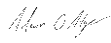
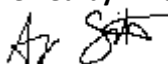
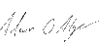


Test Report C-3770 A

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

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Company: Daktronics, Inc.	Page 1 of 22	Name: SaBLE-x-R2DAK
Report: TR 3770 A		Model: SaBLE-x-R2DAK
Quote: NBO-10-2023-006734-1		Serial: Eng Sample

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Ezurio Test Services in Review

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



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



Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

Company: Daktronics, Inc.	Page 3 of 22	Name: SaBLE-x-R2DAK
Report: TR 3770 A		Model: SaBLE-x-R2DAK
Quote: NBO-10-2023-006734-1		Serial: Eng Sample

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(d) 15.209 RSS-247 Clause 5.5 RSS-GEN Clause 8.10	Spurious Radiated Emissions in Restricted Bands 30-25000 MHz	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

Company: Daktronics, Inc.	Page 5 of 22	Name: SaBLE-x-R2DAK
Report: TR 3770 A		Model: SaBLE-x-R2DAK
Quote: NBO-10-2023-006734-1		Serial: Eng Sample

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 $\pm$
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

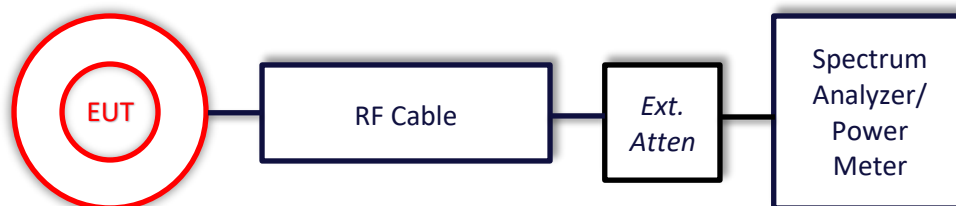
Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
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

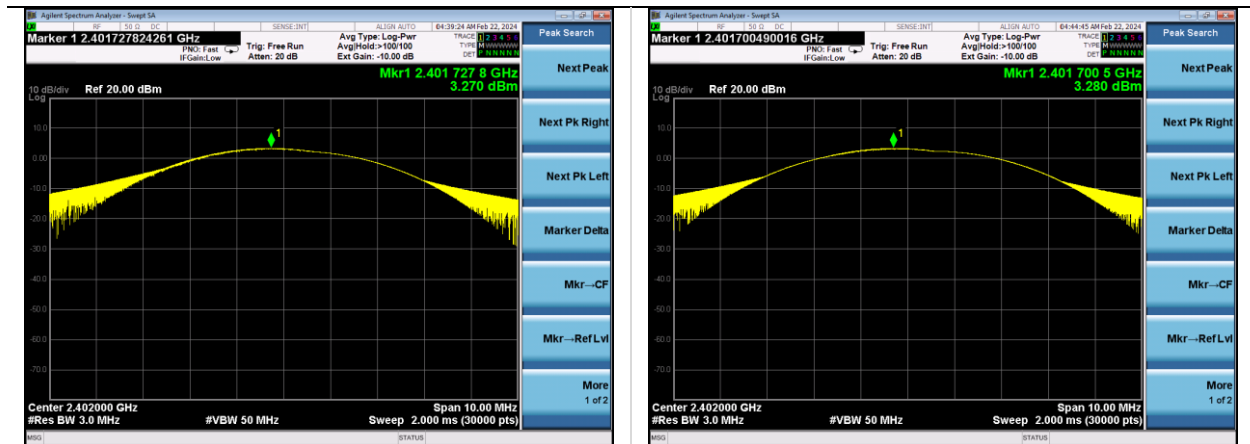
EUT Parameters

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

Table

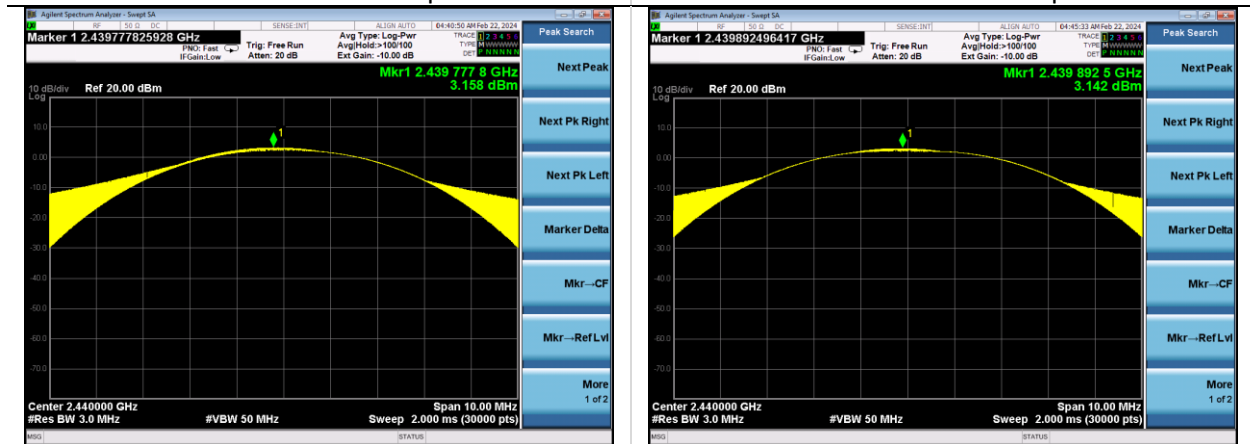
Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)	Channel	Data rate
2401.7	3.27	30.0	26.7	Low	1Mbps
2439.8	3.16	30.0	26.8	Mid	1Mbps
2480.0	2.63	30.0	27.4	High	1Mbps
2401.7	3.28	30.0	26.7	Low	2Mbps
2439.9	3.14	30.0	26.9	Mid	2Mbps
2479.9	2.61	30.0	27.4	High	2Mbps

Plots



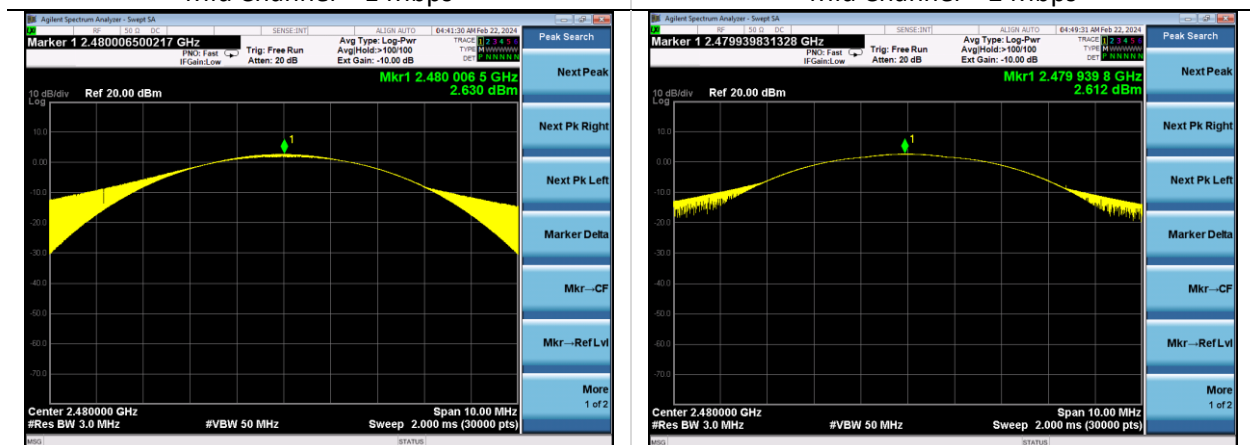
Low Channel – 1 Mbps

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 Radiated Emissions

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

Limits:

Frequency (MHz)	Peak Limit (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Average Limit (dBμV/m)
30-88	-	40.0	-
88-216	-	43.5	-
216-960	-	46.0	-
960-1000	-	54.0	-
1000-25000	74.0	-	54.0

Test Parameters

Frequency	30-25000 MHz	Distance	3m
Detector(s)	Peak, Quasi-Peak, Average	Table height	80 cm (30-1000 MHz) 150 cm (1000-25000 MHz)
RBW	1 MHz	VBW	3 MHz (peak) 2.7 kHz (average) 1 Mbps 4.7 kHz (average) 2 Mbps

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
AA 960153	Filter - High Pass 2.4 GHz	KWM	HPF-L-14186	7272-04	4/10/2023	4/10/2024	Active Calibration
AA 960209	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	037101808	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
LSC-546	Cable	A.H. Systems, Inc.	SAC-26G-6	546	7/17/2023	7/18/2024	Active Verification
AA 960150	Antenna - Biconical	ETS Lindgren	3110B	0003-3346	12/9/2023	12/9/2024	Active Calibration
AA 960163	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	500	12/11/2023	12/11/2024	Active Calibration
AA 960174	Antenna - Small Horn	ETS Lindgren	3116C-PA	00206880	12/2/2023	12/2/2024	Active Calibration

Company: Daktronics, Inc.	Page 13 of 22	Name: SaBLE-x-R2DAK
Report: TR 3770 A		Model: SaBLE-x-R2DAK
Quote: NBO-10-2023-006734-1		Serial: Eng Sample

EUT Parameters

Input Power	3.3 VDC	Mode	Continuous transmit
EUT	2402, 2440, 2480 MHz	EUT	Low, mid, high channel
Notes	No emissions found in the 30-1000 and 18000-25000 MHz range associated with transmit		

Table

Restricted Band-Edge

Average

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	EUT Orientation	Data Rate	Channel
2388.8	Horizontal	112	65	37.3	54.0	16.7	Z	1 Mbps	Low
2483.5	Horizontal	100	63	42.2	54.0	11.8	Z	1 Mbps	High
2483.5	Horizontal	100	62	46.2	54.0	7.8	Z	2 Mbps	Low
2388.4	Horizontal	221	291	38.5	54.0	15.5	Z	2 Mbps	High

Peak

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	EUT Orientation	Data Rate	Channel
2389.7	Horizontal	112.0	65.0	58.2	74.0	15.8	Z	1 Mbps	Low
2483.5	Horizontal	100.0	63.0	69.8	74.0	4.2	Z	1 Mbps	High
2483.5	Horizontal	100.0	62.0	70.2	74.0	3.8	Z	2 Mbps	Low
2389.7	Horizontal	221.0	291.0	57.6	74.0	16.4	Z	2 Mbps	High

Restricted Bands (Harmonics)

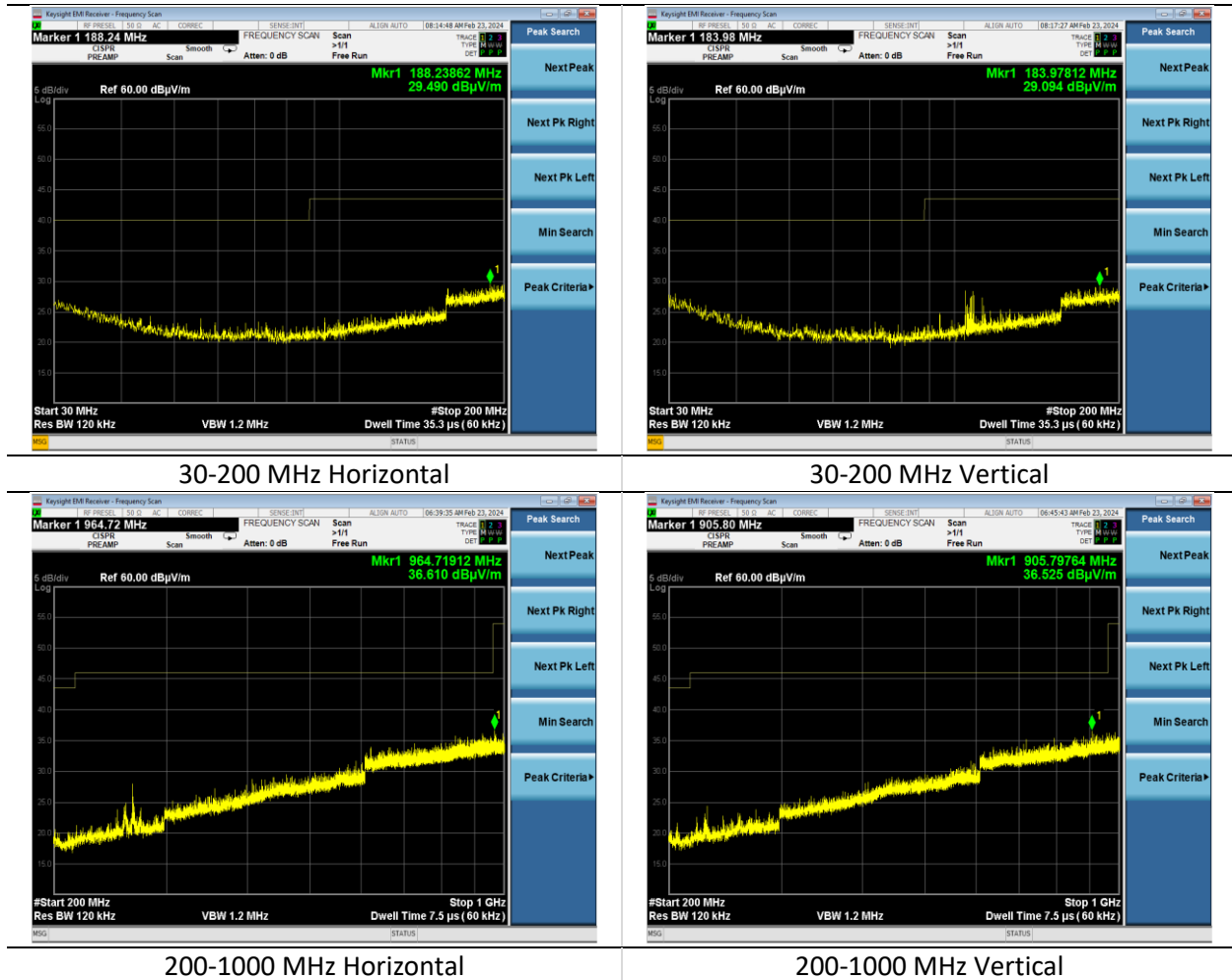
Average

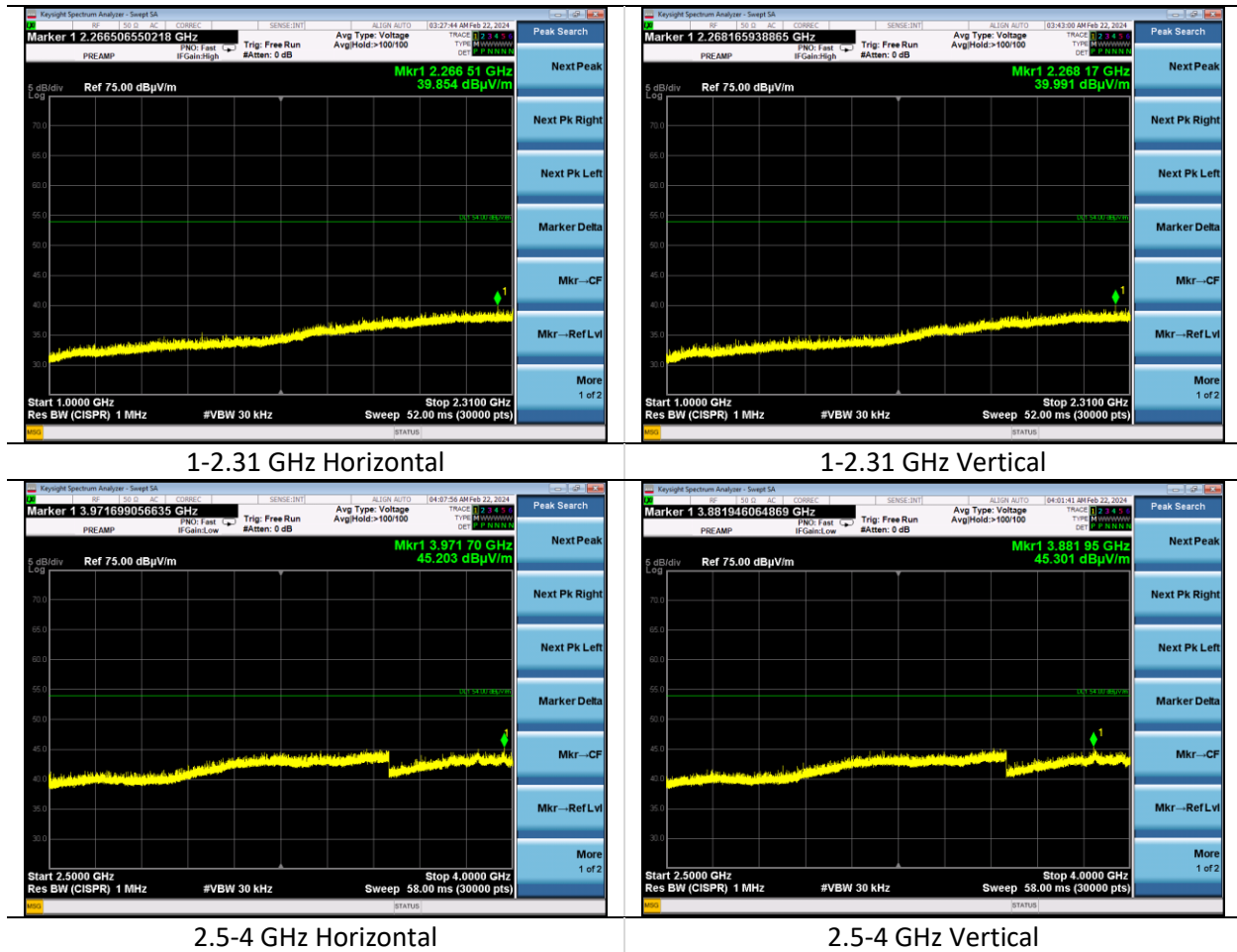
Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)	EUT Orientation	Data Rate	Channel
4808.0	Vertical	350	61	47.0	54.0	7.0	Z	1Mbps	Low
4807.9	Horizontal	157	229	47.4	54.0	6.6	Z	1Mbps	Low
4880.0	Vertical	105	56	51.6	54.0	2.4	Z	1Mbps	Mid
7319.4	Vertical	150	165	46.9	54.0	7.1	Z	1Mbps	Mid
7319.4	Horizontal	400	284	41.7	54.0	12.3	Z	1Mbps	Mid
4880.0	Horizontal	348	233	48.9	54.0	5.1	Z	1Mbps	Mid
4959.8	Vertical	368	3	51.0	54.0	3.0	Z	1Mbps	High
7439.3	Vertical	400	164	44.8	54.0	9.2	Z	1Mbps	High
7439.3	Horizontal	366	69	42.2	54.0	11.8	Z	1Mbps	High
4960.1	Horizontal	338	233	51.1	54.0	2.9	Z	1Mbps	High
4960.1	Vertical	367	2	50.9	54.0	3.1	Y	1Mbps	High
7439.3	Vertical	320	167	46.6	54.0	7.4	Y	1Mbps	High
4960.0	Horizontal	336	238	51.1	54.0	2.9	Y	1Mbps	High
7439.3	Horizontal	367	65	41.8	54.0	12.2	Y	1Mbps	High
4880.1	Vertical	381	73	47.8	54.0	6.2	Y	1Mbps	Mid
7319.3	Vertical	106	166	46.5	54.0	7.5	Y	1Mbps	Mid
7319.3	Horizontal	352	70	40.8	54.0	13.2	Y	1Mbps	Mid
4880.1	Horizontal	344	226	47.8	54.0	6.2	Y	1Mbps	Mid
4808.0	Vertical	329	72	47.6	54.0	6.4	Y	1Mbps	Low
4808.0	Horizontal	176	227	44.6	54.0	9.4	Y	1Mbps	Low
4808.0	Vertical	349	59	46.7	54.0	7.3	X	1Mbps	Low
4807.9	Horizontal	375	229	45.8	54.0	8.2	X	1Mbps	Low
4880.1	Vertical	381	68	47.3	54.0	6.7	X	1Mbps	Mid
7319.3	Vertical	124	164	47.0	54.0	7.0	X	1Mbps	Mid
7319.3	Horizontal	400	255	40.6	54.0	13.4	X	1Mbps	Mid
4879.9	Horizontal	345	231	47.1	54.0	6.9	X	1Mbps	Mid
4959.9	Vertical	368	3	50.5	54.0	3.5	X	1Mbps	High
7439.3	Vertical	400	171	44.4	54.0	9.6	X	1Mbps	High
7439.2	Horizontal	368	71	42.1	54.0	11.9	X	1Mbps	High
4960.1	Horizontal	400	314	47.8	54.0	6.2	X	1Mbps	High

Peak

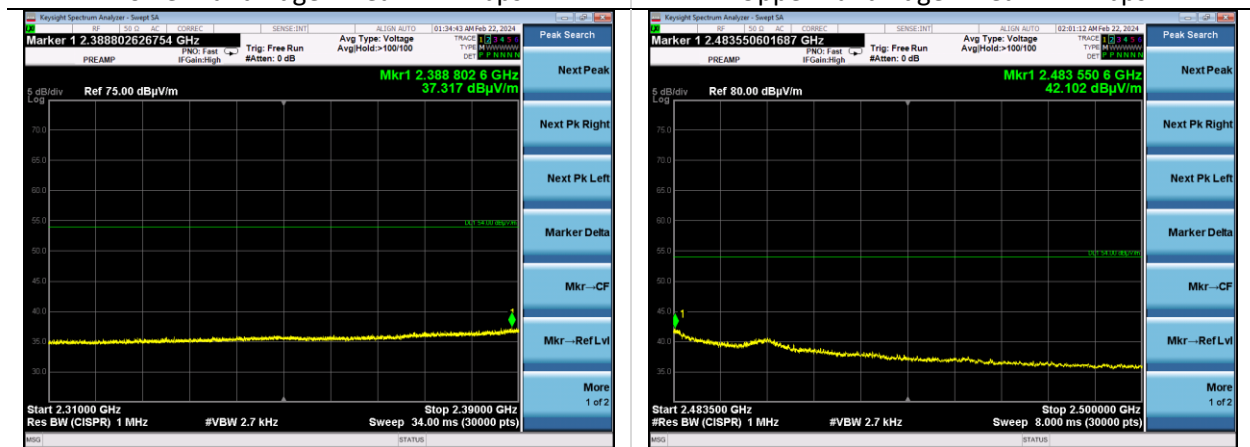
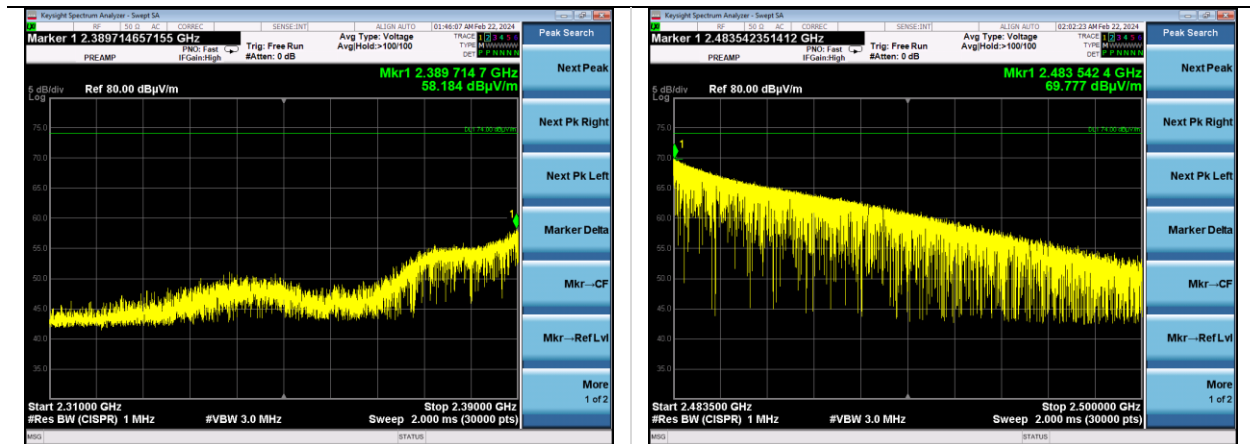
Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	EUT Orientation	Data Rate	Channel
4808.1	Vertical	350	61	52.5	74.0	21.5	Z	1Mbps	Low
4808.2	Horizontal	157	229	52.8	74.0	21.2	Z	1Mbps	Low
4880.1	Vertical	105	56	56.1	74.0	17.9	Z	1Mbps	Mid
7320.8	Vertical	150	165	52.6	74.0	21.4	Z	1Mbps	Mid
7319.1	Horizontal	400	284	49.1	74.0	24.9	Z	1Mbps	Mid
4878.1	Horizontal	348	233	54.1	74.0	19.9	Z	1Mbps	Mid
4959.5	Vertical	368	3	55.5	74.0	18.5	Z	1Mbps	High
7439.3	Vertical	400	164	51.5	74.0	22.5	Z	1Mbps	High
7439.3	Horizontal	366	69	49.5	74.0	24.5	Z	1Mbps	High
4959.6	Horizontal	338	233	55.7	74.0	18.3	Z	1Mbps	High
4959.4	Vertical	367	2	55.6	74.0	18.4	Y	1Mbps	High
7439.2	Vertical	320	167	52.5	74.0	21.5	Y	1Mbps	High
4960.0	Horizontal	336	238	55.5	74.0	18.5	Y	1Mbps	High
7440.8	Horizontal	367	65	49.1	74.0	24.9	Y	1Mbps	High
4879.5	Vertical	381	73	53.0	74.0	21.0	Y	1Mbps	Mid
7320.8	Vertical	106	166	52.6	74.0	21.4	Y	1Mbps	Mid
7319.3	Horizontal	352	70	48.2	74.0	25.8	Y	1Mbps	Mid
4880.1	Horizontal	344	226	52.9	74.0	21.1	Y	1Mbps	Mid
4808.5	Vertical	329	72	52.6	74.0	21.4	Y	1Mbps	Low
4807.4	Horizontal	176	227	50.4	74.0	23.6	Y	1Mbps	Low
4808.4	Vertical	349	59	52.1	74.0	21.9	X	1Mbps	Low
4807.6	Horizontal	375	229	51.2	74.0	22.8	X	1Mbps	Low
4880.5	Vertical	381	68	52.4	74.0	21.6	X	1Mbps	Mid
7320.8	Vertical	124	164	52.7	74.0	21.3	X	1Mbps	Mid
7320.3	Horizontal	400	255	47.7	74.0	26.3	X	1Mbps	Mid
4880.1	Horizontal	345	231	52.2	74.0	21.8	X	1Mbps	Mid
4959.6	Vertical	368	3	55.0	74.0	19.0	X	1Mbps	High
7439.2	Vertical	400	171	51.2	74.0	22.8	X	1Mbps	High
7439.4	Horizontal	368	71	49.2	74.0	24.8	X	1Mbps	High
4959.9	Horizontal	400	314	52.9	74.0	21.1	X	1Mbps	High

Plots (worst case)

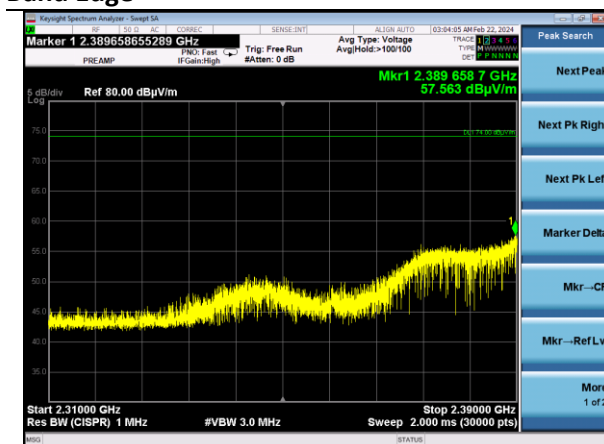




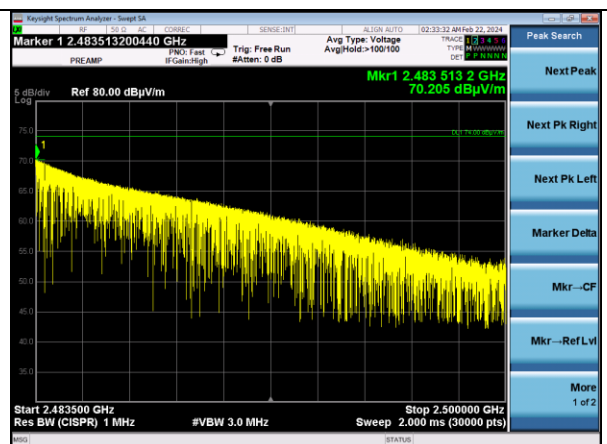
Band Edge



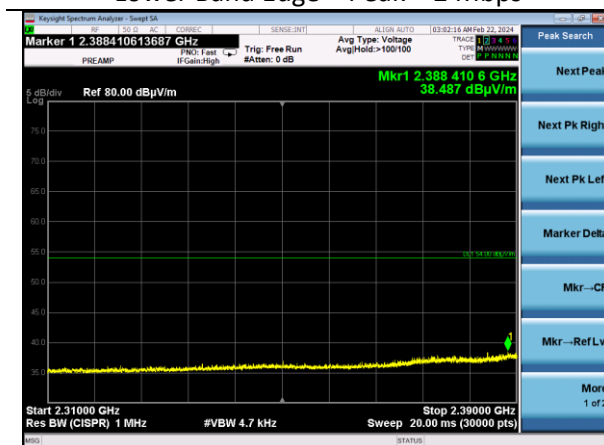
Band Edge



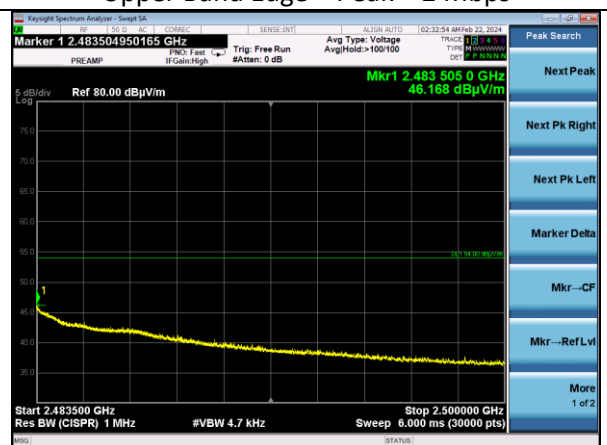
Lower Band Edge – Peak – 2 Mbps



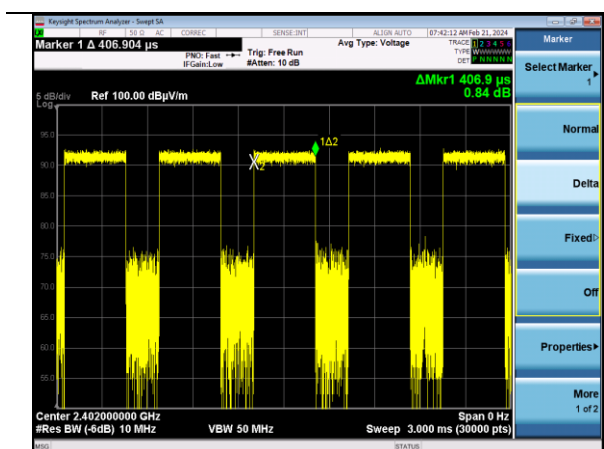
Upper Band Edge – Peak – 2 Mbps



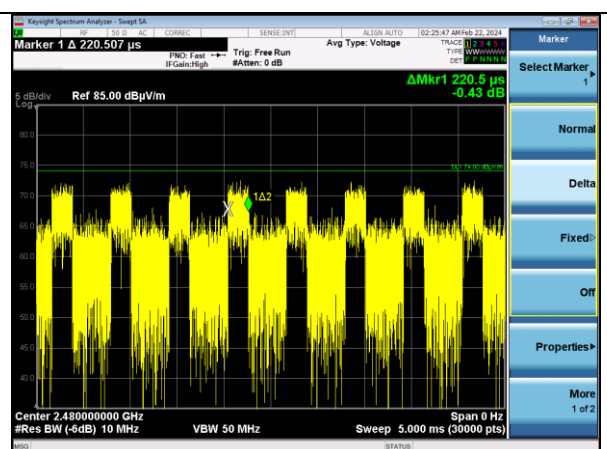
Lower Band Edge – Average – 2 Mbps



Upper Band Edge – Average – 2 Mbps

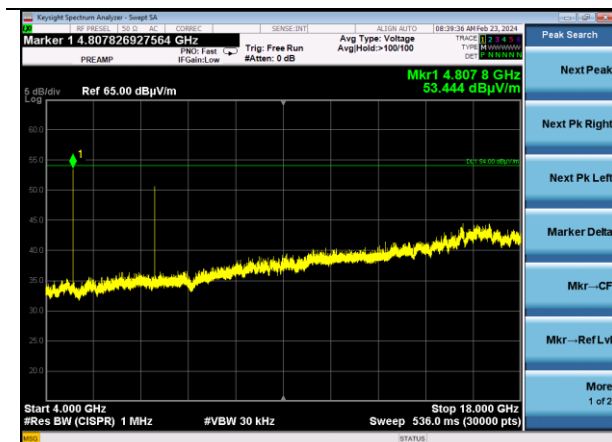


On-time – 1 Mbps

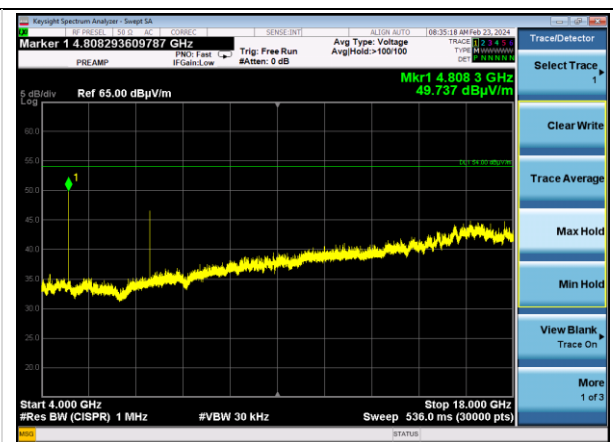


On-time – 2 Mbps

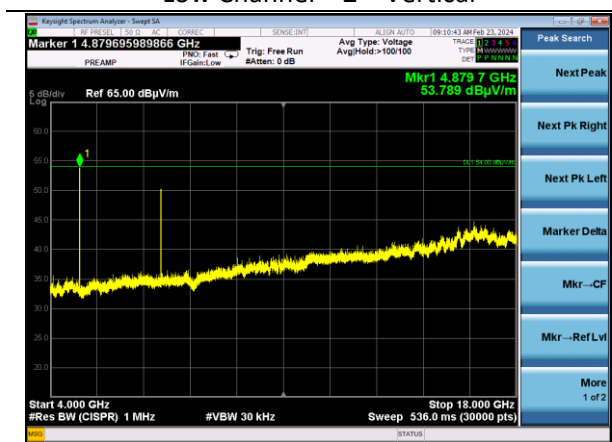
Spurious Emissions in Restricted Bands (Harmonics)



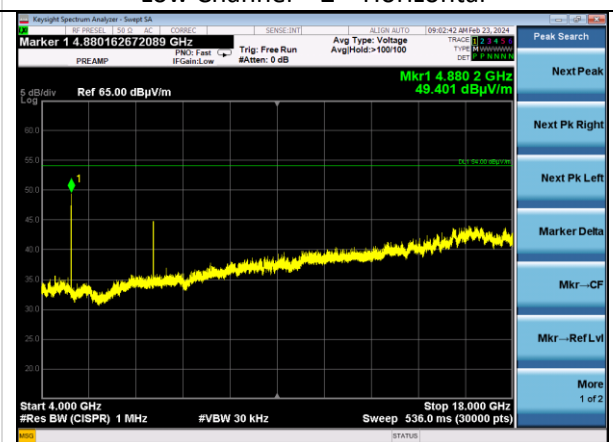
Low Channel – Z – Vertical



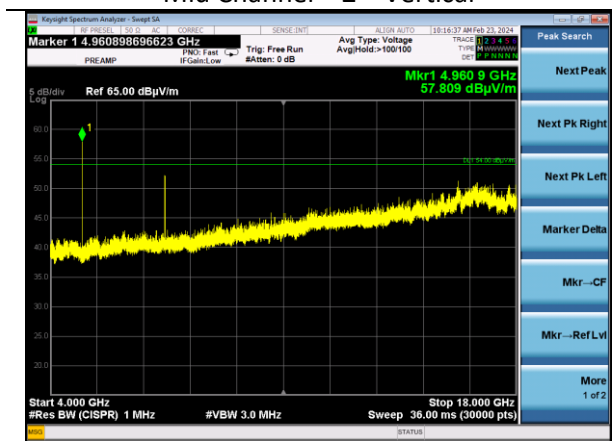
Low Channel – Z – Horizontal



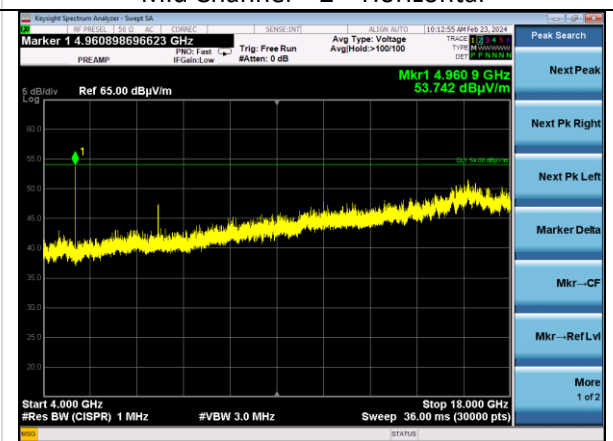
Mid Channel – Z – Vertical



Mid Channel – Z – Horizontal



High Channel – Z – Vertical



High Channel – Z – Horizontal

Company: Daktronics, Inc.	Page 21 of 22	Name: SaBLE-x-R2DAK
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Quote: NBO-10-2023-006734-1		Serial: Eng Sample

6 REVISION HISTORY

Version	Date	Notes	Person
0	02/21/2024	Initial Draft	Adam Alger
1	01/07/2025	Final Draft	Adam Alger
2	1/31/2025	TCB Comments	Adam Alger
3	2/14/2025	TCB Comments – Antenna Gain	Adam Alger
4	2/20/2025	TCB Comments – Remove Antenna Section	Adam Alger

END OF REPORT