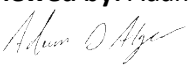
Test Report TR3664B

Equipment Under Test:	Sterling LWB+
Requirement(s):	FCC 15.247 RSS-247
Test Date(s):	3/9/2023-3/13/2023
Prepared for:	Laird Connectivity Attn: Jonathan Kaye W66 N220 Commerce Ct. Cedarburg, WI 53012

Report Issued by: Anthony Smith, EMC Engineering Specialist

Signature:  Date: 3/22/2023

Report Reviewed by: Adam Alger, Laboratory Manager

Signature:  Date: 3/22/2023

Report Constructed by: Anthony Smith, EMC Engineering Specialist

Signature:  Date: 3/17/2023

CONTENTS

Laird Connectivity Test Services in Review

The Laird Connectivity LLC 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

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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

1 TEST REPORT SUMMARY

During **March 9th, 2023 to March 13th, 2023** the Equipment Under Test (EUT), **Sterling LWB+**, as provided by **Laird Connectivity** was tested to the following requirements for the purpose of a Class 2 permissive change to add an antenna:

FCC 15.247

Requirements	Description	Specification	Method	Compliant
FCC: 15.247 (b)(1) ISED: RSS-247 5.4 (b)	Maximum Conducted Output Power	30 dBm	ANSI C63.10	Yes
FCC: 15.247 (d) ISED: RSS-GEN 8.10	Spurious Emissions in Restricted Frequency Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Yes

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	0.1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Laird Connectivity
Contact Person	Jonathan Kaye
Address	W66N220 Commerce Court Cedarburg, WI, 53012

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	Sterling LWB+
Model Number	Sterling LWB+
Serial Number	00071
FCC ID	SQG-LWBPLUS
IC ID	3147A-LWBPLUS

2.2 Product Description

WLAN and Bluetooth Module operating in the 2.4 GHz range.

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

Bluetooth Classic (Basic Rate, EDR2, EDR3). Channels tested: 0 (2402 MHz), 39 (2440 MHz), 40 (2441 MHz), 78 (2480 MHz), and Hopping Mode.

Opti PA226SA 12VDC Power Supply. Laird Connectivity SU60-SOMC Carrier Board used for programming. Dell Latitude 5480 Laptop used to program radio.

BTLRU (Bluetooth Laird Regulatory Utility) Version 10.0.0.178 utilized to control radio.

2.6 Additional Information

This testing is for a permissive change to add the iFlex-Pifa Antenna, with an antenna gain of 3.1 dBi, to the list of antennas usable by the Sterling LWB+. EUT tested via Cabinet Radiation method.

3 REFERENCES

Publication	Edition	Date	AMD 1
eCFR	-	2023	-
RSS-247	2	2017	-
RSS-GEN	5	2018	2019
ANSI C63.10	-	2013	-
KDB 178919 D01	6	2015	-

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

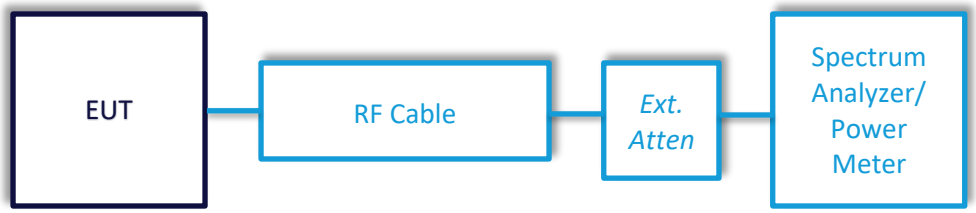
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %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

Operator	Anthony Smith	**QA**	Adam Alger
Temperature (°C)	21.0, 20.4, 21.6	**R.H. %**	29.0, 31.1, 26.2
Test Date	3/9/2023, 3/10/2023, 3/13/2023	**Location**	RF Conducted Bench
Requirement	FCC 15.247 RSS-247	**Method**	ANSI C63.10

Limits:

<30 dBm

Test Parameters

Frequency	2.4-2.4835 GHz	**Setup**	Conducted
RBW	3 MHz	**VBW**	50 MHz
Detector(s)	Peak	**Settings**	Trace Max Hold

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	3/22/2022	3/22/2023	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/12/2022	4/12/2023	Active Calibration

EUT Parameters

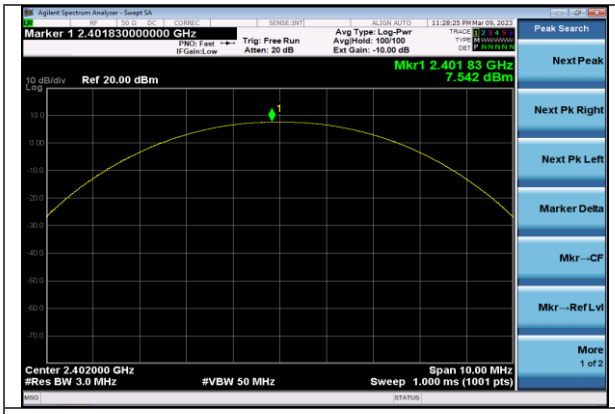
Input Power	12VDC	**Mode**	BR, EDR2, EDR3
Frequency (MHz)	2402, 2441, 2480	**Channel**	0, 40, 78

Data

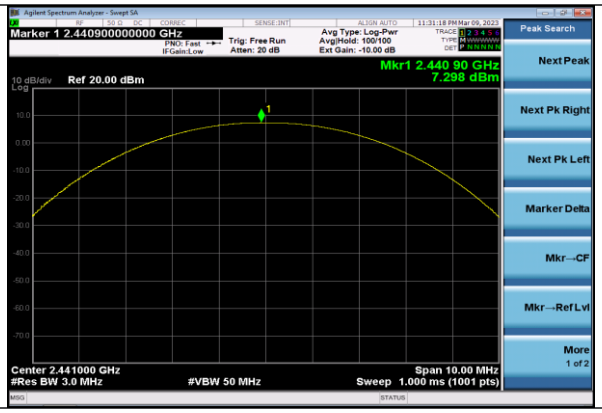
Table

Mode / Channel	Antenna Gain (dBi)	Peak Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
BR / 0	3.1	7.5	30.0	22.5
BR / 40	3.1	7.3	30.0	22.7
BR / 78	3.1	7.0	30.0	23.0
EDR2 / 0	3.1	4.0	30.0	26.0
EDR2 / 40	3.1	3.9	30.0	26.1
EDR2 / 78	3.1	3.5	30.0	26.5
EDR3 / 0	3.1	4.4	30.0	25.6
EDR3 / 40	3.1	4.4	30.0	25.6
EDR3 / 78	3.1	4.0	30.0	26.0

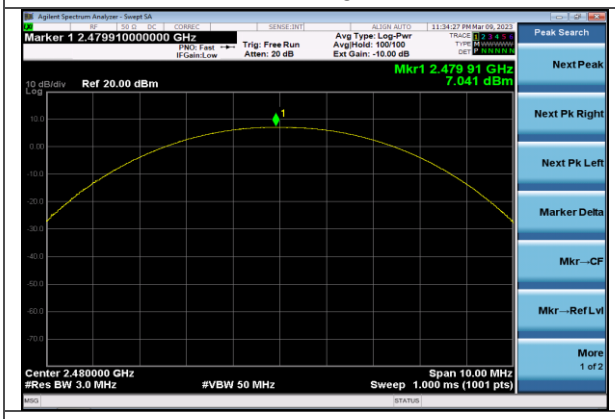
Plots



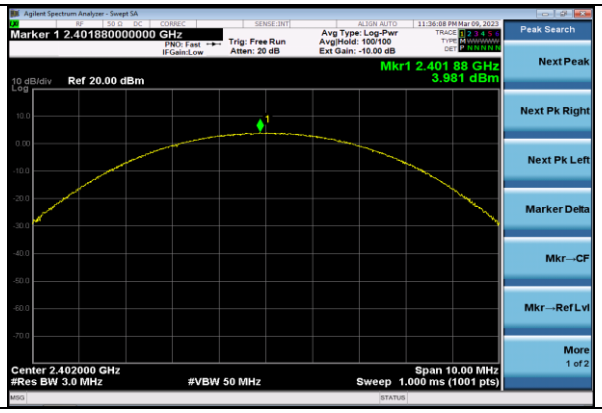
BR Tx Low



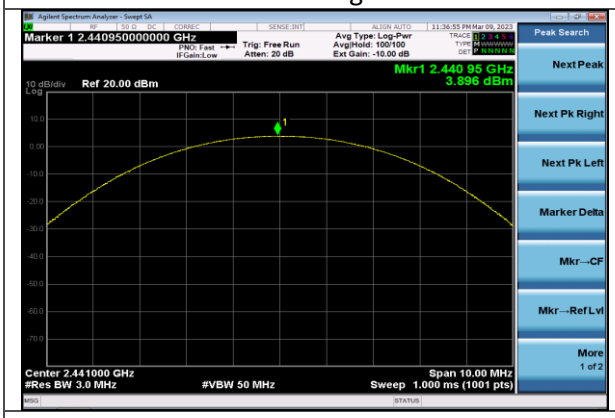
BR Tx Mid



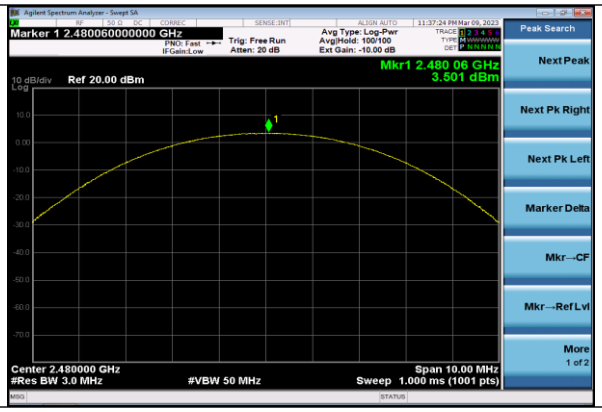
BR Tx High



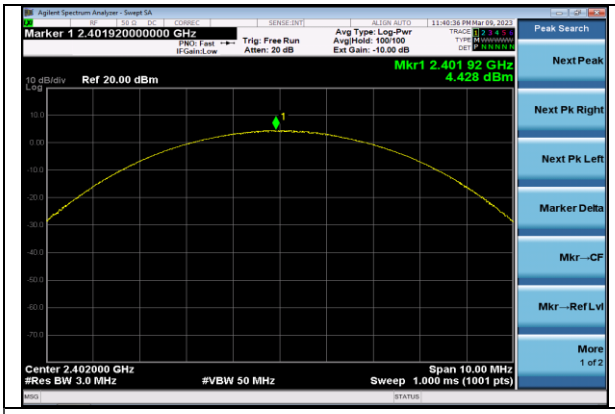
EDR2 Tx Low



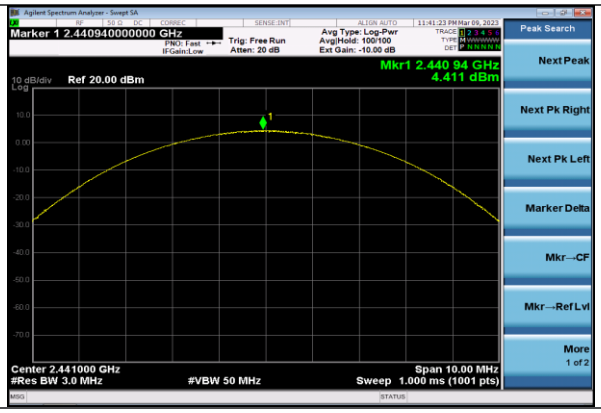
EDR2 Tx Mid



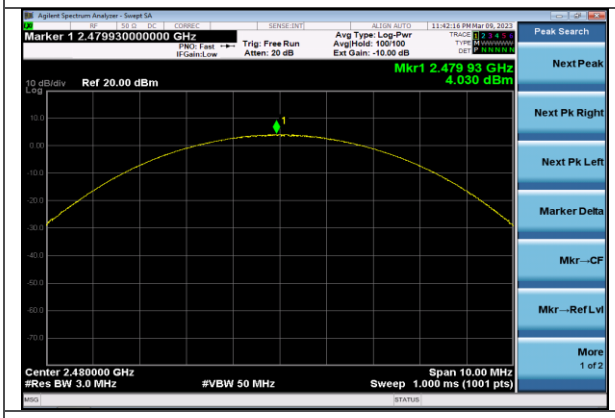
EDR2 Tx High



EDR3 Tx Low



EDR3 Tx Mid



EDR3 Tx High

5.1.2 Antenna Port Conducted Emissions – Emissions in Restricted Frequency Bands

Operator	Anthony Smith	**QA**	Adam Alger
Temperature (°C)	21.0, 20.4, 21.6	**R.H. %**	29.0, 31.1, 26.2
Test Date	3/9/2023, 3/10/2023, 3/13/2023	**Location**	RF Conducted Bench
Requirement	FCC 15.247 RSS-247	**Method**	ANSI C63.10

Restricted Band Limits:

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

Test Parameters

Frequency	1-25 GHz	**Setup**	Conducted
RBW	1 MHz	**VBW**	3 MHz Peak
Detector(s)	Peak	**Settings**	Trace Max Hold
Notes	The average value uses duty cycle reduction. See below calculation.		
Example Calculations	54 dBµV/m – 95.2 = -41.2 dBm Conducted Average Limit 74 dBµV/m – 95.2 = -21.2 dBm Conducted Peak Limit Average = Peak Value + 20log(Duty cycle) where the duty factor is calculated from the following formula for DH5 packet type which has worst duty factor: 20log (duty cycle) = **20log** $\frac{1s \div 1600 * 5}{100ms}$ **= -30.1dB**		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960172	Cable	A.H. Systems, Inc.	SAC-26G-1	387	3/22/2022	3/22/2023	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/12/2022	4/12/2023	Active Calibration

EUT Parameters

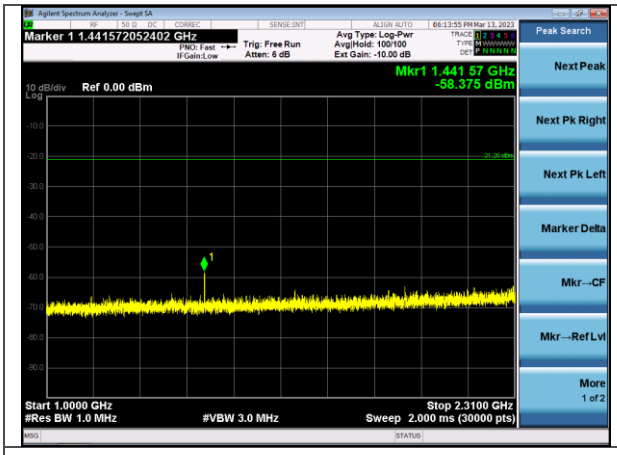
Input Power	12VDC	Mode	Basic Rate – Worst Case
Frequency (MHz)	2402, 2440, 2480	Channel	0, 39, 78

Data

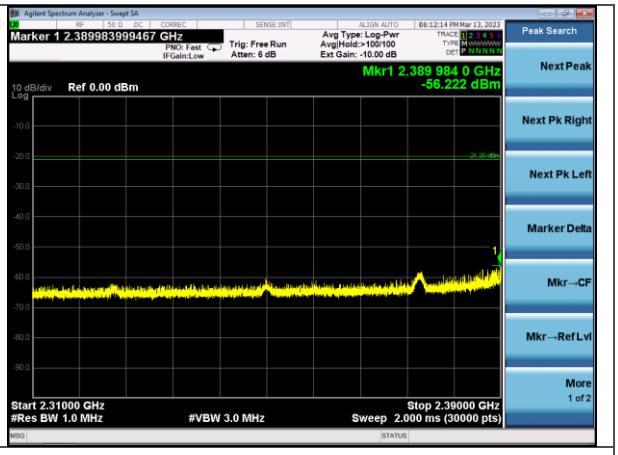
Table

Channel	Frequency (MHz)	Measurement (dBm)	Antenna Gain (dBi)	Corrected Measurement (dBm)	Limit (dBm)	Margin (dB)	Meas. Type
0	2389.9	-56.2	3.1	-53.1	-21.2	31.9	Pk
0	2389.9	-86.3	3.1	-83.2	-21.2	62.0	Avg
78	2483.7	-45.2	3.1	-42.1	-21.2	20.9	Pk
78	2483.7	-75.3	3.1	-72.2	-21.2	51.0	Avg
0	4804.1	-39.9	3.1	-36.8	-21.2	15.6	Pk
0	4804.1	-70.0	3.1	-66.9	-41.2	25.7	Avg
39	4882.1	-42.7	3.1	-39.6	-21.2	18.4	Pk
39	4882.1	-72.8	3.1	-69.7	-41.2	28.5	Avg
78	4960.1	-42.2	3.1	-39.1	-21.2	17.9	Pk
78	4960.1	-72.3	3.1	-69.2	-41.2	28.0	Avg

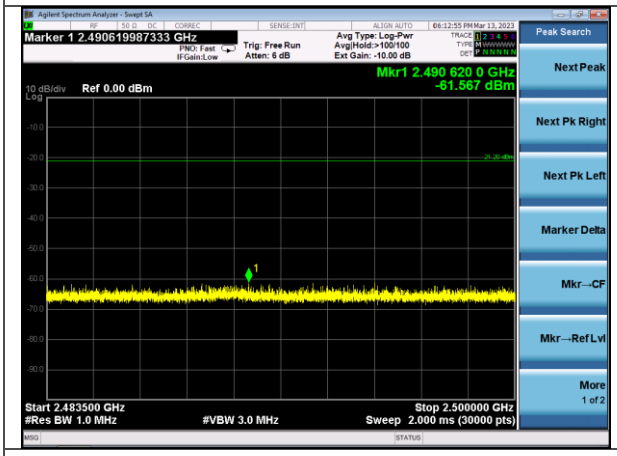
Plots



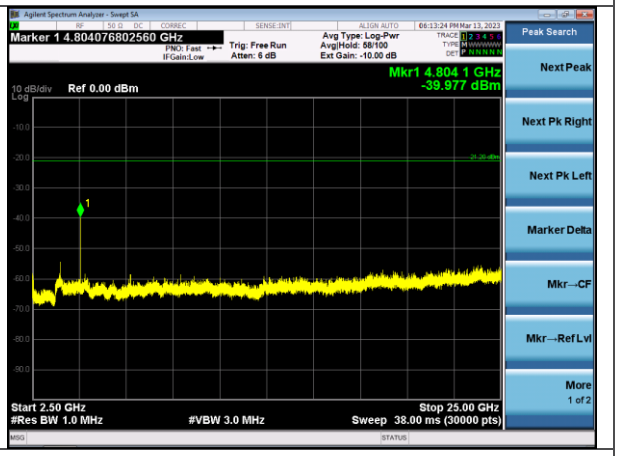
1-2.31 GHz Peak
Channel 0



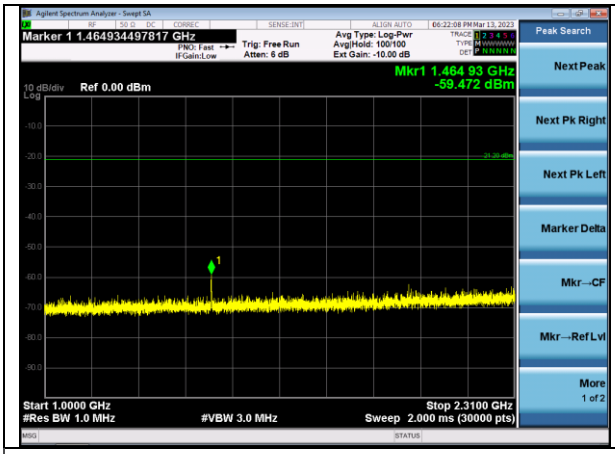
2.31-2.39 GHz Peak
Channel 0



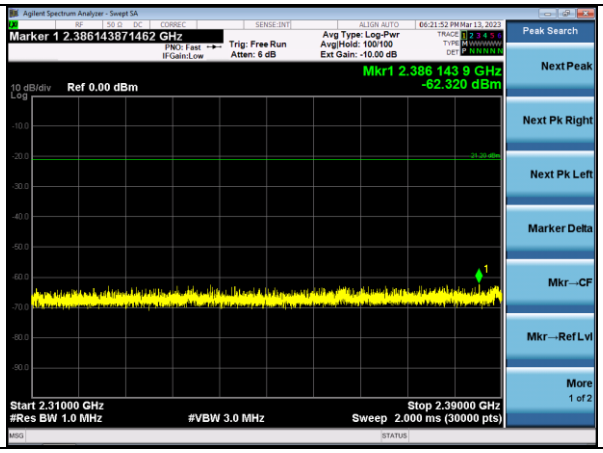
2.4835-2.5 GHz Peak
Channel 0



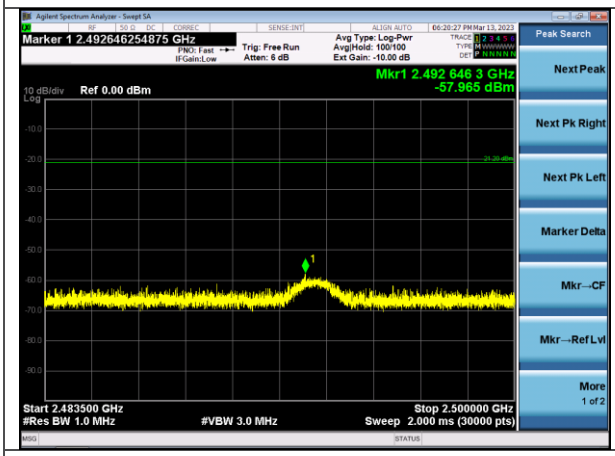
2.5-25 GHz Peak
Channel 0



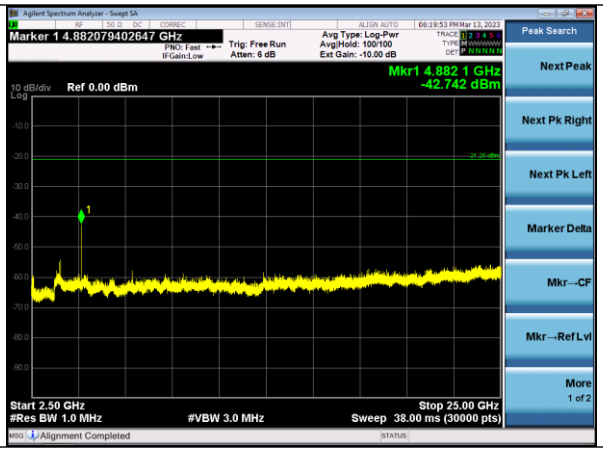
1-2.31 GHz Peak
Channel 39



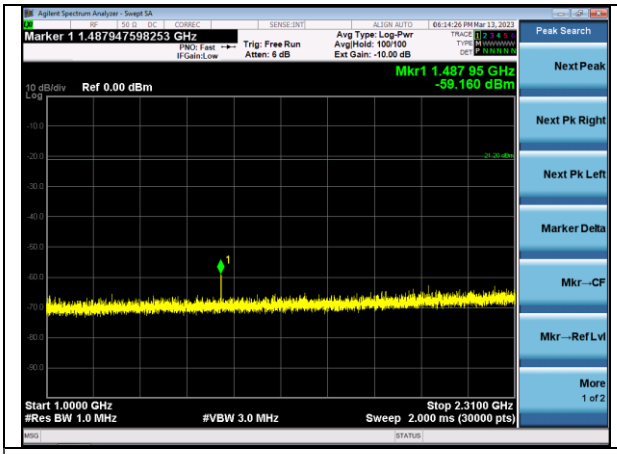
2.31-2.39 GHz Peak
Channel 39



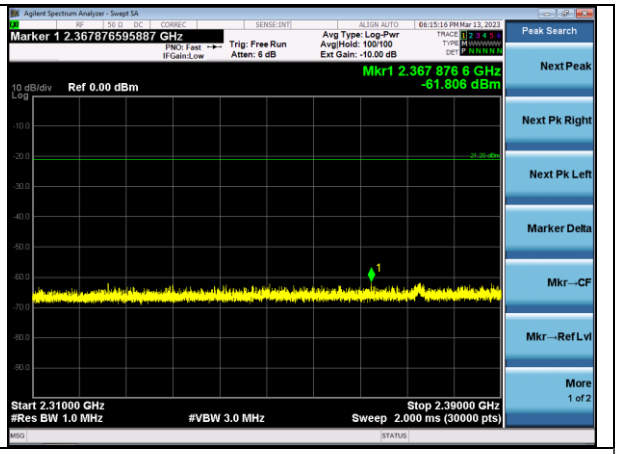
2.4835-2.5 GHz Peak
Channel 39



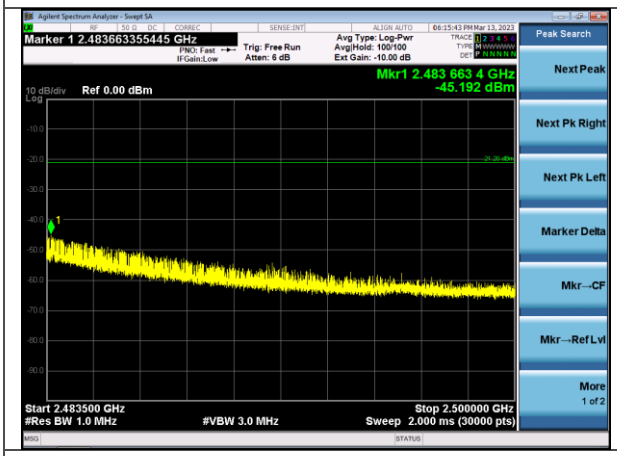
2.5-25 GHz Peak
Channel 39



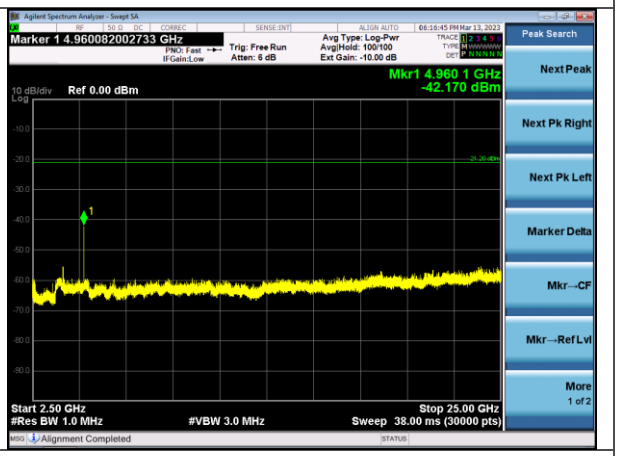
1-2.31 GHz Peak
Channel 78



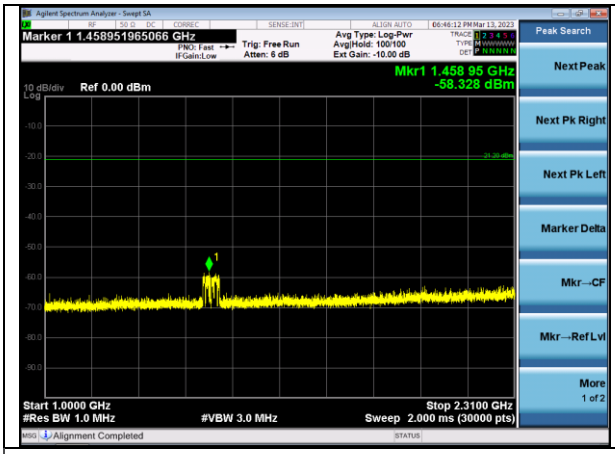
2.31-2.39 GHz Peak
Channel 78



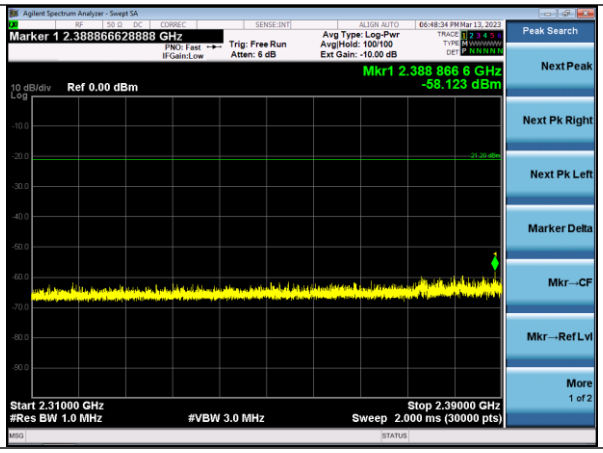
2.4835-2.5 GHz Peak
Channel 78



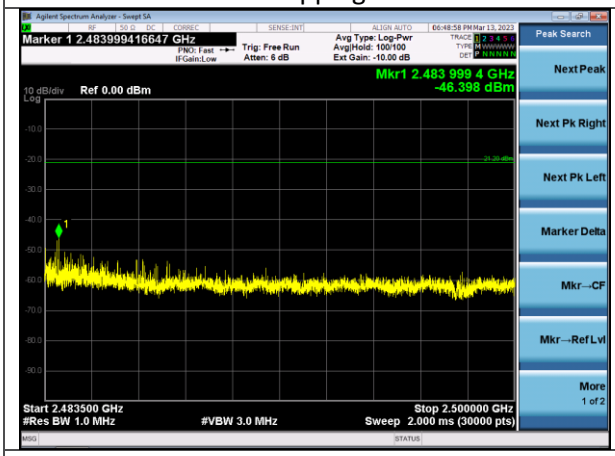
2.5-25 GHz Peak
Channel 78



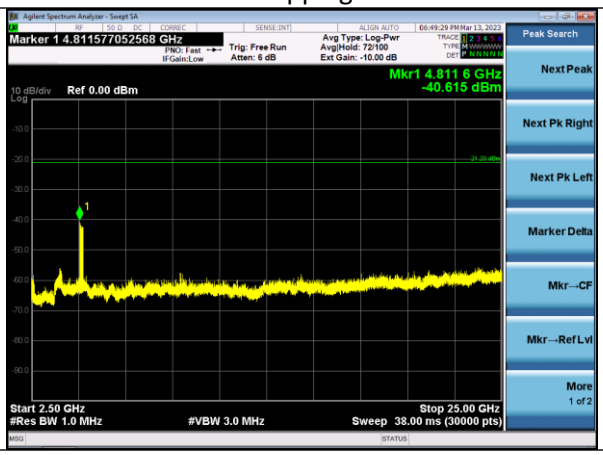
1-2.31 GHz Peak Hopping



2.31-2.39 GHz Peak Hopping



2.4835-2.5 GHz Peak Hopping



2.5-25 GHz Peak Hopping

6 REVISION HISTORY

Version	Date	Notes	Person
0	3/17/2023	Initial Draft	Anthony Smith
1	3/21/2023	Revised Draft	Anthony Smith
2	3/22/2023	Final Draft	Anthony Smith

END OF REPORT