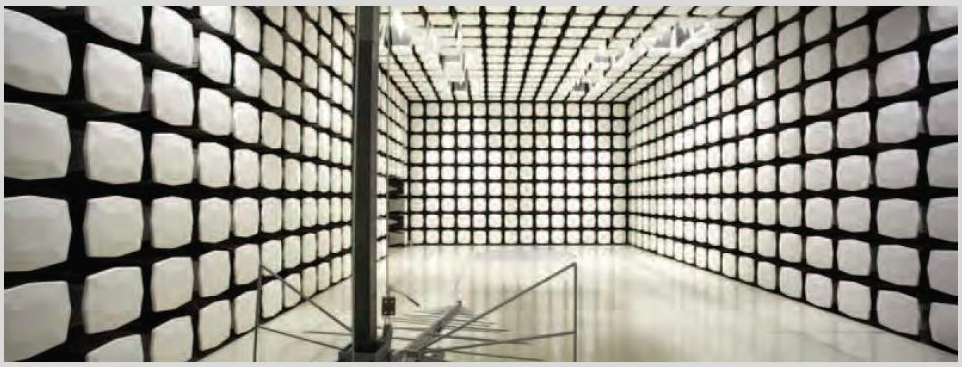
Reelables Inc.

A-Label/0001

FCC 15.249:2022
Bluetooth Radio

Report: RENC0001, Issue Date: August 1, 2022



CERTIFICATE OF TEST

Last Date of Test: July 1, 2022
Reelables Inc.
EUT: A-Label/0001

Radio Equipment Testing

Standards

Specification	Method
FCC 15.249:2022	ANSI C63.10:2013

Results

Test Description	Result	Specification Section(s)	Method Section(s)	Comments
Duty Cycle	Pass	N/A	7.5	
Emissions Bandwidth (20 dB)	Pass	15.215(c)	6.9.3	
Field Strength of Fundamental	Pass	15.249(a),(c-e)	6.6	
Field Strength of Harmonics and Spurious Radiated Emissions	Pass	15.249(a), (c-e)	6.5, 6.6	
Powerline Conducted Emissions	N/A	15.207	6.2	Not required for a battery powered EUT.
Powerline Conducted Emissions (Receiver)	N/A	15.107	ANSI C63.4 - 12.2.4	Not required for a battery powered device.
Radiated Emissions for Receiver	N/A	FCC 15.101, 15.109	ANSI C63.4 - 12.2.5	Not required.

Deviations From Test Standards

None

Approved By:

Cole Ghizzone, Department 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. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

element
2021.09.01

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 - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

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

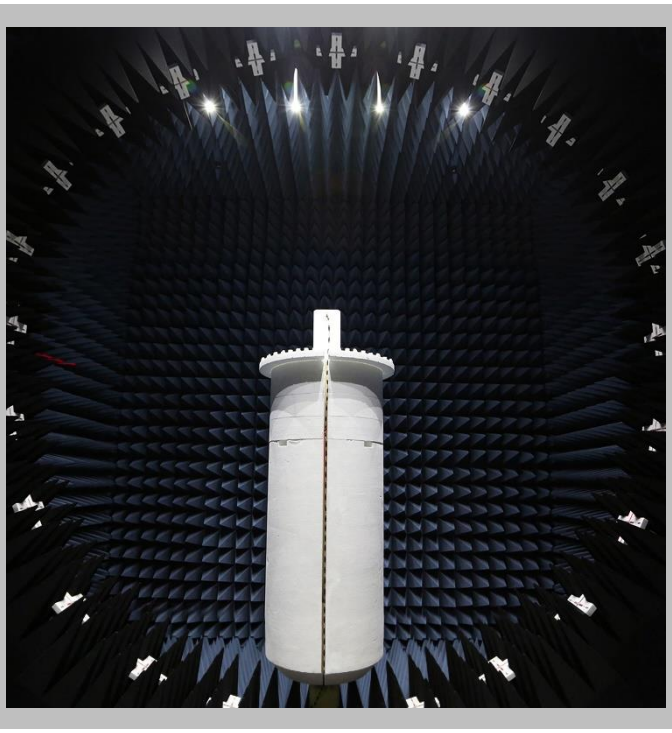
For details on the Scopes of our Accreditations, please visit:

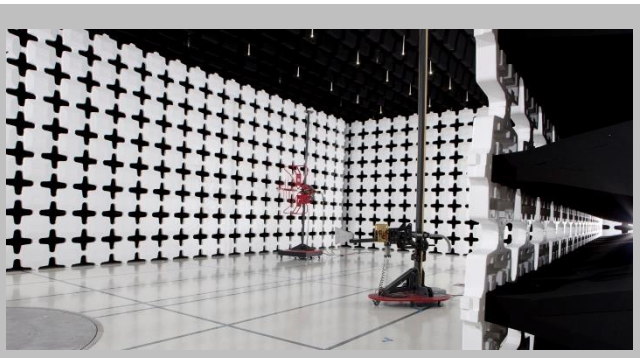
California Minnesota Oregon Texas Washington

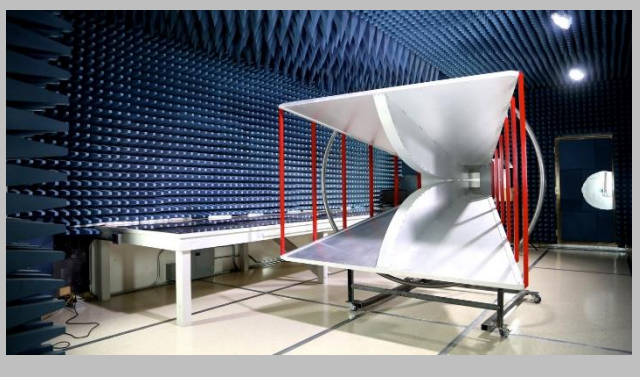
FACILITIES

element
2020.12.15

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	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
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

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 in the table below. A lab specific value may also be found in the applicable test description section. 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	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 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)	3.2 dB	-3.2 dB

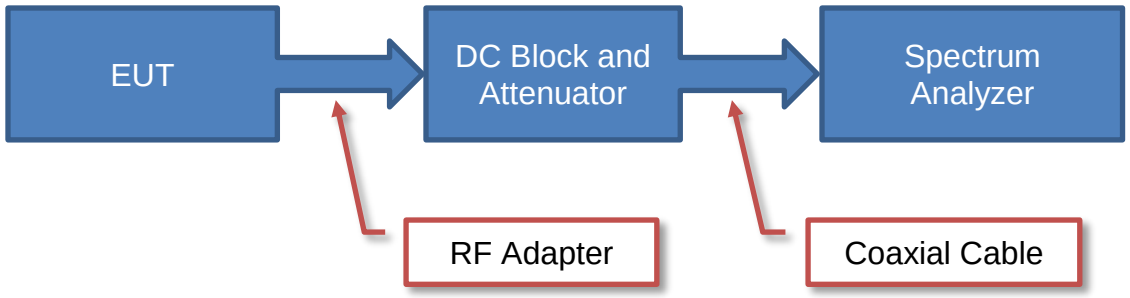
TEST SETUP BLOCK DIAGRAMS

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

Unless otherwise stated, measurements were made using the bandwidths and detectors specified. No video filter was used.

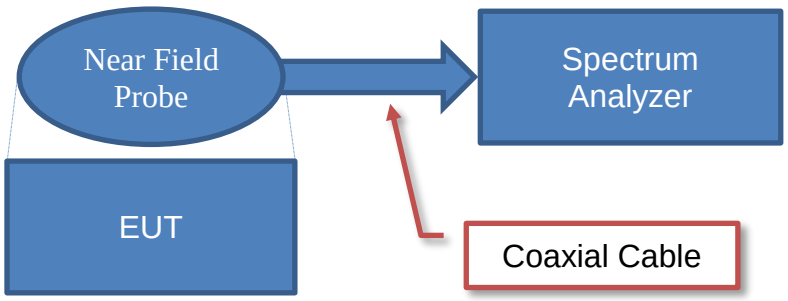
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

Near Field Test Fixture Measurements

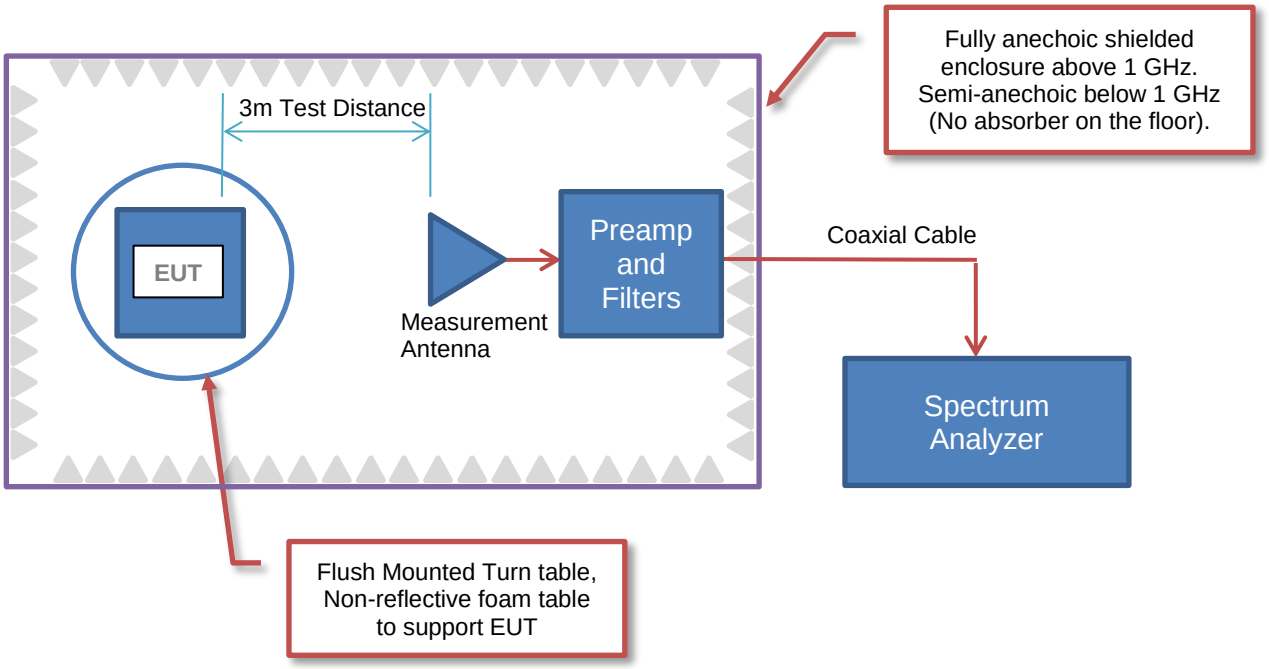


Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

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

Conducted Emissions:

Measured Level (Amplitude)		Factor: Transducer Factor		Factor: Cable Factor		External Attenuation		Adjusted Level
26.7	+	0.3	+	0.1	+	20.0	=	**47.1**

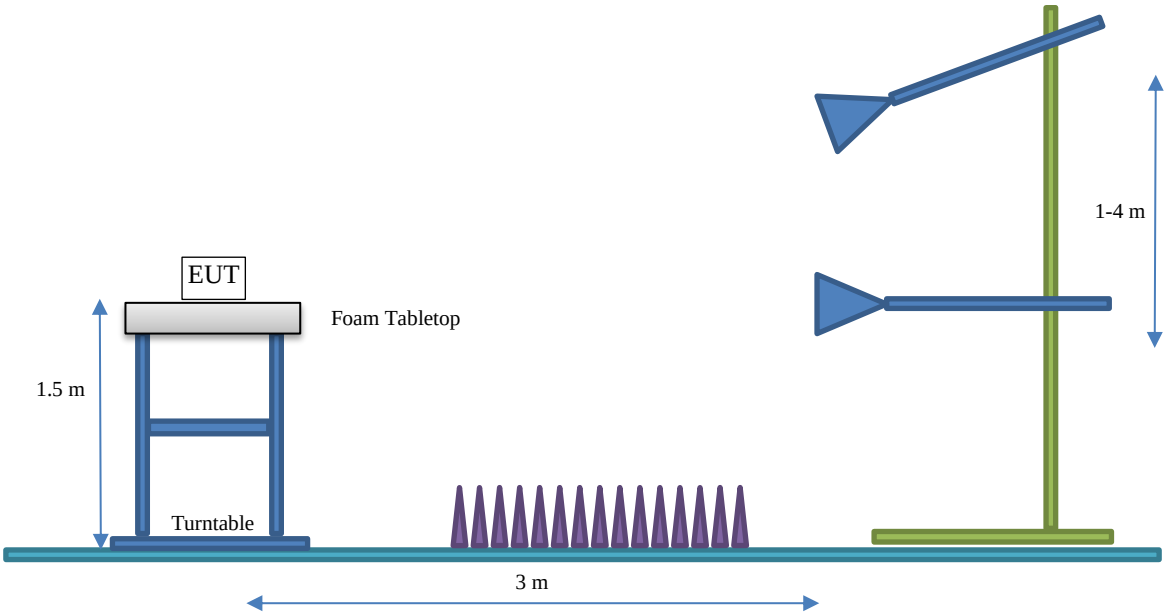
Radiated Power (ERP/EIRP) – Substitution Method:

Measured Level into Substitution Antenna (Amplitude dBm)		Substitution Antenna Factor (dBi)		EIRP to ERP (if applicable)		Measured power (dBm ERP/EIRP)
10.0	+	6.0	-	2.15	=	**13.9/16.0**

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. Above 1 GHz, when required by the measurement standard, the antenna is pointed for both azimuth and elevation to maintain the receive antenna within the cone of radiation from the EUT. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.



PRODUCT DESCRIPTION

Client and Equipment under Test (EUT) Information

Company Name:	Reelables Inc.
Address:	113 Cherry St. 76660
City, State, Zip:	Seattle, WA 98104-2205 USA
Test Requested By:	Brian Krejcarek
EUT:	A-Label/0001
First Date of Test:	June 29, 2022
Last Date of Test:	July 1, 2022
Receipt Date of Samples:	June 29, 2022
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Thin-film sticker with BLE Beacon operating on advertising channels only.

Testing Objective:
To demonstrate compliance of the Bluetooth radio to FCC 15.249 requirements.

POWER SETTINGS AND ANTENNAS

The power settings, antenna gain value(s) and cable loss (if applicable) used for the testing contained in this report were provided by the customer and will affect the validity of the results. Element assumes no responsibility for the accuracy of this information. The power settings below reflect the maximum power that the EUT is allowed to transmit at during normal operation.

ANTENNA GAIN (dBi)

Type	Provided by:	Frequency Range (MHz)	Gain (dBi)
Meandered ¼ wave monopole	Manufacturer	2400 - 2500	-2.3

The EUT was tested using the power settings provided by the manufacturer which were based upon:

x Test software settings Test software/firmware installed on EUT: 6.0.16.1144 and 5.0.20.4060
☐ Rated power settings

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types / Data Rates	Type	Channel	Frequency (MHz)	Power Setting (dBm)
BLE / GFSK, 1Mbps	DTS	37	2402	0
		38	2426	
		39	2480	

CONFIGURATIONS

Configuration RENC0001- 1

Software/Firmware Running During Test	
Description	**Version**
Radio Control Firmware	6.0.16.1144
Dialog Semiconductor - Smart Snippets	5.0.20.4060

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Bluetooth Beacon (2402 MHz)	Reelables Inc.	A-Label / 0001	04A56032
Bluetooth Beacon (2402 MHz)	Reelables Inc.	A-Label / 0001	04AB6032
Bluetooth Beacon (2426 MHz)	Reelables Inc.	A-Label / 0001	049E6032
Bluetooth Beacon (2426 MHz)	Reelables Inc.	A-Label / 0001	04756032
Bluetooth Beacon (2480 MHz)	Reelables Inc.	A-Label / 0001	04CA6032
Bluetooth Beacon (2480 MHz)	Reelables Inc.	A-Label / 0001	04A16032

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	XPS 15 9510	7VJ99K3-17144272803

Configuration RENC0001- 2

Software/Firmware Running During Test	
Description	**Version**
Firmware	2.3.4

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Bluetooth Beacon (2402, 2426, 2480 MHz)	Reelables Inc.	A-Label / 0001	04E65032

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2022-06-29	Field Strength of Harmonics and 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	2022-06-29	Field strength of Fundamental	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	2022-06-30	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.
4	2022-07-01	Emissions Bandwidth (20dB)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

DUTY CYCLE

XMit 2022.02.07.0

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
Probe - Near Field Set	EMCO	7405	IPD	NCR	NCR
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2021-12-05	2022-12-05
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2021-12-09	2022-12-09

TEST DESCRIPTION

A near-field probe was placed near the transmitter. A low-loss coaxial cable was used to connect the near-field probe to the 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.

DUTY CYCLE

XMit 2022.02.07.0

EUT:	A-Label/0001			Work Order:	RENC0001
Serial Number:	04E65032			Date:	30-Jun-22
Customer:	Reelables Inc.			Temperature:	22.8 °C
Attendees:	Brian Krejcarek			Humidity:	49.1% RH
Project:	None			Barometric Pres.:	1020 mbar
Tested by:	Jeff Alcoke	Power:	Battery	Job Site:	EV01

TEST SPECIFICATIONS	Test Method
FCC 15.249:2022	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

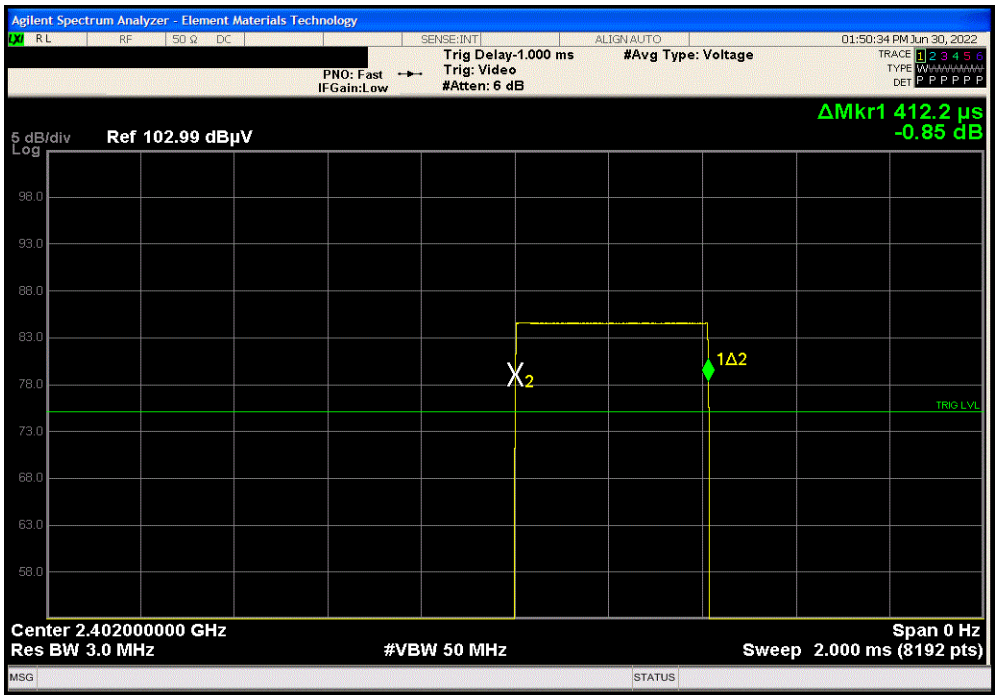
Configuration #	2	Signature

		Value (mS)	Duty Cycle (%)	Limit	Result
BLE/GFSK 1 Mbps					
	Low Ch, 2402 MHz				
	Pulse Width	0.412	-	-	-
	Period	10010	-	-	-
	Calculation	-	0.00004	-	-
	Mid Ch, 2426 MHz				
	Pulse Width	0.413	-	-	-
	Period	10010	-	-	-
	Calculation	-	0.00004	-	-
	High Ch, 2480 MHz				
	Pulse Width	0.413	-	-	-
	Period	10000	-	-	-
	Calculation	-	0.00004	-	-

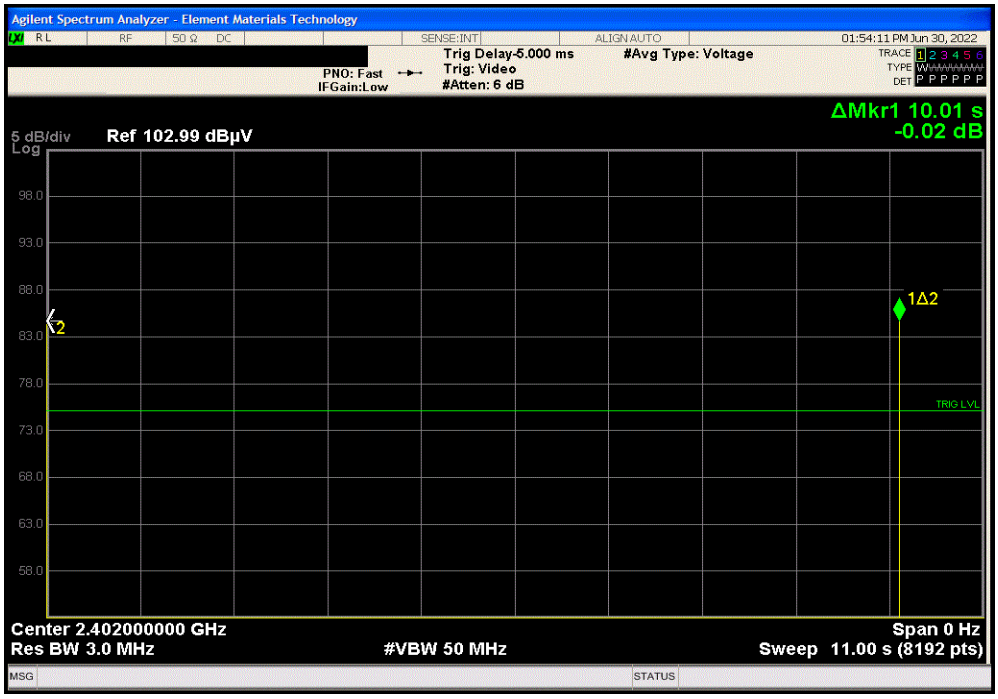
DUTY CYCLE

XMit 2022.02.07.0

BLE/GFSK 1 Mbps, Low Ch, 2402 MHz, Pulse Width						
			Value (mS)	Duty Cycle (%)	Limit	Result
			0.412	-	-	-



BLE/GFSK 1 Mbps, Low Ch, 2402 MHz, Period						
			Value (mS)	Duty Cycle (%)	Limit	Result
			10010	-	-	-



DUTY CYCLE

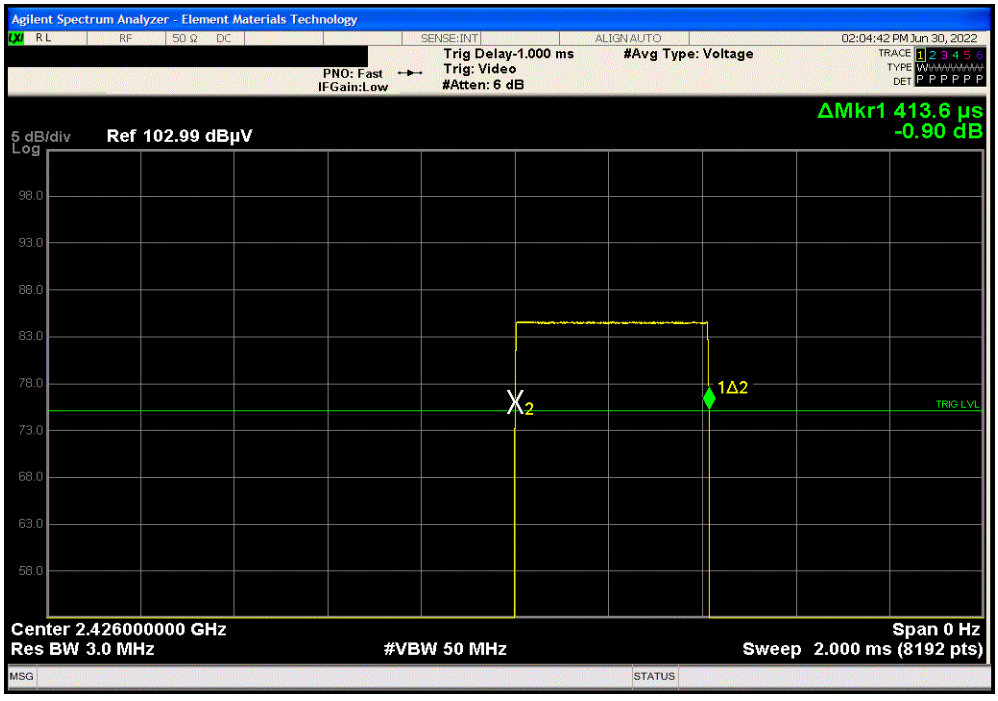
XMit 2022.02.07.0

BLE/GFSK 1 Mbps, Low Ch, 2402 MHz, Calculation						
			Value (mS)	Duty Cycle (%)	Limit	Result
			-	0.00004	-	-

Calculation Only

No Screen Capture Required

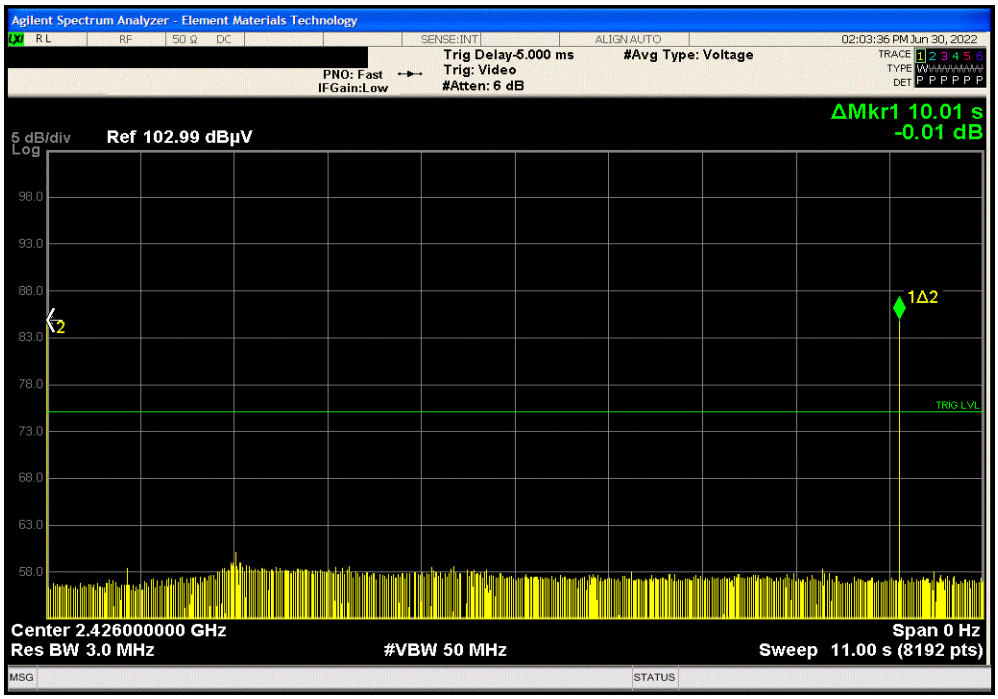
BLE/GFSK 1 Mbps, Mid Ch, 2426 MHz, Pulse Width						
			Value (mS)	Duty Cycle (%)	Limit	Result
			0.413	-	-	-



DUTY CYCLE

XMit 2022.02.07.0

BLE/GFSK 1 Mbps, Mid Ch, 2426 MHz, Period						
			Value (mS)	Duty Cycle (%)	Limit	Result
			10010	-	-	-



BLE/GFSK 1 Mbps, Mid Ch, 2426 MHz, Calculation						
			Value (mS)	Duty Cycle (%)	Limit	Result
			-	0.00004	-	-

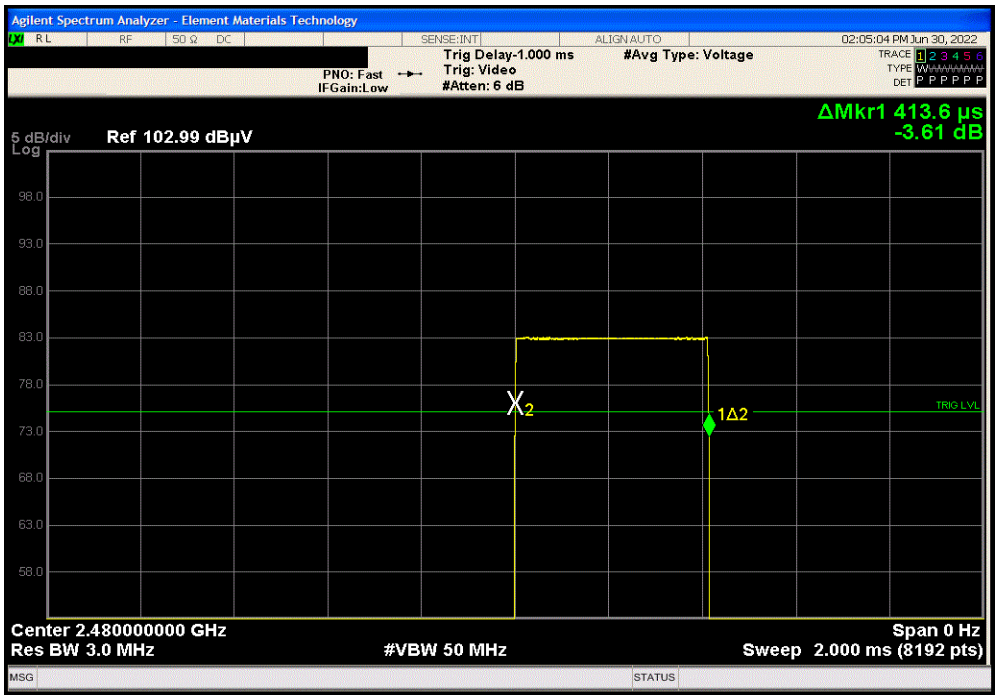
Calculation Only

No Screen Capture Required

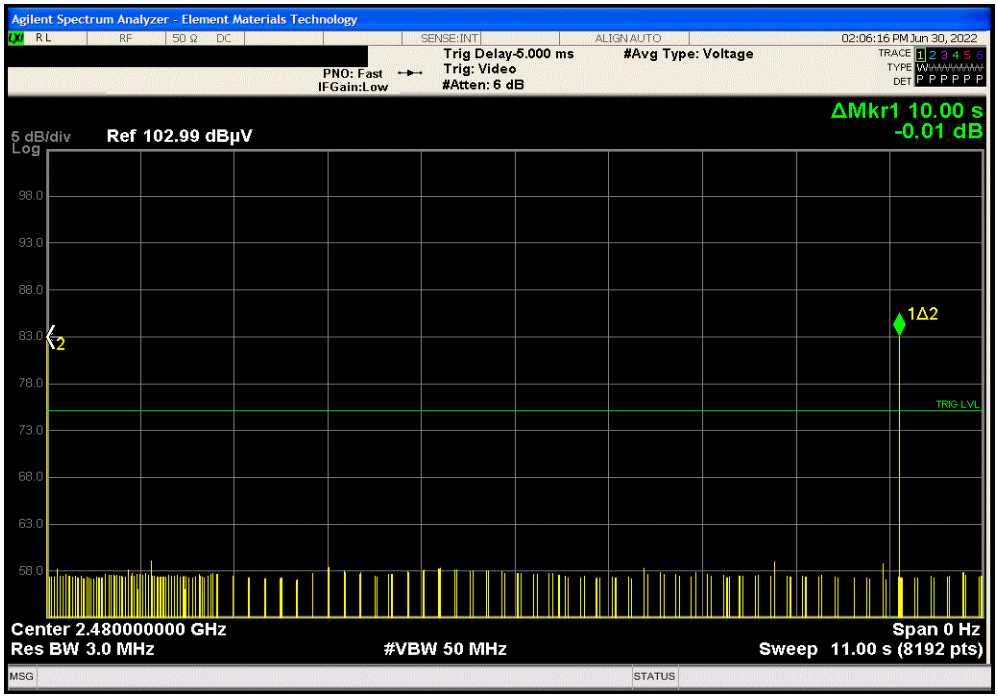
DUTY CYCLE

XMit 2022.02.07.0

BLE/GFSK 1 Mbps, High Ch, 2480 MHz, Pulse Width						
			Value (mS)	Duty Cycle (%)	Limit	Result
			0.413	-	-	-



BLE/GFSK 1 Mbps, High Ch, 2480 MHz, Period						
			Value (mS)	Duty Cycle (%)	Limit	Result
			10000	-	-	-



DUTY CYCLE

BLE/GFSK 1 Mbps, High Ch, 2480 MHz, Calculation							
				Value (mS)	Duty Cycle (%)	Limit	Result
				-	0.00004	-	-

Calculation Only

No Screen Capture Required

EMISSIONS BANDWIDTH (20 dB)

XMit 2022.02.07.0

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
Attenuator	Coaxicom	3910-10	AWX	2022-02-10	2023-02-10
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	2022-05-03	2023-05-03
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2021-12-09	2022-12-09
Cable	N/A	Double Ridge Horn Cables	EVB	2022-05-03	2023-05-03
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	2022-03-02	2024-03-02
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2021-12-09	2022-12-09

TEST DESCRIPTION

The measurement was made in a radiated configuration of the fundamental with the carrier fully maximized for its highest radiated power.

The 20 dB Emissions Bandwidth was measured with the EUT configured for continuous modulated operation.

Per ANSI C63.10:2013, 6.9.3, the spectrum analyzer was configured as follows:

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) of the spectrum analyzer was set to the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) bandwidth was set to at least 3 times the resolution bandwidth. The analyzer sweep time was set to auto to prevent video filtering or averaging. A peak detector was used.

The spectrum analyzer occupied bandwidth measurement function was used to obtain the 20 dB bandwidth.

EMISSIONS BANDWIDTH (20 dB)

element

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	**A-Label/0001**			**Work Order:**	**RENC0001**
Serial Number:	**See configuration**			**Date:**	**1-Jul-22**
Customer:	**Reelables Inc.**			**Temperature:**	**21.9 °C**
Attendees:	**Brian Krejcarek**			**Humidity:**	**51.9% RH**
Project:	**None**			**Barometric Pres.:**	**1022 mbar**
Tested by:	**Jeff Alcoke**	**Power:**	**Battery**	**Job Site:**	**EV01**

TEST SPECIFICATIONS	**Test Method**
FCC 15.249:2022	**ANSI C63.10:2013**

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

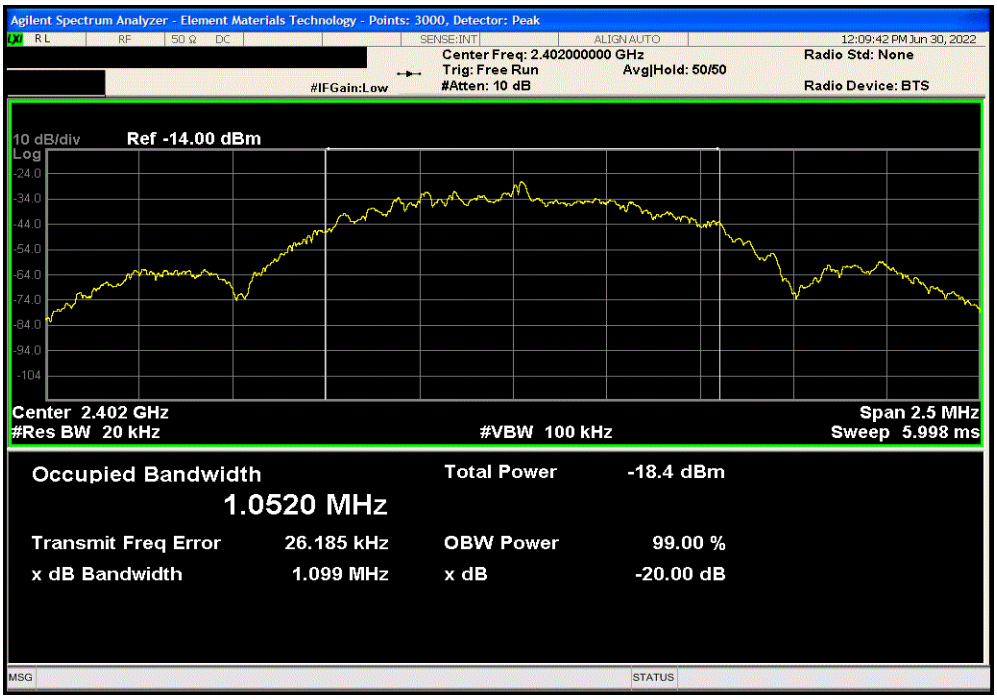
None

Configuration #	**1**	*Signature*

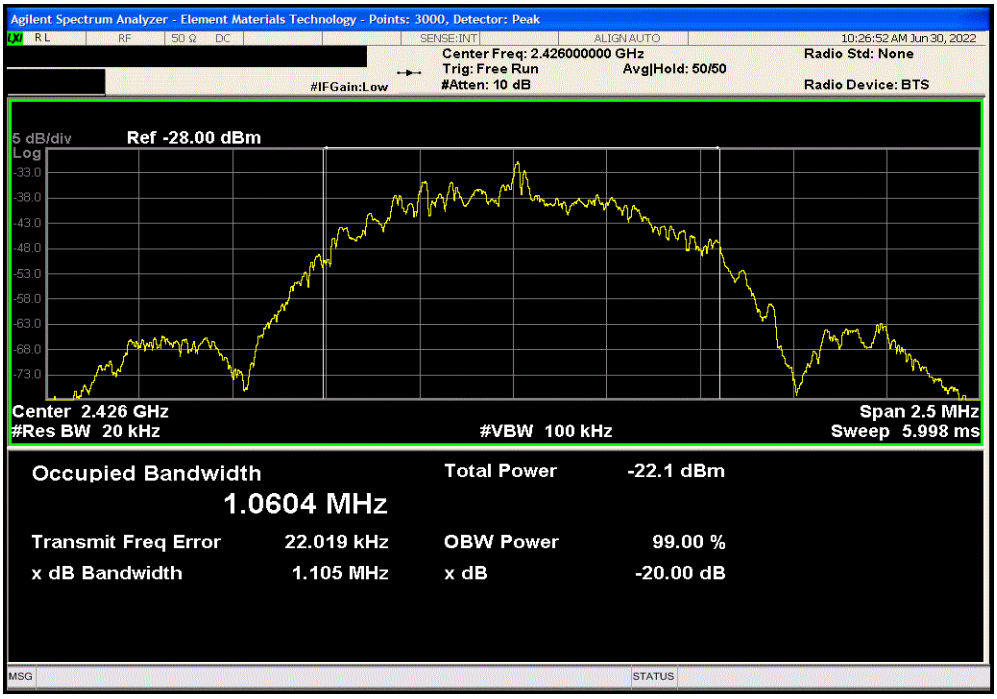
	20 dB BW (MHz)	**20 dB BW in Band (Yes / No)**	**Result**
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	1.099 MHz	Yes	Pass
Mid Channel, 2426 MHz	1.105 MHz	Yes	Pass
High Channel, 2480 MHz	1.092 MHz	Yes	Pass

EMISSIONS BANDWIDTH (20 dB)

BLE/GFSK 1 Mbps, Low Channel, 2402 MHz							
				20 dB BW (MHz)	20 dB BW in Band (Yes / No)		Result
				1.099 MHz	Yes		Pass

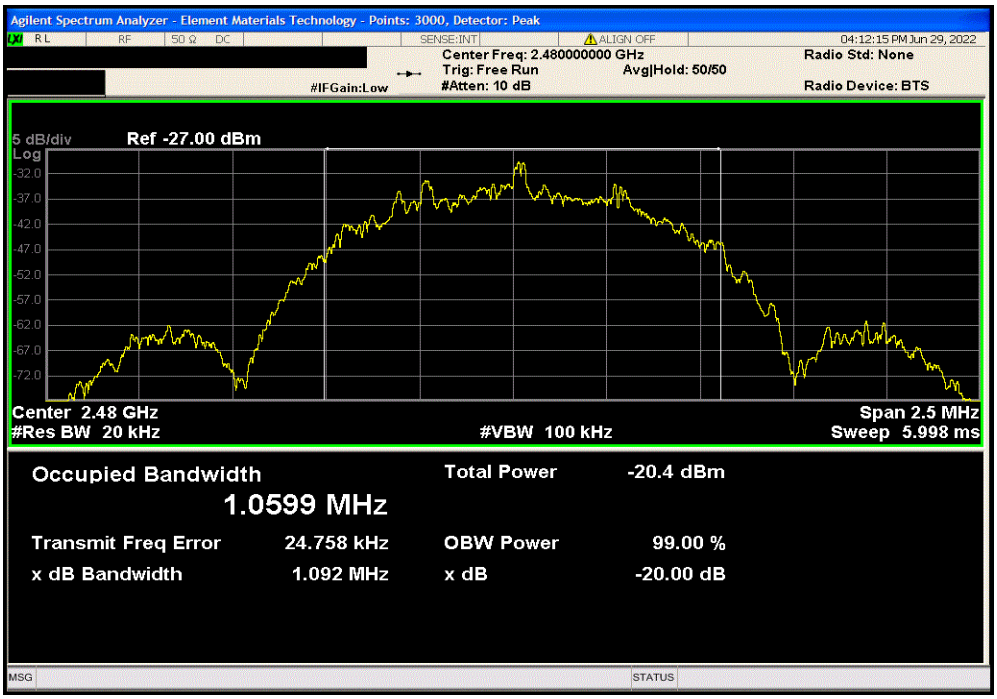


BLE/GFSK 1 Mbps, Mid Channel, 2426 MHz							
				20 dB BW (MHz)	20 dB BW in Band (Yes / No)		Result
				1.105 MHz	Yes		Pass



EMISSIONS BANDWIDTH (20 dB)

BLE/GFSK 1 Mbps, High Channel, 2480 MHz							
				20 dB BW (MHz)	20 dB BW in Band (Yes / No)		Result
				1.092 MHz	Yes		Pass



FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was configured to transmit at the lowest channel, a middle channel, and the highest channel available. While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes.

Measurements were performed using the following settings:

RBW = 2 MHz
VBW ≥ 3x RBW
Sweep = Auto
Detector = PK
Max Hold

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2021-12-09	2022-12-09
Antenna - Double Ridge	EMCO	3115	AHC	2020-07-01	2022-07-01
Cable	N/A	Double Ridge Horn Cables	EVB	2022-05-03	2023-05-03

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	5.1 dB	-5.1 dB

FREQUENCY RANGE INVESTIGATED

2402 MHz TO 2480 MHz

POWER INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

RENC0001-1

MODES INVESTIGATED

BLE/GFSK 1 Mbps, Tx, Low Ch = 2402 MHz, Mid Ch = 2426 MHz, and High Ch = 2480 MHz

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

EUT:	A-Label/0001	Work Order:	RENC0001
Serial Number:	See configuration	Date:	2022-06-29
Customer:	Reelables Inc.	Temperature:	22.8°C
Attendees:	Brian Krejcerek	Relative Humidity:	46.2%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Jeff Alcoke	Job Site:	EV01
Power:	Battery	Configuration:	RENC0001-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.249:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	3	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

Per ANSI C63.10, clause 7.5, The average measurements were derived from the operational duty cycle of the EUT. A duty cycle correction factor (DCCF) of 20*log(on time / T), where T is the period of the transmission or 100mS, whichever is less, was subtracted from the PK measurements to derive the AVG values. From the Duty Cycle measurements, the on time of the transmission is 413µS, with a period greater than 100mS.

DCCF = 20*log(0.413 / 100) = -47.7 dB

Please reference data comments below for channel and EUT orientation.

EUT OPERATING MODES

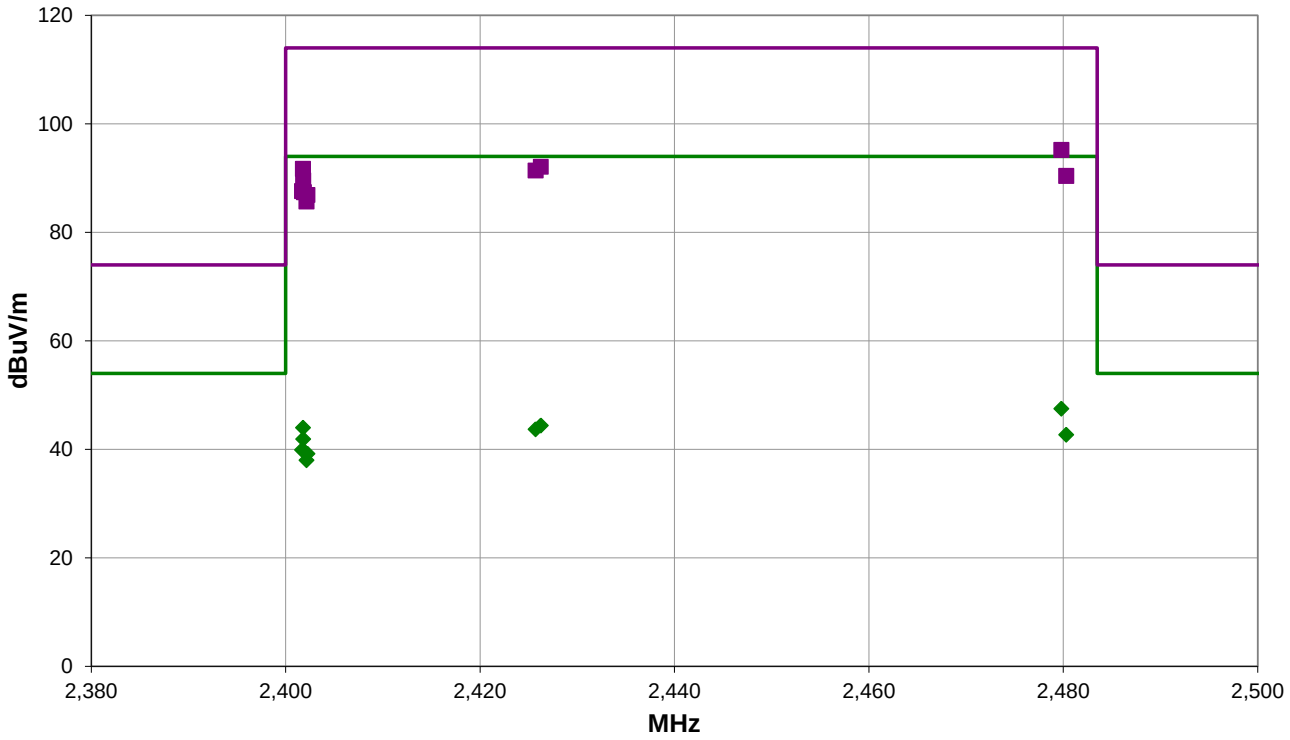
BLE/GFSK 1 Mbps, Tx, Low Ch = 2402 MHz, Mid Ch = 2426 MHz, and High Ch = 2480 MHz

DEVIATIONS FROM TEST STANDARD

None

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0



Run #: 3 ■ PK ◆ AV ● QP

RESULTS - Run #3

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
2479.800	57.1	38.1	3.8	286.0	0.0	0.0	Vert	PK	0.0	95.2	114.0	-18.8	High Ch, EUT Horz
2426.250	54.3	37.8	4.0	100.0	0.0	0.0	Vert	PK	0.0	92.1	114.0	-21.9	Mid Ch, EUT Horz
2401.783	54.0	37.7	3.7	70.0	0.0	0.0	Vert	PK	0.0	91.7	114.0	-22.3	Low Ch, EUT Horz
2425.708	53.6	37.8	1.0	51.0	0.0	0.0	Horz	PK	0.0	91.4	114.0	-22.6	Mid Ch, EUT Horz
2480.300	52.3	38.1	1.0	243.0	0.0	0.0	Horz	PK	0.0	90.4	114.0	-23.6	High Ch, EUT Horz
2401.800	51.9	37.7	1.0	0.0	0.0	0.0	Horz	PK	0.0	89.6	114.0	-24.4	Low Ch, EUT Horz
2401.683	49.9	37.7	1.0	95.0	0.0	0.0	Horz	PK	0.0	87.6	114.0	-26.4	Low Ch, EUT on Side
2401.883	49.7	37.7	3.7	139.0	0.0	0.0	Horz	PK	0.0	87.4	114.0	-26.6	Low Ch, EUT Vert
2402.242	49.2	37.7	1.0	360.0	0.0	0.0	Vert	PK	0.0	86.9	114.0	-27.1	Low Ch, EUT on Side
2402.142	48.0	37.7	1.0	182.0	0.0	0.0	Vert	PK	0.0	85.7	114.0	-28.3	Low Ch, EUT Vert
2479.800	57.1	38.1	3.8	286.0	-47.7	0.0	Vert	AV	0.0	47.5	94.0	-46.5	High Ch, EUT Horz
2426.250	54.3	37.8	4.0	100.0	-47.7	0.0	Vert	AV	0.0	44.4	94.0	-49.6	Mid Ch, EUT Horz
2401.783	54.0	37.7	3.7	70.0	-47.7	0.0	Vert	AV	0.0	44.0	94.0	-50.0	Low Ch, EUT Horz
2425.708	53.6	37.8	1.0	51.0	-47.7	0.0	Horz	AV	0.0	43.7	94.0	-50.3	Mid Ch, EUT Horz
2480.300	52.3	38.1	1.0	243.0	-47.7	0.0	Horz	AV	0.0	42.7	94.0	-51.3	High Ch, EUT Horz
2401.800	51.9	37.7	1.0	0.0	-47.7	0.0	Horz	AV	0.0	41.9	94.0	-52.1	Low Ch, EUT Horz
2401.683	49.9	37.7	1.0	95.0	-47.7	0.0	Horz	AV	0.0	39.9	94.0	-54.1	Low Ch, EUT on Side

FIELD STRENGTH OF FUNDAMENTAL

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
2401.883	49.7	37.7	3.7	139.0	-47.7	0.0	Horz	AV	0.0	39.7	94.0	-54.3	Low Ch, EUT Vert
2402.242	49.2	37.7	1.0	360.0	-47.7	0.0	Vert	AV	0.0	39.2	94.0	-54.8	Low Ch, EUT on Side
2402.142	48.0	37.7	1.0	182.0	-47.7	0.0	Vert	AV	0.0	38.0	94.0	-56.0	Low Ch, EUT Vert

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

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, 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.

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2021-12-09	2022-12-09
Antenna - Biconilog	EMCO	3142B	AXJ	2021-03-03	2023-03-03
Antenna - Double Ridge	EMCO	3115	AHC	2020-07-01	2022-07-01
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	NCR
Antenna - Standard Gain	ETS Lindgren	3160-08	AHV	NCR	NCR
Antenna - Standard Gain	ETS Lindgren	3160-09	AIV	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	2021-11-17	2022-11-17
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	2022-05-03	2023-05-03
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-08001200-30-10P	PAO	2021-11-17	2022-11-17
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVD	2021-11-17	2022-11-17
Amplifier - Pre-Amplifier	Miteq	AMF-6F-18002650-25-10P	AVU	2021-07-16	2022-07-16
Cable	N/A	Bilog Cables	EVA	2021-11-17	2022-11-17
Cable	N/A	Double Ridge Horn Cables	EVB	2022-05-03	2023-05-03
Cable	None	Standard Gain Horn Cables	EVF	2021-11-17	2022-11-17
Cable	ESM Cable Corp.	TTBJ141-KMKM-72	EVY	2021-07-16	2022-07-16

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	5.2 dB	-5.2 dB

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

FREQUENCY RANGE INVESTIGATED

30 MHz TO 26.5 GHz

POWER INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

RENC0001-1

MODES INVESTIGATED

BLE/GFSK 1 Mbps, Tx, Low Ch = 2402 MHz, Mid Ch = 2426 MHz, High Ch = 2480 MHz

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

EUT:	A-Label/0001	Work Order:	RENC0001
Serial Number:	See configuration	Date:	2022-06-29
Customer:	Reelables Inc.	Temperature:	22.8°C
Attendees:	Brian Krejcerek	Relative Humidity:	46.2%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Jeff Alcoke	Job Site:	EV01
Power:	Battery	Configuration:	RENC0001-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.249:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	15	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

Per ANSI C63.10, clause 7.5, The average measurements were derived from the operational duty cycle of the EUT. A duty cycle correction factor (DCCF) of 20*log(on time / T), where T is the period of the transmission or 100mS, whichever is less, was subtracted from the PK measurements to derive the AVG values. From the Duty Cycle measurements, the on time of the transmission is 413µS, with a period greater than 100mS.

DCCF = 20*log(0.413 / 100) = -47.7 dB

Please reference data comments below for channel and EUT orientation.

EUT OPERATING MODES

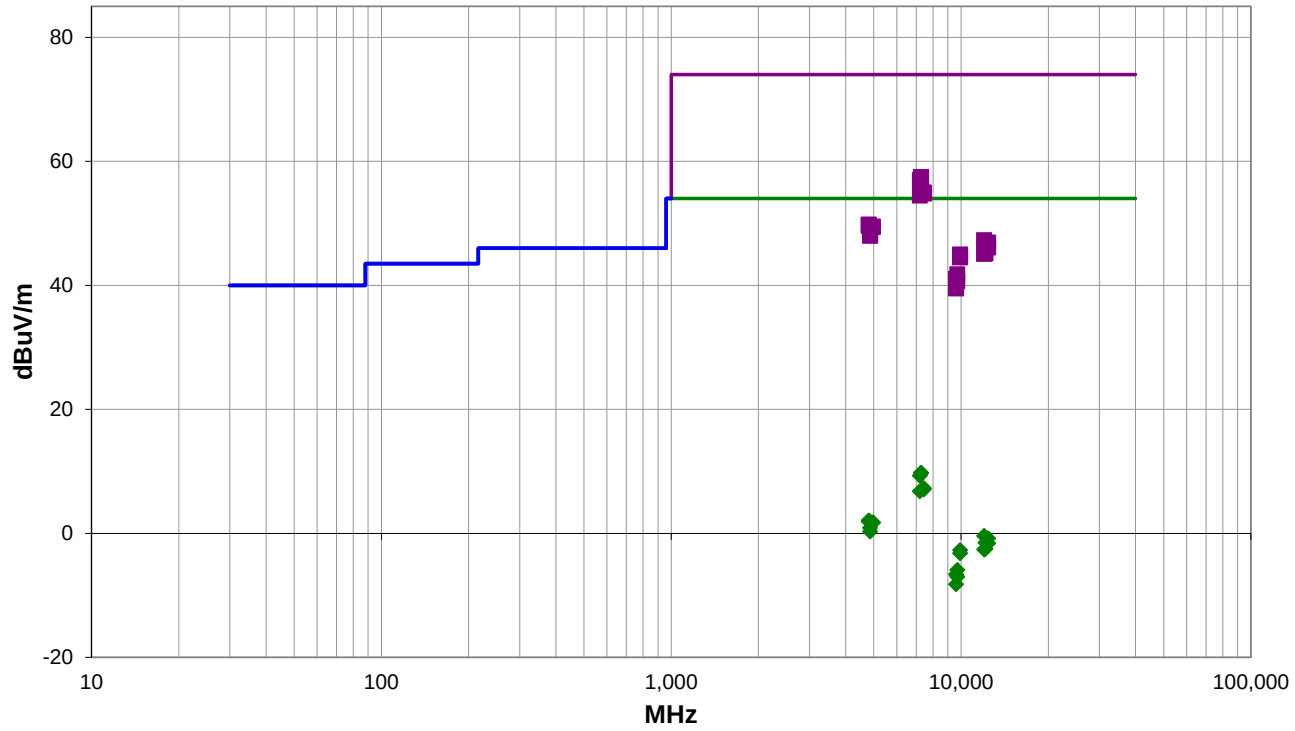
BLE/GFSK 1 Mbps, Tx, Low Ch = 2402 MHz, Mid Ch = 2426 MHz, High Ch = 2480 MHz

DEVIATIONS FROM TEST STANDARD

None

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0



Run #: 15 PK AV QP

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #15

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
7277.975	41.9	15.6	3.7	149.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	Mid Ch, EUT Horz
7277.975	41.8	15.6	2.2	29.0	0.0	0.0	Horz	PK	0.0	57.4	74.0	-16.6	Mid Ch, EUT on Side
7206.958	41.6	15.4	2.1	208.0	0.0	0.0	Horz	PK	0.0	57.0	74.0	-17.0	Low Ch, EUT on Side
7437.608	39.0	16.0	1.5	95.0	0.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0	High Ch, EUT on Side
7438.358	38.8	16.0	1.5	310.0	0.0	0.0	Vert	PK	0.0	54.8	74.0	-19.2	High Ch, EUT Horz
7203.967	39.1	15.4	1.5	218.0	0.0	0.0	Vert	PK	0.0	54.5	74.0	-19.5	Low Ch, EUT Horz
4803.517	41.5	8.3	4.0	315.0	0.0	0.0	Vert	PK	0.0	49.8	74.0	-24.2	Low Ch, EUT Horz
4802.817	41.3	8.3	1.6	5.0	0.0	0.0	Horz	PK	0.0	49.6	74.0	-24.4	Low Ch, EUT on Side
4961.675	41.0	8.5	1.5	167.0	0.0	0.0	Vert	PK	0.0	49.5	74.0	-24.5	High Ch, EUT Horz
4959.392	40.9	8.5	2.6	303.0	0.0	0.0	Horz	PK	0.0	49.4	74.0	-24.6	High Ch, EUT on Side
4850.900	40.4	8.2	2.7	167.0	0.0	0.0	Vert	PK	0.0	48.6	74.0	-25.4	Mid Ch, EUT Horz
4853.508	39.8	8.2	1.5	131.0	0.0	0.0	Horz	PK	0.0	48.0	74.0	-26.0	Mid Ch, EUT on Side
12008.920	47.5	-0.2	1.8	289.0	0.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	Low ch, EUT on Side
12398.800	46.4	0.5	2.3	59.0	0.0	0.0	Horz	PK	0.0	46.9	74.0	-27.1	High Ch, EUT on Side
12131.210	45.7	0.5	1.9	102.0	0.0	0.0	Horz	PK	0.0	46.2	74.0	-27.8	Mid Ch, EUT on Side
12401.580	45.6	0.5	2.9	76.0	0.0	0.0	Vert	PK	0.0	46.1	74.0	-27.9	High Ch, EUT Horz
12128.740	44.7	0.5	2.9	68.0	0.0	0.0	Vert	PK	0.0	45.2	74.0	-28.8	Mid Ch, EUT Horz
12008.810	45.3	-0.2	2.5	266.0	0.0	0.0	Vert	PK	0.0	45.1	74.0	-28.9	Low Ch, EUT Horz
9920.942	47.2	-2.2	2.7	60.0	0.0	0.0	Horz	PK	0.0	45.0	74.0	-29.0	High Ch, EUT on Side
9919.017	46.7	-2.2	2.6	112.0	0.0	0.0	Vert	PK	0.0	44.5	74.0	-29.5	High Ch, EUT Horz
9704.842	44.5	-2.7	1.5	143.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Mid Ch, EUT on Side
9607.817	43.8	-2.7	1.5	241.0	0.0	0.0	Horz	PK	0.0	41.1	74.0	-32.9	Low ch, EUT on Side
9703.575	43.4	-2.7	3.1	81.0	0.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	Mid Ch, EUT Horz
9607.708	42.2	-2.7	1.5	157.0	0.0	0.0	Vert	PK	0.0	39.5	74.0	-34.5	Low Ch, EUT Horz
7277.975	41.9	15.6	3.7	149.0	-47.7	0.0	Vert	AV	0.0	9.8	54.0	-44.2	Mid Ch, EUT Horz
7277.975	41.8	15.6	2.2	29.0	-47.7	0.0	Horz	AV	0.0	9.7	54.0	-44.3	Mid Ch, EUT on Side
7206.958	41.6	15.4	2.1	208.0	-47.7	0.0	Horz	AV	0.0	9.3	54.0	-44.7	Low Ch, EUT on Side
7437.608	39.0	16.0	1.5	95.0	-47.7	0.0	Horz	AV	0.0	7.3	54.0	-46.7	High Ch, EUT on Side
7438.358	38.8	16.0	1.5	310.0	-47.7	0.0	Vert	AV	0.0	7.1	54.0	-46.9	High Ch, EUT Horz
7203.967	39.1	15.4	1.5	218.0	-47.7	0.0	Vert	AV	0.0	6.8	54.0	-47.2	Low Ch, EUT Horz
4803.517	41.5	8.3	4.0	315.0	-47.7	0.0	Vert	AV	0.0	2.1	54.0	-51.9	Low Ch, EUT Horz
4802.817	41.3	8.3	1.6	5.0	-47.7	0.0	Horz	AV	0.0	1.9	54.0	-52.1	Low Ch, EUT on Side
4961.675	41.0	8.5	1.5	167.0	-47.7	0.0	Vert	AV	0.0	1.8	54.0	-52.2	High Ch, EUT Horz
4959.392	40.9	8.5	2.6	303.0	-47.7	0.0	Horz	AV	0.0	1.7	54.0	-52.3	High Ch, EUT on Side
4850.900	40.4	8.2	2.7	167.0	-47.7	0.0	Vert	AV	0.0	0.9	54.0	-53.1	Mid Ch, EUT Horz
4853.508	39.8	8.2	1.5	131.0	-47.7	0.0	Horz	AV	0.0	0.3	54.0	-53.7	Mid Ch, EUT on Side
12008.920	47.5	-0.2	1.8	289.0	-47.7	0.0	Horz	AV	0.0	-0.4	54.0	-54.4	Low ch, EUT on Side
12398.800	46.4	0.5	2.3	59.0	-47.7	0.0	Horz	AV	0.0	-0.8	54.0	-54.8	High Ch, EUT on Side
12131.210	45.7	0.5	1.9	102.0	-47.7	0.0	Horz	AV	0.0	-1.5	54.0	-55.5	Mid Ch, EUT on Side
12401.580	45.6	0.5	2.9	76.0	-47.7	0.0	Vert	AV	0.0	-1.6	54.0	-55.6	High Ch, EUT Horz

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
12128.740	44.7	0.5	2.9	68.0	-47.7	0.0	Vert	AV	0.0	-2.5	54.0	-56.5	Mid Ch, EUT Horz
12008.810	45.3	-0.2	2.5	266.0	-47.7	0.0	Vert	AV	0.0	-2.6	54.0	-56.6	Low Ch, EUT Horz
9920.942	47.2	-2.2	2.7	60.0	-47.7	0.0	Horz	AV	0.0	-2.7	54.0	-56.7	High Ch, EUT on Side
9919.017	46.7	-2.2	2.6	112.0	-47.7	0.0	Vert	AV	0.0	-3.2	54.0	-57.2	High Ch, EUT Horz
9704.842	44.5	-2.7	1.5	143.0	-47.7	0.0	Horz	AV	0.0	-5.9	54.0	-59.9	Mid Ch, EUT on Side
9607.817	43.8	-2.7	1.5	241.0	-47.7	0.0	Horz	AV	0.0	-6.6	54.0	-60.6	Low ch, EUT on Side
9703.575	43.4	-2.7	3.1	81.0	-47.7	0.0	Vert	AV	0.0	-7.0	54.0	-61.0	Mid Ch, EUT Horz
9607.708	42.2	-2.7	1.5	157.0	-47.7	0.0	Vert	AV	0.0	-8.2	54.0	-62.2	Low Ch, EUT Horz

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

EUT:	A-Label/0001	Work Order:	RENC0001
Serial Number:	See configuration	Date:	2022-06-29
Customer:	Reelables Inc.	Temperature:	22.8°C
Attendees:	Brian Krejcerek	Relative Humidity:	46.2%
Customer Project:	None	Bar. Pressure (PMSL):	1025 mb
Tested By:	Jeff Alcoke	Job Site:	EV01
Power:	Battery	Configuration:	RENC0001-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.249:2022	ANSI C63.10:2013

TEST PARAMETERS

Run #:	17	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

Per ANSI C63.10, clause 7.5, The average measurements were derived from the operational duty cycle of the EUT. A duty cycle correction factor (DCCF) of 20*log(on time / T), where T is the period of the transmission or 100mS, whichever is less, was subtracted from the PK measurements to derive the AVG values. From the Duty Cycle measurements, the on time of the transmission is 413µS, with a period greater than 100mS.

DCCF = 20*log(0.413 / 100) = -47.7 dB

Please reference data comments below for channel and EUT orientation.

EUT OPERATING MODES

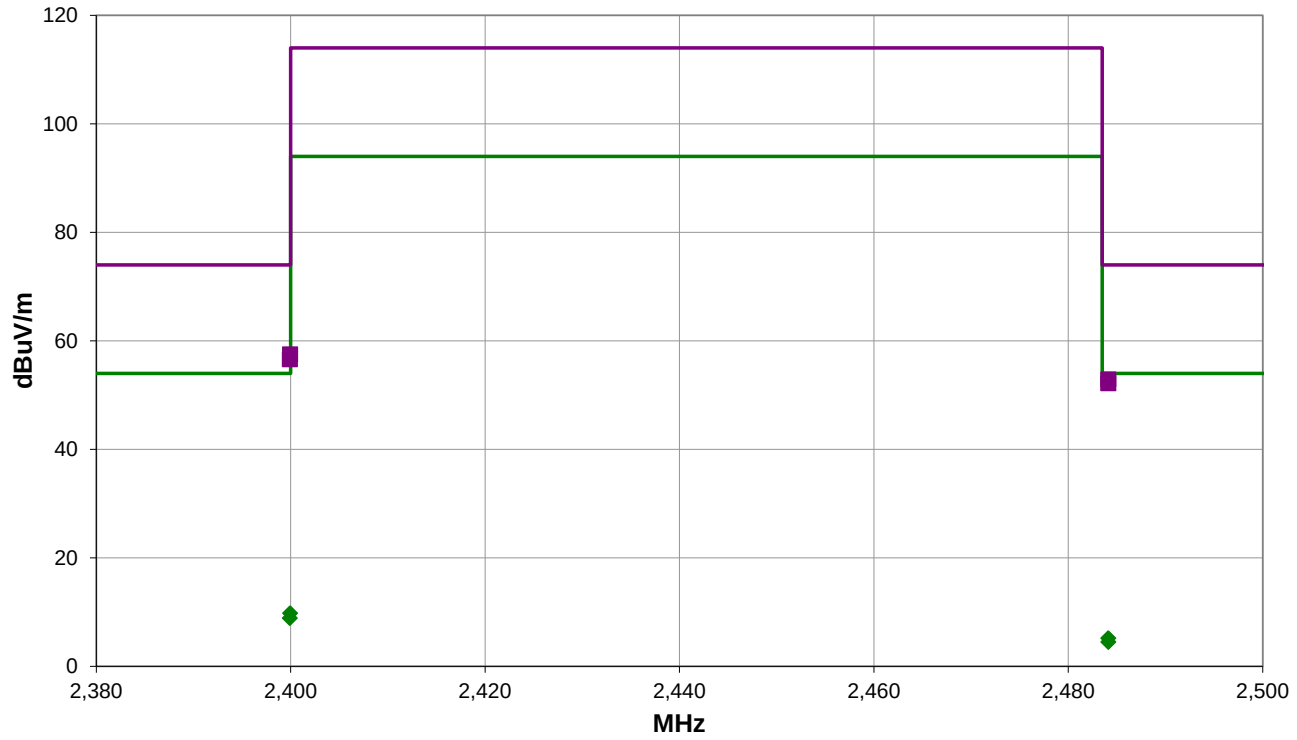
BLE/GFSK 1 Mbps, Tx, Low Ch = 2402 MHz and High Ch = 2480 MHz

DEVIATIONS FROM TEST STANDARD

None

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0



Run #: 17 PK AV QP

FIELD STRENGTH OF HARMONICS AND SPURIOUS RADIATED EMISSIONS

element
WTD.2022.02.22.0
EmiR5 2022.03.10.0
PSA-ESCI 2022.1.12.0

RESULTS - Run #17

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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
2399.940	49.2	-1.7	1.0	242.0	0.0	10.0	Horz	PK	0.0	57.5	74.0	-16.5	Low Ch, EUT Horz
2399.910	48.3	-1.7	4.0	294.0	0.0	10.0	Vert	PK	0.0	56.6	74.0	-17.4	Low Ch, EUT Horz
2484.113	44.2	-1.3	1.0	91.0	0.0	10.0	Vert	PK	0.0	52.9	74.0	-21.1	High Ch, EUT Horz
2484.117	43.5	-1.3	1.0	34.0	0.0	10.0	Horz	PK	0.0	52.2	74.0	-21.8	High Ch, EUT Horz
2399.940	49.2	-1.7	1.0	242.0	-47.7	10.0	Horz	AV	0.0	9.8	54.0	-44.2	Low Ch, EUT Horz
2399.910	48.3	-1.7	4.0	294.0	-47.7	10.0	Vert	AV	0.0	8.9	54.0	-45.1	Low Ch, EUT Horz
2484.113	44.2	-1.3	1.0	91.0	-47.7	10.0	Vert	AV	0.0	5.2	54.0	-48.8	High Ch, EUT Horz
2484.117	43.5	-1.3	1.0	34.0	-47.7	10.0	Horz	AV	0.0	4.5	54.0	-49.5	High Ch, EUT Horz

CONCLUSION

Pass

Tested By

End of Test Report