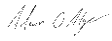
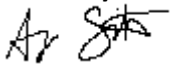
Test Report C-3770 C

Equipment Under Test:	SaBLE-x-R2DAK
Requirement(s):	FCC Part 15.247, RSS-247
Test Date(s):	February 20-21, 2024
Prepared for:	Daktronics, Inc. Attn: Jason Boeve 201 Daktronics Drive Brookings, SD 57006

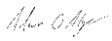
Report Issued by: Adam Alger, Manager EMC Laboratory

Signature:  Date: 02/20/2025

Report Reviewed by: Anthony Smith

Signature:  Date: 01/07/2025

Report Constructed by: Adam Alger, Manager EMC Laboratory

Signature:  Date: 02/21/2024

CONTENTS

Ezurio Test Services in Review

The Ezurio laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

Certificate #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

---

Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Government of Canada

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **February 20-21, 2024** the Equipment Under Test (EUT), **SaBLE-x-R2DAK**, as provided by **Daktronics** was tested to the following requirements:

FCC 15.247 | RSS-247 – DTS Bluetooth Low Energy

Requirements	Description	Method	Compliant
15.247 RSS-247	Radiated Field Strength Measurement for determining antenna gain	ANSI C63.10	Yes
15.247(b)(3) RSS-247 Clause 5.4 (d)	RF Output Power	ANSI C63.10	Yes

Note: Class 2 permissive change testing to add an antenna.

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Daktronics, Inc.
Contact Person	Jason Boeve
Address	201 Daktronics Drive Brookings, SD 57006

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	SaBLE-x-R2DAK
Model Number	SaBLE-x-R2DAK
Serial Number	Eng. Sample
FCC ID	2A4GK-DAKT041000
IC ID	28286-DAKT041000

2.2 Product Description

Bluetooth Low Energy module

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

3.3 VDC powered module on dev board connected to Taoglas WCM.01.0151 antenna tested on a representative ground plane on low (2402 MHz), Mid (2440 MHz), and High (2480 MHz) channels at 1 Mbps and 2 Mbps data rates.

Antenna ground plane dimensions: 610mm x 210mm x 1.6mm

Antenna cables: SMA to RP-SMA 308cm + 15cm u.fl to SMA

3 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2
FCC eCFR 47 Part 15	-	2024	-	-
ANSI C63.10	-	2020	-	-
RSS-247	3	2023	-	-
RSS-GEN	5	2018	2019	2021
KDB 558074 D01	-	2019	-	-

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References
CISPR 16-4-1
CISPR 16-4-2
CISPR 32
ANSI C63.23
A2LA P103
A2LA P103c
ETSI TR 100-028

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

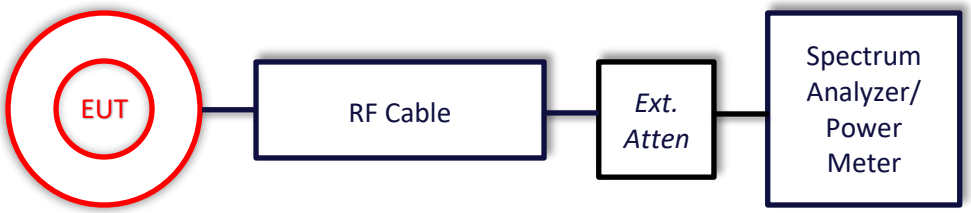
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 Antenna Port Conducted Emissions

Operator	Nicole Sedmak	**QA**	Dylan Rosenfeldt
Temperature	22.8°C	**R.H. %**	27.70%
Test Date	2/21/2024	**Location**	Bench
Requirement	15.247, RSS-247	**Method**	ANSI C63.10 Section 11.9.1.1

Limits: 30 dBm

Test Parameters

Frequency	2402, 2440, 2480 MHz	**Setup**	Antenna port
RBW	3 MHz	**VBW**	50 MHz
Detector(s)	Peak	**Settings**	Peak, max hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	6/13/2023	6/12/2024	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/10/2023	4/10/2024	Active Calibration

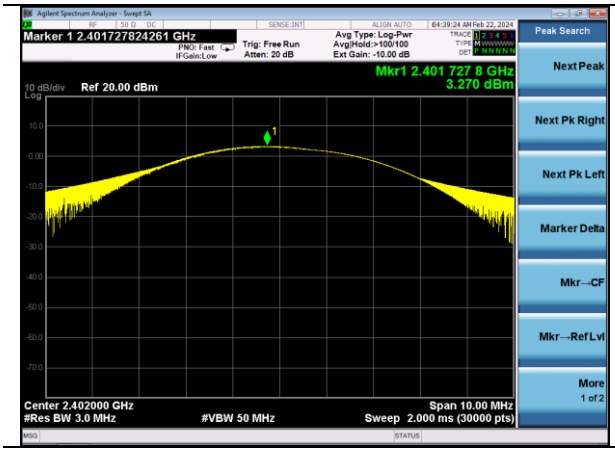
EUT Parameters

Input Power	3.3 VDC	**Mode**	Continuous Transmit Modulated
Frequency	2402, 2440, 2480 MHz	**Channel**	Low, Mid, High

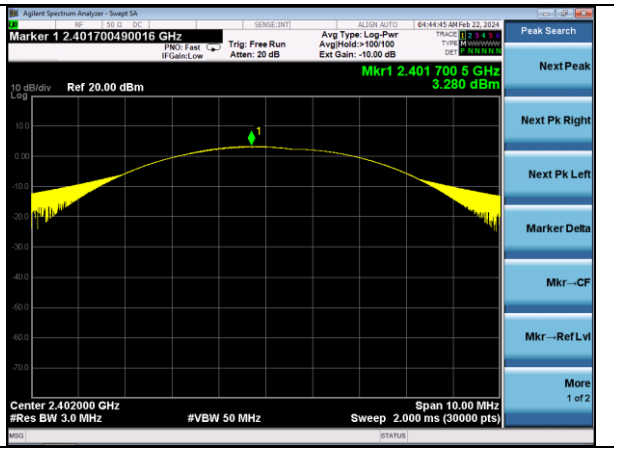
Table

Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)	Channel	Data rate
2401.7	3.27	30.0	26.7	Low	1Mbps
2439.8	3.16	30.0	26.8	Mid	1Mbps
2480.0	2.63	30.0	27.4	High	1Mbps
2401.7	3.28	30.0	26.7	Low	2Mbps
2439.9	3.14	30.0	26.9	Mid	2Mbps
2479.9	2.61	30.0	27.4	High	2Mbps

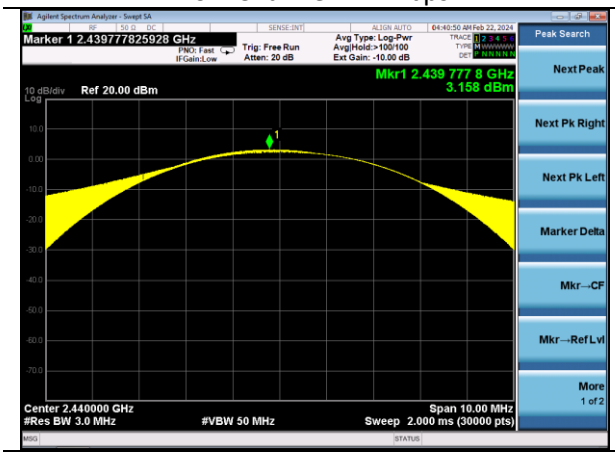
Plots



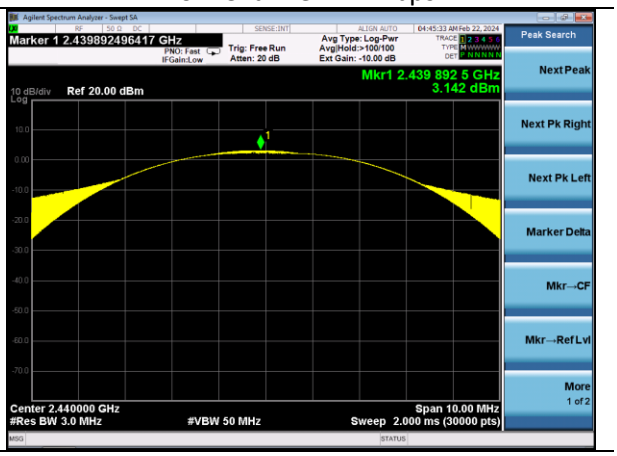
Low Channel – 1 Mbps



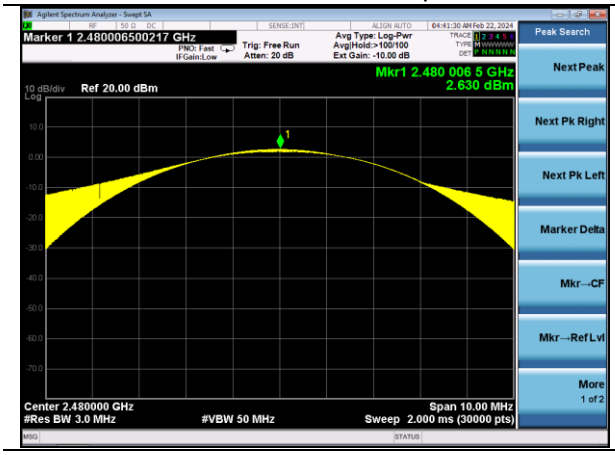
Low Channel – 2 Mbps



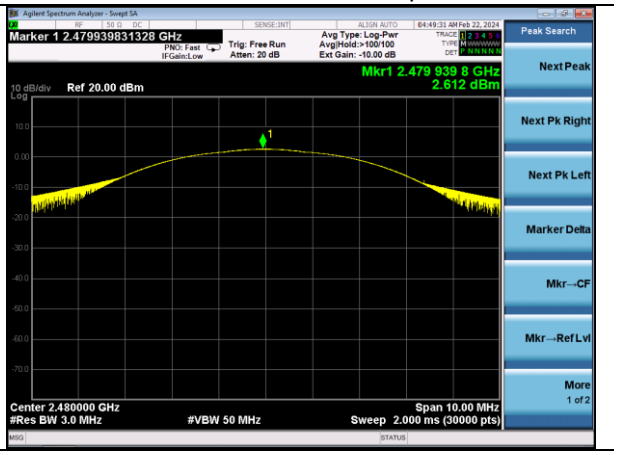
Mid Channel – 1 Mbps



Mid Channel – 2 Mbps



High Channel – 1 Mbps

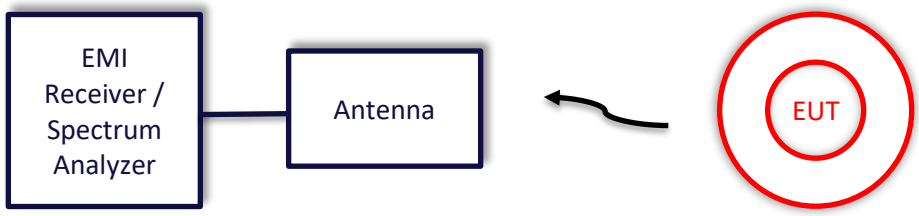


High Channel – 2 Mbps

5.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBµV/m) Margin (dB) = Limit (dBµV/m) - Corrected Reading (dBµV/m) Example at 4000 MHz: Reading = 40 dBµV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBµV/m Average Limit = 20 log (500) = 54 dBµV/m Margin = 54 dBµV/m - 50.8 dBµV/m = 3.2 dB

Block Diagram



5.2.1 Antenna Gain

Operator	Nicole Sedmak	**QA**	Dylan Rosenfeldt
Temperature	24.0°C	**R.H. %**	23.90%
Test Date	2/20/2024	**Location**	Chamber 3
Requirement	15.247, RSS-247	**Method**	ANSI C63.10 Section 6.5 and 6.6

Test Parameters

Frequency	2402, 2440, 2480 MHz	**Distance**	3m
Detector(s)	Peak	**Table height**	150 cm
RBW	3 MHz	**VBW**	50 MHz

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960007	Antenna - Double Ridge Horn	EMCO	3115	9311-4138	11/19/2023	11/19/2024	Active Calibration
EE 960203	Analyzer - EMI Receiver	Keysight	N9038A	MY56400072	4/10/2023	4/10/2024	Active Calibration
LSC-300	Cable	Chamber 3 Emissions	-	-	1/5/2023	1/5/2024	Active Verification

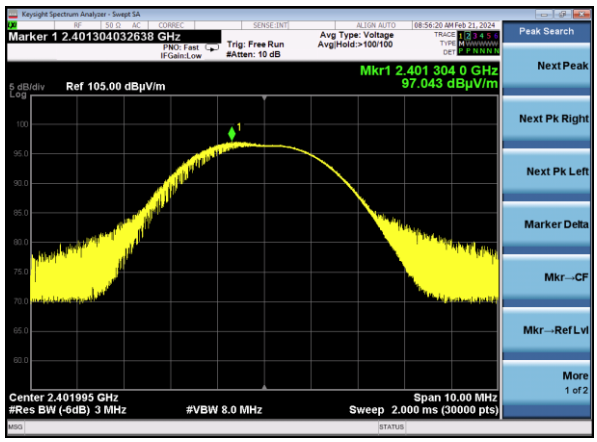
EUT Parameters

Input Power	3.3 VDC	**Mode**	Continuous transmit modulated
EUT	2402, 2440, 2480 MHz	**EUT**	Low, mid, high channel

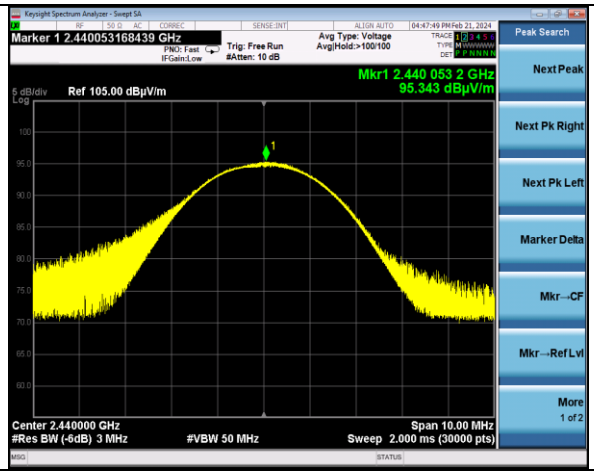
Frequency (MHz)	Radiated Field Strength (dBµV/m)	Output Power (dBm)	Antenna gain (dBi)
2402	97.0	3.27	-1.5
2440	95.3	3.16	-3.1
2480	95.6	2.63	-2.2

Example Calculation:
Radiated Field Strength (dBµV/m @ 3m) – [Output Power (dBm)+ 95.2 (conversion to dBµV/m @ 3m)]

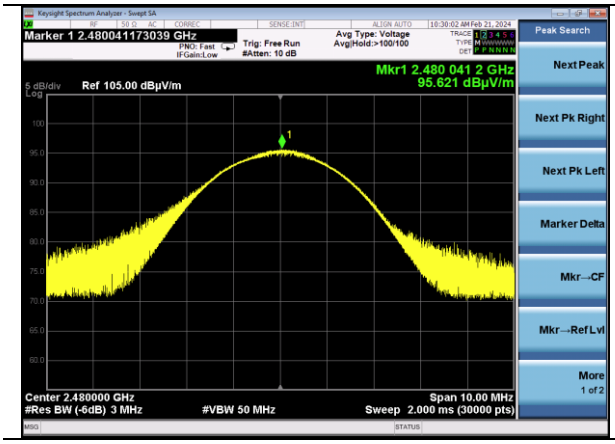
Radiated Fundamental



2402 MHz – Horizontal – Z-orientation



2440 MHz – Vertical – X-orientation



2480 MHz – Horizontal – Z-orientation

6 REVISION HISTORY

Version	Date	Notes	Person
0	02/21/2024	Initial Draft	Adam Alger
1	02/20/2025	TCB Comments – Separate Antenna Report	Adam Alger

END OF REPORT