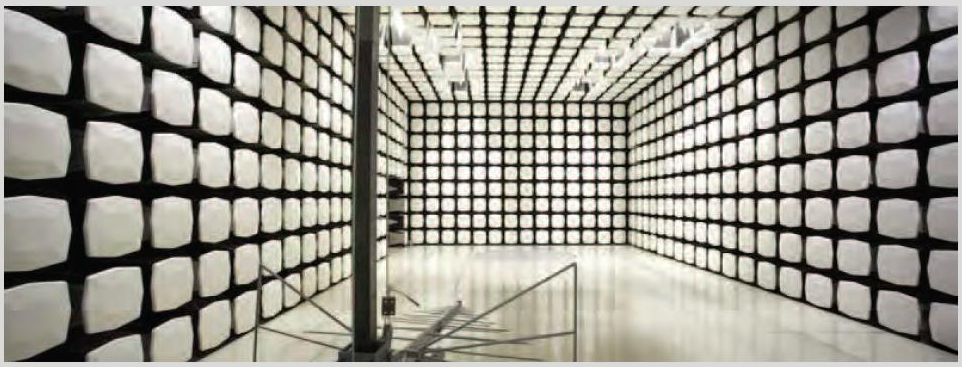
Clearity, LLC

Kairos

FCC 15.247:2018

Bluetooth Low Energy Radio

Report # CLRT0006



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

Last Date of Test: March 21, 2018
Clearity, LLC
Model: Kairos

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

2018.2.20

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.

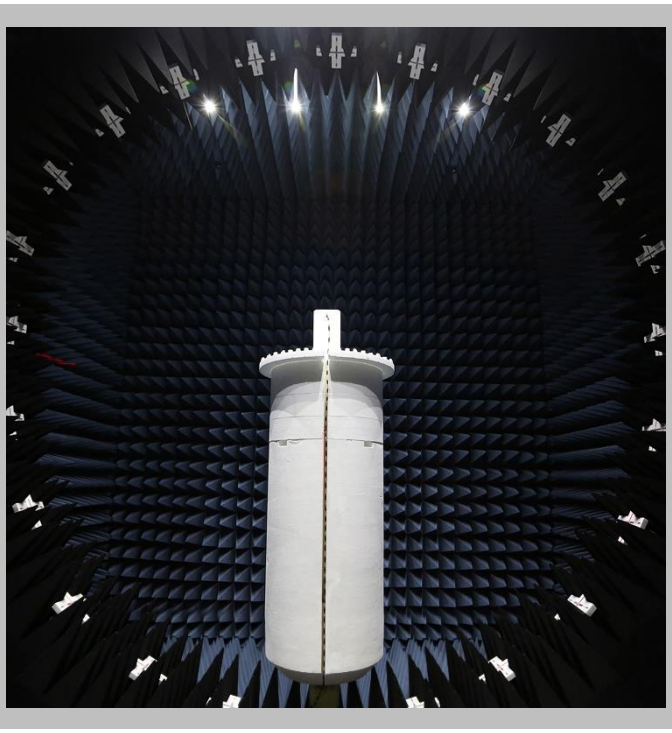
SCOPE

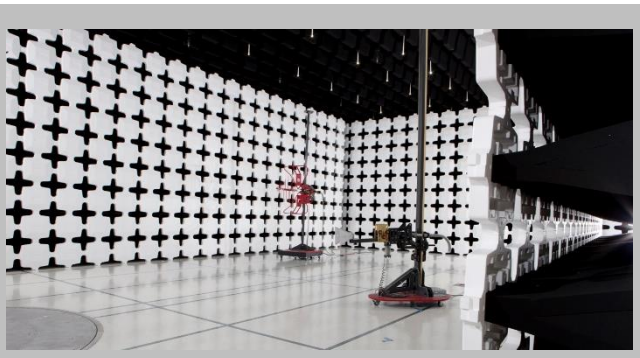
For details on the Scopes of our Accreditations, please visit:
http://portlandcustomer.element.com/ts/scope/scope.htm
http://gsi.nist.gov/global/docs/cabs/designations.html

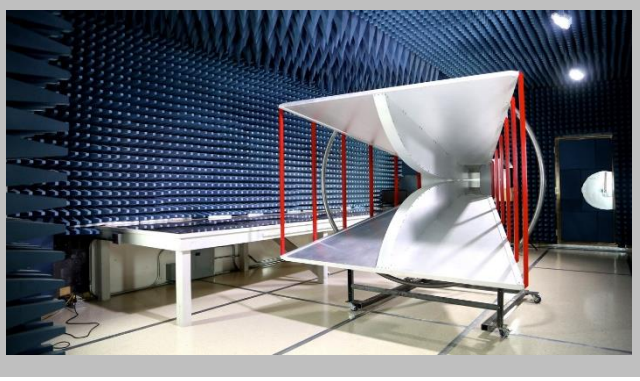
FACILITIES

2017.9.15

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 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, 2834E-3	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







EMISSIONS MEASUREMENTS

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.

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

Measurements were made using the bandwidths and detectors specified. No video filter was used.

Sample Calculations

Radiated Emissions:

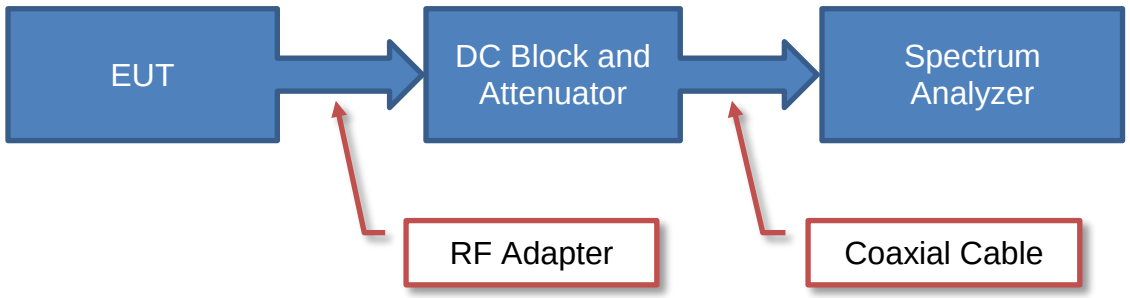
Field Strength		Measured Level		Antenna Factor		Cable Factor		Amplifier Gain		Distance Adjustment Factor		External Attenuation
33.5	=	42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0

Conducted Emissions:

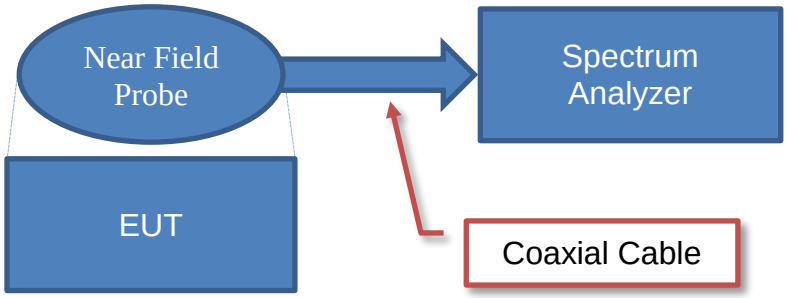
Adjusted Level		Measured Level		Transducer Factor		Cable Factor		External Attenuation
47.1	=	26.7	+	0.3	+	0.1	+	20.0

Test Setup Block Diagrams

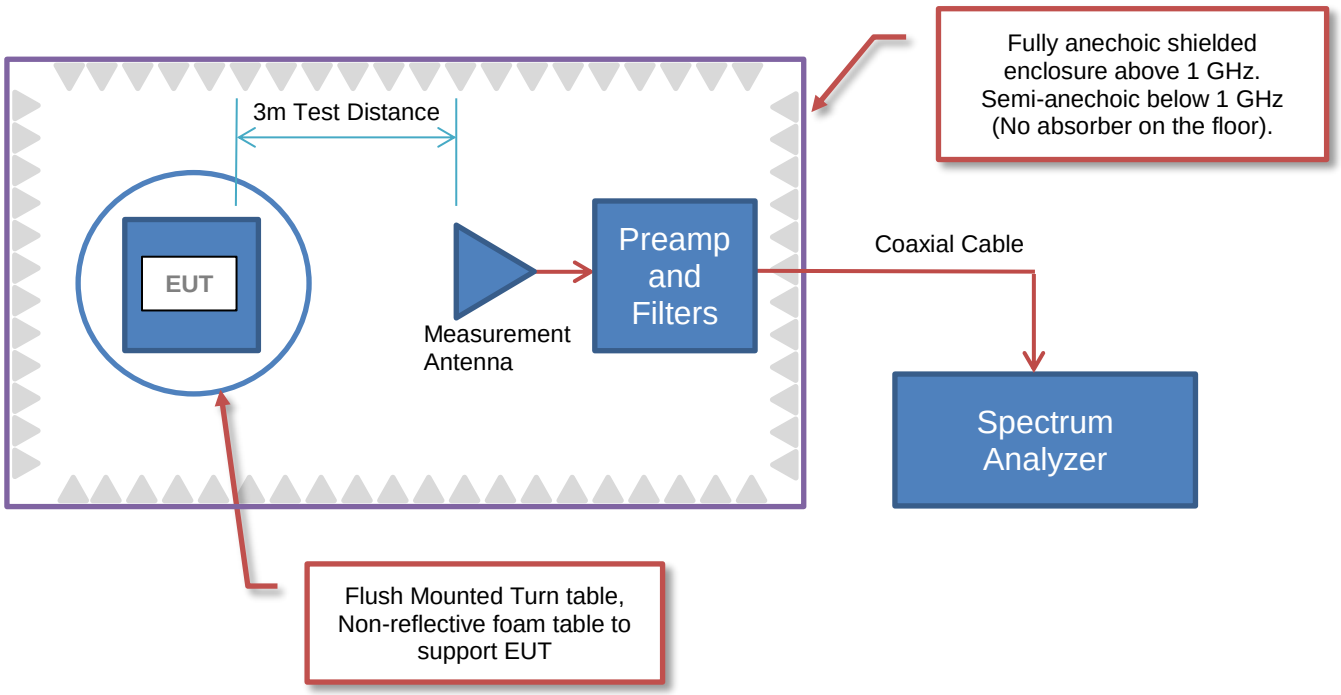
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

2017-1-25

Client and Equipment Under Test (EUT) Information

Company Name:	Clearity, LLC
Address:	2488 E. 81st Street Suite 2000
City, State, Zip:	Tulsa, OK 74137
Test Requested By:	Brian Dobson
Model:	Kairos
First Date of Test:	March 20, 2018
Last Date of Test:	March 21, 2018
Receipt Date of Samples:	March 20, 2018
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Hearing Aid with a Bluetooth Low Energy radio.

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 CLRT0006- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Hearing Aid	Clearity, LLC	Kairos	2001

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Communication Accelerator Adaptor	ON Semiconductor	None	None
Development Board	Nordic Semiconductor	PCA10028	681943980
Power Supply (Laptop)	Lenovo	ADLX45NAC2A	8SSA10E75803A2WH62S02H5
Laptop	Lenovo	X260	PC-0BF458 16/03

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Hearing Aid Serial Cable	No	2.1m	No	Hearing Aid	Communication Accelerator Adaptor
USB Cable (Communication Accelerator Adaptor)	No	2.0m	No	Laptop	Communication Accelerator Adaptor
USB Cable (Development Board)	No	1.3m	No	Laptop	Development Board
AC Cable (Laptop)	No	0.9m	No	AC Mains	Power Supply (Laptop)
DC Cable (Laptop)	No	1.6m	Yes	Power Supply (Laptop)	Laptop
USB UART Cable	No	1.8m	No	Laptop	Development Board

CONFIGURATIONS

Configuration CLRT0006- 3

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Hearing Aid	Clearity, LLC	Kairos	2007

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Communication Accelerator Adaptor	ON Semiconductor	None	None
Development Board	Nordic Semiconductor	PCA10028	681943980
Power Supply (Laptop)	Lenovo	ADLX45NAC2A	8SSA10E75803A2WH62S02H5
Laptop	Lenovo	X260	PC-0BF458 16/03

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Hearing Aid Serial Cable	No	2.1m	No	Hearing Aid	Communication Accelerator Adaptor
USB Cable (Communication Accelerator Adaptor)	No	2.0m	No	Laptop	Communication Accelerator Adaptor
USB Cable (Development Board)	No	1.3m	No	Laptop	Development Board
AC Cable (Laptop)	No	0.9m	No	AC Mains	Power Supply (Laptop)
DC Cable (Laptop)	No	1.6m	Yes	Power Supply (Laptop)	Laptop
USB UART Cable	No	1.8m	No	Laptop	Development Board

MODIFICATIONS

2017-1-25

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	3/20/2018	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	3/21/2018	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	3/21/2018	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	3/21/2018	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	3/21/2018	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	3/21/2018	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	3/21/2018	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
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	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23.3 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.6% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2018	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

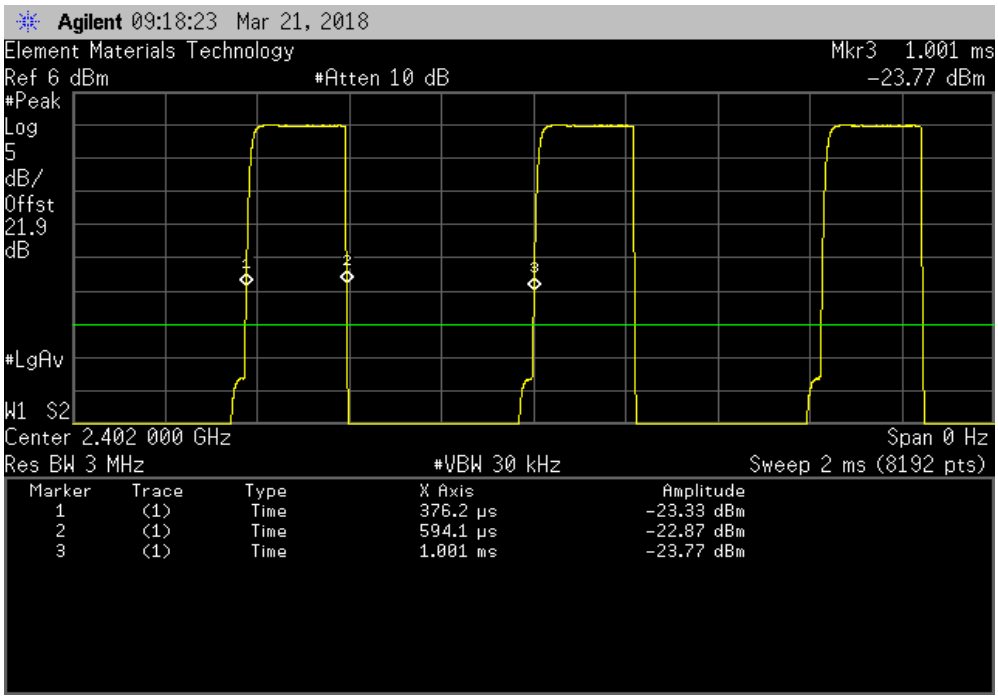
Configuration #	3	Signature

	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
BLE/GFSK Low Channel, 2402 MHz	217.904 us	624.808 us	1	34.9	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, 2442 MHz	217.525 us	624.771 us	1	34.8	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	219.021 us	625.259 us	1	35	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	N/A	N/A	5	N/A	N/A	N/A

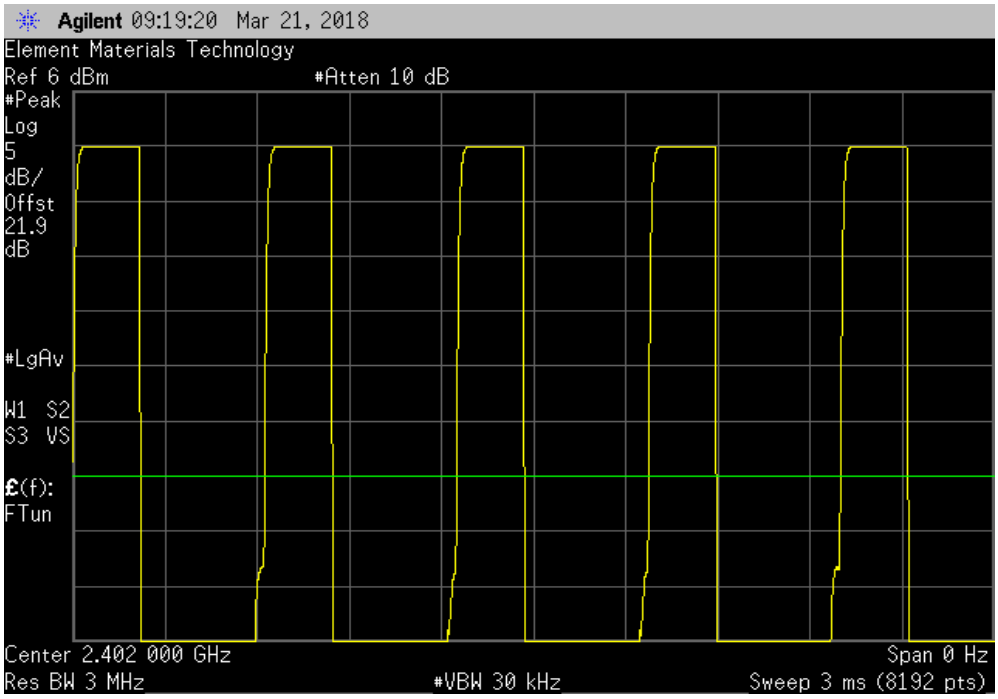
DUTY CYCLE

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	217.904 us	624.808 us	1	34.9	N/A	N/A



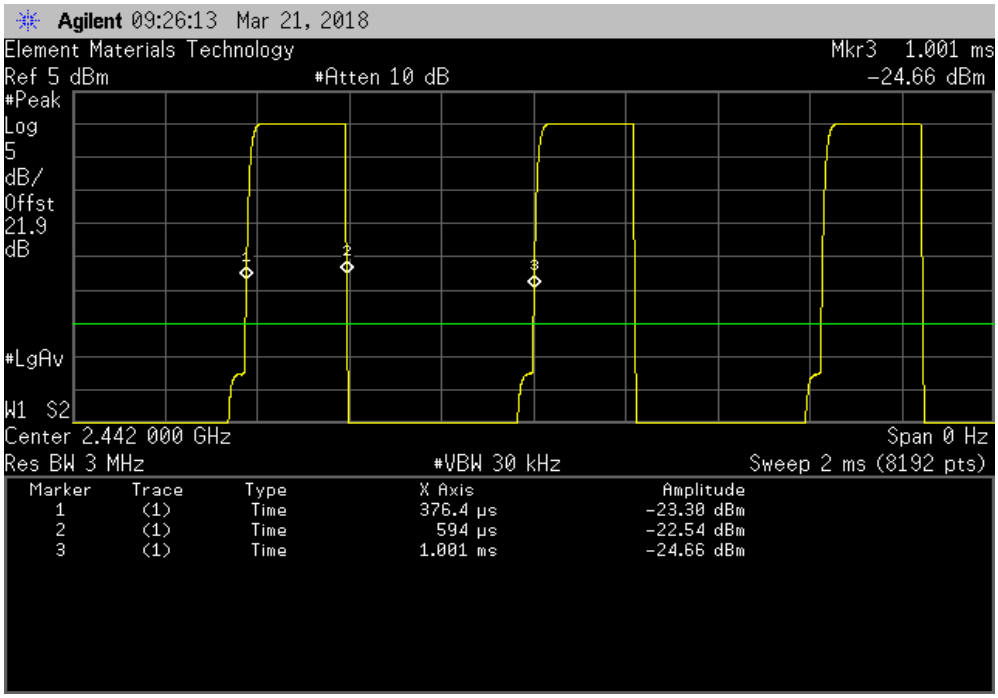
BLE/GFSK Low Channel, 2402 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



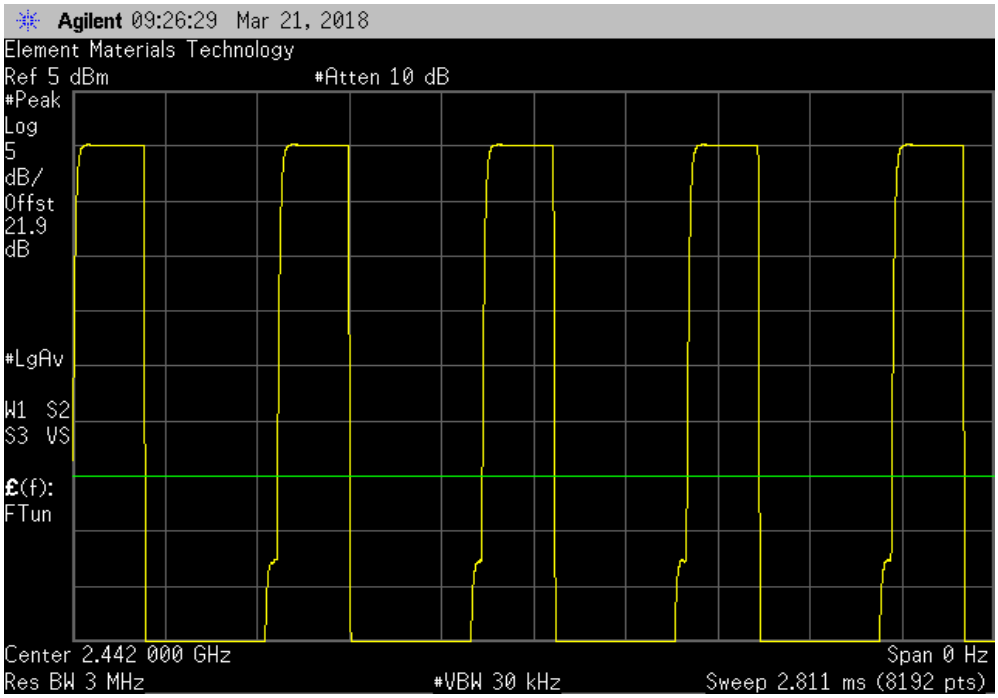
DUTY CYCLE

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	217.525 us	624.771 us	1	34.8	N/A	N/A



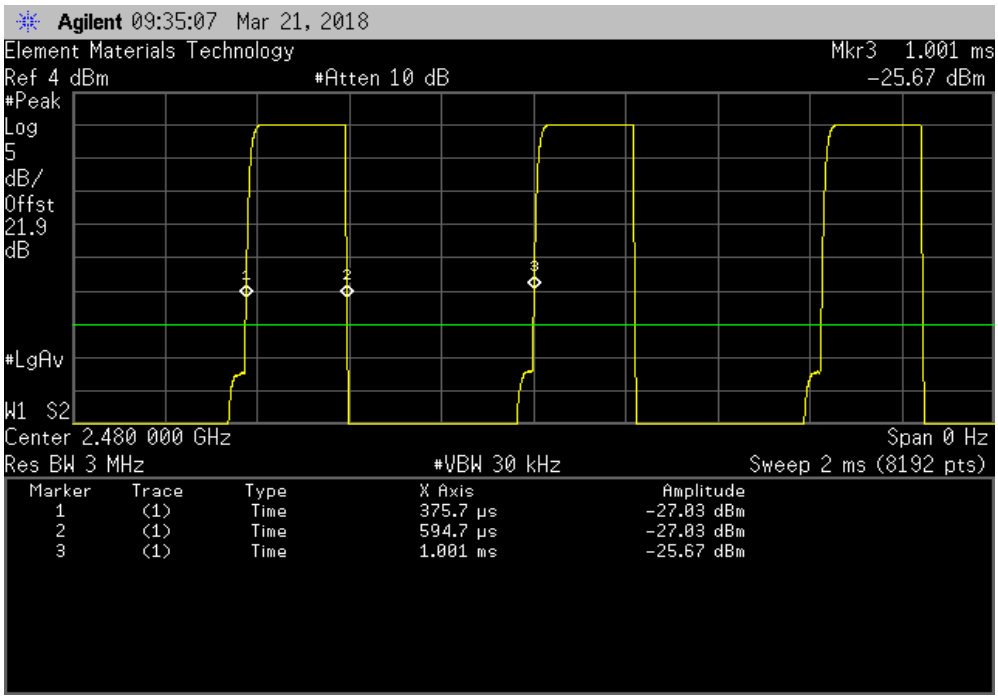
BLE/GFSK Mid Channel, 2442 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



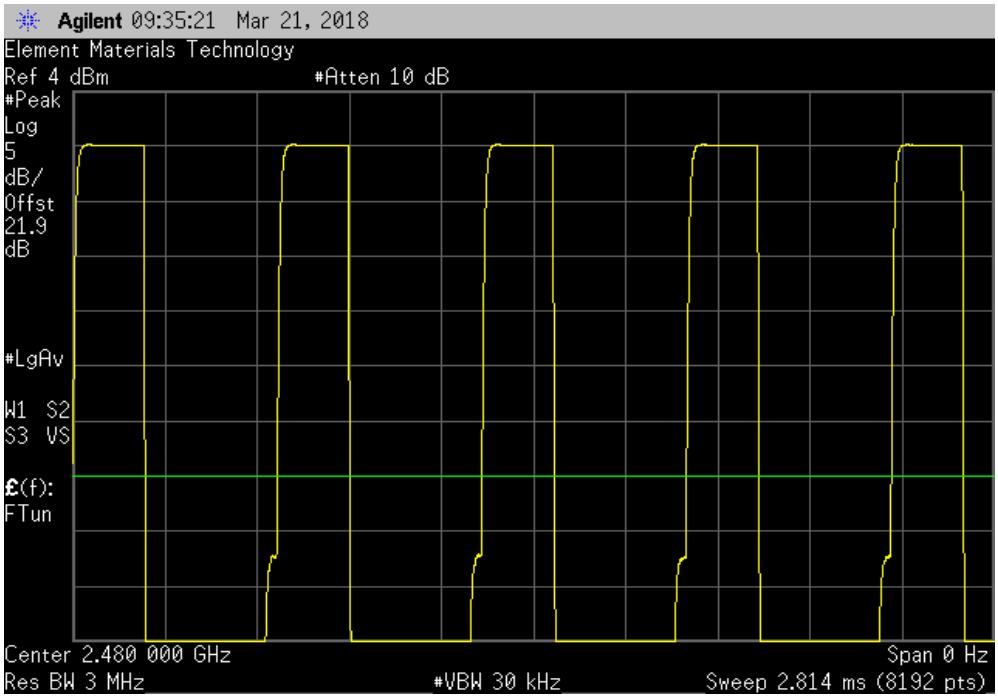
DUTY CYCLE

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK High Channel, 2480 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	219.021 us	625.259 us	1	35	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
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	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.1% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**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
BLE/GFSK Low Channel, 2402 MHz	668.351 kHz	500 kHz	Pass
BLE/GFSK Mid Channel, 2442 MHz	668.797 kHz	500 kHz	Pass
BLE/GFSK High Channel, 2480 MHz	666.374 kHz	500 kHz	Pass

OCCUPIED BANDWIDTH

TbtTx 2017.12.14 XMit 2017.12.13

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

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

OCCUPIED BANDWIDTH

TbtTx 2017.12.14 XMit 2017.12.13

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

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
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
Generator - Signal	Agilent	N5183A	TID	25-Apr-17	25-Apr-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23.1 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.3% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2018	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

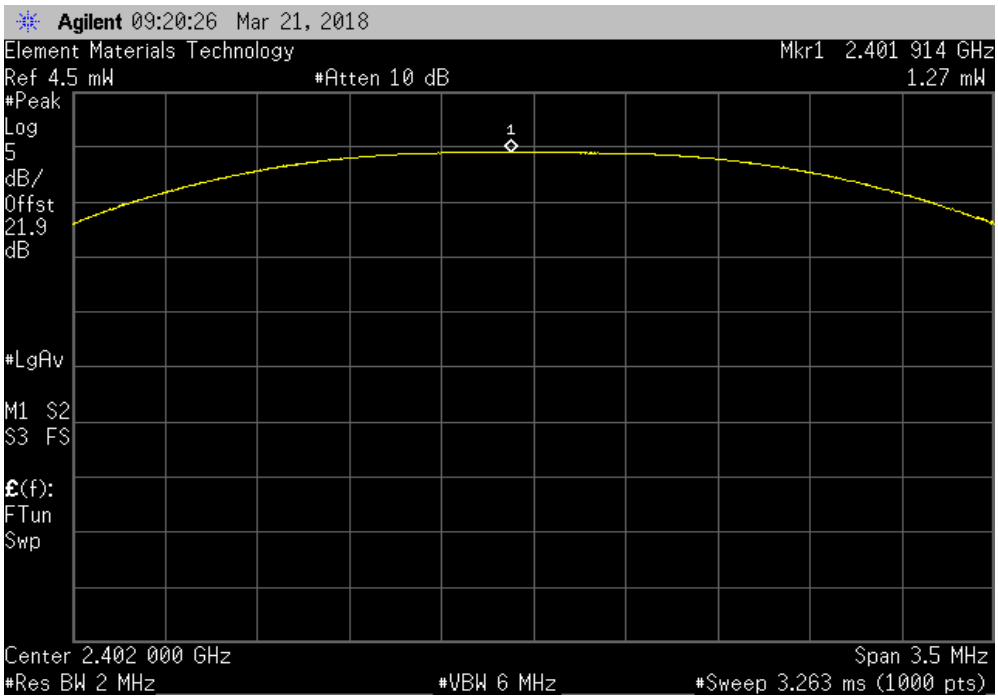
Configuration #	3	Signature

	Value	Limit (<)	Result
BLE/GFSK Low Channel, 2402 MHz	1.267 mW	1 W	Pass
BLE/GFSK Mid Channel, 2442 MHz	1.042 mW	1 W	Pass
BLE/GFSK High Channel, 2480 MHz	827.37 uW	1 W	Pass

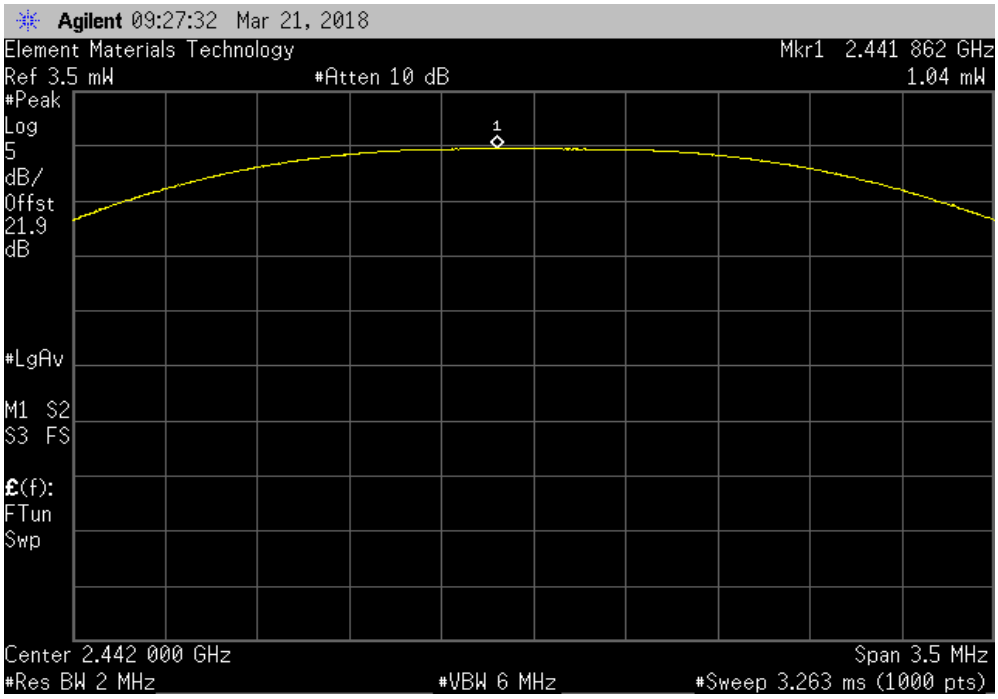
OUTPUT POWER

TbtTx 2017.12.14 XMit 2017.12.13

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



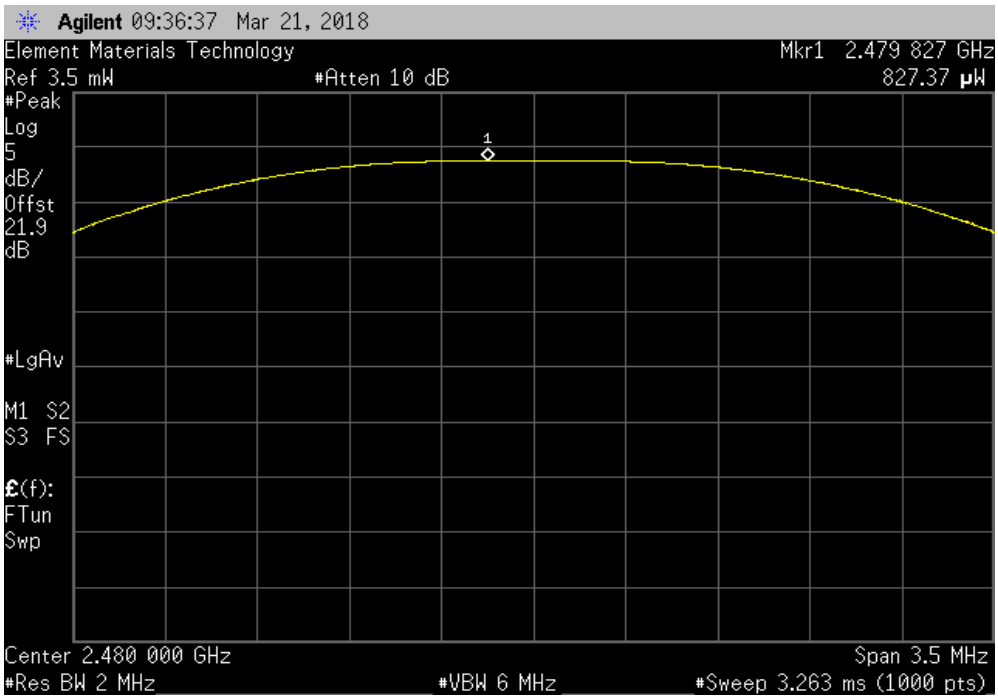
BLE/GFSK Mid Channel, 2442 MHz						
				Value	Limit (<)	Result
				1.042 mW	1 W	Pass



OUTPUT POWER

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK High Channel, 2480 MHz						
				Value	Limit (<)	Result
				827.37 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
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
Generator - Signal	Agilent	N5183A	TID	25-Apr-17	25-Apr-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23.2 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.4% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2018	ANSI C63.10:2013

COMMENTS

None

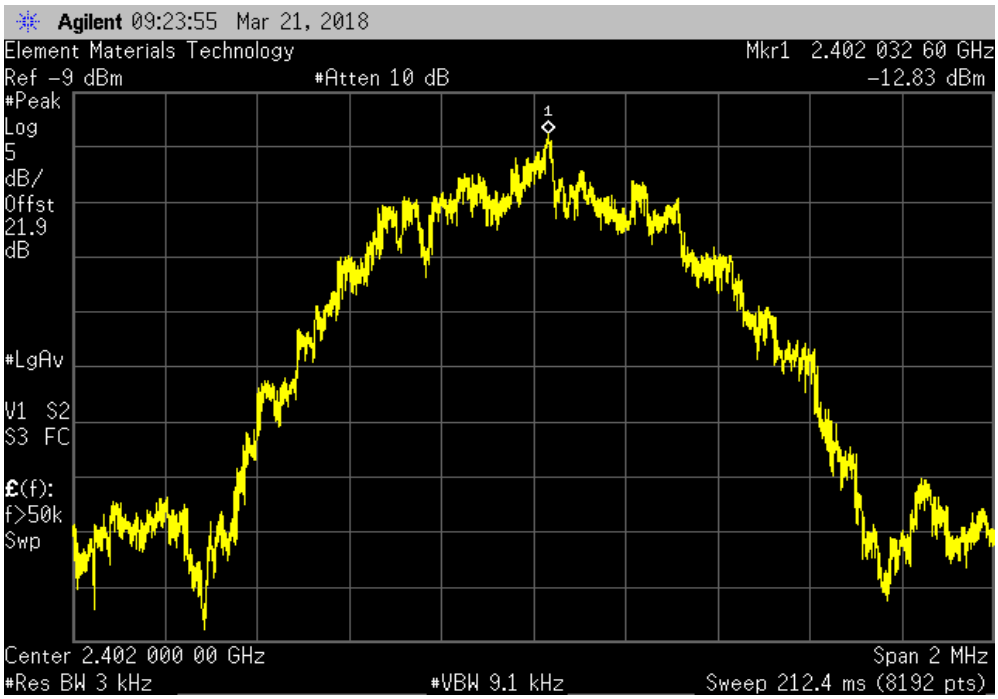
DEVIATIONS FROM TEST STANDARD

None

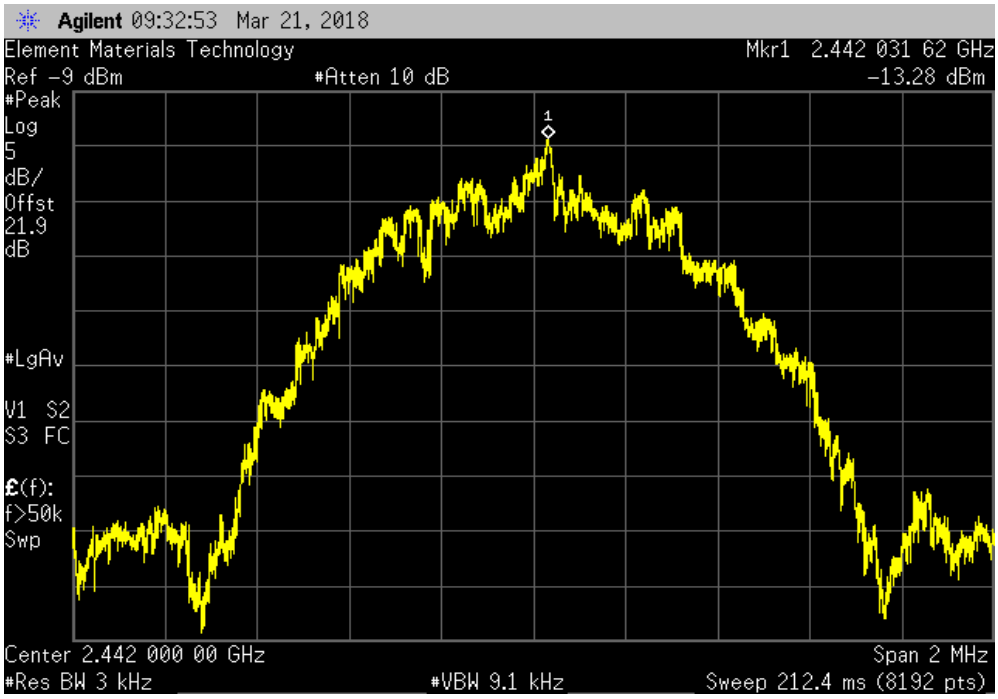
Configuration #	3	*Signature*

	Value dBm/3kHz	Limit < dBm/3kHz	Results
BLE/GFSK Low Channel, 2402 MHz	-12.826	8	Pass
BLE/GFSK Mid Channel, 2442 MHz	-13.276	8	Pass
BLE/GFSK High Channel, 2480 MHz	-13.852	8	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-12.826	8	Pass



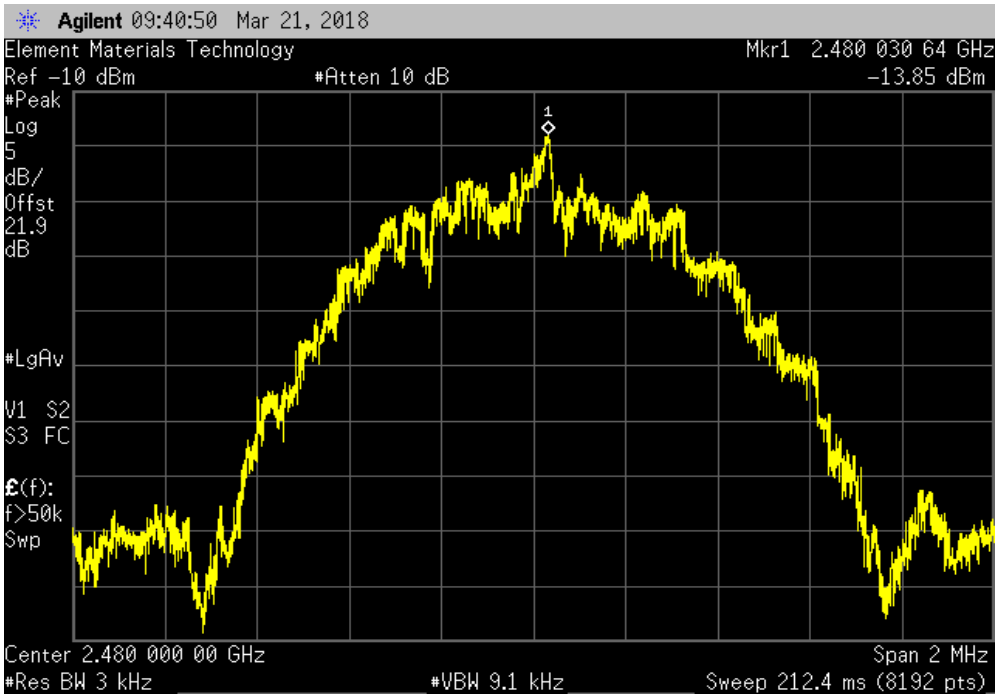
BLE/GFSK Mid Channel, 2442 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-13.276	8	Pass



POWER SPECTRAL DENSITY

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK High Channel, 2480 MHz							
					Value dBm/3kHz	Limit < dBm/3kHz	Results
					-13.852	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
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	15-Mar-18	15-Mar-19
Block - DC	Fairview Microwave	SD3379	AMI	12-Sep-17	12-Sep-18
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-18	13-Feb-19
Generator - Signal	Agilent	N5183A	TID	25-Apr-17	25-Apr-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23.1 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.3% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2018	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

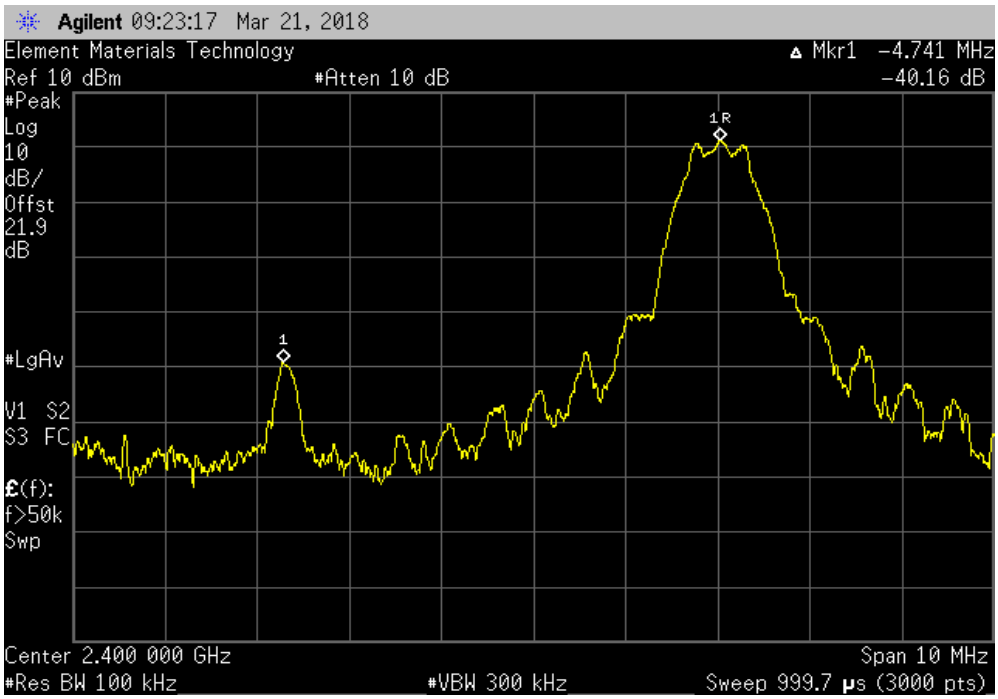
Configuration #	3	*Signature*

	Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	-40.16	-20	Pass
BLE/GFSK High Channel, 2480 MHz	-37.58	-20	Pass

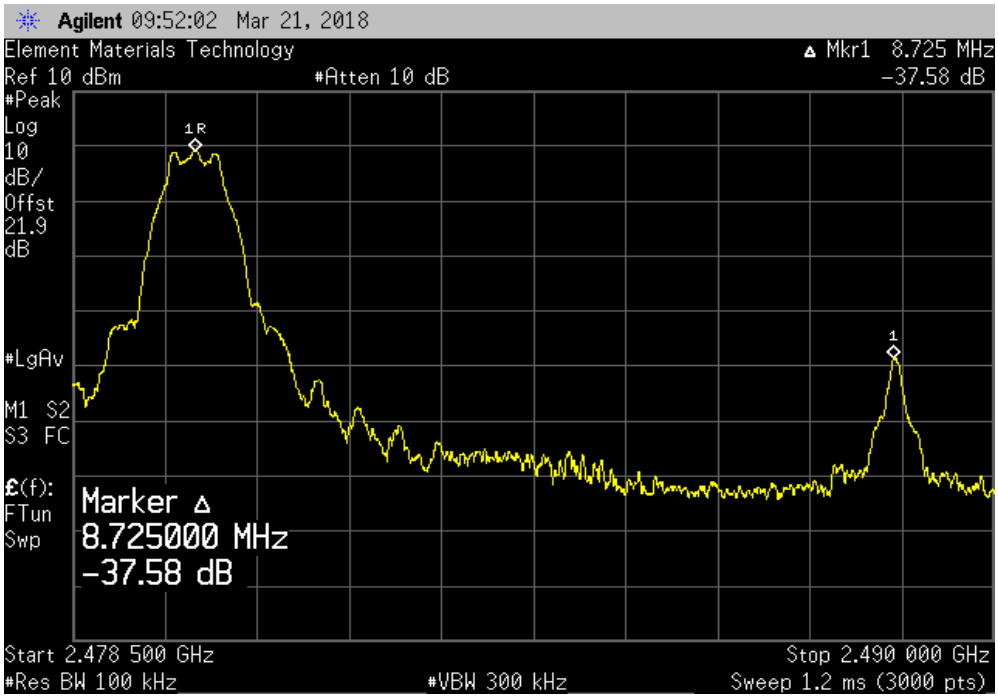
BAND EDGE COMPLIANCE

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-40.16	-20	Pass



BLE/GFSK High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-37.58	-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
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
Generator - Signal	Agilent	N5183A	TID	25-Apr-17	25-Apr-19
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2-Aug-17	2-Aug-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

TbtTx 2017.12.14 XMit 2017.12.13

EUT:	Kairos			**Work Order:**	CLRT0006
Serial Number:	2007			**Date:**	21-Mar-18
Customer:	Clearity, LLC			**Temperature:**	23.2 °C
Attendees:	Brian Dobson, Pete Salmi			**Humidity:**	20.4% RH
Project:	None			**Barometric Pres.:**	1024 mbar
Tested by:	Kyle McMullan	**Power:**	Battery	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2018	ANSI C63.10:2013

COMMENTS

None

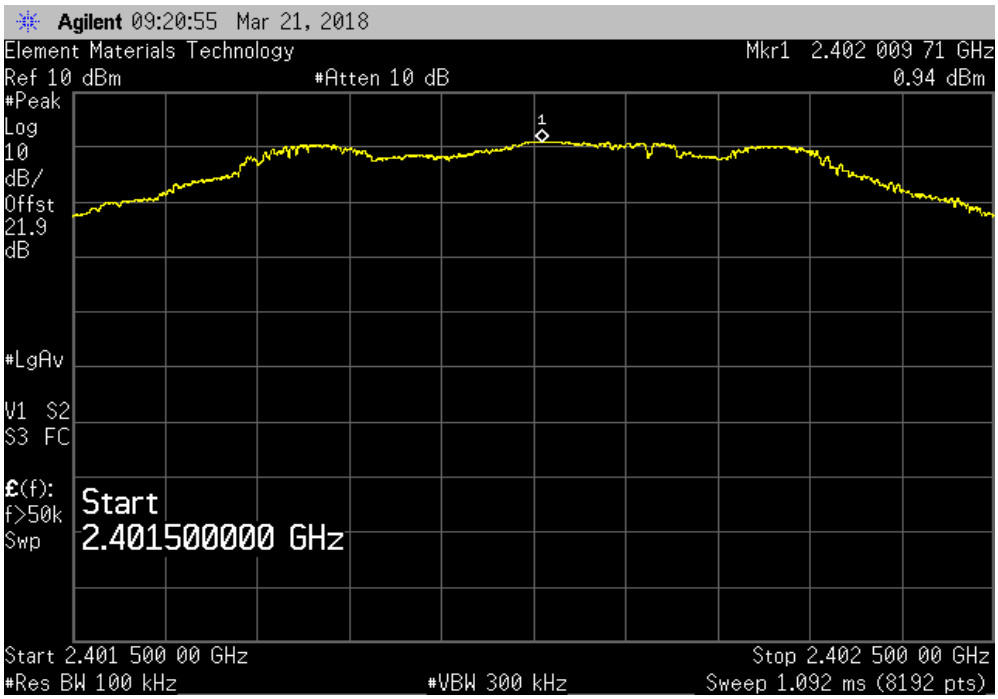
DEVIATIONS FROM TEST STANDARD

None

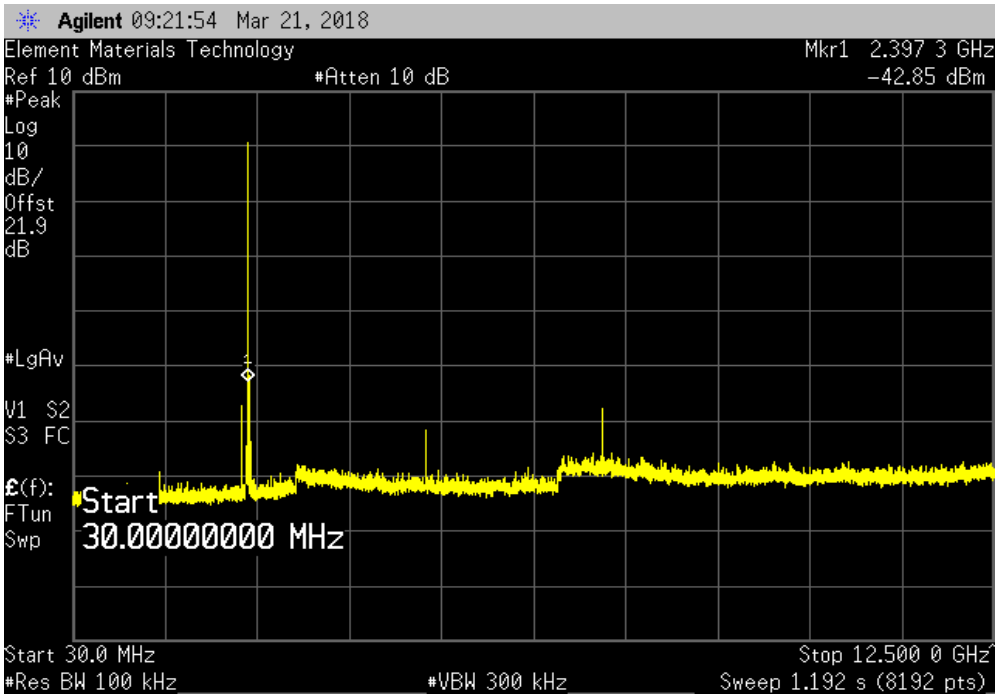
Configuration #	3	Signature

	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	-43.79	-20	Pass
BLE/GFSK Low Channel, 2402 MHz	12.5 GHz - 25 GHz	-53.03	-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	-47.37	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz	12.5 GHz - 25 GHz	-52.84	-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	-37.53	-20	Pass
BLE/GFSK High Channel, 2480 MHz	12.5 GHz - 25 GHz	-51.56	-20	Pass

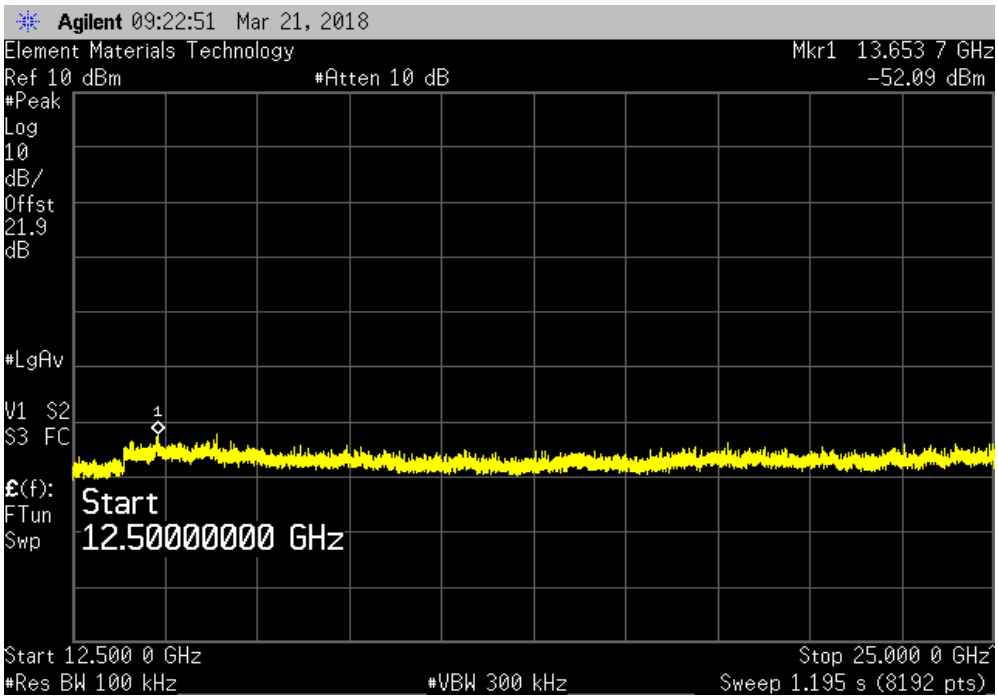
BLE/GFSK Low Channel, 2402 MHz						
	Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental			N/A	N/A	N/A



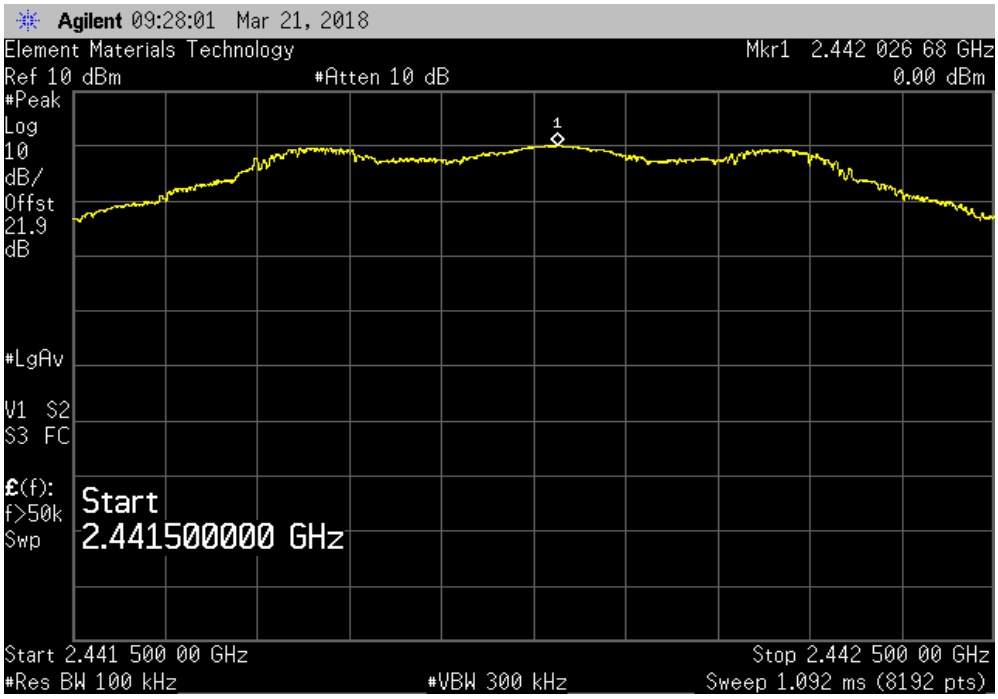
BLE/GFSK Low Channel, 2402 MHz					
Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz			-43.79	-20	Pass



BLE/GFSK Low Channel, 2402 MHz				
Frequency Range		**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz		-53.03	-20	Pass

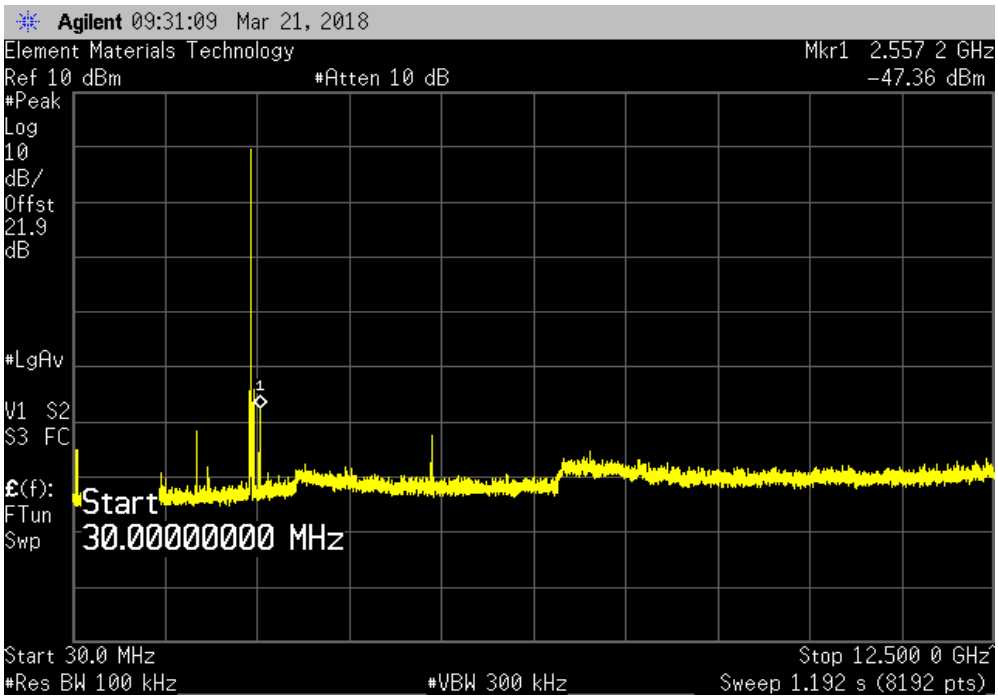


BLE/GFSK Mid Channel, 2442 MHz						
	Frequency Range			**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
	Fundamental			N/A	N/A	N/A

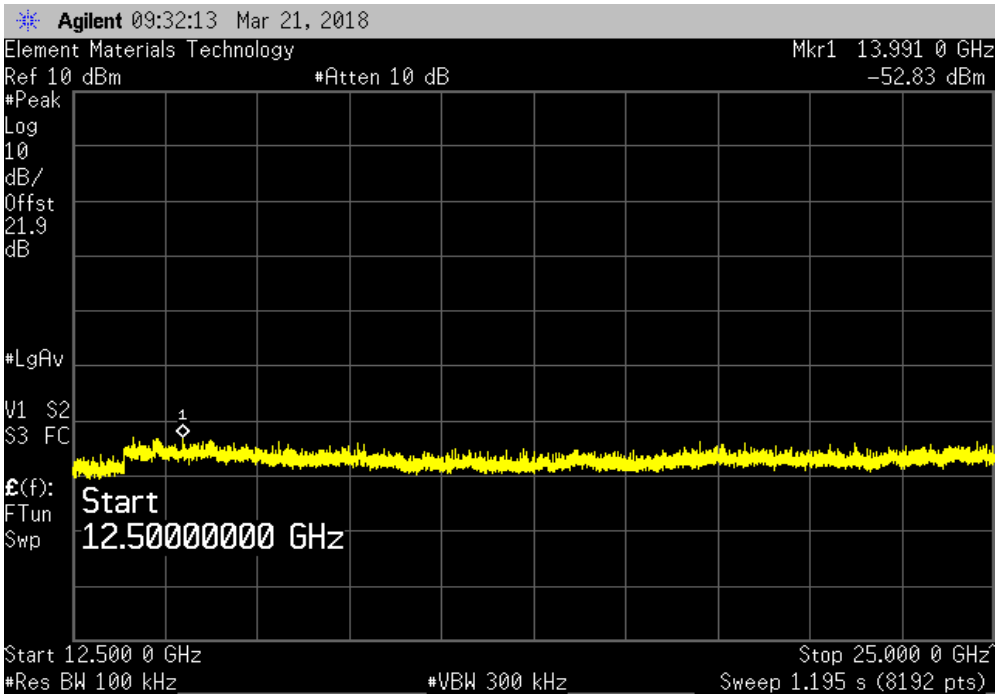


TbtTx 2017.12.14 XMit 2017.12.13

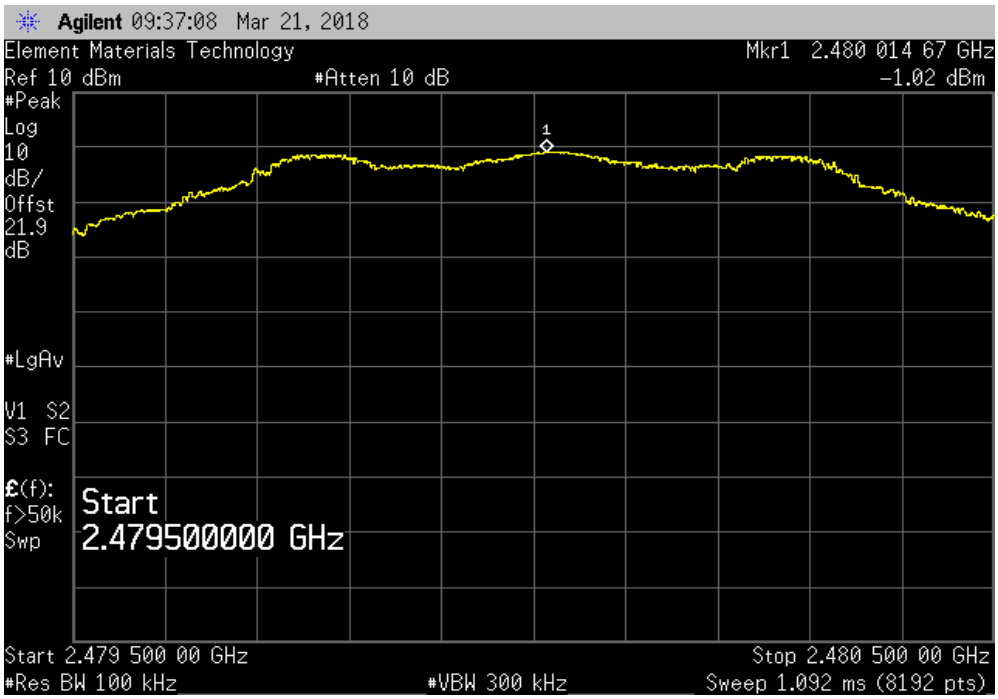
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz		-47.37	-20	Pass



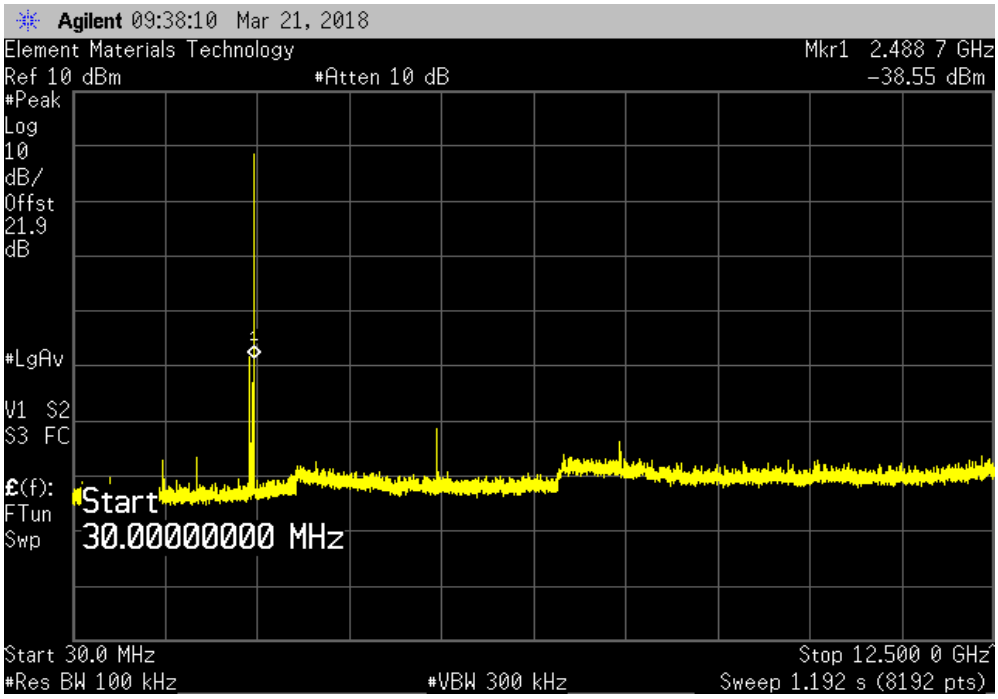
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range		Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz		-52.84	-20	Pass



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



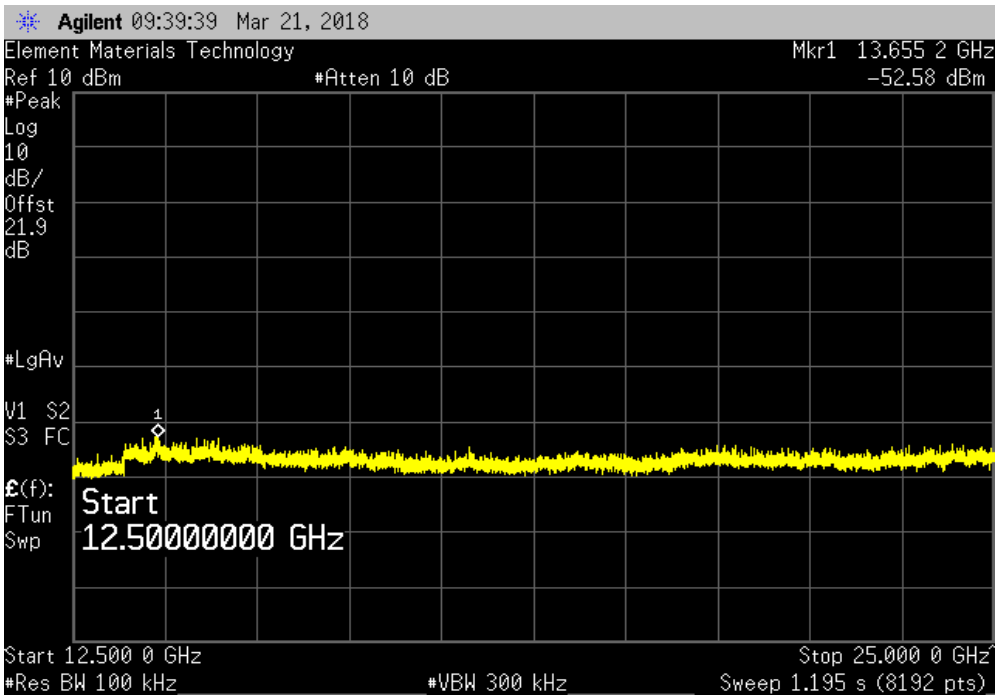
BLE/GFSK High Channel, 2480 MHz					
Frequency Range			Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz			-37.53	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

TbtTx 2017.12.14 XMit 2017.12.13

BLE/GFSK High Channel, 2480 MHz				
Frequency Range		**Max Value (dBc)**	**Limit ≤ (dBc)**	**Result**
12.5 GHz - 25 GHz		-51.56	-20	Pass



SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2017.12.19

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 (2442 MHz), and high channel (2480 MHz)

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

CLRT0006 - 1

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	20-Sep-2017	12 mo
Filter - High Pass	Micro-Tronics	HPM50111	LFN	20-Sep-2017	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFK	20-Sep-2017	12 mo
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	12-Sep-2017	12 mo
Cable	ESM Cable Corp	TTBJ141 KMKM-72	MNP	12-Sep-2017	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
Cable	ESM Cable Corp.	Standard Gain Horn Cables	MNJ	12-Jul-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
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVT	13-Feb-2018	12 mo
Cable	ESM Cable Corp.	Double Ridge Guide Horn Cables	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
Antenna - Biconilog	Teseq	CBL 6141B	AYD	25-Jan-2018	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	19-Dec-2017	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.

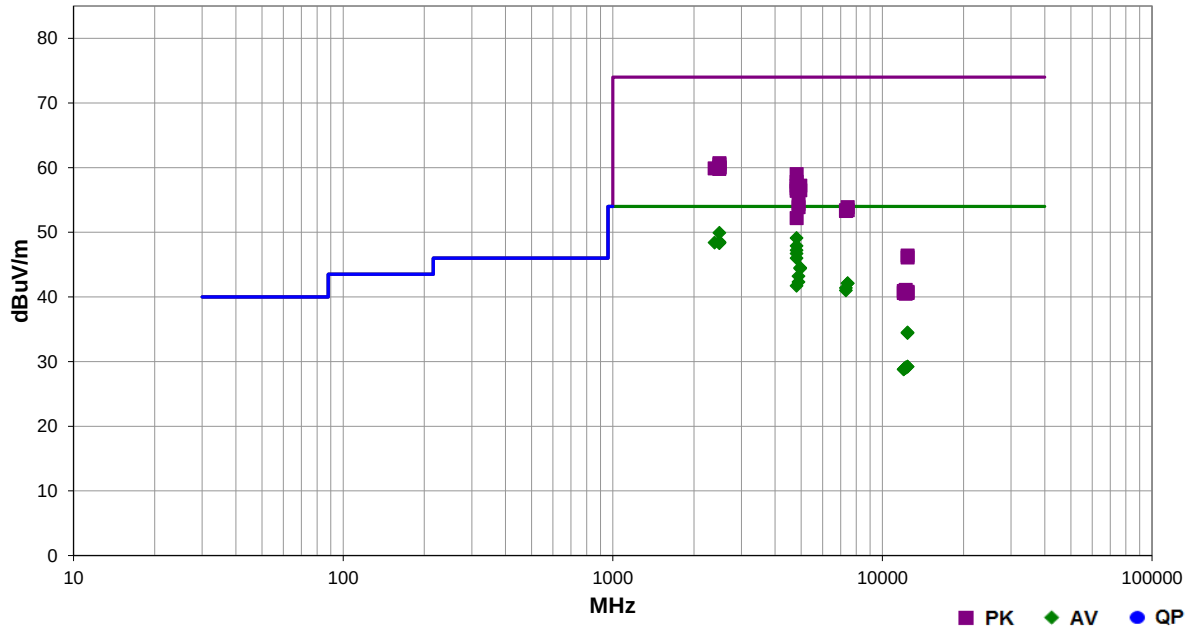
SPURIOUS RADIATED EMISSIONS

EmiR5 2018.02.06 PSA-ESCI 2017.12.19

Work Order:	CLRT0006	**Date:**	20-Mar-2018		
Project:	None	**Temperature:**	22.6 °C		
Job Site:	MN05	**Humidity:**	21.2% RH		
Serial Number:	2001	**Barometric Pres.:**	1020 mbar	**Tested by:**	Dustin Sparks
EUT:	Kairos				
Configuration:	1				
Customer:	Clearity, LLC				
Attendees:	Brian Dobson, Pete Salmi				
EUT Power:	Battery				
Operating Mode:	Transmitting BLE - low channel (2402 MHz), mid channel (2442 MHz), and high channel (2480 MHz)				
Deviations:	None				
Comments:	None				

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

Run #	12	**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
2486.950	34.1	-4.2	1.0	125.0	3.0	20.0	Vert	AV	0.0	49.9	54.0	-4.1	High ch, EUT vert
4804.017	44.1	5.0	1.4	205.0	3.0	0.0	Horz	AV	0.0	49.1	54.0	-4.9	Low ch, EUT horz
2486.067	32.7	-4.2	3.1	347.0	3.0	20.0	Horz	AV	0.0	48.5	54.0	-5.5	High ch, EUT horz
2488.383	32.6	-4.2	1.0	265.9	3.0	20.0	Vert	AV	0.0	48.4	54.0	-5.6	High ch, EUT horz
2488.308	32.6	-4.2	1.0	27.0	3.0	20.0	Horz	AV	0.0	48.4	54.0	-5.6	High ch, EUT on side
2486.033	32.6	-4.2	1.0	109.1	3.0	20.0	Vert	AV	0.0	48.4	54.0	-5.6	High ch, EUT on side
2388.208	32.4	-4.0	1.0	288.0	3.0	20.0	Vert	AV	0.0	48.4	54.0	-5.6	Low ch, EUT vert
2488.292	32.5	-4.2	1.5	8.1	3.0	20.0	Horz	AV	0.0	48.3	54.0	-5.7	High ch, EUT vert
4804.042	42.9	5.0	1.9	103.0	3.0	0.0	Horz	AV	0.0	47.9	54.0	-6.1	Low ch, EUT on side
4804.058	42.2	5.0	1.0	114.0	3.0	0.0	Vert	AV	0.0	47.2	54.0	-6.8	Low ch, EUT horz
4804.100	41.7	5.0	1.0	105.1	3.0	0.0	Vert	AV	0.0	46.7	54.0	-7.3	Low ch, EUT vert
4804.058	41.0	5.0	2.0	135.0	3.0	0.0	Horz	AV	0.0	46.0	54.0	-8.0	Low ch, EUT vert
4960.050	38.8	5.7	1.0	129.0	3.0	0.0	Horz	AV	0.0	44.5	54.0	-9.5	High ch, EUT horz
4960.125	38.7	5.7	1.0	142.1	3.0	0.0	Vert	AV	0.0	44.4	54.0	-9.6	High ch, EUT horz
4884.058	37.8	5.4	1.0	217.1	3.0	0.0	Vert	AV	0.0	43.2	54.0	-10.8	Mid ch, EUT horz
4884.050	36.9	5.4	1.9	300.9	3.0	0.0	Horz	AV	0.0	42.3	54.0	-11.7	Mid ch, EUT horz
7441.042	31.2	10.9	1.0	173.1	3.0	0.0	Horz	AV	0.0	42.1	54.0	-11.9	High ch, EUT horz
7439.392	31.2	10.9	1.0	325.0	3.0	0.0	Vert	AV	0.0	42.1	54.0	-11.9	High ch, EUT horz

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
4804.008	36.7	5.0	1.5	203.1	3.0	0.0	Vert	AV	0.0	41.7	54.0	-12.3	Low ch, EUT on side
7325.775	30.9	10.5	2.8	250.9	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	Mid ch, EUT horz
7327.617	30.5	10.5	3.0	198.0	3.0	0.0	Vert	AV	0.0	41.0	54.0	-13.0	Mid ch, EUT horz
2486.483	44.9	-4.2	1.5	8.1	3.0	20.0	Horz	PK	0.0	60.7	74.0	-13.3	High ch, EUT vert
2485.650	44.7	-4.2	1.0	265.9	3.0	20.0	Vert	PK	0.0	60.5	74.0	-13.5	High ch, EUT horz
2485.500	44.3	-4.2	1.0	27.0	3.0	20.0	Horz	PK	0.0	60.1	74.0	-13.9	High ch, EUT on side
2484.833	44.2	-4.2	1.0	125.0	3.0	20.0	Vert	PK	0.0	60.0	74.0	-14.0	High ch, EUT vert
2483.792	44.2	-4.2	1.0	109.1	3.0	20.0	Vert	PK	0.0	60.0	74.0	-14.0	High ch, EUT on side
2387.117	43.9	-4.0	1.0	288.0	3.0	20.0	Vert	PK	0.0	59.9	74.0	-14.1	Low ch, EUT vert
2483.558	44.0	-4.2	3.1	347.0	3.0	20.0	Horz	PK	0.0	59.8	74.0	-14.2	High ch, EUT horz
4804.342	54.0	5.0	1.4	205.0	3.0	0.0	Horz	PK	0.0	59.0	74.0	-15.0	Low ch, EUT horz
4804.158	52.8	5.0	1.9	103.0	3.0	0.0	Horz	PK	0.0	57.8	74.0	-16.2	Low ch, EUT on side
4804.133	52.2	5.0	1.0	114.0	3.0	0.0	Vert	PK	0.0	57.2	74.0	-16.8	Low ch, EUT horz
4960.442	51.5	5.7	1.0	129.0	3.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	High ch, EUT horz
4804.383	51.8	5.0	1.0	105.1	3.0	0.0	Vert	PK	0.0	56.8	74.0	-17.2	Low ch, EUT vert
4960.275	50.8	5.7	1.0	142.1	3.0	0.0	Vert	PK	0.0	56.5	74.0	-17.5	High ch, EUT horz
4804.067	51.4	5.0	2.0	135.0	3.0	0.0	Horz	PK	0.0	56.4	74.0	-17.6	Low ch, EUT vert
12401.680	29.6	4.9	1.0	205.0	3.0	0.0	Vert	AV	0.0	34.5	54.0	-19.5	High ch, EUT horz
4884.508	49.0	5.4	1.0	217.1	3.0	0.0	Vert	PK	0.0	54.4	74.0	-19.6	Mid ch, EUT horz
12400.220	29.5	4.9	1.0	64.0	3.0	0.0	Horz	AV	0.0	34.4	54.0	-19.6	High ch, EUT horz
4884.433	48.5	5.4	1.9	300.9	3.0	0.0	Horz	PK	0.0	53.9	74.0	-20.1	Mid ch, EUT horz
7441.208	43.0	10.9	1.0	325.0	3.0	0.0	Vert	PK	0.0	53.9	74.0	-20.1	High ch, EUT horz
7324.108	42.9	10.5	3.0	198.0	3.0	0.0	Vert	PK	0.0	53.4	74.0	-20.6	Mid ch, EUT horz
7441.833	42.5	10.9	1.0	173.1	3.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6	High ch, EUT horz
7327.833	42.8	10.5	2.8	250.9	3.0	0.0	Horz	PK	0.0	53.3	74.0	-20.7	Mid ch, EUT horz
4804.367	47.2	5.0	1.5	203.1	3.0	0.0	Vert	PK	0.0	52.2	74.0	-21.8	Low ch, EUT on side
12398.340	29.6	-0.4	2.9	124.1	3.0	0.0	Horz	AV	0.0	29.2	54.0	-24.8	High ch, EUT horz
12398.650	29.6	-0.4	1.6	163.1	3.0	0.0	Vert	AV	0.0	29.2	54.0	-24.8	High ch, EUT horz
12209.310	30.2	-1.1	3.6	235.0	3.0	0.0	Vert	AV	0.0	29.1	54.0	-24.9	Mid ch, EUT horz
12207.800	30.1	-1.1	1.0	282.0	3.0	0.0	Horz	AV	0.0	29.0	54.0	-25.0	Mid ch, EUT horz
12010.800	30.2	-1.4	1.0	348.9	3.0	0.0	Horz	AV	0.0	28.8	54.0	-25.2	Low ch, EUT horz
12012.130	30.2	-1.4	1.0	221.1	3.0	0.0	Vert	AV	0.0	28.8	54.0	-25.2	Low ch, EUT horz
12402.440	41.5	4.9	1.0	205.0	3.0	0.0	Vert	PK	0.0	46.4	74.0	-27.6	High ch, EUT horz
12400.880	41.2	4.9	1.0	64.0	3.0	0.0	Horz	PK	0.0	46.1	74.0	-27.9	High ch, EUT horz
12207.850	42.2	-1.1	1.0	282.0	3.0	0.0	Horz	PK	0.0	41.1	74.0	-32.9	Mid ch, EUT horz
12011.300	42.3	-1.4	1.0	348.9	3.0	0.0	Horz	PK	0.0	40.9	74.0	-33.1	Low ch, EUT horz
12398.080	41.2	-0.4	2.9	124.1	3.0	0.0	Horz	PK	0.0	40.8	74.0	-33.2	High ch, EUT horz
12398.900	41.0	-0.4	1.6	163.1	3.0	0.0	Vert	PK	0.0	40.6	74.0	-33.4	High ch, EUT horz
12008.210	42.0	-1.4	1.0	221.1	3.0	0.0	Vert	PK	0.0	40.6	74.0	-33.4	Low ch, EUT horz
12208.180	41.6	-1.1	3.6	235.0	3.0	0.0	Vert	PK	0.0	40.5	74.0	-33.5	Mid ch, EUT horz