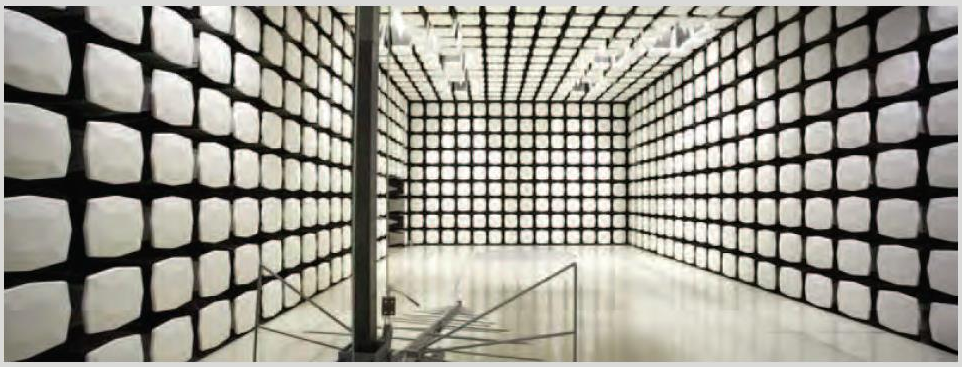
PayRange Inc.

BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)

Bluetooth Radio

FCC 15.247:2023, RSS-247 Issue 3:2023
RSS-Gen Issue 5:2018+A1:2019+A2:2021

Report: PAYR0024.1 Rev. 1, Issue Date: June 5, 2024



CERT #3310.02

TABLE OF CONTENTS

element
2023.04.17

Section	Page Number

CERTIFICATE OF TEST

Last Date of Test: October 9, 2023
PayRange Inc.
EUT: BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

Note: RSS-247 Issue 3 has been updated superseding prior issues. The changes between the specifications do not affect the results of the prior testing. The manufacturer attests that no changes have been made to the product.

Guidance

FCC KDB 558074 v05r02:2019

Results

Test Description	Result	FCC Section(s)	RSS Section(s)	ANSI C63.10 Section(s)	Comments
Powerline Conducted Emissions	Pass	15.207	RSS-Gen 8.8	6.2	
Duty Cycle	Pass	KDB 558074 -6.0	RSS-Gen 3.2	11.6	
DTS Bandwidth (6 dB)	Pass	15.247(a)(2), KDB 558074 -8.2	RSS-247 5.2(a)	11.8.2	
Occupied Bandwidth (99%)	Pass	KDB 558074 -2.1	RSS-Gen 6.7	6.9.3	
Output Power	Pass	15.247(b)(3), KDB 558074 -8.3.1	RSS-247 5.4(d, f), RSS-Gen 6.12	11.9.1.1	
Equivalent Isotropic Radiated Power	Pass	15.247(b)(3), KDB 558074 -8.3.1	RSS-247 5.4(d, f), RSS-Gen 6.12	11.9.1.1	
Power Spectral Density	Pass	15.247(e), KDB 558074 -8.4	RSS-247 5.2(b)	11.10.2	
Band Edge Compliance	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Spurious Conducted Emissions	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Spurious Radiated	Pass	15.247(d),	RSS-247 5.5,	11.12.1,	

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.

CERTIFICATE OF TEST

Emissions		KDB 558074 - 8.6, 8.7	RSS-Gen 6.13, 8.10	11.13.2, 6.5, 6.6	

Deviations From Test Standards

None

Approved By:

Chuck Heller, 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. 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		
01	Report revised to reflect RSS-247 Issue 3	2024-06-04	1, 3, 28, 38, 43, 45, 50, 54, 67, 69, 71, 73

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - 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

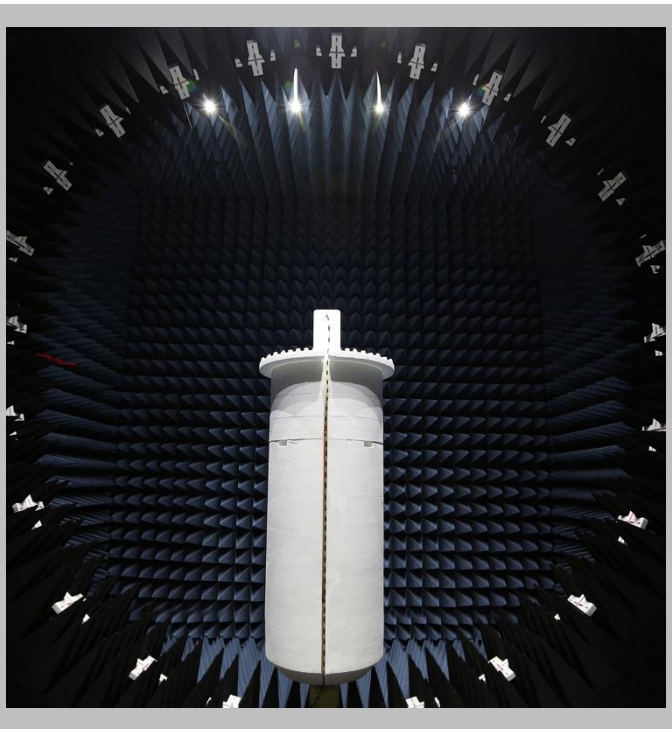
For details on the Scopes of our Accreditations, please visit:

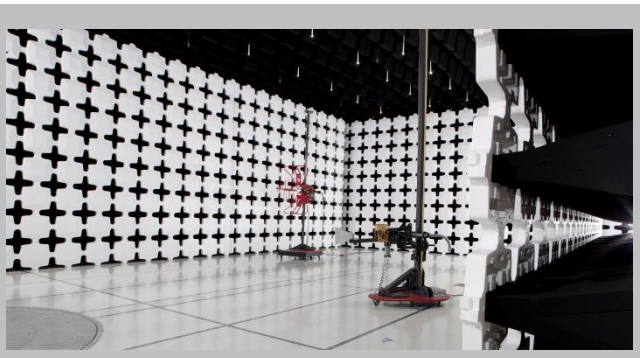
California Minnesota Oregon Texas Washington

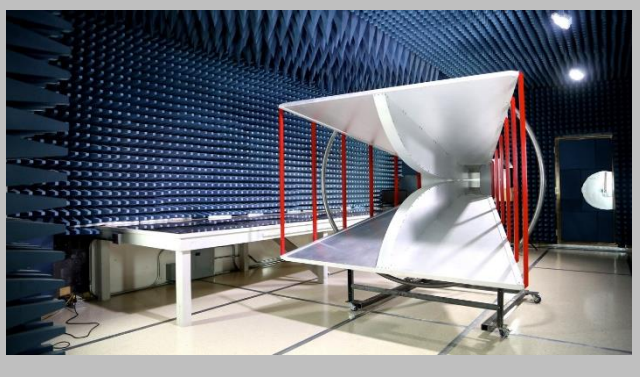
FACILITIES

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
RP.2023.05.08.0

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 Location: Oregon

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

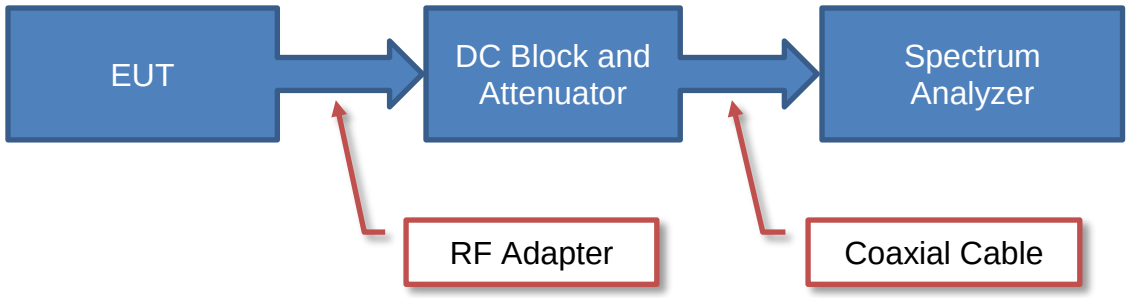
TEST SETUP BLOCK DIAGRAMS

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.

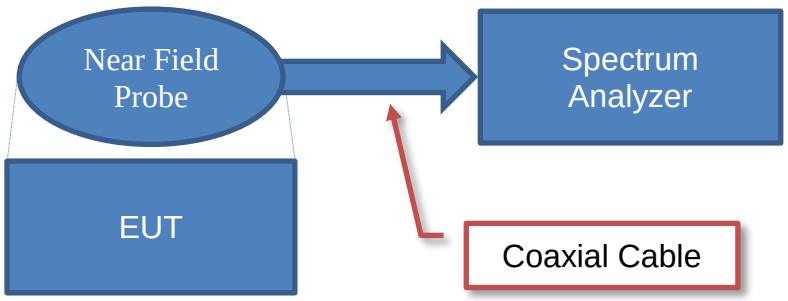
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

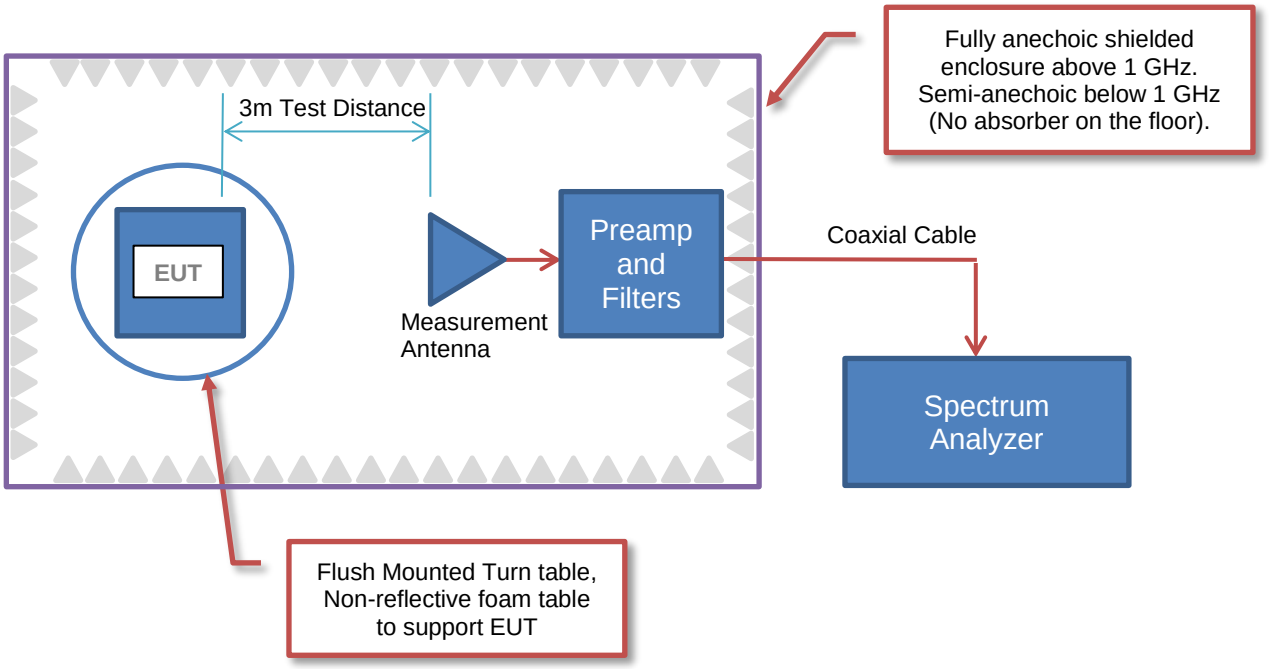


Sample Calculation (logarithmic units)

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**

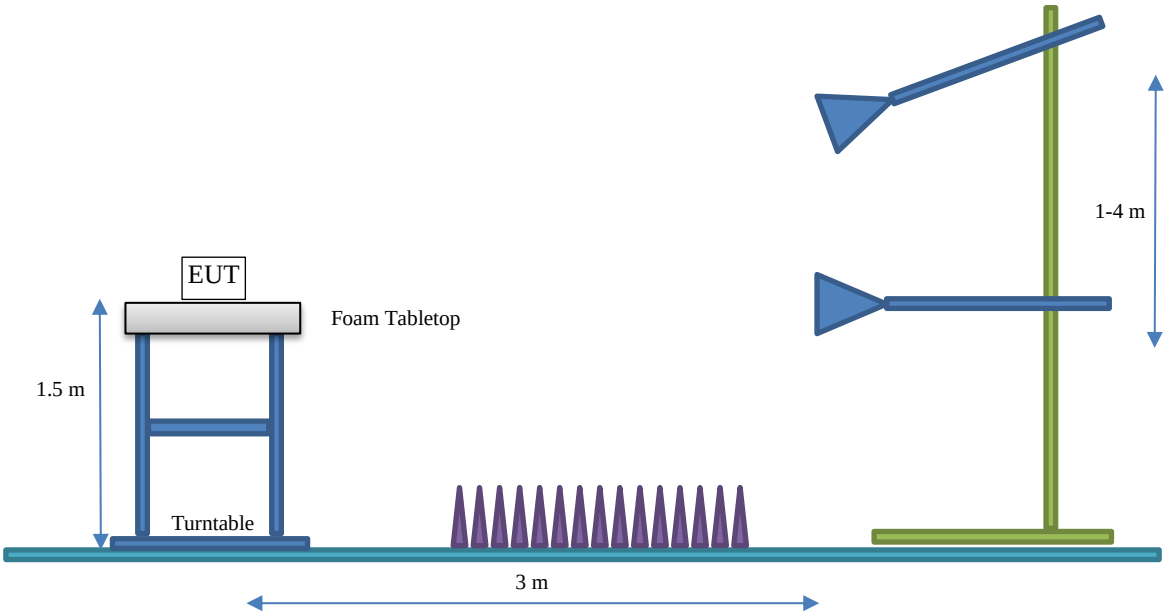
Radiated Power (ERP/EIRP) – Substitution Method:

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:	PayRange Inc.
Address:	9600 NE Cascades Pkwy, Suite #280
City, State, Zip:	Portland, OR 97220
Test Requested By:	Mike Mitchell
EUT:	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)
First Date of Test:	October 6, 2023
Last Date of Test:	October 9, 2023
Receipt Date of Samples:	October 6, 2023
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
BluKey Plus™ S (BK+SS) and BluKey Plus™ SD (BK+SD) devices allow wireless payment from smartphones to vending machines via BLE. Both model variants utilize the same PCB and RF path. The key differences between the models are; BluKey Plus™ S (BK+S) model variant has a DEX connector for collecting and auditing event data whereas the BluKey Plus™ SD (BK+SD) model variant has the DEX connector depopulated from the PCB.

Testing Objective:
To demonstrate compliance of the Bluetooth radio to FCC 15.247/RSS-247 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)
MID SMT	Molex	2400 – 2483.5	3.7

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

☐ Test software settings Test software/firmware installed on EUT: FAB6A60
☒ Rated power settings

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types / Data Rates	Type	Channel	Frequency (MHz)	Power Setting (dBm)
BLE GFSK 125 kbps, 500 kbps, 1 Mbps, 2 Mbps	DTS	0	2402	10
		20	2442	10
		39	2480	10

CONFIGURATIONS

Configuration PAYR0024-1

Software/Firmware Running During Test	
Description	**Version**
Firmware	FAB6A60

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Vending Machine Payment Device	PayRange Inc.	BluKey Plus™ S (BK+S) / 10.02077	B

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC Power Adapter	XP Power	VEL36US120-US-JA	None

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	HP	15-BS115DX	CND8076QJL

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC	No	1.8	No	MDB Input	AC Power Adapter
MDB-1 Output Extension	No	5.7	No	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)	Unterminated
MDB-2 Output	No	0.9	No	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)	Unterminated
MDB Input	No	3.1	No	DC Power	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)
DEX Extension	No	1.0	No	BluKey Plus™ S (BK+S)	Unterminated

CONFIGURATIONS

Configuration PAYR0024-2

Software/Firmware Running During Test	
Description	**Version**
Firmware	FAB6A60

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Remote Vending Machine Payment Device	PayRange Inc.	BluKey Plus™ SD (BK+SD) / 10.02079	G

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC Power Adapter	XP Power	VEL36US120-US-JA	None

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	HP	15-BS115DX	CND8076QJL

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC	No	1.8	No	MDB Input	AC Power Adapter
MDB-1 Output Extension	No	5.7	No	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)	Unterminated
MDB-2 Output	No	0.9	No	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)	Unterminated
MDB Input	No	3.1	No	DC Power	BluKey Plus™ S (BK+S), BluKey Plus™ SD (BK+SD)

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-10-06	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	2023-10-09	Powerline 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.
3	2023-10-09	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.
4	2023-10-09	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	2023-10-09	Equivalent Isotropic Radiated 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.
6	2023-10-09	Occupied Bandwidth (99%)	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	2023-10-09	DTS Bandwidth (6 DB)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2023-10-09	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.
9	2023-10-09	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.
10	2023-10-09	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.08.03.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Gauss Instruments	TDEMI 30M	ARN	2023-05-08	2024-05-08
Conducted Cable Assembly	Northwest EMC	EVG, HHD, RKT, VAB	EVGA	2023-05-16	2024-05-16
LISN	Solar Electronics	9252-50-R-24-BNC	LIR	2023-09-11	2024-09-11

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	3.2 dB	-3.2 dB

CONFIGURATIONS INVESTIGATED

PAYR0024-1

MODES INVESTIGATED

Continuous Tx, BLE, 125 kbps, Mid Ch = 2442 MHz

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.08.03.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

EUT:	BluKey Plus™ S (BK+S)	Work Order:	PAYR0024
Serial Number:	B	Date:	2023-10-09
Customer:	PayRange Inc.	Temperature:	22.2°C
Attendees:	Mike Mitchell	Relative Humidity:	49.3%
Customer Project:	None	Bar. Pressure (PMSL):	1005 mb
Tested By:	Jeff Alcoke and Chris Ladwig	Job Site:	EV07
Power:	12 VDC via 110VAC/60Hz	Configuration:	PAYR0024-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	4	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

None

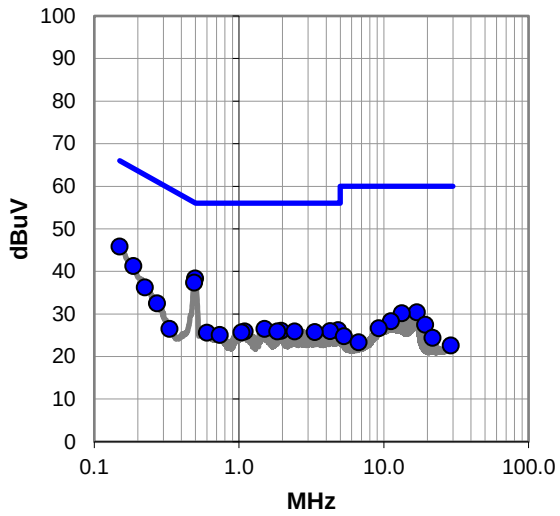
EUT OPERATING MODES

Continuous Tx, BLE, 125 kbps, Mid Ch = 2442 MHz

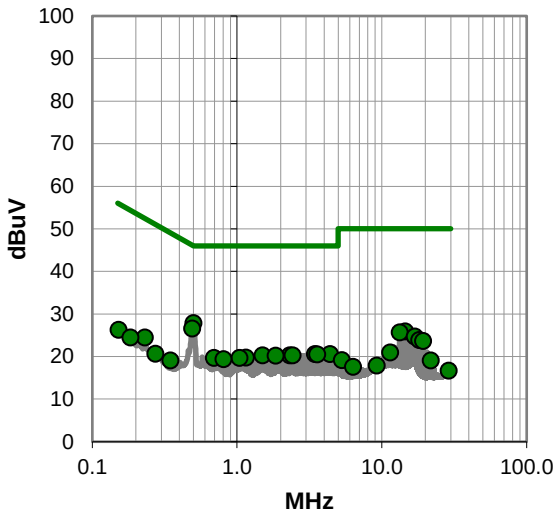
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.08.03.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #4

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.498	18.5	19.9	38.4	56.0	-17.6
0.489	17.5	19.9	37.4	56.2	-18.8
0.150	25.8	20.1	45.9	66.0	-20.1
0.187	21.3	20.0	41.3	64.2	-22.9
0.223	16.3	20.0	36.3	62.7	-26.4
0.272	12.5	20.0	32.5	61.1	-28.6
1.497	6.4	20.1	26.5	56.0	-29.5
16.897	9.4	21.0	30.4	60.0	-29.6
13.280	9.4	20.8	30.2	60.0	-29.8
4.839	6.0	20.2	26.2	56.0	-29.8
1.958	6.0	20.1	26.1	56.0	-29.9
4.264	5.8	20.2	26.0	56.0	-30.0
1.096	5.9	20.0	25.9	56.0	-30.1
1.842	5.8	20.1	25.9	56.0	-30.1
2.420	5.8	20.1	25.9	56.0	-30.1
3.340	5.6	20.2	25.8	56.0	-30.2
1.038	5.7	20.0	25.7	56.0	-30.3
0.602	5.6	20.0	25.6	56.0	-30.4
0.736	5.1	20.0	25.1	56.0	-30.9
11.177	7.6	20.7	28.3	60.0	-31.7
19.314	6.4	21.1	27.5	60.0	-32.5
0.332	6.6	19.9	26.5	59.4	-32.9
9.245	6.2	20.5	26.7	60.0	-33.3
5.300	4.6	20.2	24.8	60.0	-35.2
21.728	3.1	21.3	24.4	60.0	-35.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.499	8.0	19.9	27.9	46.0	-18.1
0.489	6.7	19.9	26.6	46.2	-19.6
14.486	5.1	20.8	25.9	50.0	-24.1
13.277	4.9	20.8	25.7	50.0	-24.3
16.897	3.7	21.0	24.7	50.0	-25.3
3.456	0.4	20.2	20.6	46.0	-25.4
4.378	0.4	20.2	20.6	46.0	-25.4
3.572	0.3	20.2	20.5	46.0	-25.5
1.497	0.2	20.1	20.3	46.0	-25.7
2.304	0.2	20.1	20.3	46.0	-25.7
2.419	0.2	20.1	20.3	46.0	-25.7
1.844	0.1	20.1	20.2	46.0	-25.8
18.106	2.9	21.0	23.9	50.0	-26.1
1.152	-0.2	20.0	19.8	46.0	-26.2
19.314	2.6	21.1	23.7	50.0	-26.3
0.690	-0.3	20.0	19.7	46.0	-26.3
1.036	-0.3	20.0	19.7	46.0	-26.3
0.806	-0.6	20.0	19.4	46.0	-26.6
0.231	4.5	20.0	24.5	52.4	-27.9
11.406	0.3	20.7	21.0	50.0	-29.0
0.152	6.2	20.1	26.3	55.9	-29.6
0.184	4.5	20.0	24.5	54.3	-29.8
0.345	-0.8	19.9	19.1	49.1	-30.0
0.272	0.7	20.0	20.7	51.1	-30.4
5.300	-1.0	20.2	19.2	50.0	-30.8

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.08.03.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

EUT:	BluKey Plus™ S (BK+S)	Work Order:	PAYR0024
Serial Number:	B	Date:	2023-10-09
Customer:	PayRange Inc.	Temperature:	22.2°C
Attendees:	Mike Mitchell	Relative Humidity:	49.3%
Customer Project:	None	Bar. Pressure (PMSL):	1005 mb
Tested By:	Jeff Alcoke and Chris Ladwig	Job Site:	EV07
Power:	12 VDC via 110VAC/60Hz	Configuration:	PAYR0024-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	5	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

None

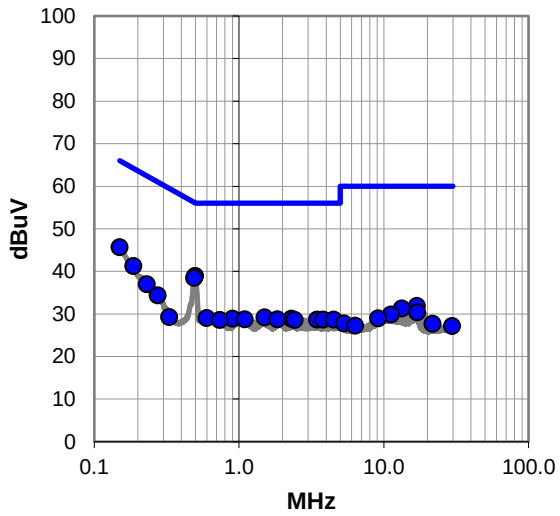
EUT OPERATING MODES

Continuous Tx, BLE, 125 kbps, Mid Ch = 2442 MHz

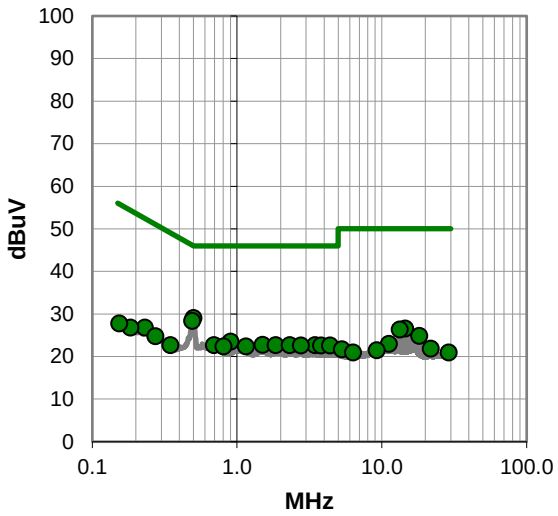
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.08.03.0
EmiR5 2022.07.06.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #5

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.498	19.1	19.9	39.0	56.0	-17.0
0.489	18.6	19.9	38.5	56.2	-17.7
0.150	25.6	20.1	45.7	66.0	-20.3
0.187	21.3	20.0	41.3	64.2	-22.9
0.231	17.0	20.0	37.0	62.4	-25.4
0.274	14.4	20.0	34.4	61.0	-26.6
1.497	9.1	20.1	29.2	56.0	-26.8
0.597	9.1	20.0	29.1	56.0	-26.9
0.902	8.9	20.0	28.9	56.0	-27.1
2.304	8.8	20.1	28.9	56.0	-27.1
1.094	8.8	20.0	28.8	56.0	-27.2
1.844	8.7	20.1	28.8	56.0	-27.2
3.456	8.5	20.2	28.7	56.0	-27.3
3.801	8.5	20.2	28.7	56.0	-27.3
4.494	8.5	20.2	28.7	56.0	-27.3
0.737	8.6	20.0	28.6	56.0	-27.4
2.419	8.5	20.1	28.6	56.0	-27.4
16.899	10.9	21.0	31.9	60.0	-28.1
13.280	10.5	20.8	31.3	60.0	-28.7
16.975	9.4	21.0	30.4	60.0	-29.6
11.177	9.2	20.7	29.9	60.0	-30.1
0.330	9.4	19.9	29.3	59.5	-30.2
9.119	8.5	20.5	29.0	60.0	-31.0
5.300	7.6	20.2	27.8	60.0	-32.2
21.726	6.4	21.3	27.7	60.0	-32.3

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.499	9.2	19.9	29.1	46.0	-16.9
0.489	8.5	19.9	28.4	46.2	-17.8
0.902	3.5	20.0	23.5	46.0	-22.5
1.497	2.7	20.1	22.8	46.0	-23.2
0.692	2.7	20.0	22.7	46.0	-23.3
1.844	2.6	20.1	22.7	46.0	-23.3
2.304	2.6	20.1	22.7	46.0	-23.3
3.456	2.5	20.2	22.7	46.0	-23.3
14.485	5.8	20.8	26.6	50.0	-23.4
2.765	2.5	20.1	22.6	46.0	-23.4
3.803	2.4	20.2	22.6	46.0	-23.4
4.378	2.4	20.2	22.6	46.0	-23.4
0.806	2.4	20.0	22.4	46.0	-23.6
1.152	2.4	20.0	22.4	46.0	-23.6
13.280	5.6	20.8	26.4	50.0	-23.6
18.106	3.9	21.0	24.9	50.0	-25.1
0.231	6.8	20.0	26.8	52.4	-25.6
0.272	4.8	20.0	24.8	51.1	-26.3
0.345	2.8	19.9	22.7	49.1	-26.4
11.175	2.3	20.7	23.0	50.0	-27.0
0.184	6.8	20.0	26.8	54.3	-27.5
0.153	7.7	20.1	27.8	55.8	-28.0
21.733	0.6	21.3	21.9	50.0	-28.1
5.300	1.5	20.2	21.7	50.0	-28.3
9.197	1.0	20.5	21.5	50.0	-28.5

CONCLUSION

Pass

Tested By

DUTY CYCLE

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

TEST DESCRIPTION

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 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.

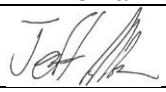
If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2023-08-29	2024-08-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2022-12-02	2023-12-02
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

DUTY CYCLE

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

EUT:	BluKey Plus™ S (BK+S)	Work Order:	PAYR0024
Serial Number:	B	Date:	2023-10-09
Customer:	PayRange Inc.	Temperature:	22°C
Attendees:	Mike Mitchell	Relative Humidity:	48.4%
Customer Project:	None	Bar. Pressure (PMSL):	999 mbar
Tested By:	Jeff Alcoke and Chris Ladwig	Job Site:	EV06
Power:	12 VDC via 110VAC/60Hz	Configuration:	PAYR0024-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC block, 20 dB attenuator, and measurement cable

DEVIATIONS FROM TEST STANDARD

None

TEST RESULTS

	Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A ()	Results
BLE/GFSK 125 kbps						
Low Channel, 2402 MHz	17.072 ms	17.498 ms	1	97.6	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz	17.072 ms	17.501 ms	1	97.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz	17.072 ms	17.501 ms	1	97.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 500 kbps						
Low Channel, 2402 MHz	4.574 ms	5 ms	1	91.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz	4.574 ms	5 ms	1	91.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz	4.574 ms	5 ms	1	91.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 1 Mbps						
Low Channel, 2402 MHz	2.152 ms	2.5 ms	1	86.1	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz	2.152 ms	2.5 ms	1	86.1	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
High Channel, 2480 MHz	2.152 ms	2.5 ms	1	86.1	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
BLE/GFSK 2 Mbps						
Low Channel, 2402 MHz	1.089 ms	1.875 ms	1	58.1	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Channel, 2442 MHz	1.094 ms	1.875 ms	1	58.3	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A

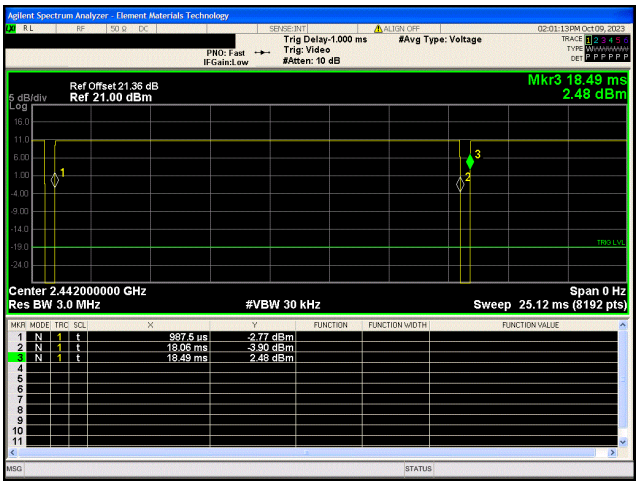
DUTY CYCLE

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

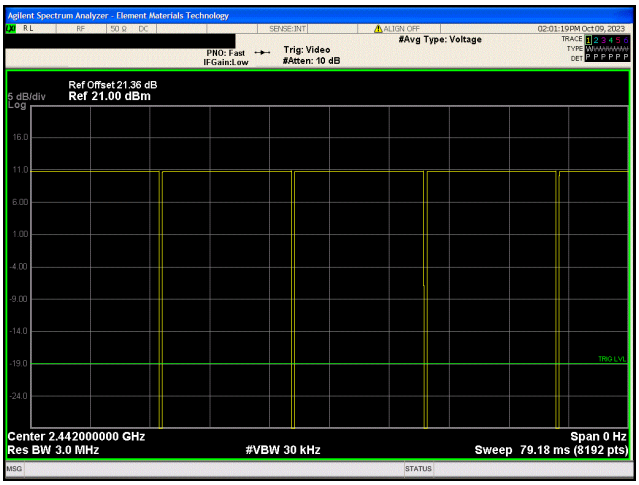
	Pulse Width	Period	Number of Pulses	Value (%)	Limit N/A ()	Results
High Channel, 2480 MHz	1.091 ms	1.875 ms	1	58.2	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

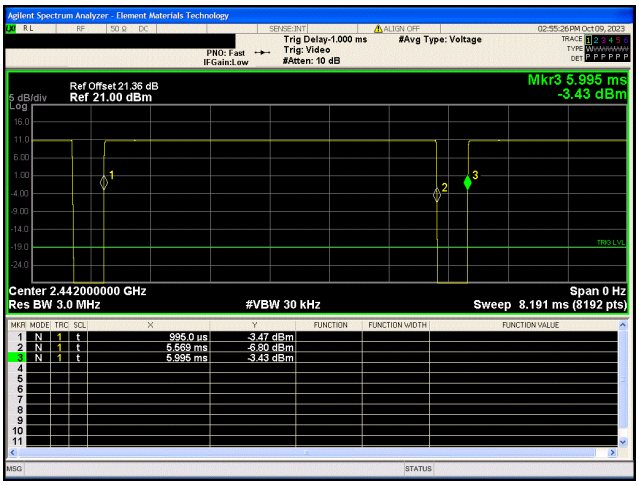
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



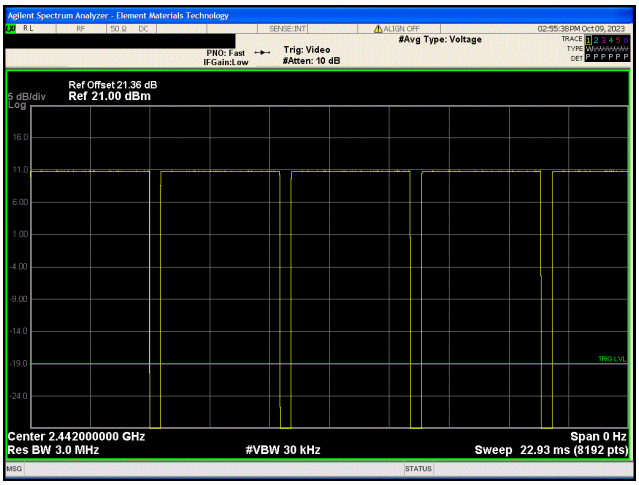
BLE/GFSK 125 kbps
Mid Channel, 2442 MHz



BLE/GFSK 125 kbps
Mid Channel, 2442 MHz



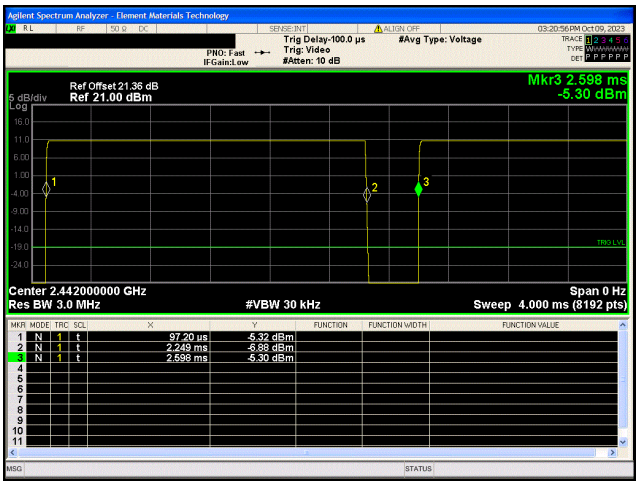
BLE/GFSK 500 kbps
Mid Channel, 2442 MHz



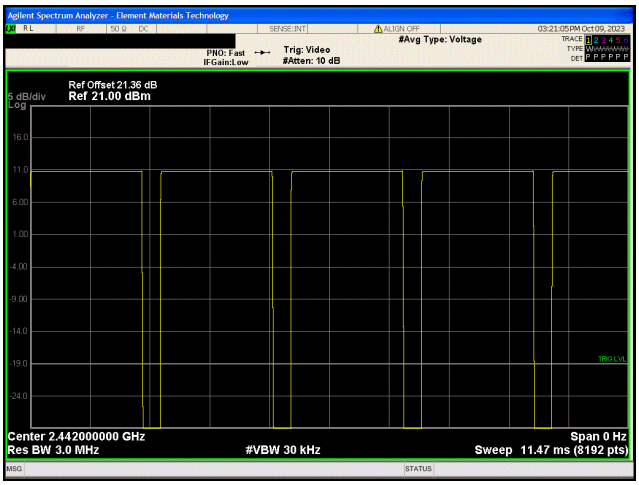
BLE/GFSK 500 kbps
Mid Channel, 2442 MHz

DUTY CYCLE

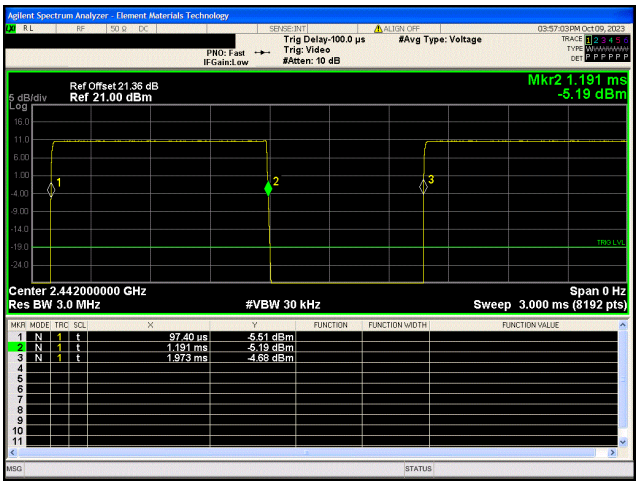
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



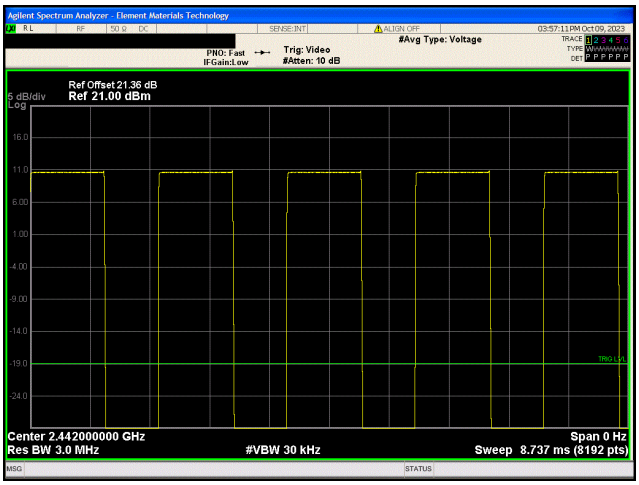
BLE/GFSK 1 Mbps
Mid Channel, 2442 MHz



BLE/GFSK 1 Mbps
Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps
Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps
Mid Channel, 2442 MHz

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

TEST DESCRIPTION

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 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.

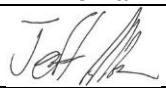
The 6dB DTS bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2023-08-29	2024-08-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2022-12-02	2023-12-02
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

EUT:	BluKey Plus™ S (BK+S)	Work Order:	PAYR0024
Serial Number:	B	Date:	2023-10-09
Customer:	PayRange Inc.	Temperature:	22°C
Attendees:	Mike Mitchell	Relative Humidity:	48.4%
Customer Project:	None	Bar. Pressure (PMSL):	999 mbar
Tested By:	Jeff Alcoke and Chris Ladwig	Job Site:	EV06
Power:	12 VDC via 110VAC/60Hz	Configuration:	PAYR0024-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC block, 20 dB attenuator, and measurement cable

DEVIATIONS FROM TEST STANDARD

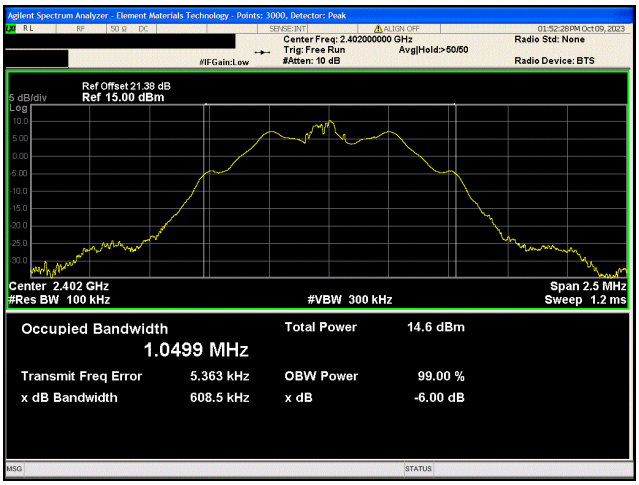
None

TEST RESULTS

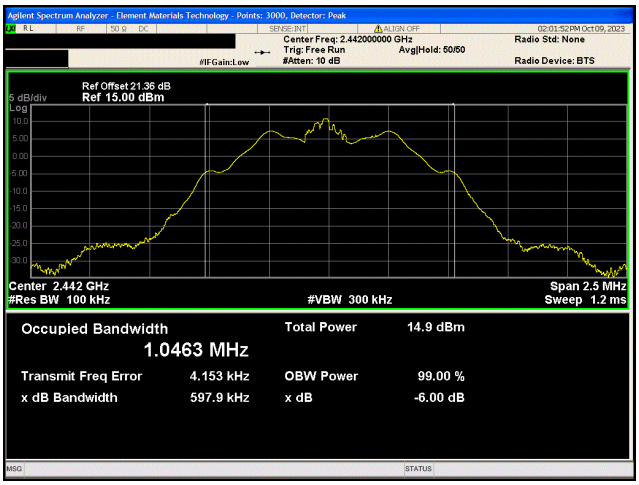
	Value	Limit (≥)	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	608.523 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	597.86 kHz	500 kHz	Pass
High Channel, 2480 MHz	606.883 kHz	500 kHz	Pass
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	658.811 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	657.345 kHz	500 kHz	Pass
High Channel, 2480 MHz	656.651 kHz	500 kHz	Pass
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	661.284 kHz	500 kHz	Pass
Mid Channel, 2442 MHz	660.128 kHz	500 kHz	Pass
High Channel, 2480 MHz	656.184 kHz	500 kHz	Pass
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	1.105 MHz	500 kHz	Pass
Mid Channel, 2442 MHz	1.104 MHz	500 kHz	Pass
High Channel, 2480 MHz	1.103 MHz	500 kHz	Pass

DTS BANDWIDTH (6 dB)

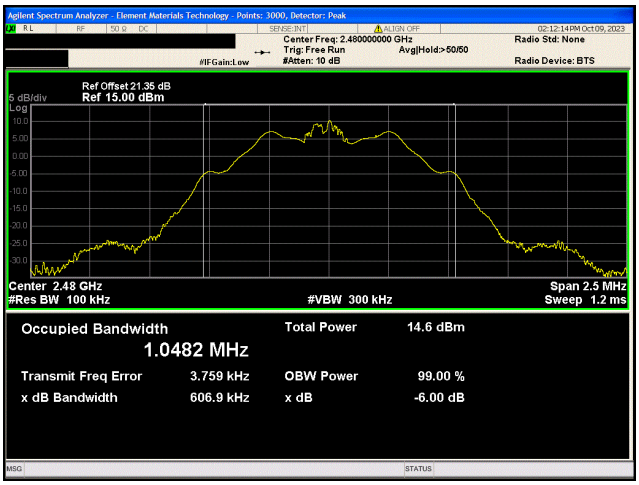
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



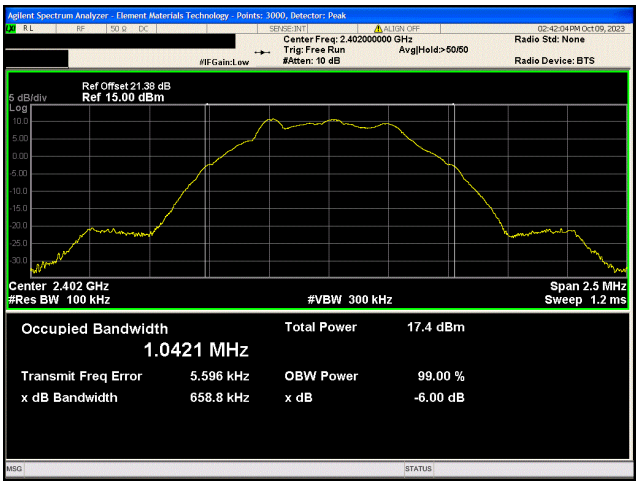
BLE/GFSK 125 kbps
Low Channel, 2402 MHz



BLE/GFSK 125 kbps
Mid Channel, 2442 MHz



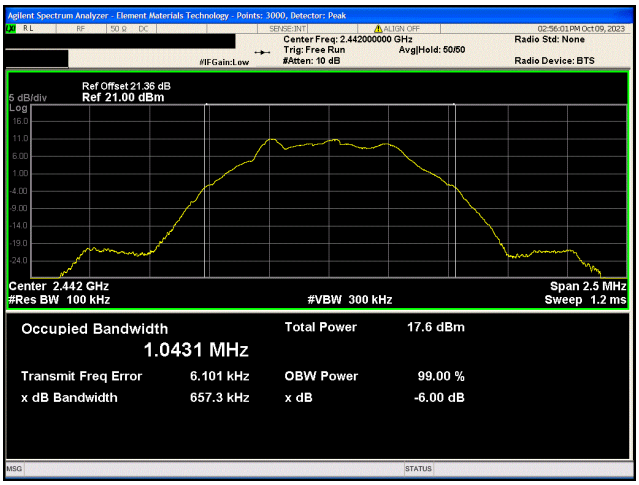
BLE/GFSK 125 kbps
High Channel, 2480 MHz



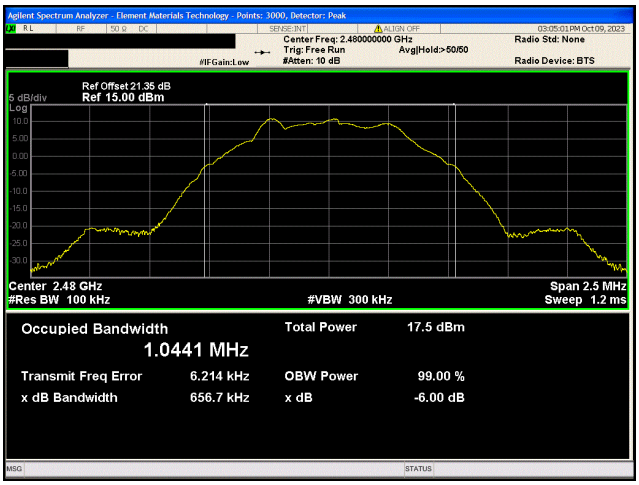
BLE/GFSK 500 kbps
Low Channel, 2402 MHz

DTS BANDWIDTH (6 dB)

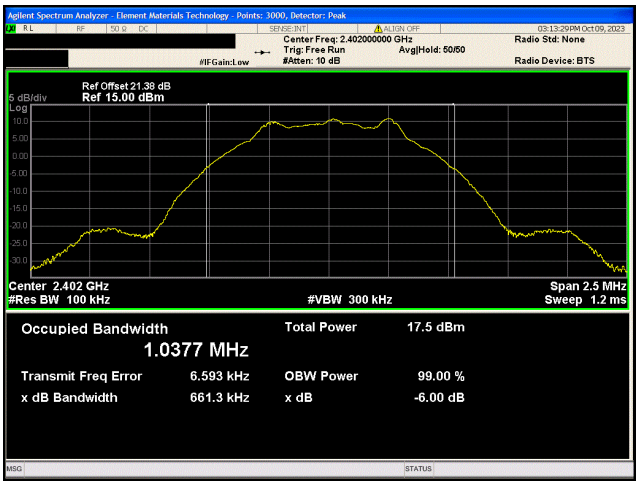
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



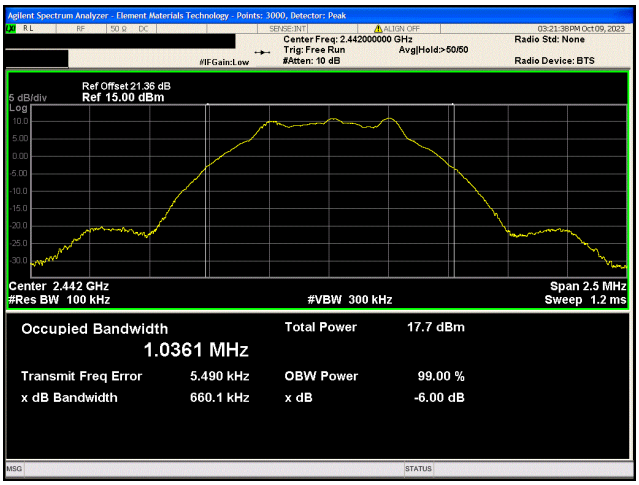
BLE/GFSK 500 kbps
Mid Channel, 2442 MHz



BLE/GFSK 500 kbps
High Channel, 2480 MHz



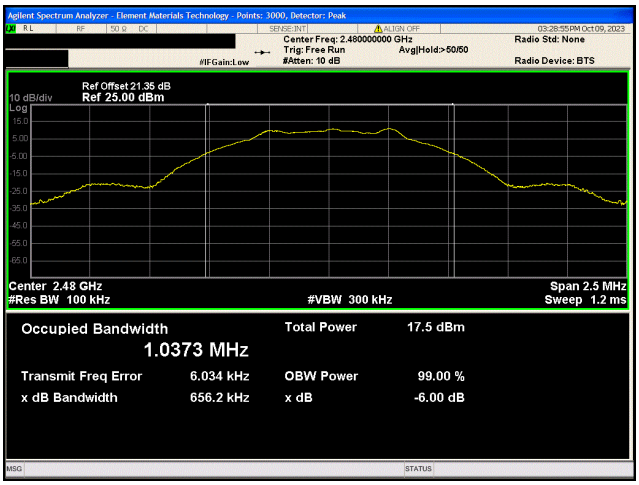
BLE/GFSK 1 Mbps
Low Channel, 2402 MHz



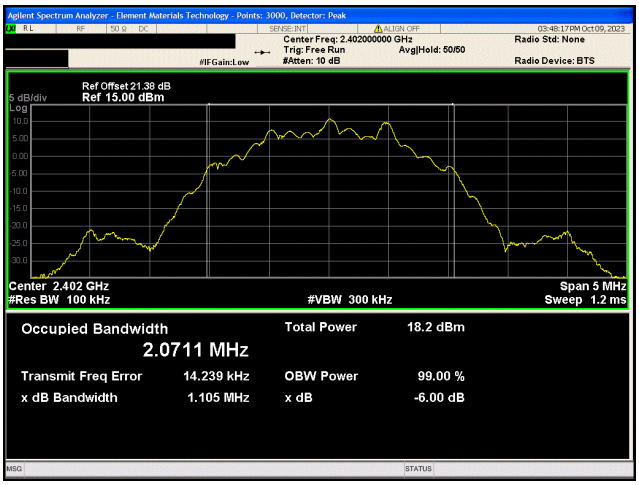
BLE/GFSK 1 Mbps
Mid Channel, 2442 MHz

DTS BANDWIDTH (6 dB)

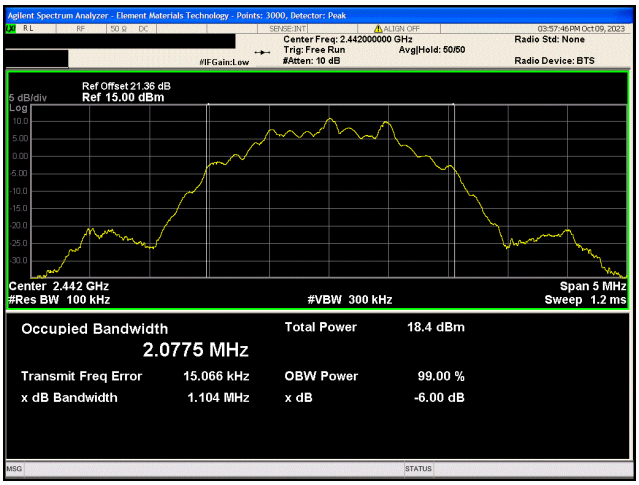
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



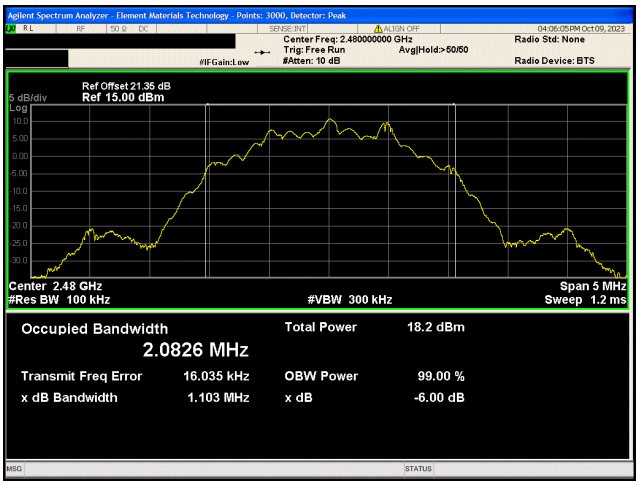
BLE/GFSK 1 Mbps
High Channel, 2480 MHz



BLE/GFSK 2 Mbps
Low Channel, 2402 MHz



BLE/GFSK 2 Mbps
Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps
High Channel, 2480 MHz

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

TEST DESCRIPTION

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 measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The 99% occupied 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 sample detector was used unless the device was not able to be operated in a continuous transmit mode, in which case a peak detector was used.

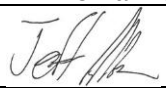
The spectrum analyzer occupied bandwidth measurement function was used to sum the power of the transmission in linear terms to obtain the 99% bandwidth.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	2023-08-29	2024-08-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2022-12-02	2023-12-02
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.08.15.2
WTD.2023.08.03.0

EUT:	BluKey Plus™ S (BK+S)	Work Order:	PAYR0024
Serial Number:	B	Date:	2023-10-09
Customer:	PayRange Inc.	Temperature:	22°C
Attendees:	Mike Mitchell	Relative Humidity:	48.4%
Customer Project:	None	Bar. Pressure (PMSL):	999 mbar
Tested By:	Jeff Alcoke and Chris Ladwig	Job Site:	EV06
Power:	12 VDC via 110VAC/60Hz	Configuration:	PAYR0024-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Reference level offset includes: DC block, 20 dB attenuator, and measurement cable

DEVIATIONS FROM TEST STANDARD

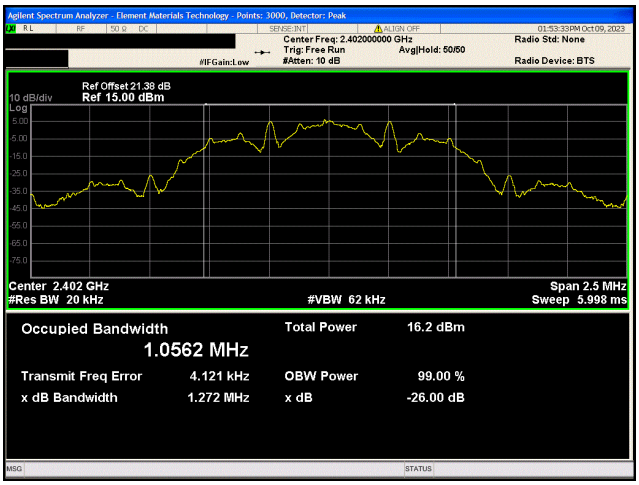
None

TEST RESULTS

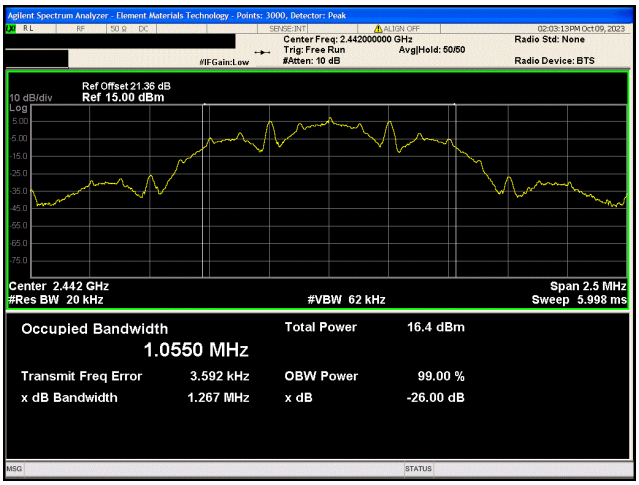
	Value	Limit	Result
BLE/GFSK 125 kbps			
Low Channel, 2402 MHz	1.056 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.055 MHz	N/A	N/A
High Channel, 2480 MHz	1.054 MHz	N/A	N/A
BLE/GFSK 500 kbps			
Low Channel, 2402 MHz	1.025 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.023 MHz	N/A	N/A
High Channel, 2480 MHz	1.025 MHz	N/A	N/A
BLE/GFSK 1 Mbps			
Low Channel, 2402 MHz	1.034 MHz	N/A	N/A
Mid Channel, 2442 MHz	1.036 MHz	N/A	N/A
High Channel, 2480 MHz	1.035 MHz	N/A	N/A
BLE/GFSK 2 Mbps			
Low Channel, 2402 MHz	2.083 MHz	N/A	N/A
Mid Channel, 2442 MHz	2.094 MHz	N/A	N/A
High Channel, 2480 MHz	2.098 MHz	N/A	N/A

OCCUPIED BANDWIDTH (99%)

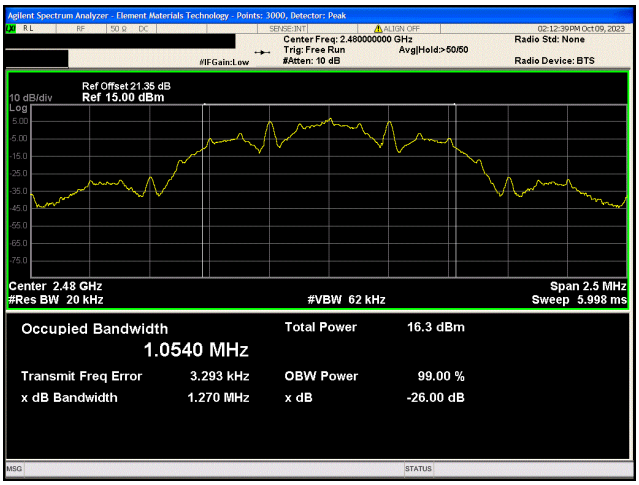
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



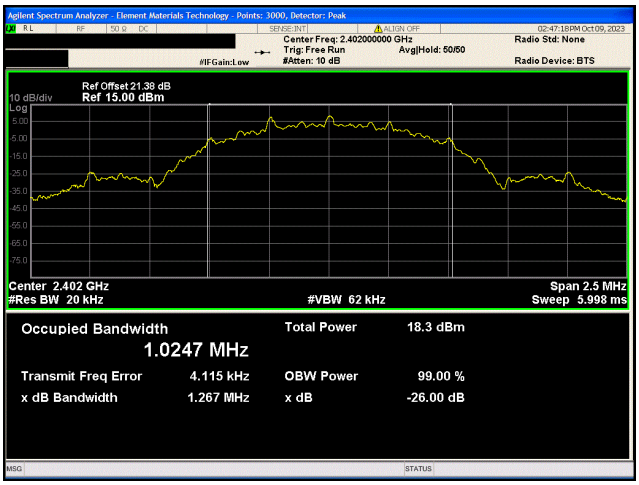
BLE/GFSK 125 kbps
Low Channel, 2402 MHz



BLE/GFSK 125 kbps
Mid Channel, 2442 MHz



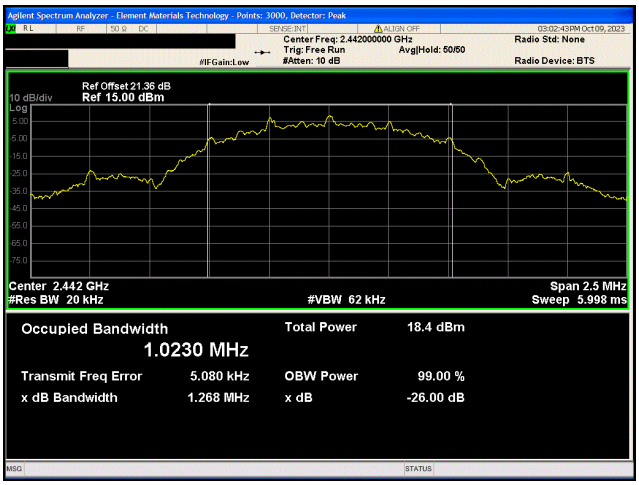
BLE/GFSK 125 kbps
High Channel, 2480 MHz



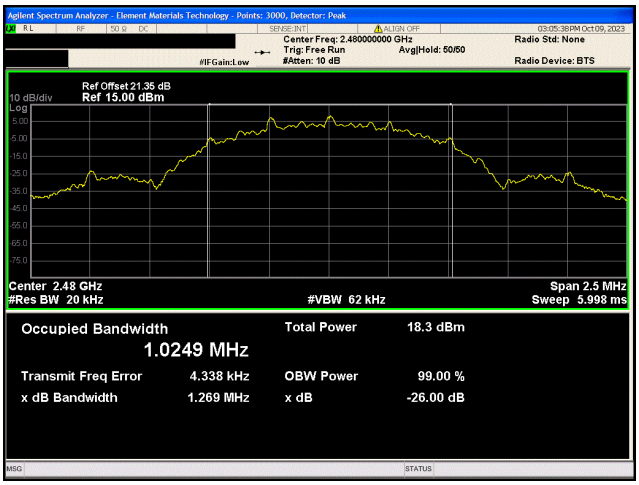
BLE/GFSK 500 kbps
Low Channel, 2402 MHz

OCCUPIED BANDWIDTH (99%)

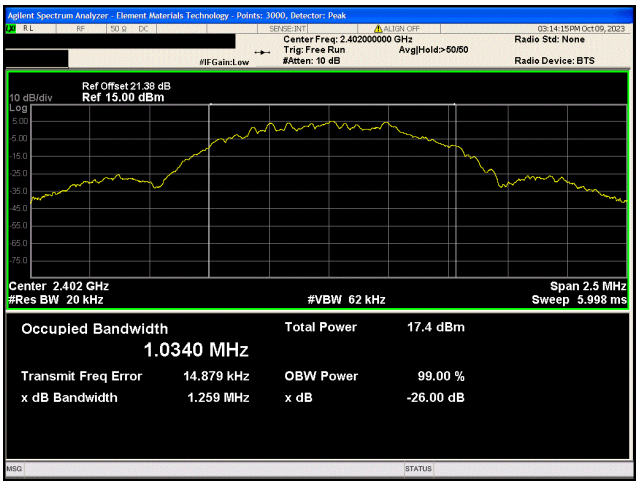
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



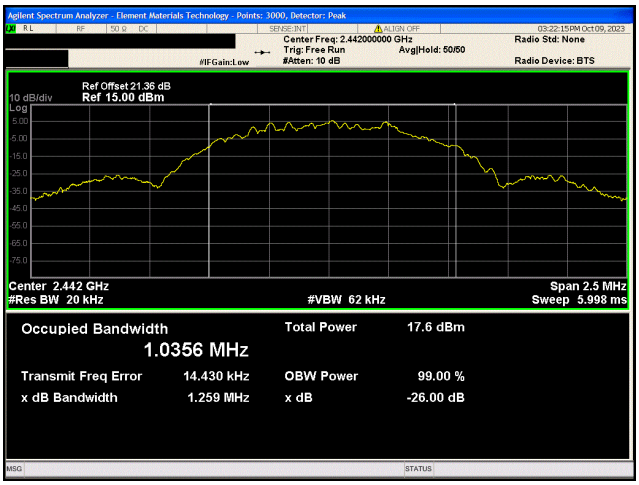
BLE/GFSK 500 kbps
Mid Channel, 2442 MHz



BLE/GFSK 500 kbps
High Channel, 2480 MHz



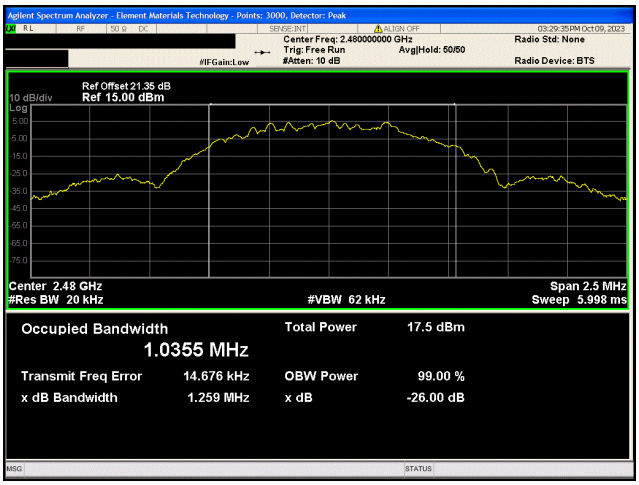
BLE/GFSK 1 Mbps
Low Channel, 2402 MHz



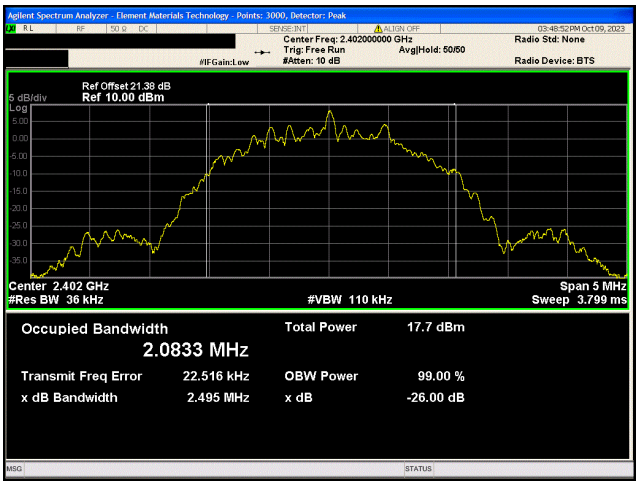
BLE/GFSK 1 Mbps
Mid Channel, 2442 MHz

OCCUPIED BANDWIDTH (99%)

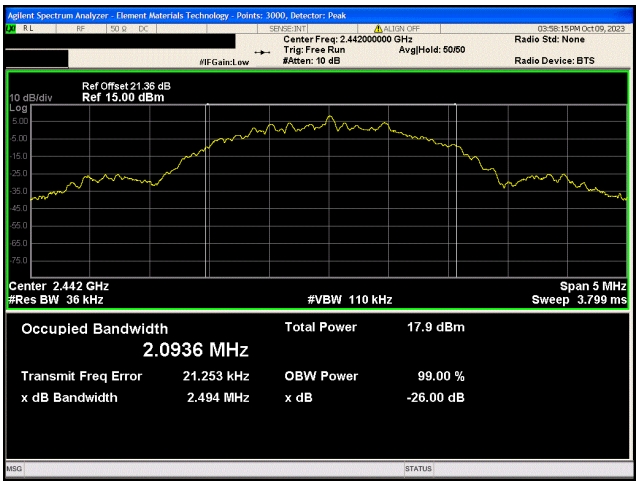
element
TbtTx 2023.08.15.2
WTD.2023.08.03.0



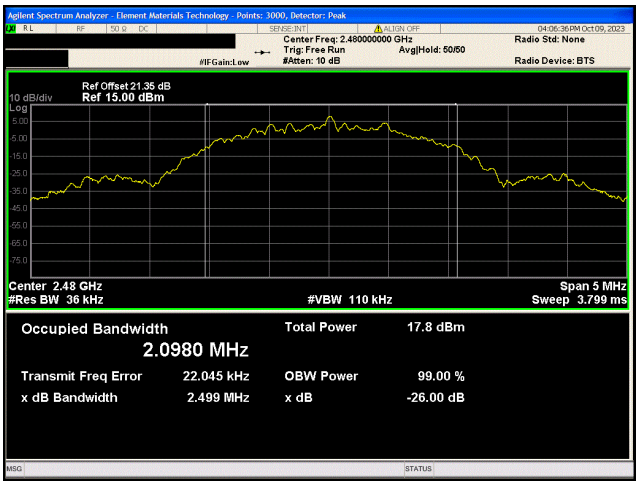
BLE/GFSK 1 Mbps
High Channel, 2480 MHz



BLE/GFSK 2 Mbps
Low Channel, 2402 MHz



BLE/GFSK 2 Mbps
Mid Channel, 2442 MHz



BLE/GFSK 2 Mbps
High Channel, 2480 MHz