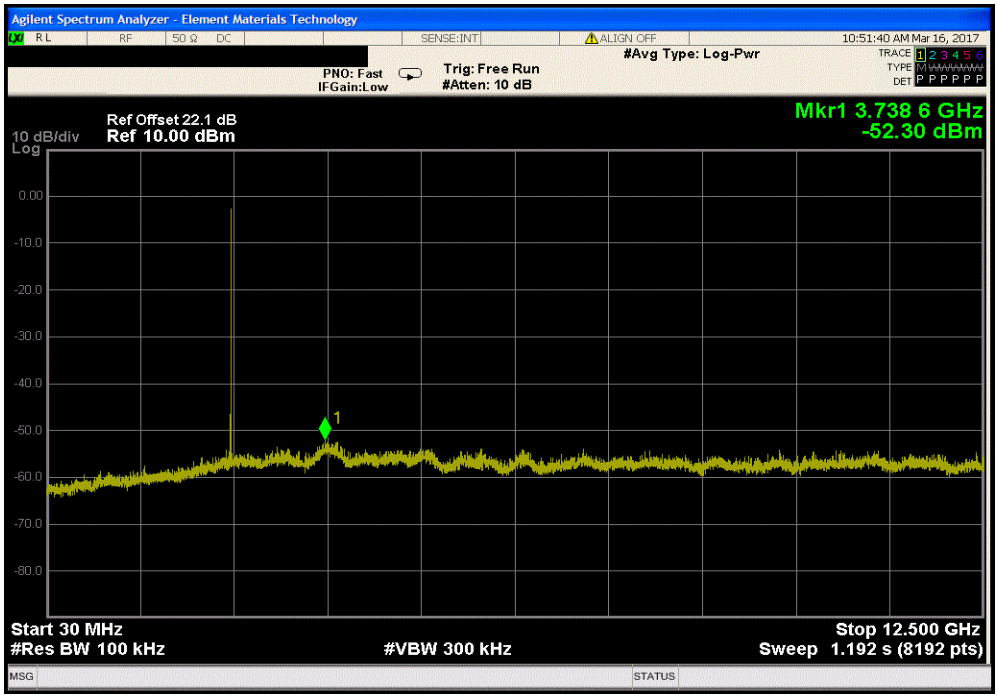
SPURIOUS CONDUCTED EMISSIONS

TbtTx 2017.01.27 XMit 2017.01.26

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

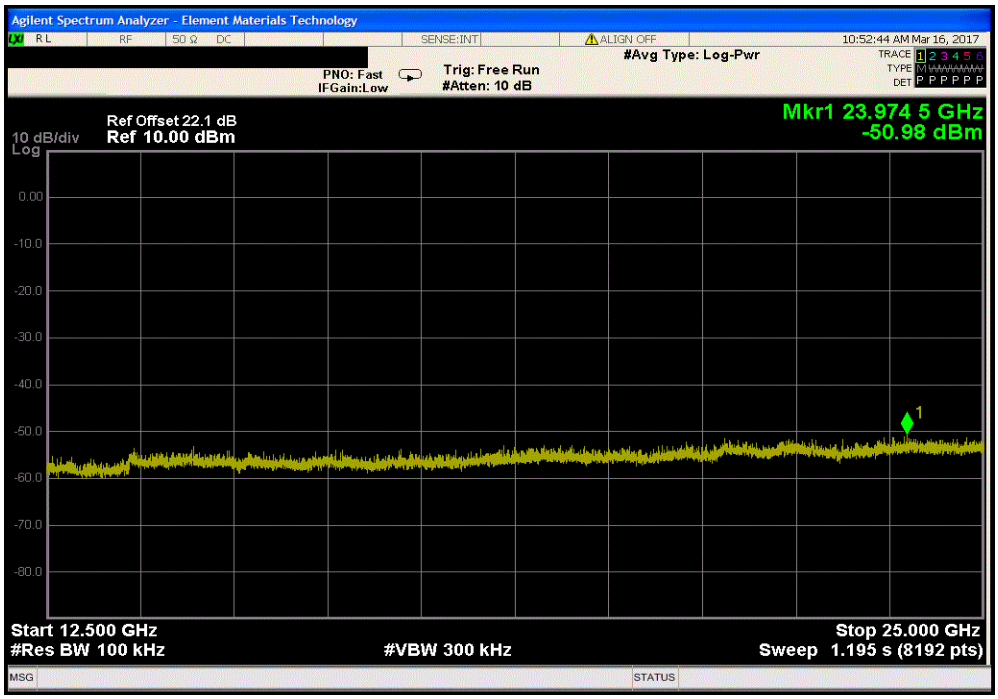


BLE/GFSK High Channel, 2480 MHz					
Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz			-49.98	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

BLE/GFSK High Channel, 2480 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz		-48.66	-20	Pass



SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2017.01.26

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 BLE - low channel (2402 MHz), mid channel (2440 MHz), and high channel (2480 MHz)

POWER SETTINGS INVESTIGATED

3 VDC (Battery)

CONFIGURATIONS INVESTIGATED

STAK0086 - 2

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26500 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
Attenuator	Fairview Microwave	SA18E-20	TWZ	9/23/2016	12 mo
Cable	Northwest EMC	18-26GHz Standard Gain Horn Cable	MNP	9/15/2016	12 mo
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	7/29/2016	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	MNI	12/1/2016	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	12/1/2016	12 mo
Filter - High Pass	Micro-Tronics	HPM50111	LFN	9/23/2016	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFK	9/22/2016	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AYD	1/6/2016	24 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AXP	NCR	0 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVW	2/14/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	2/14/2017	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	12/1/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	9/15/2016	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVV	2/14/2017	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJA	6/23/2016	24 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AIQ	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	12/22/2016	12 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.

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.

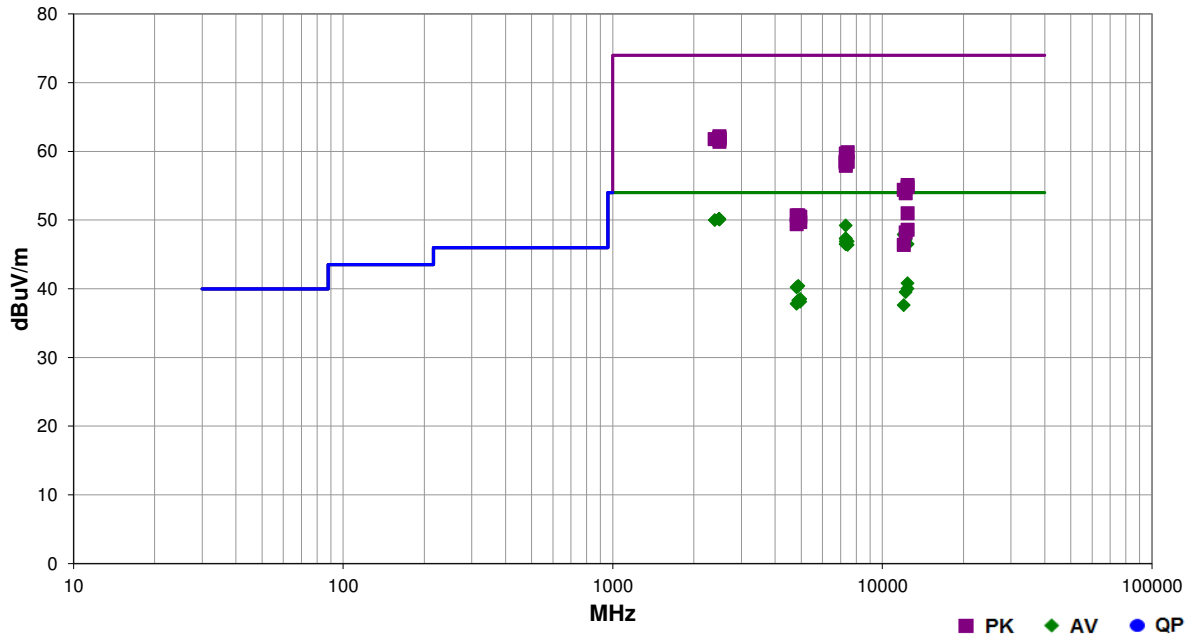
SPURIOUS RADIATED EMISSIONS

EmiR5 2017.01.25 PSA-ESCI 2017.01.26

Work Order:	STAK0086	**Date:**	03/21/17		
Project:	None	**Temperature:**	21.5 °C		
Job Site:	MN05	**Humidity:**	19% RH		
Serial Number:	N170742842	**Barometric Pres.:**	1033 mbar	**Tested by:**	Dustin Sparks
EUT:	TruLink Remote Model 600				
Configuration:	2				
Customer:	Starkey Laboratories, Inc.				
Attendees:	Charlie Esch				
EUT Power:	3 VDC (Battery)				
Operating Mode:	Transmitting BLE - low channel (2402 MHz), mid channel (2440 MHz), and high channel (2480 MHz)				
Deviations:	None				
Comments:	None				

Test Specifications	**Test Method**
FCC 15.247:2017	ANSI C63.10:2013

Run #	55	**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)	Comments
2484.333	32.7	-2.5	1.0	88.1	3.0	20.0	Vert	AV	0.0	50.2	54.0	-3.8	High ch, EUT vertical
2483.992	32.6	-2.5	1.3	168.0	3.0	20.0	Horz	AV	0.0	50.1	54.0	-3.9	High ch, EUT vertical
2483.792	32.6	-2.5	1.0	354.9	3.0	20.0	Horz	AV	0.0	50.1	54.0	-3.9	High ch, EUT on side
2484.400	32.6	-2.5	1.8	317.0	3.0	20.0	Vert	AV	0.0	50.1	54.0	-3.9	High ch, EUT on side
2483.800	32.6	-2.5	1.0	289.0	3.0	20.0	Horz	AV	0.0	50.1	54.0	-3.9	High ch, EUT horz
2485.550	32.6	-2.5	1.0	5.1	3.0	20.0	Vert	AV	0.0	50.1	54.0	-3.9	High ch, EUT horz
2389.792	32.3	-2.3	3.3	147.0	3.0	20.0	Vert	AV	0.0	50.0	54.0	-4.0	Low ch, EUT vertical
7319.375	34.1	15.1	2.1	235.0	3.0	0.0	Horz	AV	0.0	49.2	54.0	-4.8	Mid ch, EUT vertical
12398.820	47.3	0.9	1.5	137.1	3.0	0.0	Horz	AV	0.0	48.2	54.0	-5.8	High ch, EUT vertical
12008.880	48.9	-1.0	1.6	311.0	3.0	0.0	Horz	AV	0.0	47.9	54.0	-6.1	Low ch, EUT vertical
7319.500	32.2	15.1	1.0	126.0	3.0	0.0	Vert	AV	0.0	47.3	54.0	-6.7	Mid ch, EUT vertical
7319.458	32.2	15.1	1.0	203.1	3.0	0.0	Horz	AV	0.0	47.3	54.0	-6.7	Mid ch, EUT on side
12198.820	47.1	0.0	1.6	328.0	3.0	0.0	Horz	AV	0.0	47.1	54.0	-6.9	Mid ch, EUT vertical
7319.483	31.8	15.1	1.0	82.0	3.0	0.0	Vert	AV	0.0	46.9	54.0	-7.1	Mid ch, EUT on side
7440.408	31.9	15.0	1.0	160.1	3.0	0.0	Vert	AV	0.0	46.9	54.0	-7.1	High ch, EUT vertical
7319.575	31.4	15.1	1.0	18.0	3.0	0.0	Horz	AV	0.0	46.5	54.0	-7.5	Mid ch, EUT horz
7320.658	31.4	15.1	1.0	176.0	3.0	0.0	Vert	AV	0.0	46.5	54.0	-7.5	Mid ch, EUT horz
12401.090	40.4	6.1	1.7	173.1	3.0	0.0	Horz	AV	0.0	46.5	54.0	-7.5	High ch, EUT vert

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
7439.992	31.4	15.0	1.0	29.1	3.0	0.0	Horz	AV	0.0	46.4	54.0	-7.6	High ch, EUT vertical
2487.433	44.7	-2.5	1.8	317.0	3.0	20.0	Vert	PK	0.0	62.2	74.0	-11.8	High ch, EUT on side
2483.500	44.5	-2.5	1.0	289.0	3.0	20.0	Horz	PK	0.0	62.0	74.0	-12.0	High ch, EUT horz
2485.467	44.4	-2.5	1.0	354.9	3.0	20.0	Horz	PK	0.0	61.9	74.0	-12.1	High ch, EUT on side
2485.517	44.3	-2.5	1.3	168.0	3.0	20.0	Horz	PK	0.0	61.8	74.0	-12.2	High ch, EUT vertical
2386.667	44.1	-2.3	3.3	147.0	3.0	20.0	Vert	PK	0.0	61.8	74.0	-12.2	Low ch, EUT vertical
2484.117	44.2	-2.5	1.0	5.1	3.0	20.0	Vert	PK	0.0	61.7	74.0	-12.3	High ch, EUT horz
2486.183	43.9	-2.5	1.0	88.1	3.0	20.0	Vert	PK	0.0	61.4	74.0	-12.6	High ch, EUT vertical
12401.120	34.7	6.1	1.0	124.1	3.0	0.0	Vert	AV	0.0	40.8	54.0	-13.2	High ch, EUT vert
4879.975	33.7	6.7	1.0	47.1	3.0	0.0	Vert	AV	0.0	40.4	54.0	-13.6	Mid ch, EUT vertical
4803.892	33.6	6.6	1.0	28.0	3.0	0.0	Vert	AV	0.0	40.2	54.0	-13.8	Low ch, EUT vertical
12398.870	39.1	0.9	1.0	126.0	3.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0	High ch, EUT vertical
7439.875	44.9	15.0	1.0	160.1	3.0	0.0	Vert	PK	0.0	59.9	74.0	-14.1	High ch, EUT vertical
7320.625	44.6	15.1	2.1	235.0	3.0	0.0	Horz	PK	0.0	59.7	74.0	-14.3	Mid ch, EUT vertical
12198.800	39.5	0.0	1.0	170.1	3.0	0.0	Vert	AV	0.0	39.5	54.0	-14.5	Mid ch, EUT vertical
7319.083	43.5	15.1	1.0	126.0	3.0	0.0	Vert	PK	0.0	58.6	74.0	-15.4	Mid ch, EUT vertical
7318.733	43.4	15.1	1.0	82.0	3.0	0.0	Vert	PK	0.0	58.5	74.0	-15.5	Mid ch, EUT on side
4960.142	31.7	6.8	1.0	245.0	3.0	0.0	Vert	AV	0.0	38.5	54.0	-15.5	High ch, EUT vertical
7440.225	43.5	15.0	1.0	29.1	3.0	0.0	Horz	PK	0.0	58.5	74.0	-15.5	High ch, EUT vertical
7319.367	43.3	15.1	1.0	203.1	3.0	0.0	Horz	PK	0.0	58.4	74.0	-15.6	Mid ch, EUT on side
7318.758	43.2	15.1	1.0	176.0	3.0	0.0	Vert	PK	0.0	58.3	74.0	-15.7	Mid ch, EUT horz
4879.875	31.6	6.7	1.0	268.9	3.0	0.0	Horz	AV	0.0	38.3	54.0	-15.7	Mid ch, EUT vertical
4959.800	31.3	6.8	1.0	330.9	3.0	0.0	Horz	AV	0.0	38.1	54.0	-15.9	High ch, EUT vertical
7319.317	42.8	15.1	1.0	18.0	3.0	0.0	Horz	PK	0.0	57.9	74.0	-16.1	Mid ch, EUT horz
4806.317	31.2	6.6	1.0	347.9	3.0	0.0	Horz	AV	0.0	37.8	54.0	-16.2	Low ch, EUT vertical
12008.780	38.6	-1.0	1.6	164.0	3.0	0.0	Vert	AV	0.0	37.6	54.0	-16.4	Low ch, EUT vertical
12401.280	49.0	6.1	1.7	173.1	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9	High ch, EUT vert
12398.710	53.9	0.9	1.5	137.1	3.0	0.0	Horz	PK	0.0	54.8	74.0	-19.2	High ch, EUT vertical
12011.360	55.4	-1.0	1.6	311.0	3.0	0.0	Horz	PK	0.0	54.4	74.0	-19.6	Low ch, EUT vertical
12198.660	53.9	0.0	1.6	328.0	3.0	0.0	Horz	PK	0.0	53.9	74.0	-20.1	Mid ch, EUT vertical
12401.060	44.9	6.1	1.0	124.1	3.0	0.0	Vert	PK	0.0	51.0	74.0	-23.0	High ch, EUT vert
4879.925	44.0	6.7	1.0	47.1	3.0	0.0	Vert	PK	0.0	50.7	74.0	-23.3	Mid ch, EUT vertical
4803.683	44.1	6.6	1.0	28.0	3.0	0.0	Vert	PK	0.0	50.7	74.0	-23.3	Low ch, EUT vertical
4960.117	43.7	6.8	1.0	330.9	3.0	0.0	Horz	PK	0.0	50.5	74.0	-23.5	High ch, EUT vertical
4879.517	43.1	6.7	1.0	268.9	3.0	0.0	Horz	PK	0.0	49.8	74.0	-24.2	Mid ch, EUT vertical
4959.725	42.9	6.8	1.0	245.0	3.0	0.0	Vert	PK	0.0	49.7	74.0	-24.3	High ch, EUT vertical
4803.600	42.8	6.6	1.0	347.9	3.0	0.0	Horz	PK	0.0	49.4	74.0	-24.6	Low ch, EUT vertical
12398.880	47.7	0.9	1.0	126.0	3.0	0.0	Vert	PK	0.0	48.6	74.0	-25.4	High ch, EUT vertical
12201.380	48.2	0.0	1.0	170.1	3.0	0.0	Vert	PK	0.0	48.2	74.0	-25.8	Mid ch, EUT vertical
12011.280	47.4	-1.0	1.6	164.0	3.0	0.0	Vert	PK	0.0	46.4	74.0	-27.6	Low ch, EUT vertical