

Test Report TR3664C

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: 3/17/2023

Report Reviewed by: Name, Title

Signature:

Date:

Report Constructed by: Anthony Smith, EMC Engineering Specialist

Signature: 

Date: 3/17/2023

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Company: Laird Connectivity	Page 1 of 29	Name: Sterling LWB+
Report: TR3664C		Model: Sterling LWB+
Quote: NBO-2022-005678		Serial: 00071

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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:



A2LA – American Association for Laboratory Accreditation

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

A2LA Certificate Number: 1255.01

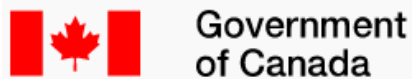
Scope of accreditation includes all test methods listed herein unless otherwise noted



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

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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)(3) ISED: RSS-247 5.4 (d)	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

WLAN 2.4 GHz 802.11b/g/n (1 Mbps, 6 Mbps, MCS0). Channels tested: 1 (2412 MHz), 6 (2437 MHz), and 11 (2462 MHz).

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

LRU (Laird Regulatory Utility) Version 10.54.0.13 utilized to control radio.

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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.

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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 \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

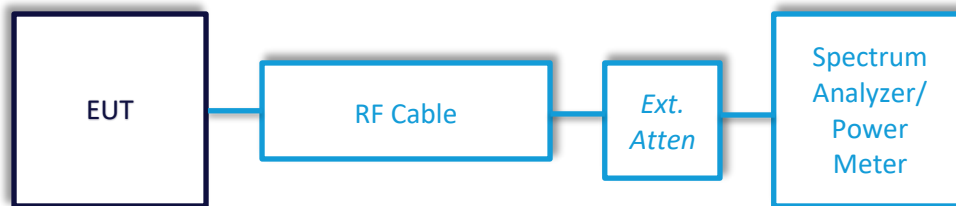
Parameter	ETSI U.C. \pm	U.C. \pm
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	<p>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.</p> <p>The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.</p>
Example Calculations	<p>Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm)</p> <p>Margin (dB) = Limit (dBm) – Corrected Reading (dBm)</p>

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	300 kHz	VBW	1 MHz
Detector(s)	Average	Settings	Trace Average
Notes	AVGSA-1 Method used for 1 Mbps (DC over 98%) AVGSA-2 Method used for 6 Mbps and MCS0 (DC under 98%)		
Example Calculations	6 Mbps DC: 97.63%. DC Correction 0.1 dB MCS0 DC: 97.46%. DC Correction 0.11 dB		

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

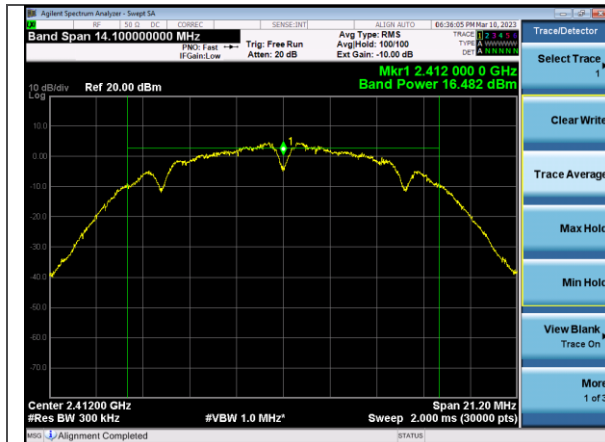
Input Power	12VDC	Mode	802.11 b/g/n
Frequency	2412, 2437, 2462 MHz	Channel	1, 6, 11

Data

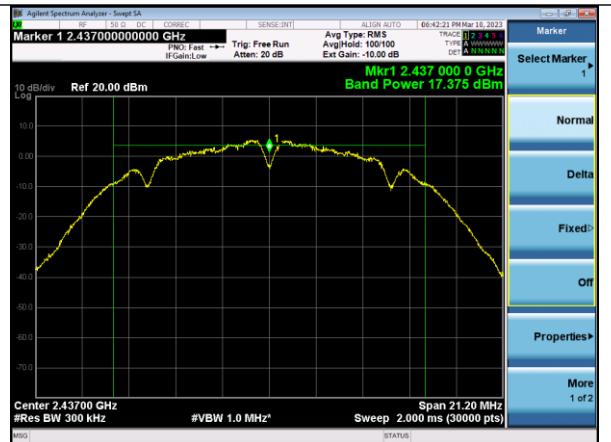
Table

Mode / Channel	Antenna Gain (dBi)	Maximum Average Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
1 Mbps / 1	3.1	16.5	30.0	13.5
1 Mbps / 6	3.1	17.4	30.0	12.6
1 Mbps / 11	3.1	17.3	30.0	12.7
6 Mbps / 1	3.1	13.6	30.0	16.4
6 Mbps / 6	3.1	17.6	30.0	12.4
6 Mbps / 11	3.1	13.6	30.0	16.4
MCS0 / 1	3.1	12.5	30.0	17.5
MCS0 / 6	3.1	17.5	30.0	12.5
MCS0 / 11	3.1	12.5	30.0	17.5

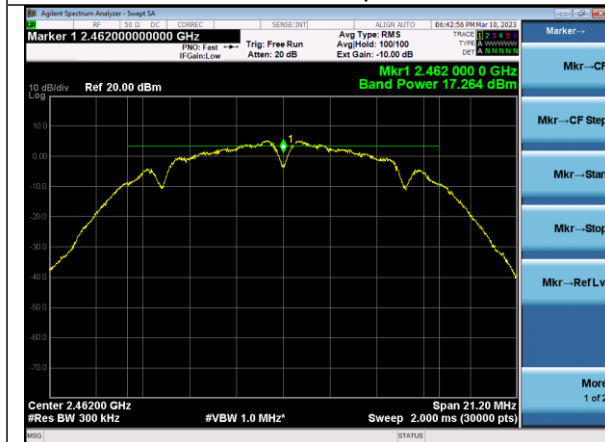
Plots



Ch 1 1Mbps



Ch 6 1Mbps

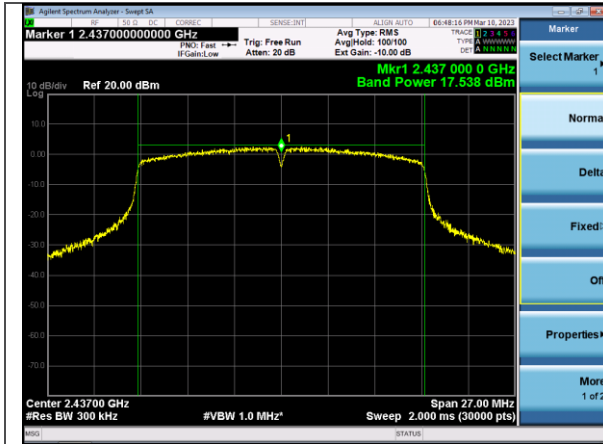


Ch 11 1Mbps

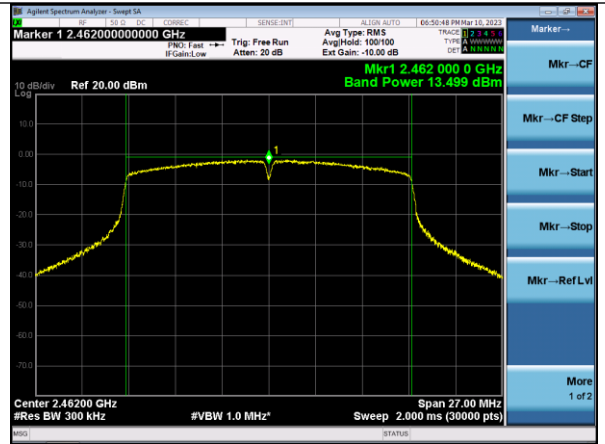


Ch 1 6Mbps

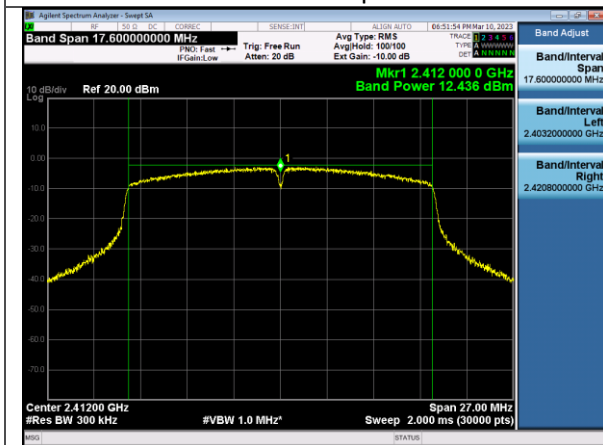
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Quote: NBO-2022-005678		Serial: 00071



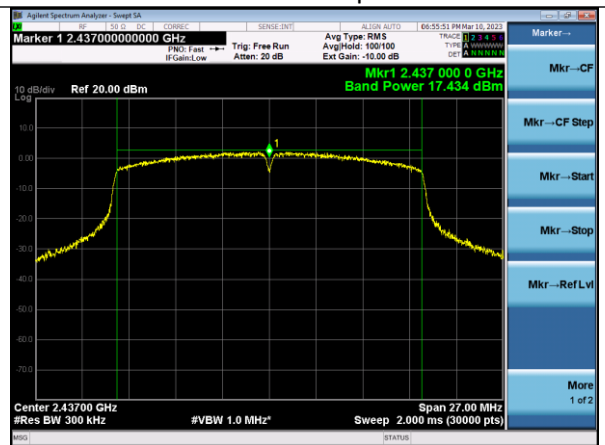
Ch 6 6Mbps



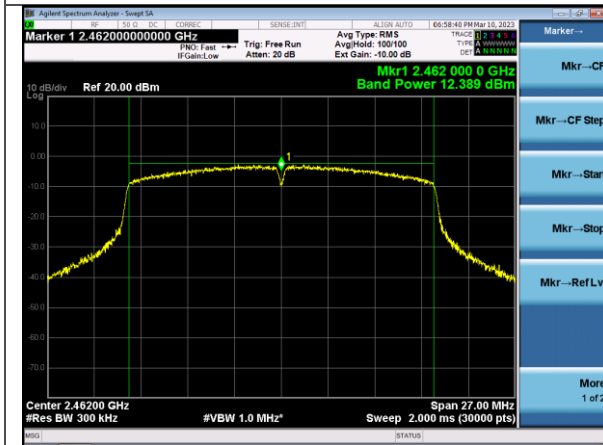
Ch 11 6Mbps



Ch 1 MCS0



Ch 6 MCS0



Ch 11 MCS0

Company: Laird Connectivity

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Name: Sterling LWB+

Model: Sterling LWB+

Serial: 00071

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

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	200 Hz Avg (1Mbps) 510 Hz Avg (6Mbps) 560 Hz Avg (MCS0) 3 MHz Peak
Detector(s)	Peak	Settings	Trace Max Hold
Notes			
Example Calculations	54 dBμV/m – 95.2 = -41.2 dBm Conducted Average Limit 74 dBμV/m – 95.2 = -21.2 dBm Conducted Peak Limit		

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	1 Mbps, 6 Mbps, MCS0
Frequency	2412, 2437, 2462 MHz	Channel	1, 6, 11

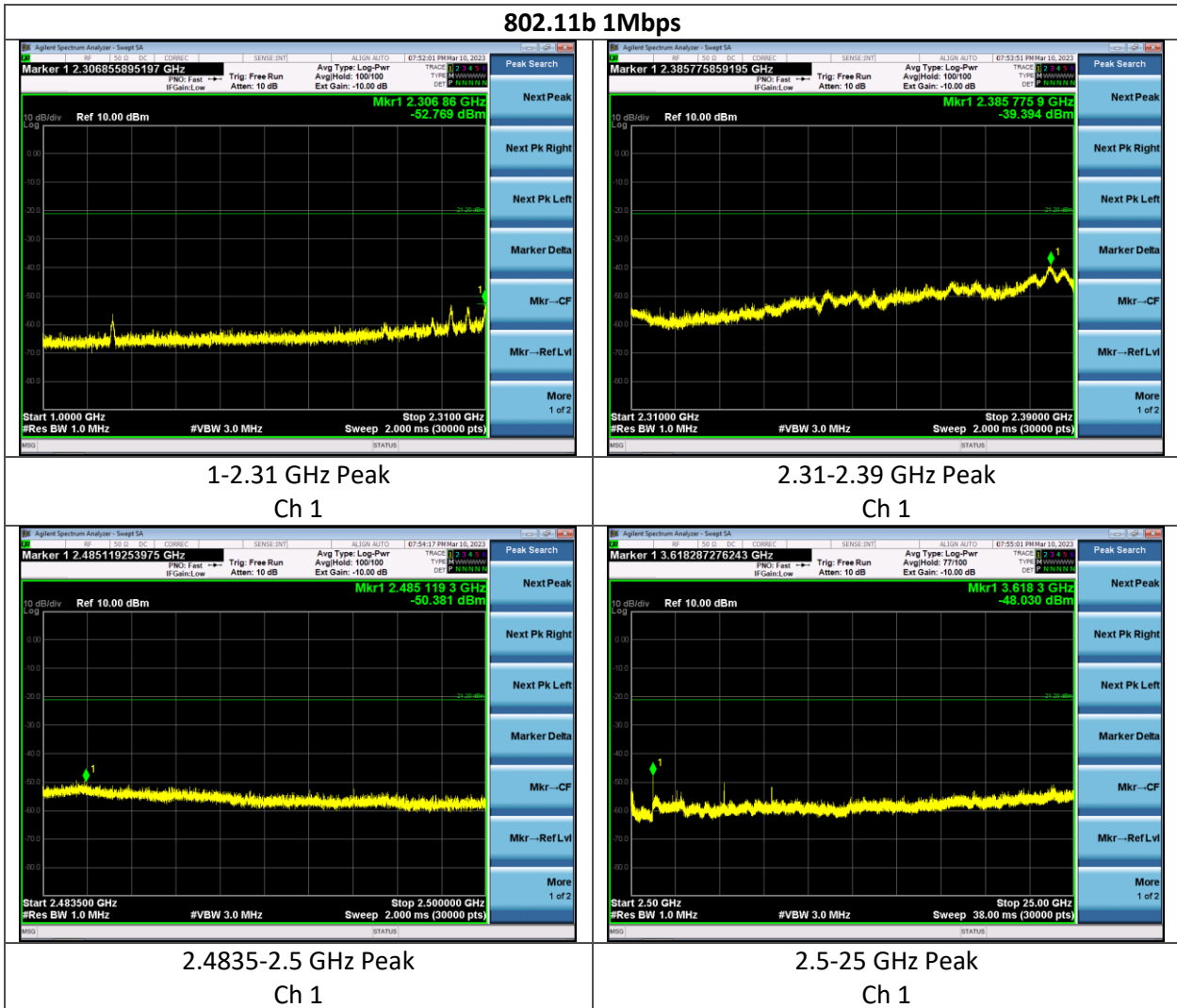
Data

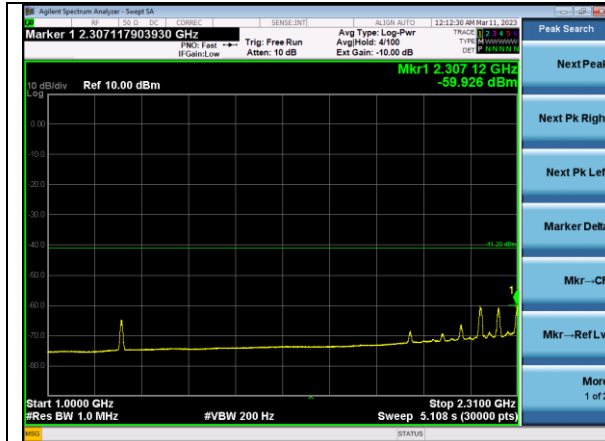
Table

Mode / Channel	Freq. (MHz)	Meas. (dBm)	Antenna Gain (dBi)	Corrected Meas. (dBm)	Limit (dBm)	Margin (dB)	Meas. Type
1Mbps/1	2385.8	-39.4	3.1	-36.3	-21.2	15.1	Peak
1Mbps/1	2385.6	-46.7	3.1	-43.6	-41.2	2.4	Avg
1Mbps/11	2488.6	-38.0	3.1	-34.9	-21.2	13.7	Peak
1Mbps/11	2488.7	-44.6	3.1	-41.5	-41.2	0.3	Avg
1Mbps/11	4923.9	-53.3	3.1	-50.2	-41.2	9.0	Avg
1Mbps/6	2385.8	-53.7	3.1	-50.6	-41.2	9.4	Avg
1Mbps/1	3618.3	-48.0	3.1	-44.9	-21.2	23.7	Peak
6Mbps/11	2483.6	-47.6	3.1	-44.5	-41.2	3.3	Avg
6Mbps/1	2389.9	-47.2	3.1	-44.1	-41.2	2.9	Avg
6Mbps/11	2484.4	-33.1	3.1	-30.1	-21.2	8.9	Peak
6Mbps/1	2388.6	-33.8	3.1	-30.7	-21.2	9.5	Peak
MCS0/1	2389.5	-34.5	3.1	-31.4	-21.2	10.2	Peak
MCS0/11	2483.6	-33.9	3.1	-30.8	-21.2	9.6	Peak
MCS0/1	2389.9	-47.9	3.1	-44.8	-41.2	3.6	Avg
MCS0/11	2483.5	-48.1	3.1	-45.0	-41.2	3.8	Avg
MCS0/1	3618.3	-47.1	3.1	-44.0	-21.2	22.8	Peak
MCS0/1	3618.3	-50.2	3.1	-47.1	-41.2	5.9	Avg

Plots

802.11b 1Mbps





1-2.31 GHz Average
Ch 1



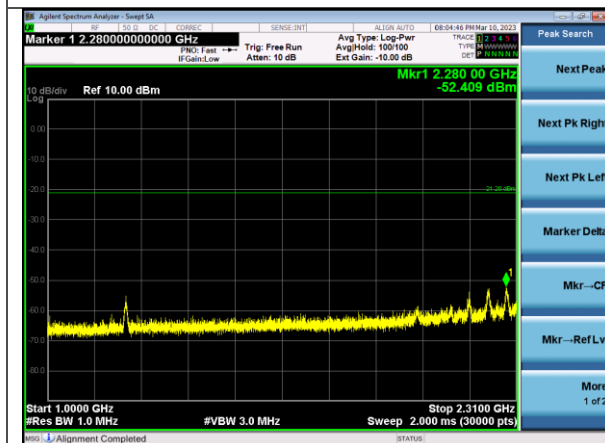
2.31-2.39 GHz Average
Ch 1



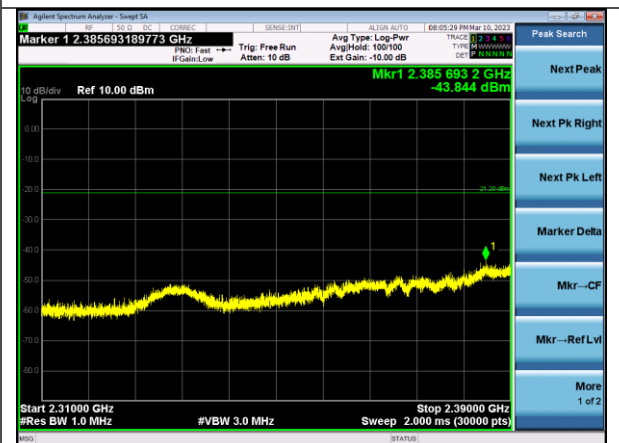
2.4835-2.5 GHz Average
Ch 1



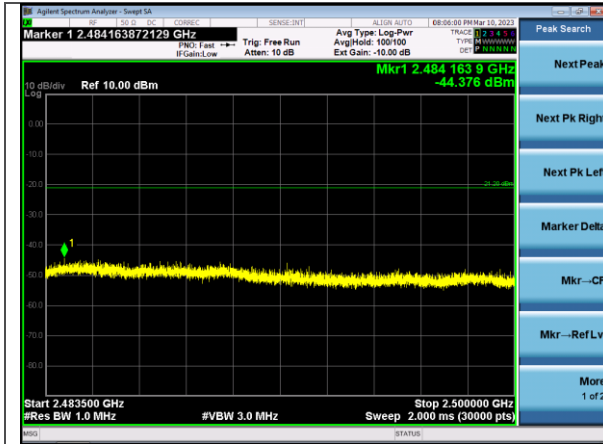
2.5-25 GHz Average
Ch 1



1-2.31 GHz Peak
Ch 6



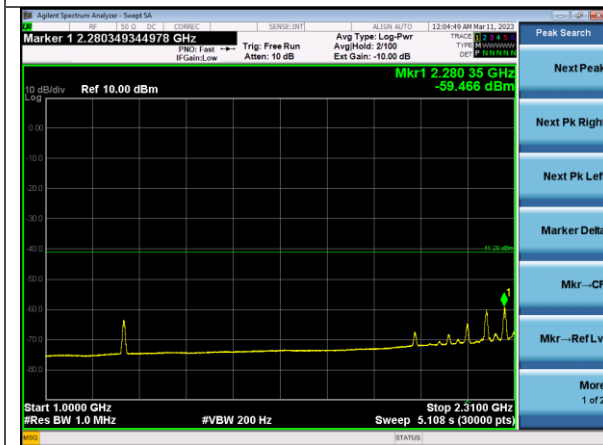
2.31-2.39 GHz Peak
Ch 6



2.4835-2.5 GHz Peak
Ch 6



2.5-25 GHz Peak
Ch 6



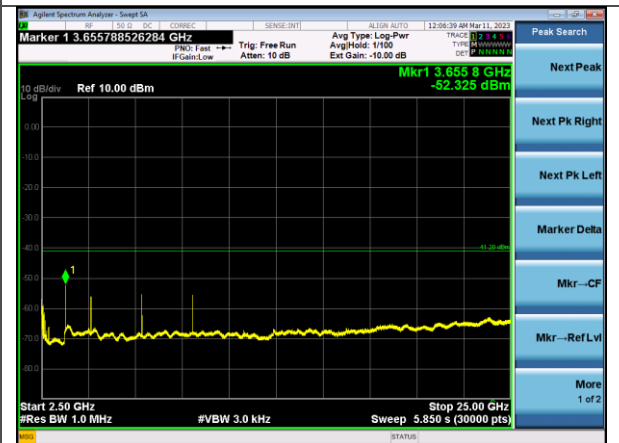
1-2.31 GHz Average
Ch 6



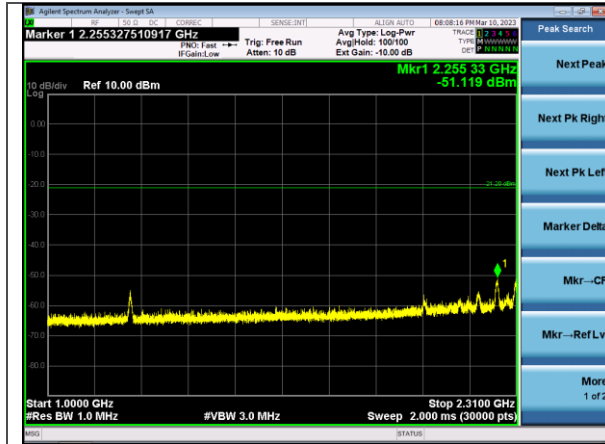
2.31-2.39 GHz Average
Ch 6



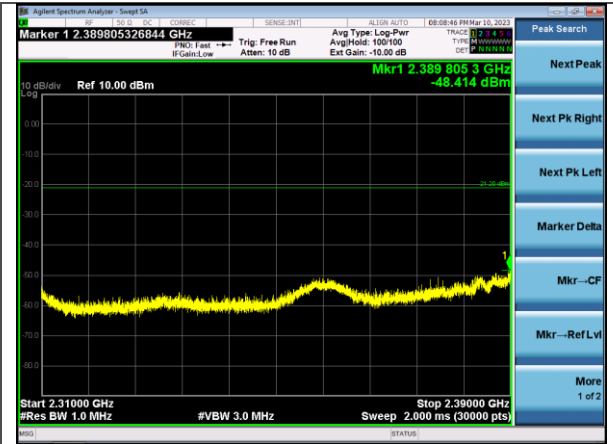
2.4835-2.5 GHz Average
Ch 6



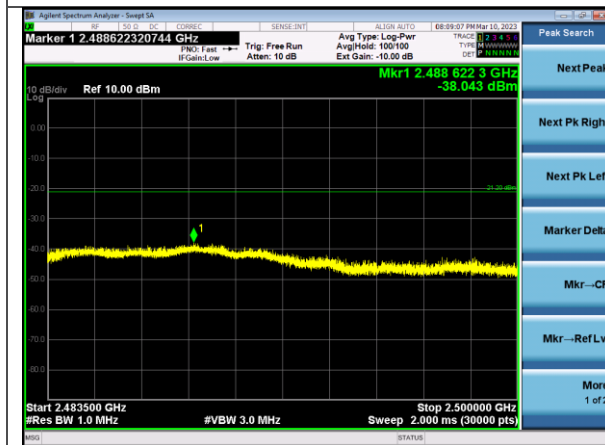
2.5-25 GHz Average
Ch 6



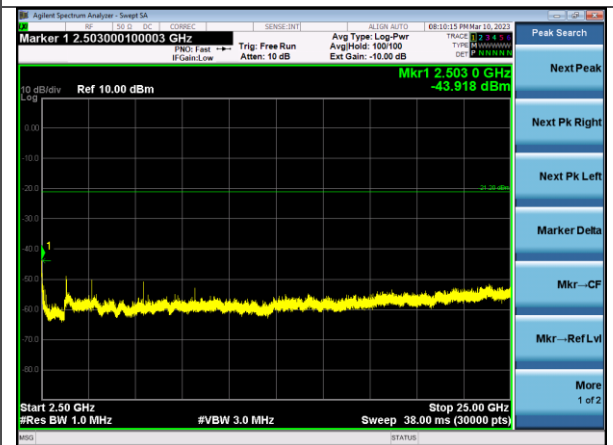
1-2.31 GHz Peak
Ch 11



2.31-2.39 GHz Peak
Ch 11



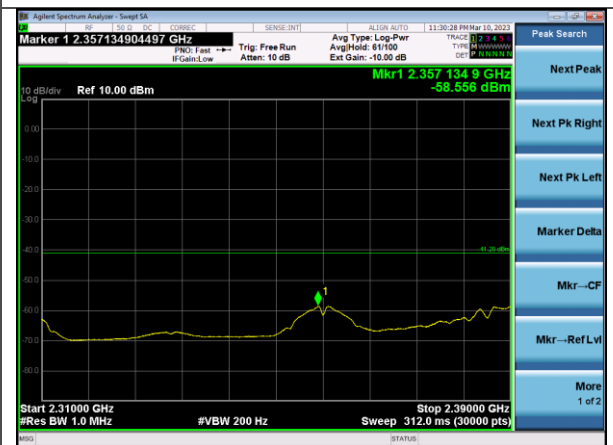
2.4835-2.5 GHz Peak
Ch 11



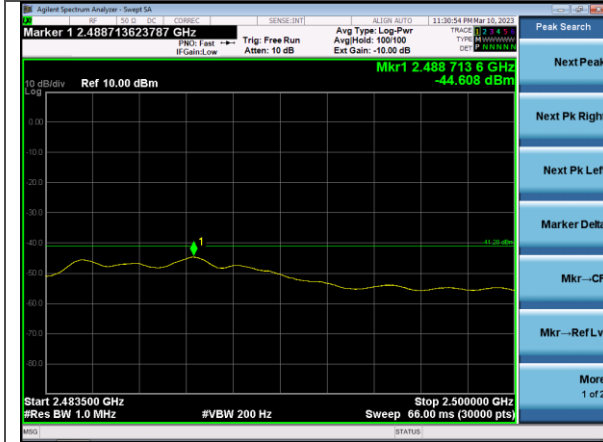
2.5-25 GHz Peak
Ch 11



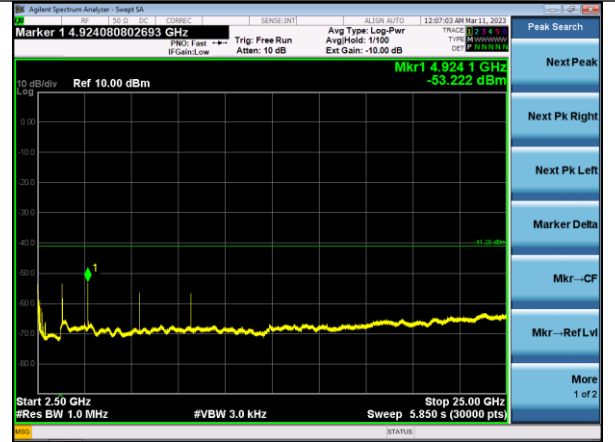
1-2.31 GHz Average
Ch 11



2.31-2.39 GHz Average
Ch 11



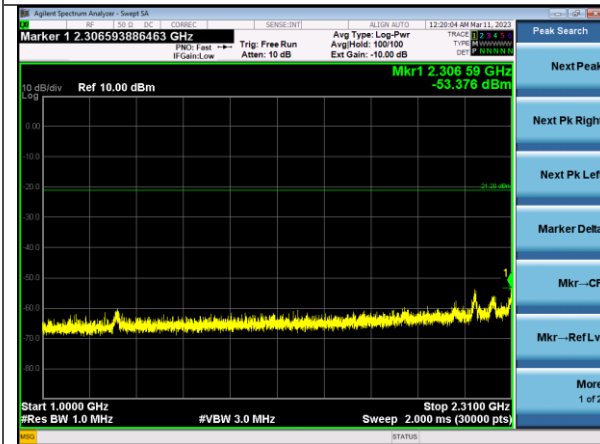
2.4835-2.5 GHz Average
Ch 11



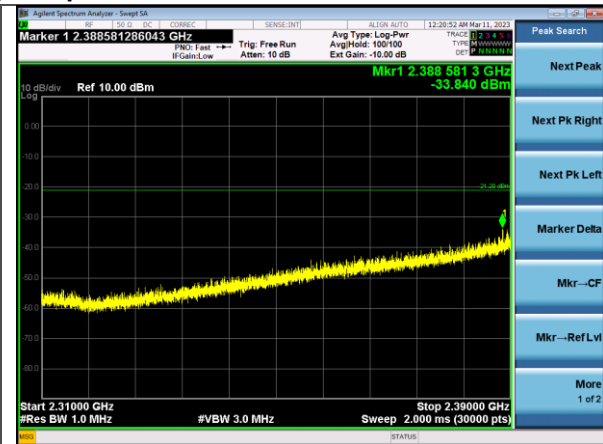
2.5-25 GHz Average
Ch 11

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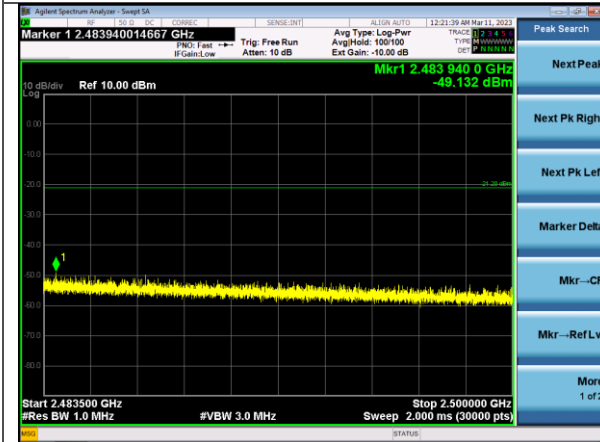
802.11g 6Mbps



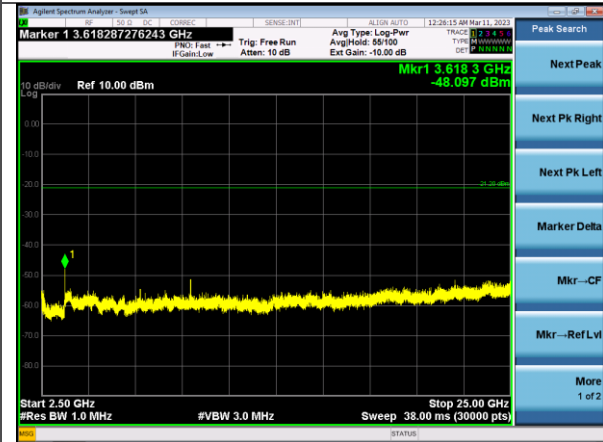
1-2.31 GHz Peak
Ch 1



2.31-2.39 GHz Peak
Ch 1



2.4835-2.5 GHz Peak
Ch 1



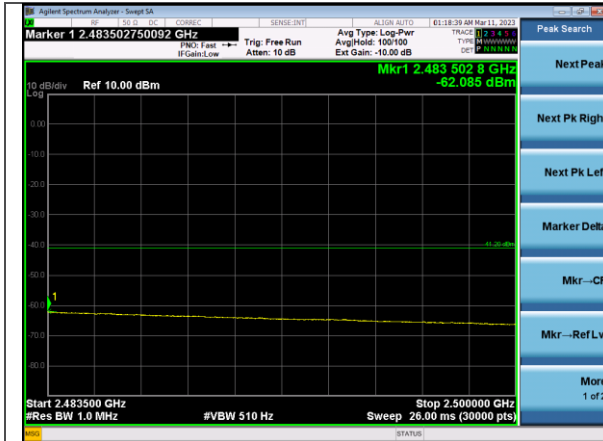
2.5-25 GHz Peak
Ch 1



1-2.31 GHz Average
Ch 1



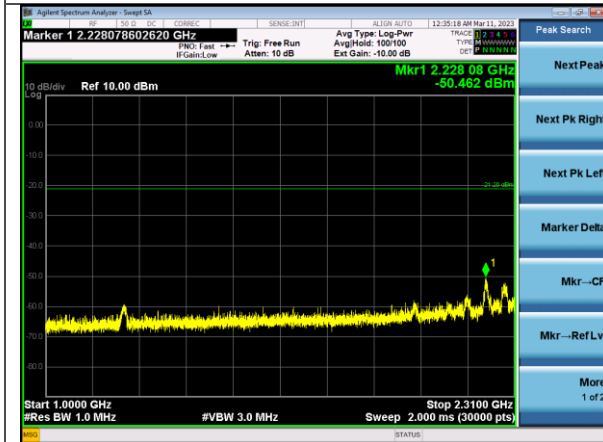
2.31-2.39 GHz Average
Ch 1



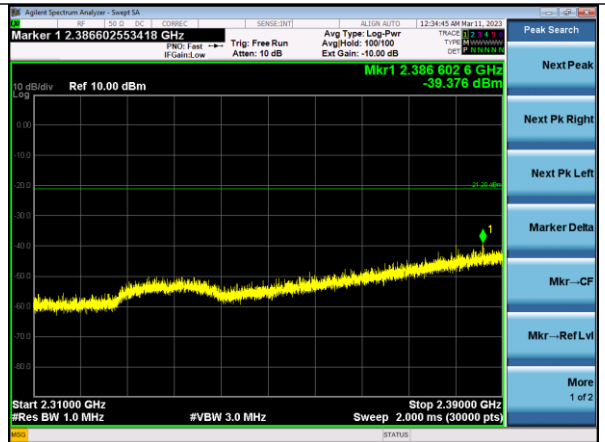
2.4835-2.5 GHz Average
Ch 1



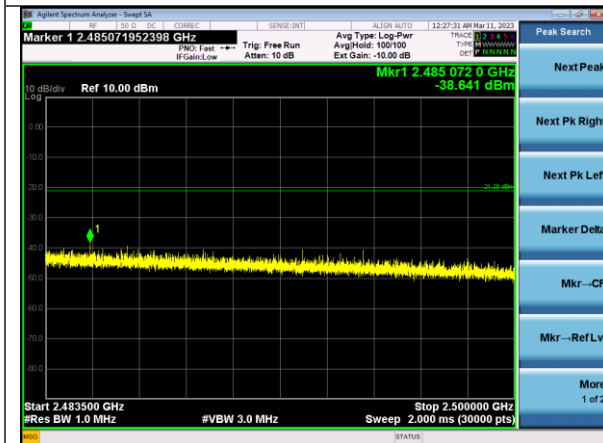
2.5-25 GHz Average
Ch 1



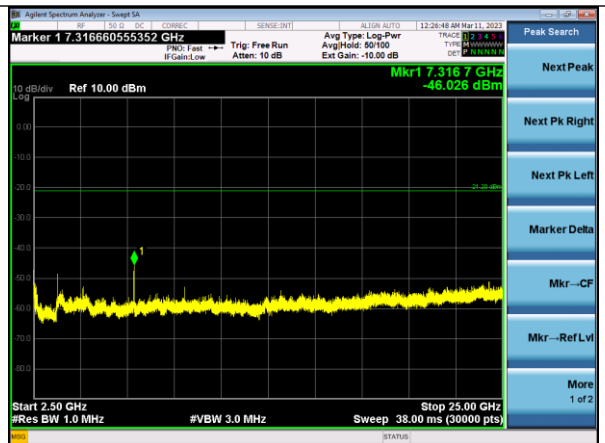
1-2.31 GHz Peak
Ch 6



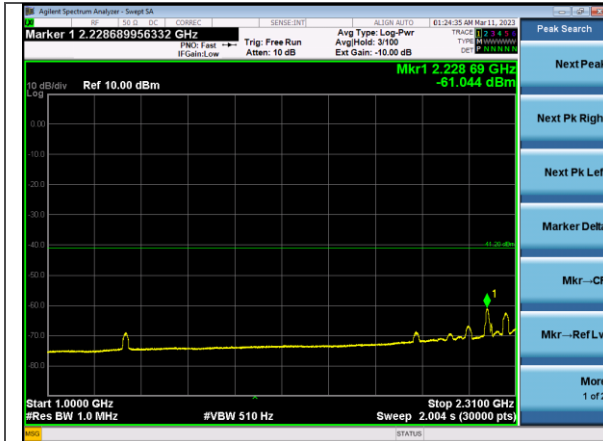
2.31-2.39 GHz Peak
Ch 6



2.4835-2.5 GHz Peak
Ch 6



2.5-25 GHz Peak
Ch 6



1-2.31 GHz Average
Ch 6



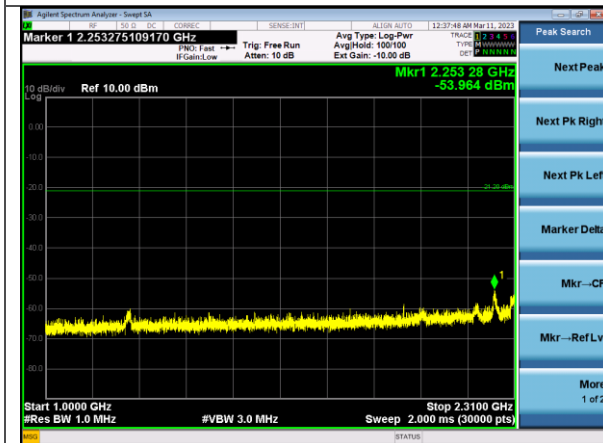
2.31-2.39 GHz Average
Ch 6



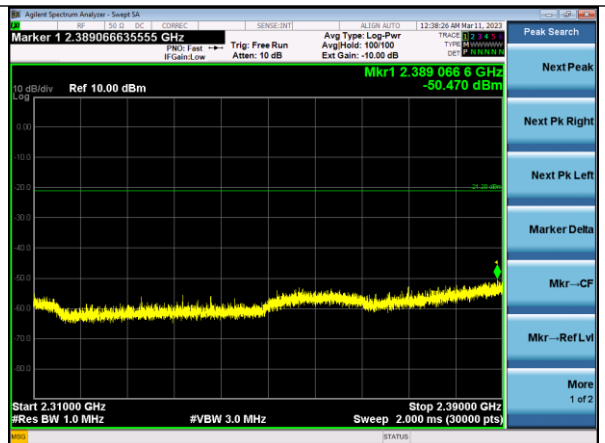
2.4835-2.5 GHz Average
Ch 6



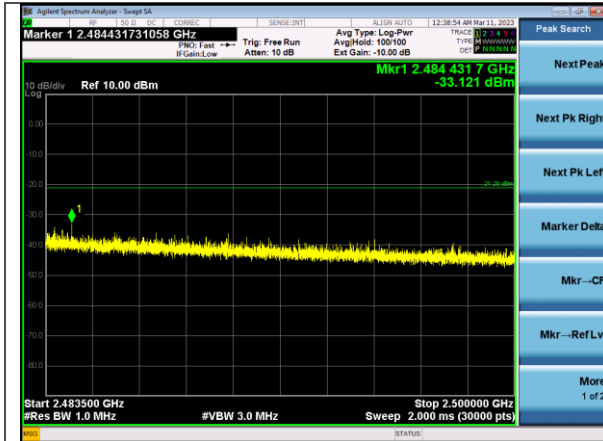
2.5-25 GHz Average
Ch 6



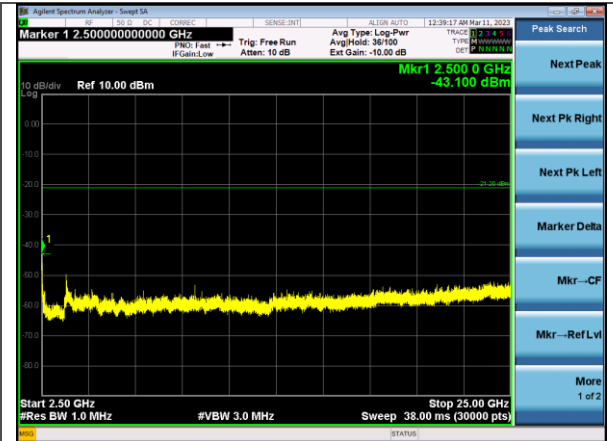
1-2.31 GHz Peak
Ch 11



2.31-2.39 GHz Peak
Ch 11



2.4835-2.5 GHz Peak
Ch 11



2.5-25 GHz Peak
Ch 11



1-2.31 GHz Average
Ch 11



2.31-2.39 GHz Average
Ch 11



2.4835-2.5 GHz Average
Ch 11



2.5-25 GHz Average
Ch 11