Toll-free: (866) 311-3268
www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Deviceroy

EUT Name: ARIA1

Model: ARIA1

FCC ID: 2A3KPARIA1
IC: 29172-ARIA1

To

FCC Part 15.247
And
ISED RSS-247

Date of Issue: 11/16/2022

On the behalf of the applicant:	**Viceroy Devices Corporation dba Deviceroy** **Salt Lake City, Utah, USA**
Attention of:	**Steve Ellis** **Ph: 801-440-4480** **Email: sellis@deviceroy.com**

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p22a0015
Test Result - Pass

Alex Macon
Sr Compliance Engineer

Test Summary

FCC 15.247 Specification	RSS-247 Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)(3)	Section 5.4 (d)	Output Power	Pass	
15.247(d)	Section 5.5	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Emissions At Band Edges	Pass	
15.247(a)(2)	Sections 5.2 (a)	Occupied Bandwidth	Pass	RSS-Gen Section 6.7 99% BW Also Reported
15.247(e)	Section 5.2 (b)	Power Spectral Density	Pass	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	Pass	

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 558074 D01 v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	November 16, 2022	Alex Macon	Original Document

Table of Contents

ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

FCC Site Reg. #349717

IC Site Reg. #2044A-2

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
19.3 – 23.5	27.6 – 34.5	970.8 – 981.1

EUT Description ARIA Modem

Product Marketing Name (PMN)	ARIA
Hardware Version Identification Number (HVIN)	1.0.1
Firmware Version Identification Number (FVIN)	1.0.fcc
Serial Number (SN)	5309
Frequency Range	2402-2480 MHz
Modulation(s)	GFSK
Nominal Bandwidth(s):	1 / 2 MHz
Antenna	Type: Chip Part Number: NN02-101 Pk Gain: 2.4 dBi Frequency Range: 2400 – 2500 MHz

General Description of EUT and its intended use:
The DUT is a POE powered transceiver for digital transmission with 900 MHz and 2.4 GHz BLE capabilities. This report covers the BLE

EUT operation during test:
A test mode sample with omni antenna attached was used for the Radiated Spurious Emissions (RSE) demonstration. All combinations of BLE and LoRa simultaneous transmission were investigated in 3 orthogonal axis and the worst case data has been reported. A temporary SMA port was used to perform all other tests using Antenna Port Conducted measurements.

Test mode samples were operated via TeraTerm commands.

Support Equipment

Qty	Description	Manufacturer	Model	S/N
1	Laptop	NA	NA	NA

Support Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	USB 2.0	<3m	Y	Y	Communication Board
1	Ethernet	<3m	Y	N	POE

Modifications:

none

15.203: Antenna Requirement:

X	The antenna is permanently attached to the EUT
	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

Occupied Bandwidth

Engineer: Aaron S. Froehlich
Test Date: 10/31/2022

Test Procedure

The method of ANSI C63.10 Clause 11.8.1, were utilized to measure the 6 dB DTS Bandwidth. The “n dB down” function of the spectrum analyzer, with n = 6, was used as long as the marker did not settle in a null region. When that was the case, the markers were manually configured from the edge of the emission until a value equal to or less than n dB below the peak was used.

The method of clause 6.9.3 was utilized to measure the 99% Occupied Bandwidth.

Limit 6 dB

47 CFR 15.247(a)(2) & RSS-247 5.2 (a)

The minimum 6 dB Bandwidth shall be at least 500 kHz

Limit 99%

RSS-Gen Section 6.7 requires the 99% Occupied Bandwidth be reported in addition to all other required bandwidths.

The Spectrum Analyzer was set to the following:

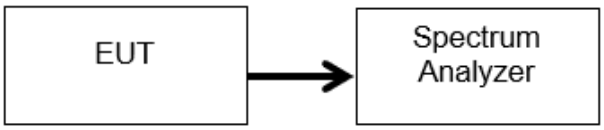
6 dB DTS Bandwidth

Span	Between 1.5 times and 5.0 times the OBW
RBW	100 kHz
VBW	300 kHz

99% Occupied Bandwidth

Span	Between 1.5 times and 5.0 times the OBW
RBW	1% to 5% of the OBW
VBW	~3-time RBW

Test Setup



Test Data

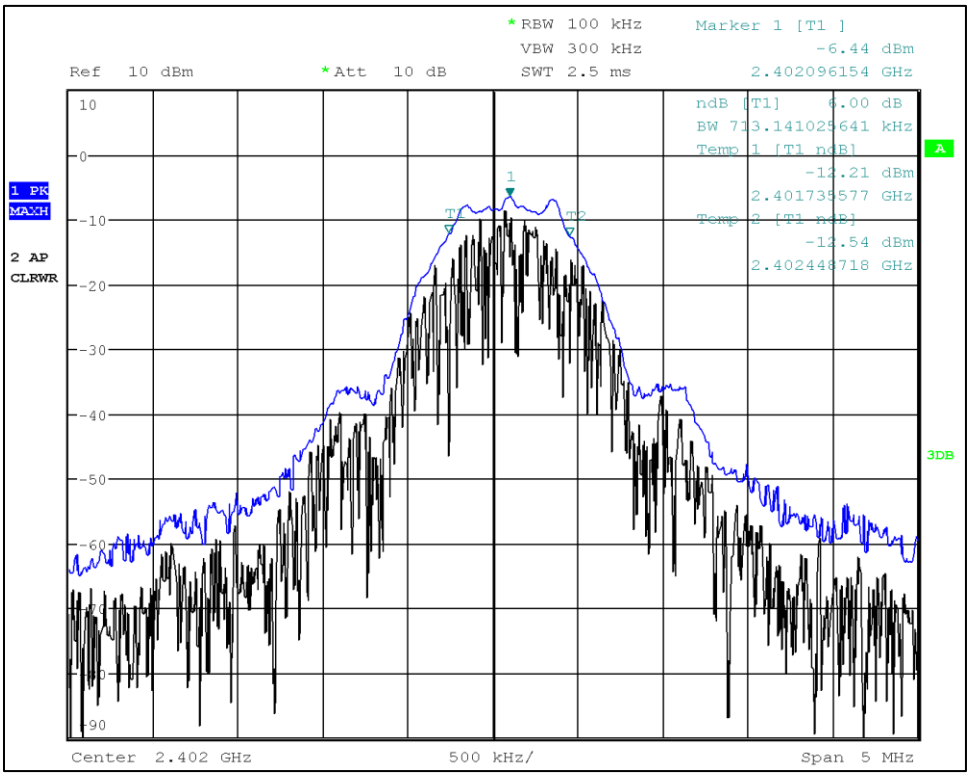
Tabular Data

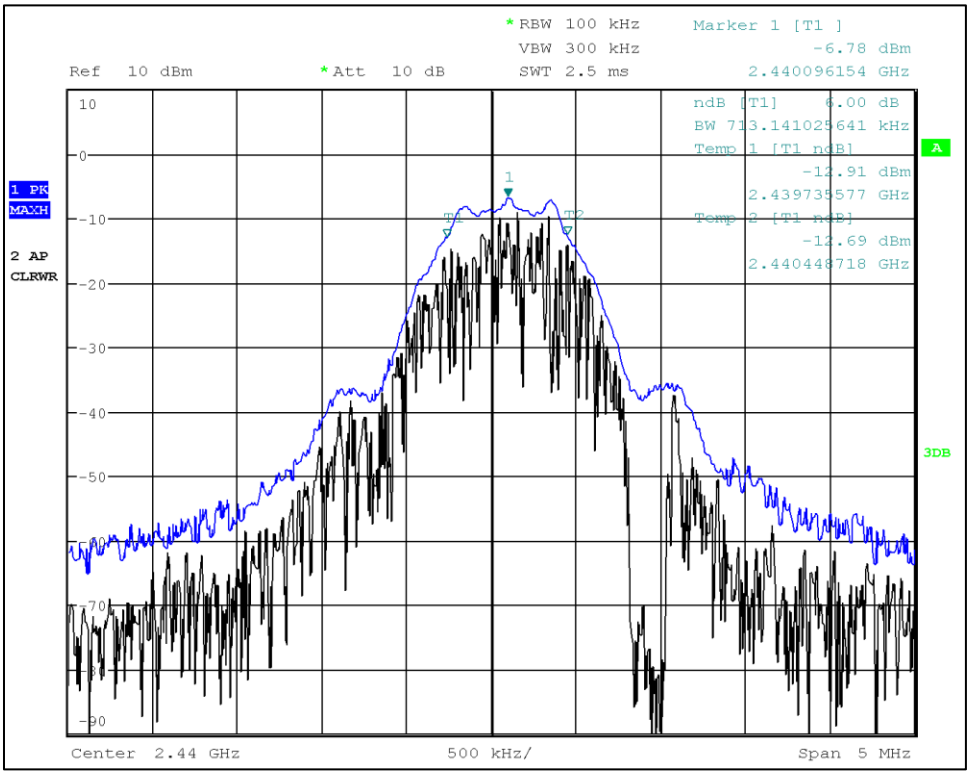
Data Rate	Frequency	99% OBW	DTS	Limit	Margin	Result
	MHz	MHz	MHz	MHz	MHz	
1M	2402	1.058	0.713	0.500	-0.213	Compliant
1M	2440	1.058	0.713	0.500	-0.213	Compliant
1M	2480	1.063	0.721	0.500	-0.221	Compliant
2M	2402	2.043	1.138	0.500	-0.638	Compliant
2M	2440	2.043	1.106	0.500	-0.606	Compliant
2M	2480	2.027	1.106	0.500	-0.606	Compliant

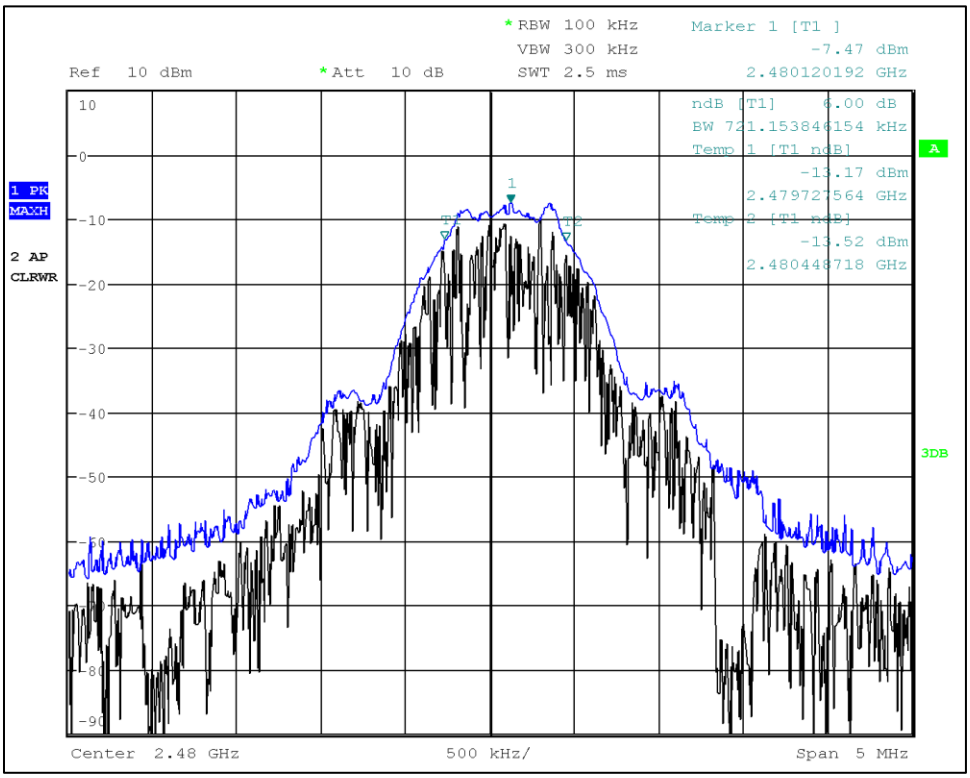
Margin = Limit - DTS

6 dB DTS Plots

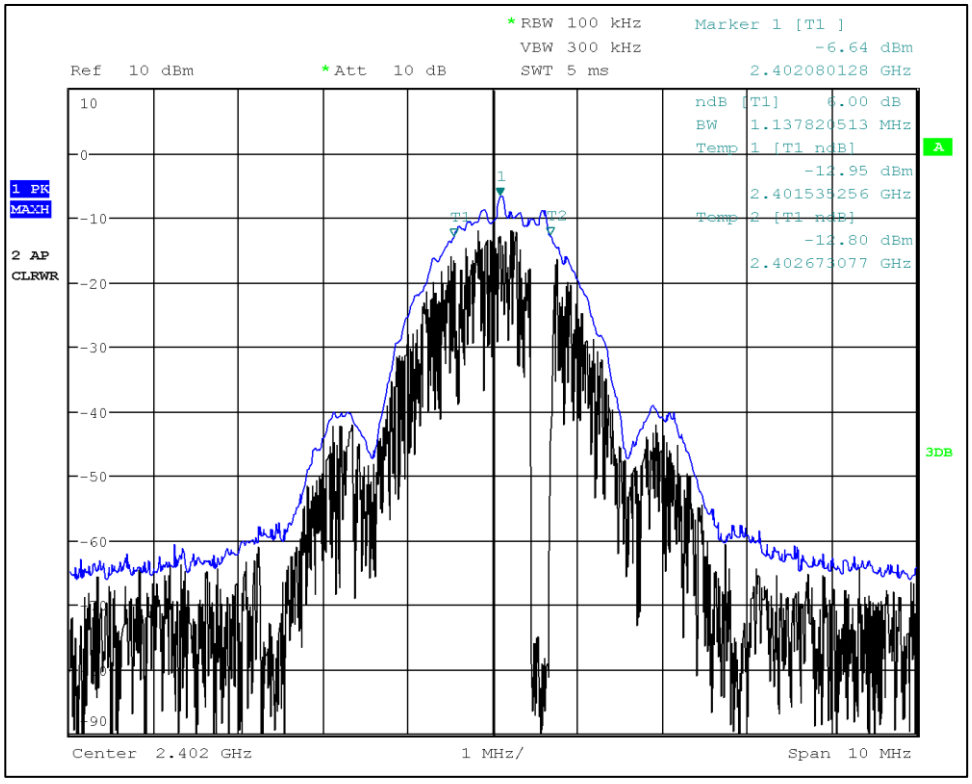
1Mbps

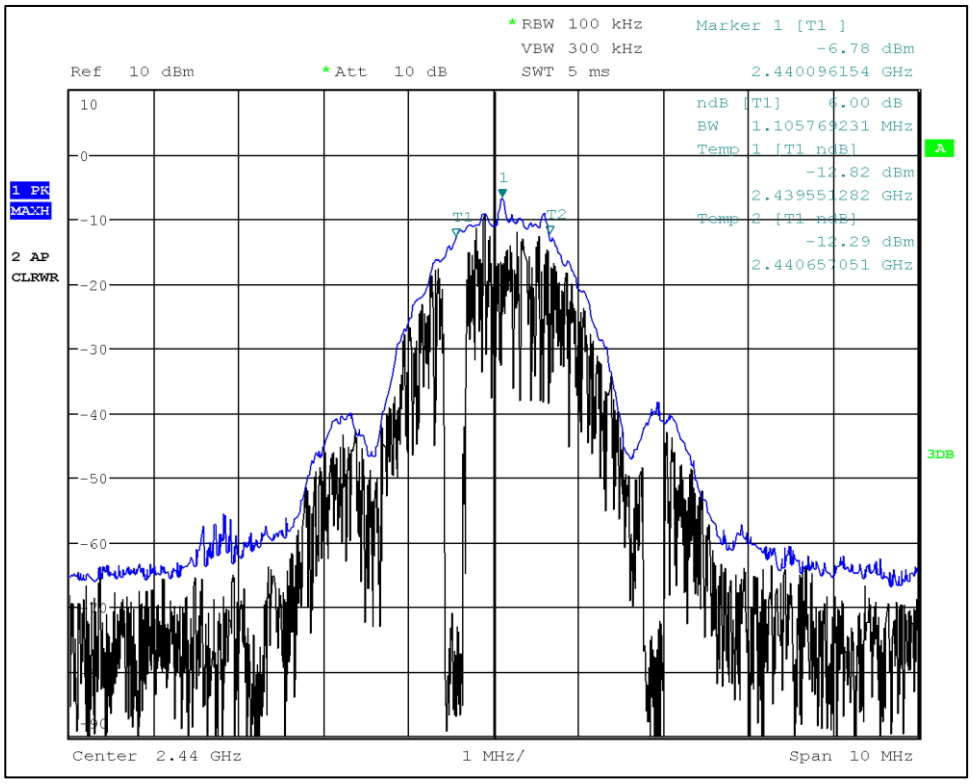


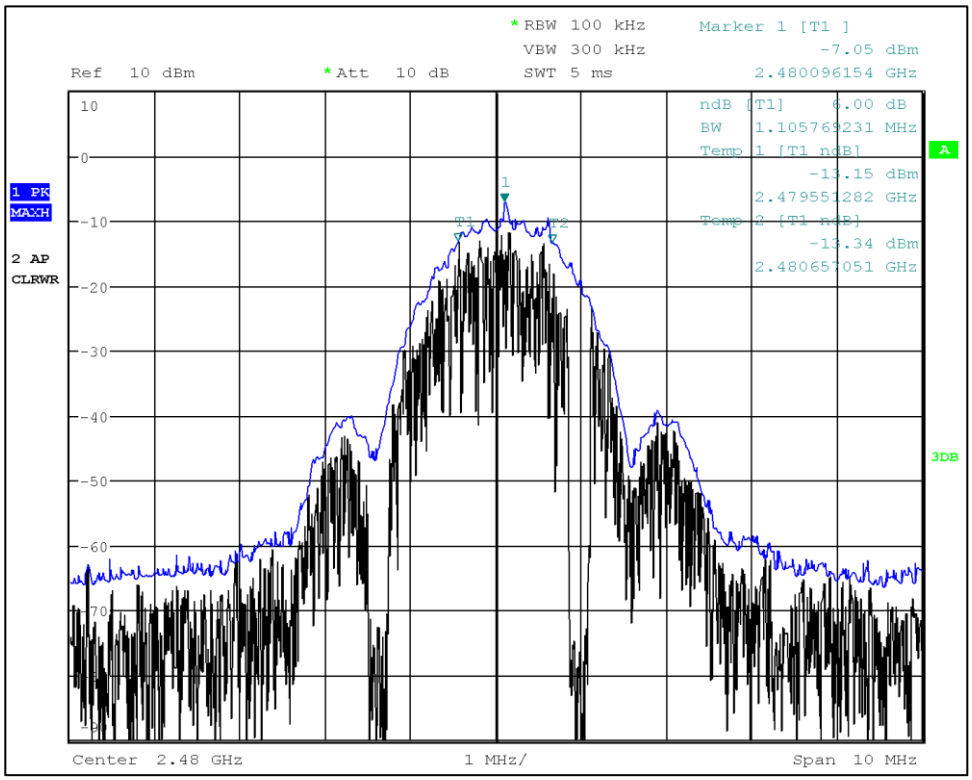

*RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
-6.78 dBm
2.440096154 GHz
Ref 10 dBm
*Att 10 dB
ndB [T1] 6.00 dB
BW 713.141025641 kHz
Temp 1 [T1 ndB]
-12.91 dBm
2.439735577 GHz
Temp 2 [T1 ndB]
-12.69 dBm
2.440448718 GHz
1 PK MAXH
2 AP CLRWR
A
3DB
Center 2.44 GHz
500 kHz/
Span 5 MHz


*RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
-7.47 dBm
2.480120192 GHz
Ref 10 dBm
*Att 10 dB
ndB [T1] 6.00 dB
BW 721.153846154 kHz
Temp 1 [T1 ndB]
-13.17 dBm
2.479727564 GHz
Temp 2 [T1 ndB]
-13.52 dBm
2.480448718 GHz
1 PK MAXH
2 AP CLRWR
A
3DB
Center 2.48 GHz
500 kHz/
Span 5 MHz

2Mbps

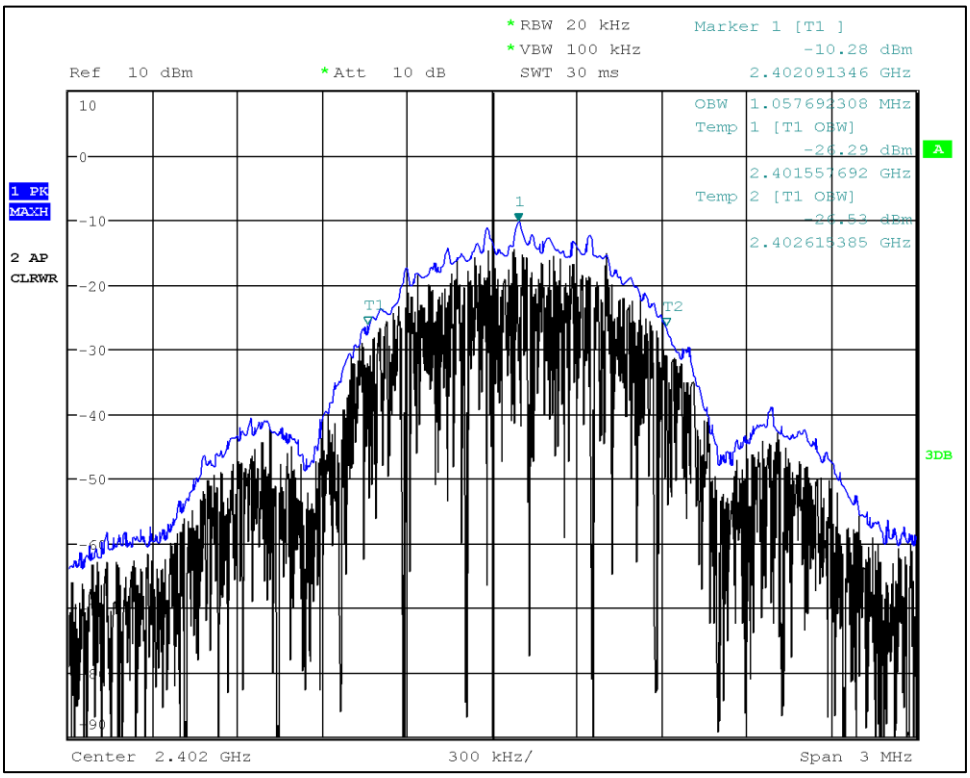

*RBW 100 kHz
VBW 300 kHz
SWT 5 ms
Marker 1 [T1]
-6.64 dBm
2.402080128 GHz
Ref 10 dBm
*Att 10 dB
ndB [T1] 6.00 dB
BW 1.137820513 MHz
Temp 1 [T1 ndB]
-12.95 dBm
2.401535256 GHz
Temp 2 [T1 ndB]
-12.80 dBm
2.402673077 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
Center 2.402 GHz
1 MHz/
Span 10 MHz

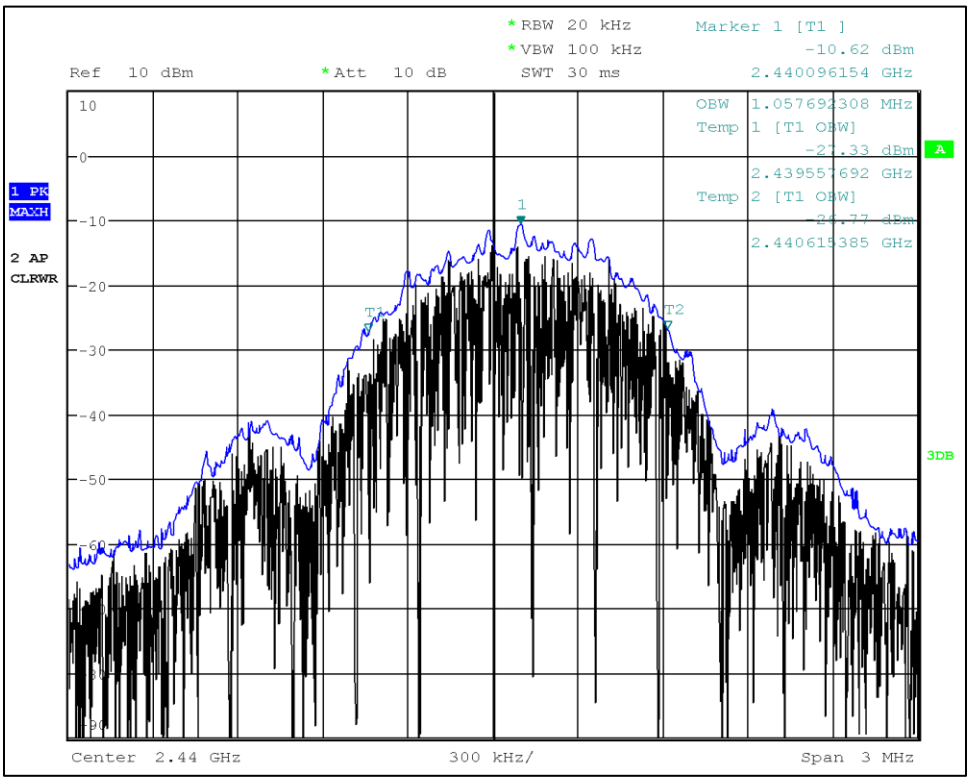

*RBW 100 kHz
VBW 300 kHz
SWT 5 ms
Marker 1 [T1]
-6.78 dBm
2.440096154 GHz
Ref 10 dBm
*Att 10 dB
ndB [T1] 6.00 dB
BW 1.105769231 MHz
Temp 1 [T1 ndB]
-12.82 dBm
2.439551282 GHz
Temp 2 [T1 ndB]
-12.29 dBm
2.440657051 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
Center 2.44 GHz
1 MHz/
Span 10 MHz

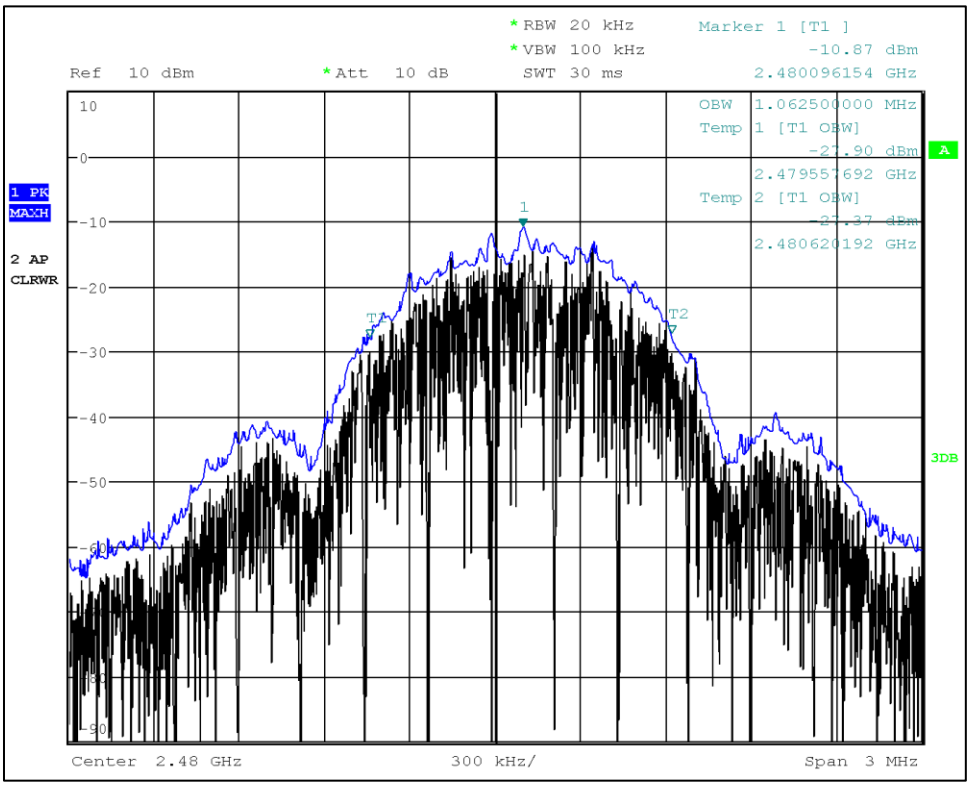

*RBW 100 kHz
VBW 300 kHz
SWT 5 ms
Marker 1 [T1]
-7.05 dBm
2.480096154 GHz
Ref 10 dBm
*Att 10 dB
ndB [T1] 6.00 dB
BW 1.105769231 MHz
Temp 1 [T1 ndB]
-13.15 dBm
2.479551282 GHz
Temp 2 [T1 ndB]
-13.34 dBm
2.480657051 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
Center 2.48 GHz
1 MHz/
Span 10 MHz

99% Plots

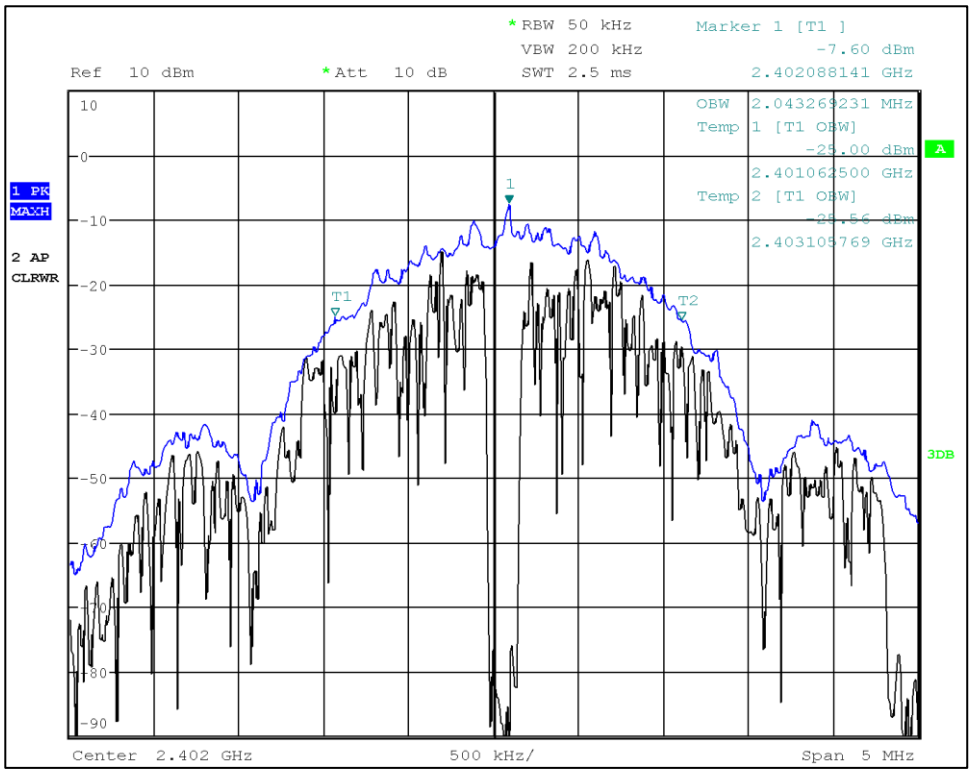
1Mbps

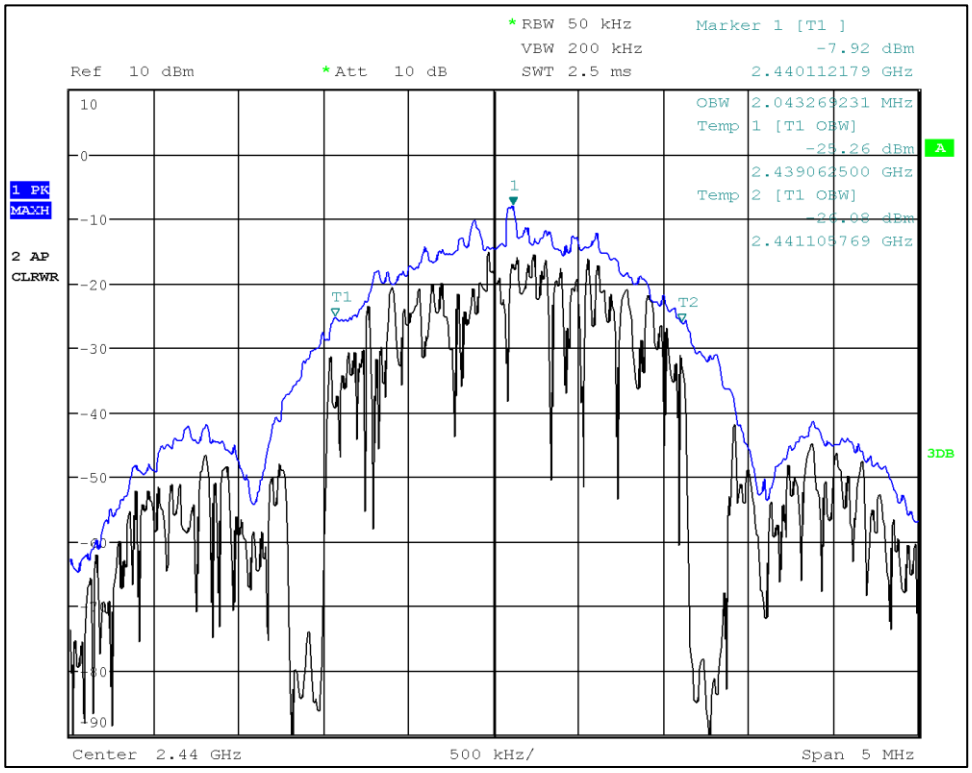


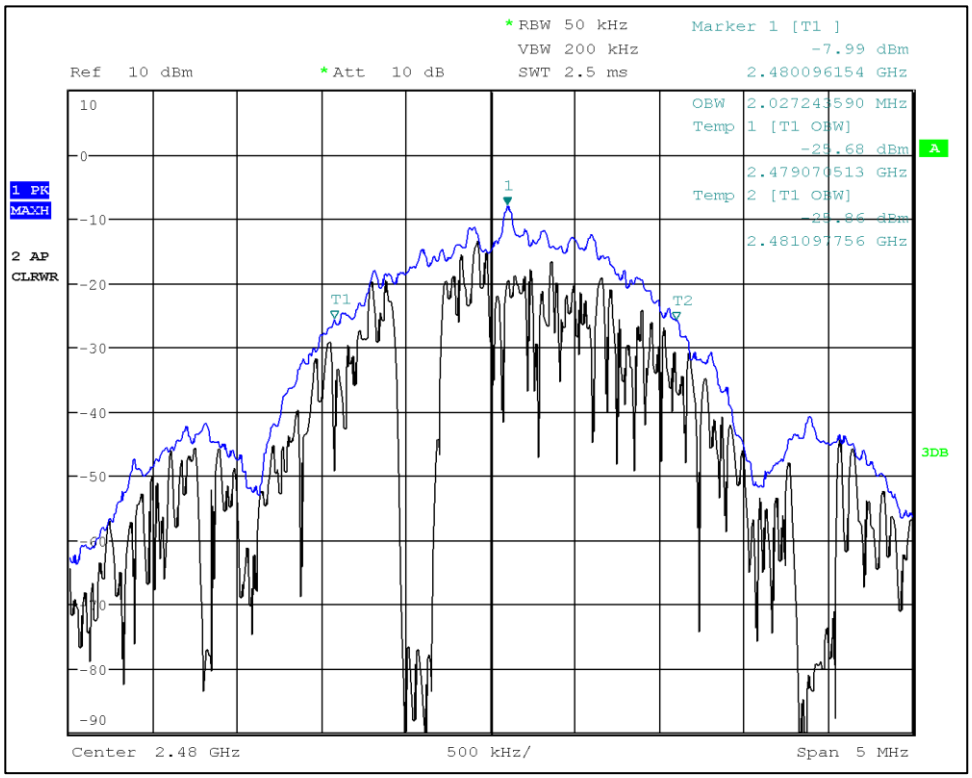



*RBW 20 kHz
*VBW 100 kHz
Ref 10 dBm
*Att 10 dB
SWT 30 ms
Marker 1 [T1]
-10.87 dBm
2.480096154 GHz
OBW 1.062500000 MHz
Temp 1 [T1 OBW]
-27.90 dBm
2.479557692 GHz
Temp 2 [T1 OBW]
-27.37 dBm
2.480620192 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
Center 2.48 GHz
300 kHz/
Span 3 MHz

2Mbps


*RBW 50 kHz
VBW 200 kHz
Ref 10 dBm
*Att 10 dB
SWT 2.5 ms
Marker 1 [T1]
-7.60 dBm
2.402088141 GHz
OBW 2.043269231 MHz
Temp 1 [T1 OBW]
-25.00 dBm
2.401062500 GHz
Temp 2 [T1 OBW]
-25.56 dBm
2.403105769 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
Center 2.402 GHz
500 kHz/
Span 5 MHz


*RBW 50 kHz
VBW 200 kHz
Ref 10 dBm
*Att 10 dB
SWT 2.5 ms
Marker 1 [T1]
-7.92 dBm
2.440112179 GHz
OBW 2.043269231 MHz
Temp 1 [T1 OBW]
-25.26 dBm
2.439062500 GHz
Temp 2 [T1 OBW]
-24.08 dBm
2.441105769 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
T1
T2
Center 2.44 GHz
500 kHz/
Span 5 MHz


*RBW 50 kHz
VBW 200 kHz
Ref 10 dBm
*Att 10 dB
SWT 2.5 ms
Marker 1 [T1]
-7.99 dBm
2.480096154 GHz
OBW 2.027243590 MHz
Temp 1 [T1 OBW]
-25.68 dBm
2.479070513 GHz
Temp 2 [T1 OBW]
-25.86 dBm
2.481097756 GHz
1 PK
MAXH
2 AP
CLRWR
A
3DB
T1
T2
Center 2.48 GHz
500 kHz/
Span 5 MHz

Output Power

Engineer: Aaron S. Froehlich
Test Date: 10/31/22

Test Procedure

The methods of ANSI C63.10 Clause 11.9.2.2.2 AVGSA-1 were utilized to measure the average Maximum Conducted Output Power. Gate triggering was applied to ensure the averaging included no off time of the transmitter.

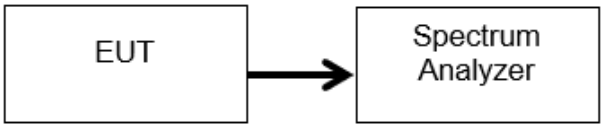
Limit

47 CFR 15.247(b)(3) & RSS-247 Clause 5.4 d.
The maximum conducted output power of the intentional radiator shall not exceed 1 Watt.

Spectrum Analyzer Settings:

Span	At least 1.5 times the OBW
RBW	1% to 5% of the OBW, not to exceed 1 MHz
VBW	≥ [3 x RBW]
Sweep	Auto
Detector	RMS (power averaging)
Trace Mode	Average
Trace Count	≥ 100
Integration	Via channel power measurement function

Test Setup



Test Data

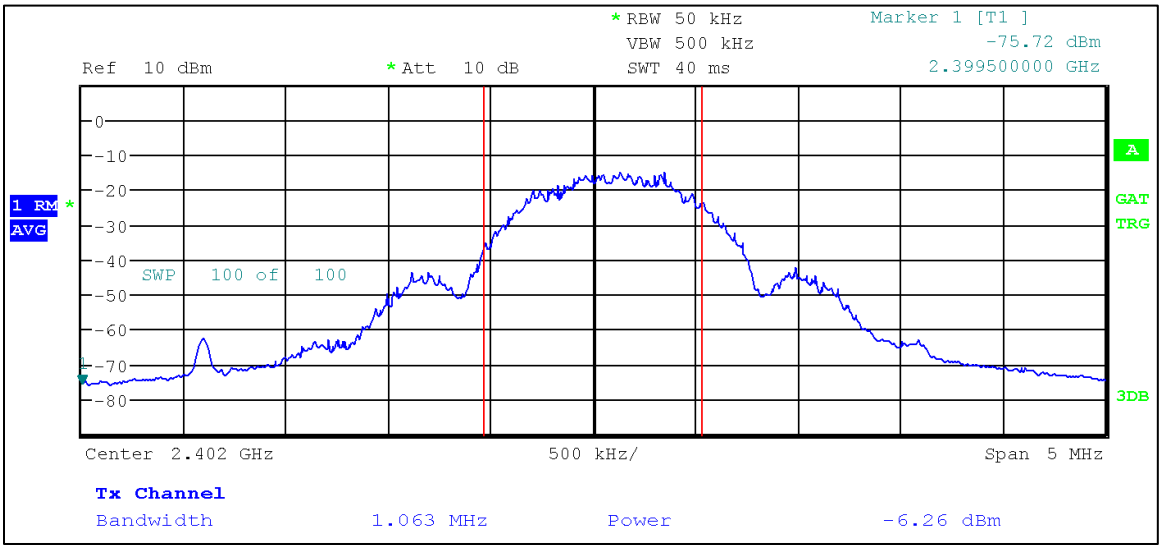
Tabular Data

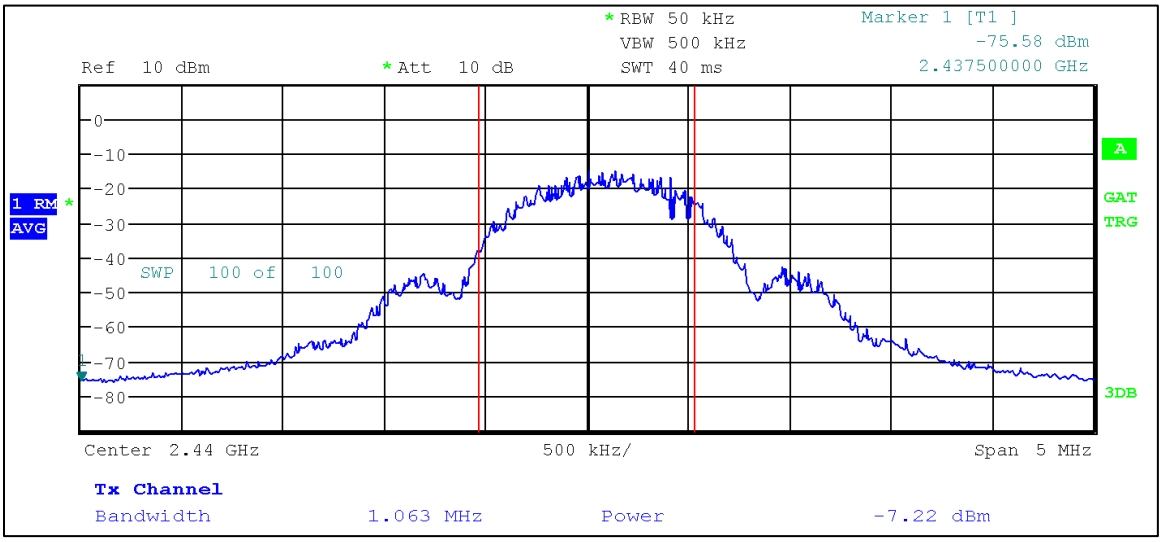
Mode	Data Rate	Frequency	Raw Pk	Loss	Final Avg	Limit	Margin	Ant Gain	EIRP	Limit	Margin
	Mbps	MHz	dBm	dB	dBm	dBm	dB	dBi	dBm	dBm	dB
BLE	1	2402	-6.26	1.29	-4.97	30.00	-34.97	2.40	-2.57	36.00	-38.57
BLE	1	2440	-7.22	1.30	-5.92	30.00	-35.92	2.40	-3.52	36.00	-39.52
BLE	1	2480	-7.05	1.35	-5.70	30.00	-35.70	2.40	-3.30	36.00	-39.30
BLE	2	2402	-6.24	1.29	-4.95	30.00	-34.95	2.40	-2.55	36.00	-38.55
BLE	2	2440	-6.94	1.30	-5.64	30.00	-35.64	2.40	-3.24	36.00	-39.24
BLE	2	2480	-7.17	1.35	-5.82	30.00	-35.82	2.40	-3.42	36.00	-39.42

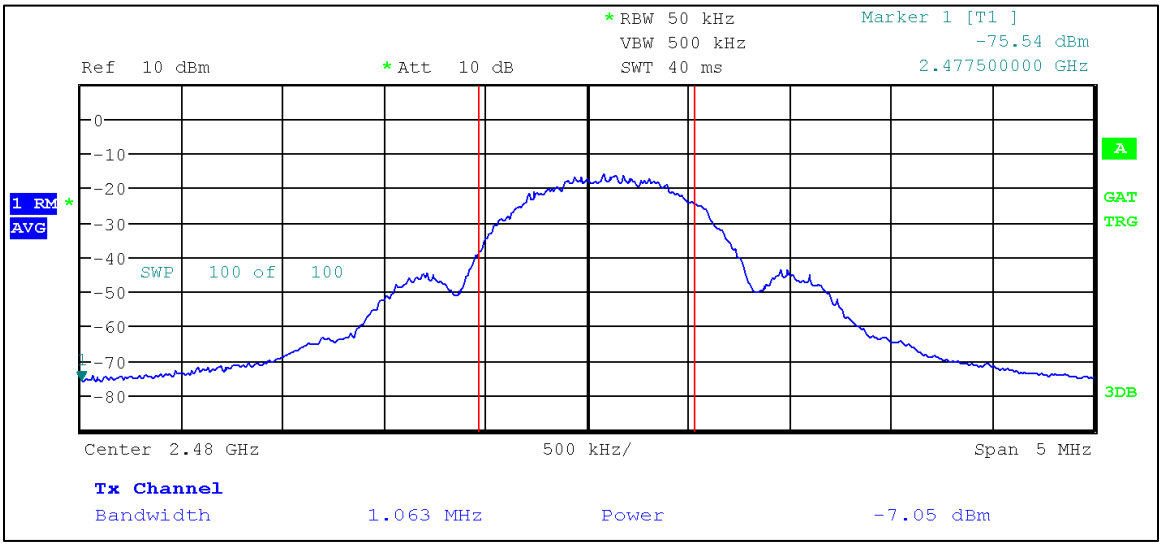
Margin = Avg Pwr – Limit

Plots

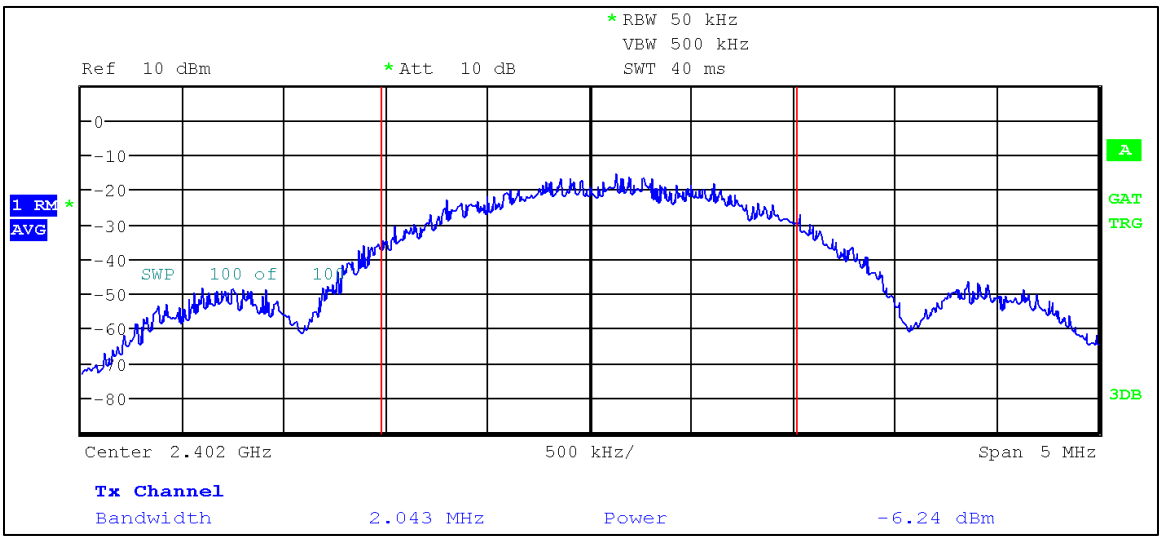
1 Mbps

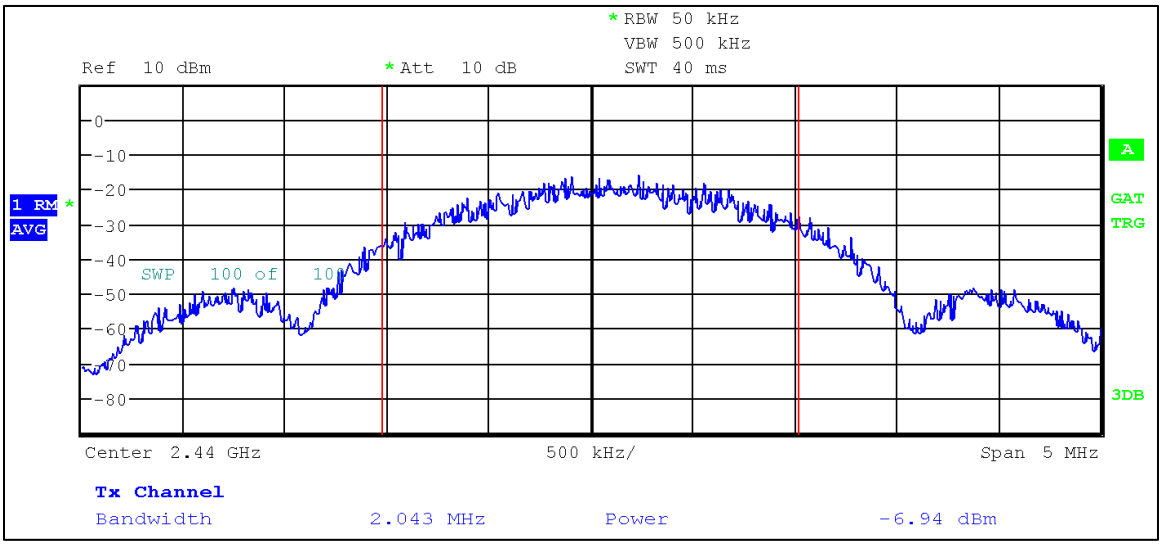

RBW 50 kHz
VBW 500 kHz
SWT 40 ms
Marker 1 [T1]
-75.72 dBm
2.399500000 GHz
Ref 10 dBm
Att 10 dB
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.402 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 1.063 MHz
Power -6.26 dBm

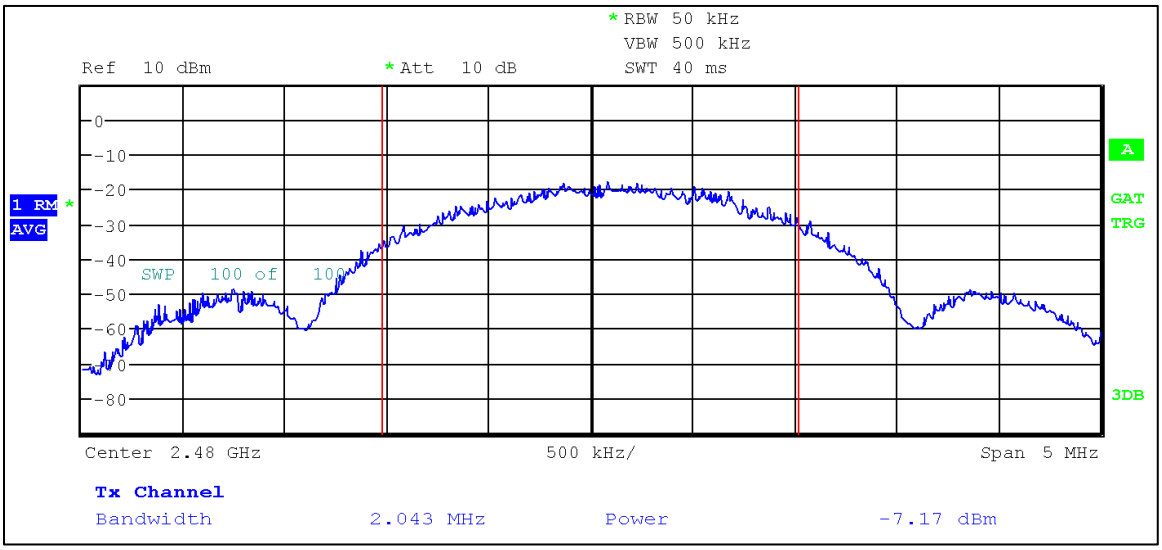

RBW 50 kHz
VBW 500 kHz
SWT 40 ms
Marker 1 [T1]
-75.58 dBm
2.437500000 GHz
Ref 10 dBm
Att 10 dB
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.44 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 1.063 MHz
Power -7.22 dBm


RBW 50 kHz
VBW 500 kHz
SWT 40 ms
Marker 1 [T1]
-75.54 dBm
2.477500000 GHz
Ref 10 dBm
Att 10 dB
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.48 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 1.063 MHz
Power -7.05 dBm

2 Mbps


*RBW 50 kHz
VBW 500 kHz
Ref 10 dBm
*Att 10 dB
SWT 40 ms
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.402 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 2.043 MHz
Power -6.24 dBm


*RBW 50 kHz
VBW 500 kHz
Ref 10 dBm
*Att 10 dB
SWT 40 ms
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.44 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 2.043 MHz
Power -6.94 dBm


*RBW 50 kHz
VBW 500 kHz
Ref 10 dBm
*Att 10 dB
SWT 40 ms
1 RM
AVG
SWP 100 of 100
A
GAT
TRG
3DB
Center 2.48 GHz
500 kHz/
Span 5 MHz
Tx Channel
Bandwidth 2.043 MHz
Power -7.17 dBm

Power Spectral Density

Engineer: Aaron S. Froehlich
Test Date: 11/01/2022

Test Procedure

The test methods and settings of ANSI C63.10 Clause 11.10.3 AVGPSD-1 were used to demonstrate compliance matching the Averaging method used to demonstrate Maximum Conducted Output Power.

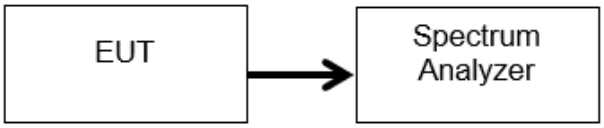
Limit

47 CFR 15.247(e) & RSS-247 Clause 5.2 (b)
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Spectrum Analyzer Settings:

Span	At least 1.5 times the OBW
RBW	3 kHz ≤ RBW ≤ 100 kHz
VBW	≥ [3 x RBW]
Sweep	Auto
Detector	RMS (power averaging)
Trace Mode	Average
Trace Count	≥ 100
Method	Peak Marker Function

Test Setup



Test Data

Tabular Data

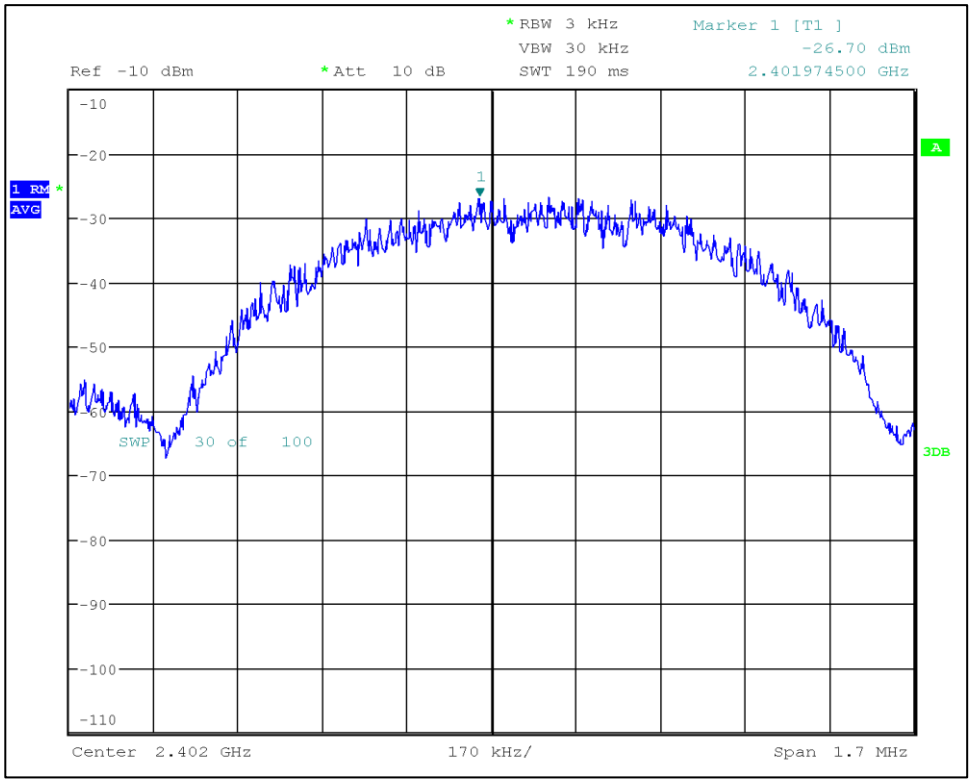
Data Rate	Frequency	Raw PSD	Loss	Avg PSD	Limit	Margin
	MHz	dBm	dB	dBm	dBm	dB
1M	2402	-26.70	1.29	-25.41	8.00	-33.41
1M	2440	-26.57	1.30	-25.27	8.00	-33.27
1M	2480	-26.33	1.35	-24.98	8.00	-32.98
2M	2402	-27.95	1.29	-26.66	8.00	-34.66
2M	2440	-28.14	1.30	-26.84	8.00	-34.84
2M	2480	-28.14	1.35	-26.79	8.00	-34.79

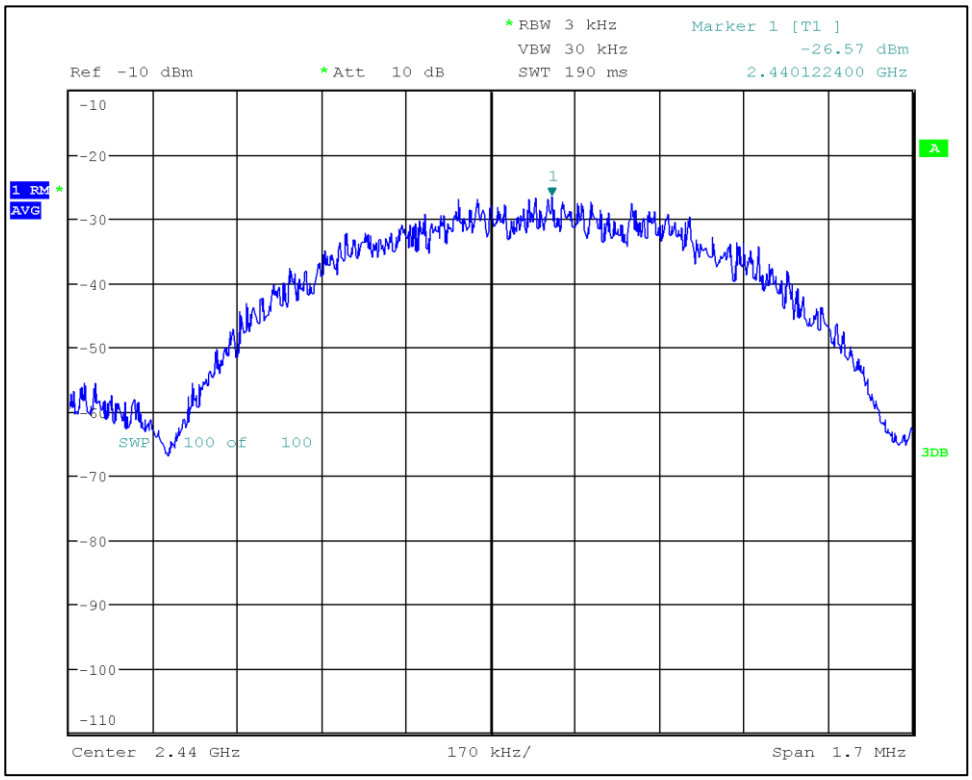
Avg PSD = Raw PSD + Loss

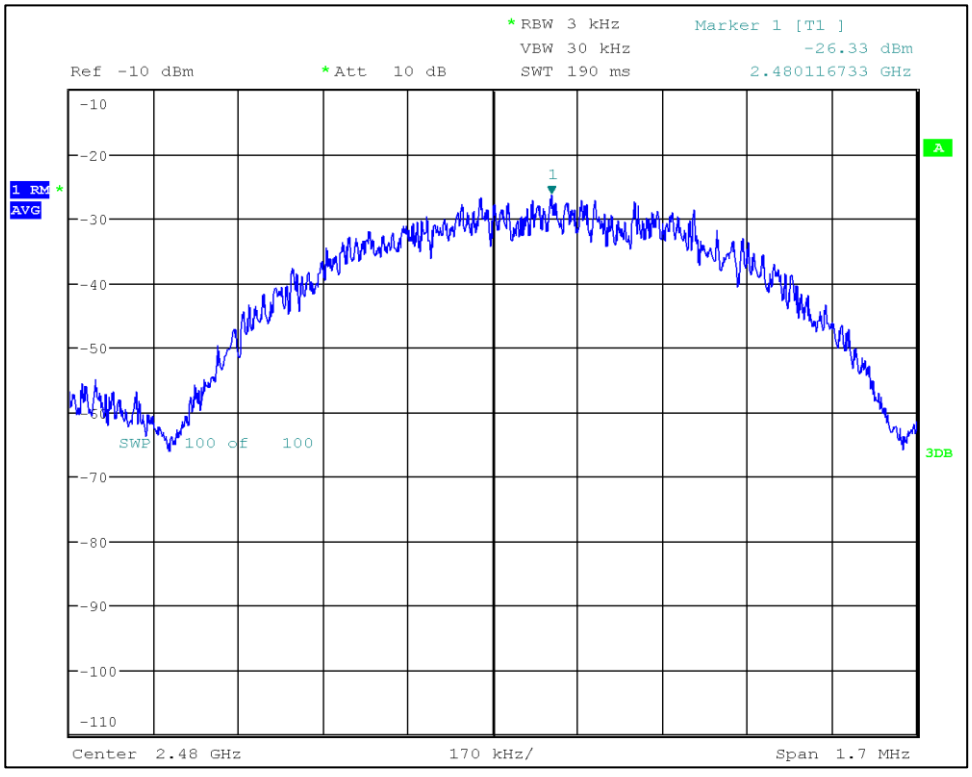
Margin = Avg PSD - Limit

Plots

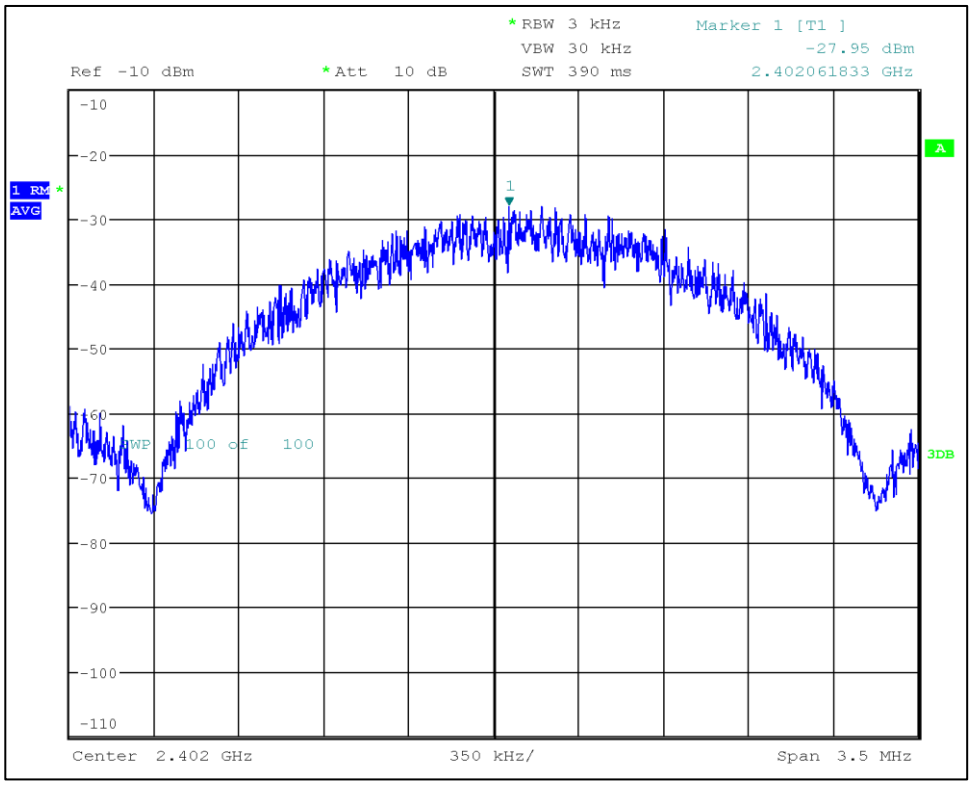
1 Mbps

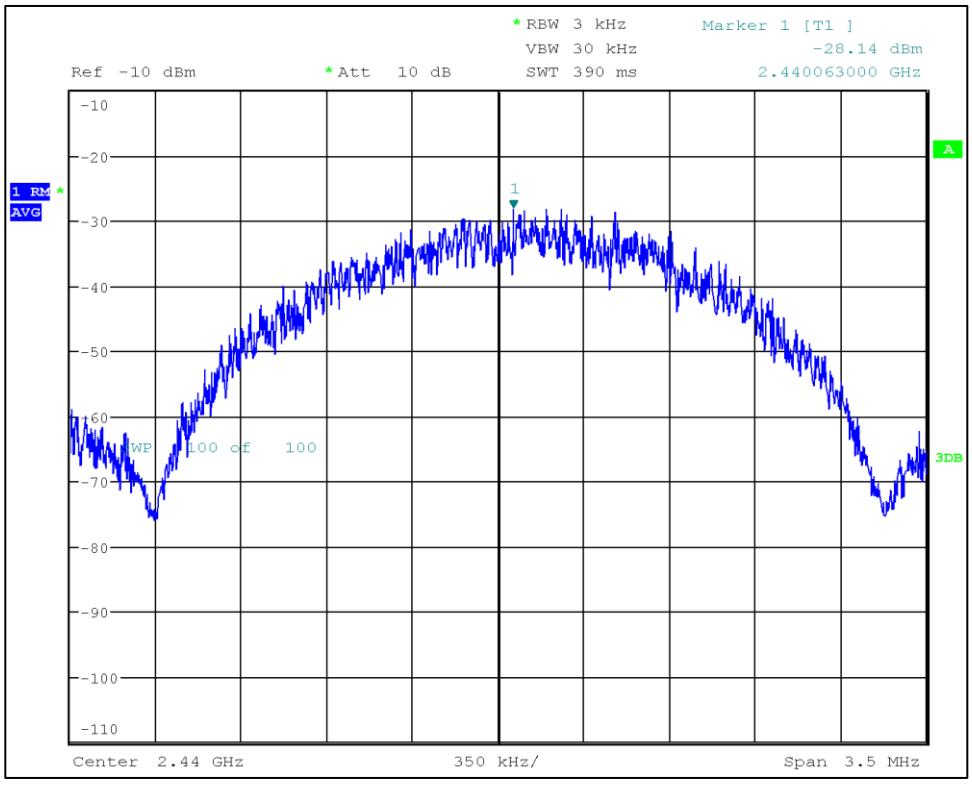


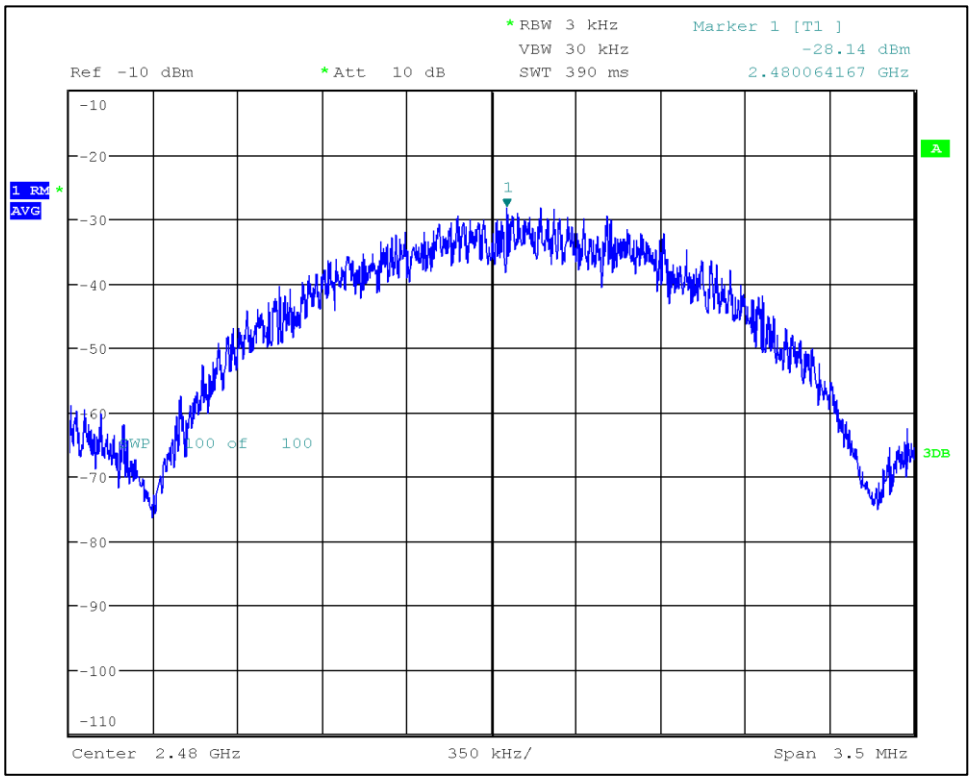

*RBW 3 kHz
VBW 30 kHz
SWT 190 ms
Marker 1 [T1]
-26.57 dBm
2.440122400 GHz
Ref -10 dBm
*Att 10 dB
1 RM *
AVG
A
3DB
SWP 100 of 100
Center 2.44 GHz
170 kHz/
Span 1.7 MHz


*RBW 3 kHz
VBW 30 kHz
SWT 190 ms
Marker 1 [T1]
-26.33 dBm
2.480116733 GHz
Ref -10 dBm
*Att 10 dB
1 RM *
AVG
A
3DB
SWP 100 of 100
Center 2.48 GHz
170 kHz/
Span 1.7 MHz

2 Mbps


*RBW 3 kHz
VBW 30 kHz
SWT 390 ms
Marker 1 [T1]
-27.95 dBm
2.402061833 GHz
Ref -10 dBm
*Att 10 dB
1 RM *
AVG
A
3DB
SWP 100 of 100
Center 2.402 GHz
350 kHz/
Span 3.5 MHz


*RBW 3 kHz
VBW 30 kHz
SWT 390 ms
Marker 1 [T1]
-28.14 dBm
2.440063000 GHz
Ref -10 dBm
*Att 10 dB
1 RM *
AVG
A
3DB
SWP 100 of 100
Center 2.44 GHz
350 kHz/
Span 3.5 MHz


*RBW 3 kHz
VBW 30 kHz
SWT 390 ms
Marker 1 [T1]
-28.14 dBm
2.480064167 GHz
Ref -10 dBm
*Att 10 dB
1 RM
AVG
A
3DB
SWP 100 of 100
Center 2.48 GHz
350 kHz/
Span 3.5 MHz

Emissions at Band Edges

Engineer: Aaron S. Froehlich

Test Date: 11/03/2022

Test Procedure

The relative method of ANSI C63.10 Clause 6.10.4 was used to demonstrate Band Edge Compliance with the 2400-2483.5 MHz Band.

Additionally, the method of Clause 6.10.5.2 was used to demonstrate Restricted-Band Band-Edge for the adjacent 2310-2390 MHz, and 2483.5-2500 MHz bands.

Both measurements were made using antenna port conducted measurements. The Restricted-Band Band-Edge (RB BE) data has been converted into equivalent radiated field strengths using the equation of Clause 11.12.2.2, as a reference level offset. Per Clause 11.12.2.6 a minimum antenna gain (AG) of 2 dBi has been applied, (when actual antenna gain is lower). Peak compliance has been demonstrated with a Max Hold on trace 1; Average compliance with an RMS detector averaged over 100 sweeps of Trace 2.

When the average measurement obtained using this method was greater than the limit, an additional measurement at the Band Edge was performed using the integration method of Clause 11.13.3.4 to demonstrate compliance.

Worst-case mode of operation was determined based on the widest bandwidth and highest power mode of operation per Clause 5.6.2.2 a).

RB BE Offset Calculations

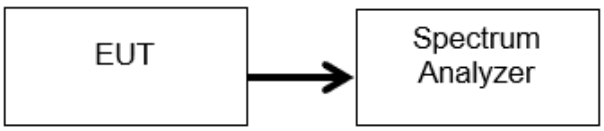
Data Rate	Freq	CF	AG	Offset
2M	2402	95.3	2.4	97.7
2M	2480	95.3	2.4	97.7

CF (Conversion Factor) = -20 • Log10(D) + 104.8
Where D = 3 meters
Offset = CF + CL + AG

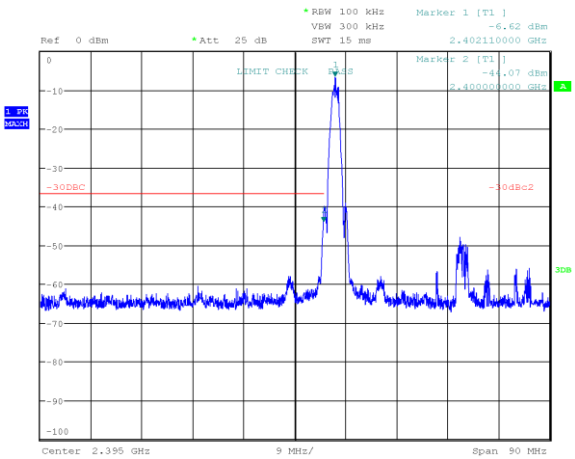
Limits

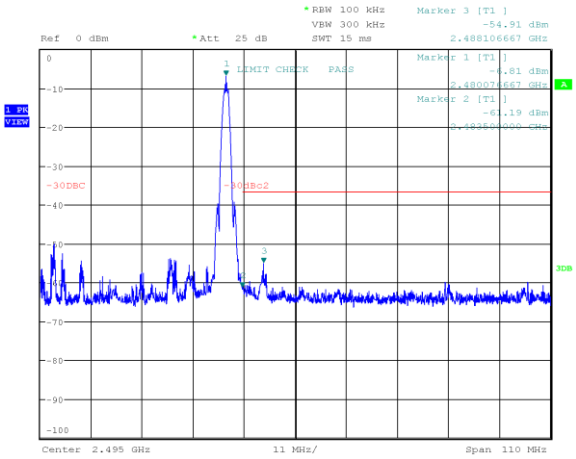
47 CFR 15.247(d) & RSS 247 Section 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Test Setup

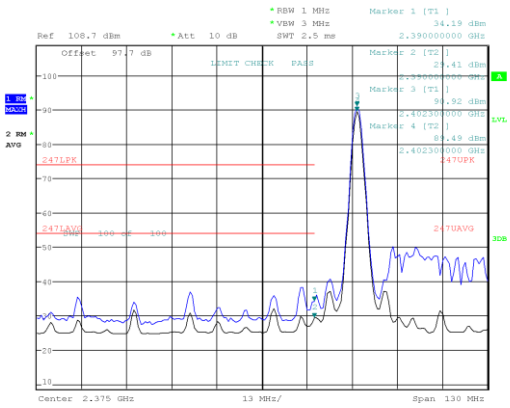


Band Edge Test Data

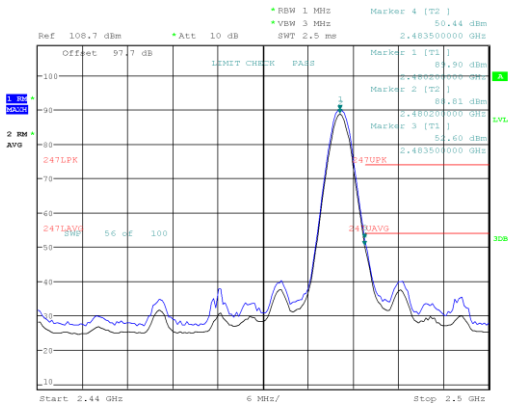




Restricted-Band Band-Edge Test Data



condspur_b3_1g2g
Date: 15.NOV.2022 21:33:31



condspur_b3_1g2g
Date: 15.NOV.2022 21:35:58

Conducted Spurious Emissions

Engineer: Aaron S. Froehlich

Test Date: 11/09/21

Test Procedure

Conducted Spurious Emissions has been measured using the methods of ANSI C63.10 clause 7.8.8. The antenna port was connected to a spectrum analyzer and the range of 30 MHz to 10 times the operating frequency was scanned with a resolution bandwidth of 100 kHz, video bandwidth pf 300 kHz and a coupled sweep time. The frequency range was subdivided into 17 evenly spaced subranges with 30001 sweep points per subrange.

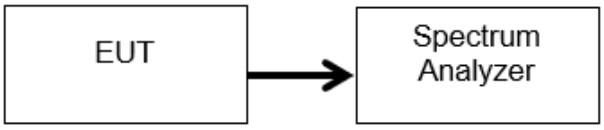
Per ANSI C63.10 Clause 5.6.2.2 b) the mode with the highest output power for each modulation family has been tested and reported.

Limits

47 CFR 15.247(d) & RSS 247 Section 5.5

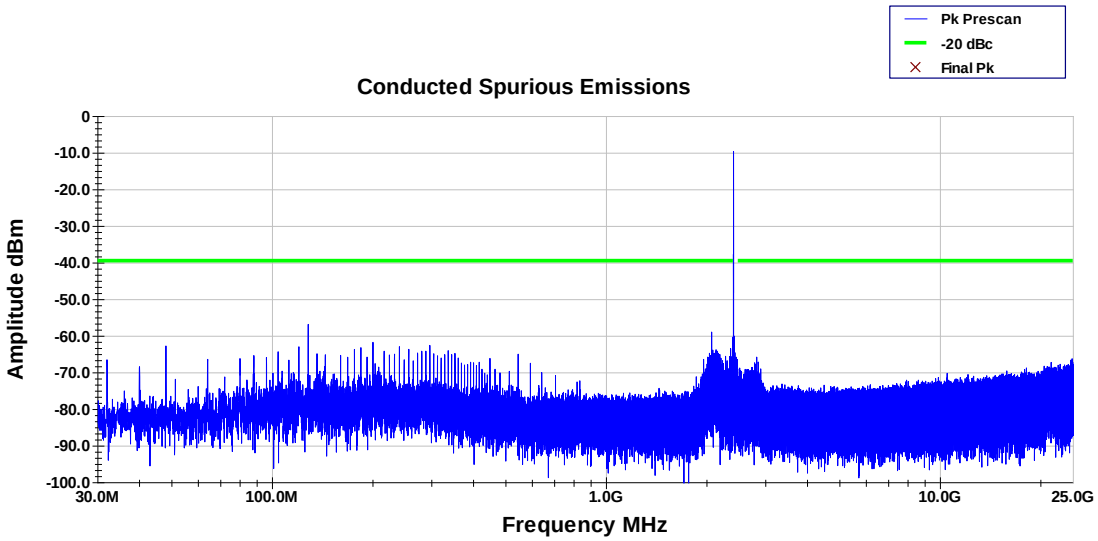
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Test Setup

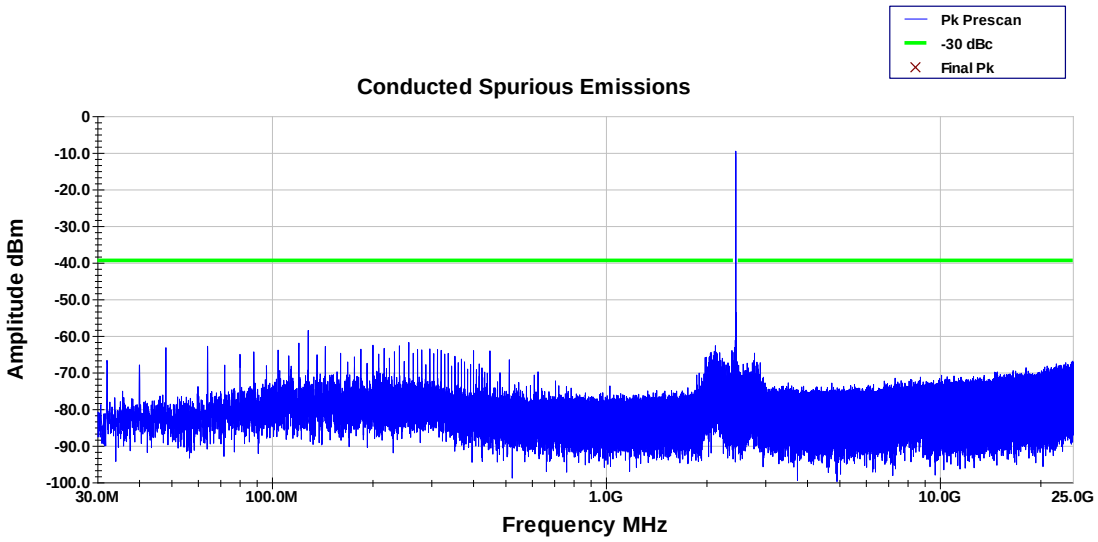


Test Data

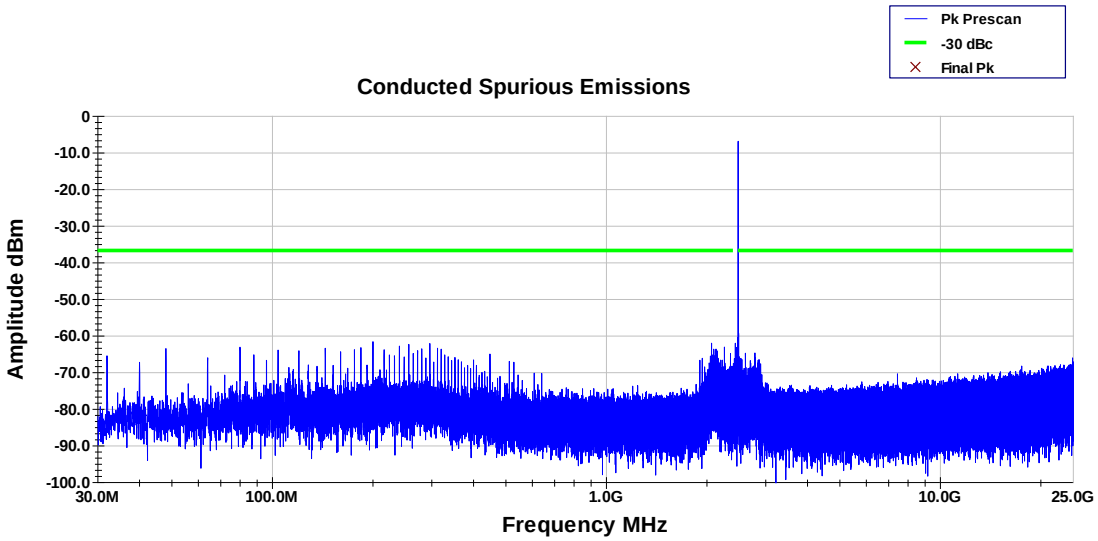
BLE 1M Low Ch



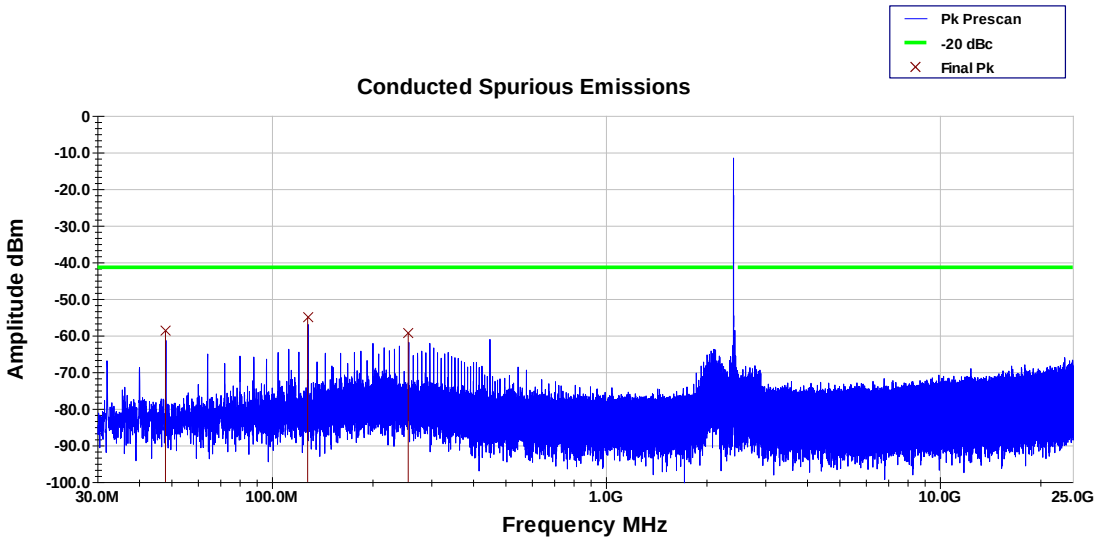
BLE 1M Mid Ch



BLE 1M High Ch

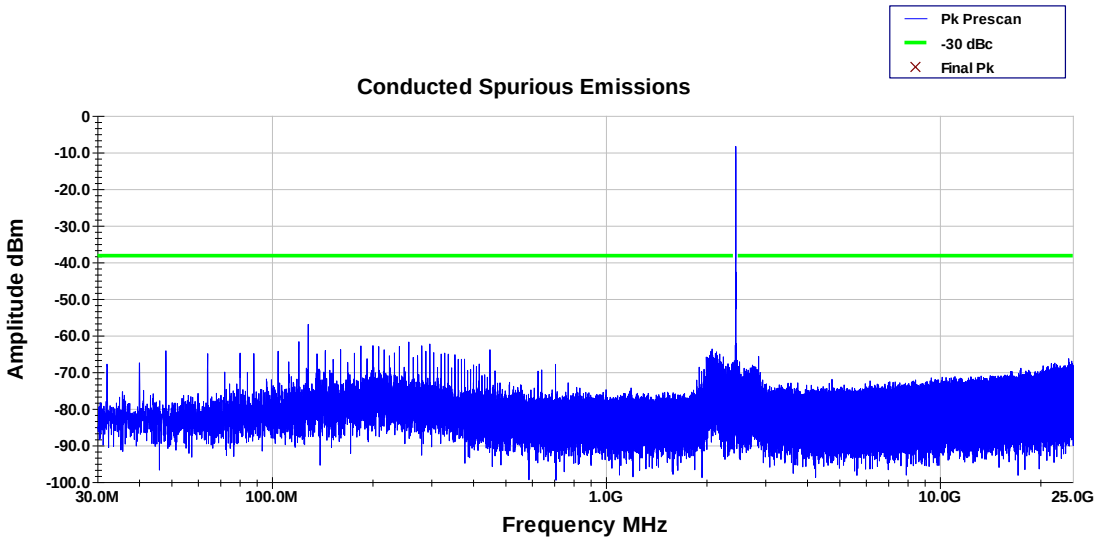


BLE 2M Low Ch

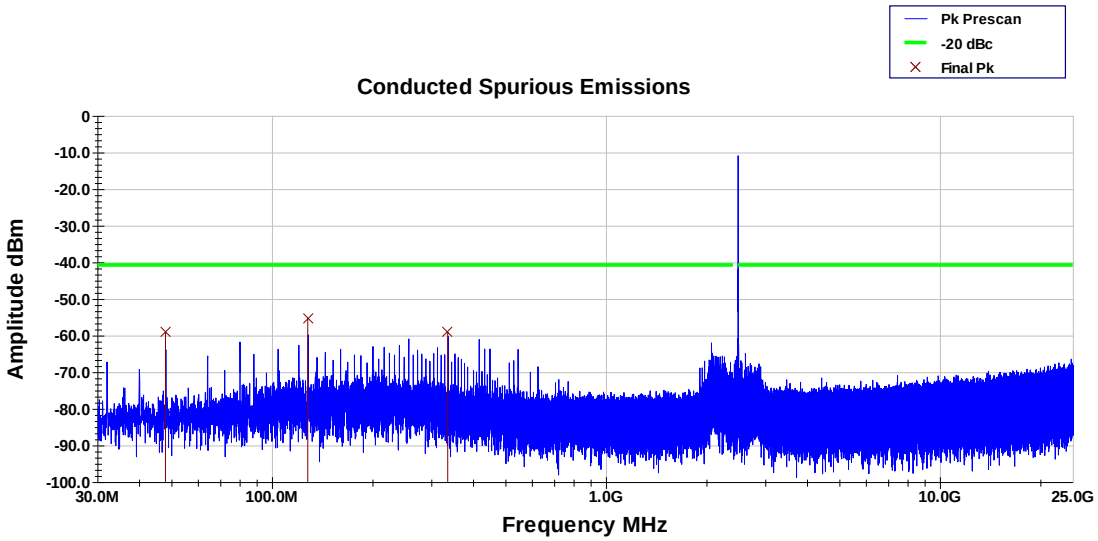


Frequency	Raw Pk	Final Pk	Path Loss	Limit	Pk Margin
(MHz)	dBm	dBm	dB	dBm	dB
48.031 MHz	-58.87	-58.67	0.20	-41.39	-17.28
128.02 MHz	-55.33	-55.09	0.24	-41.39	-13.69
255.98 MHz	-59.87	-59.47	0.40	-41.39	-18.08
Final = Raw + Path Loss					
Margin = Final - Limit					

BLE 2M Mid Ch


Pk Prescan
-30 dBc
Final Pk
Conducted Spurious Emissions
Amplitude dBm
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
30.0M
100.0M
1.0G
10.0G
25.0G
Frequency MHz

BLE 2M High Ch



Frequency	Raw Pk	Final Pk	Path Loss	Limit	Pk Margin
(MHz)	dBm	dBm	dB	dBm	dB
48.031 MHz	-59.34	-59.14	0.20	-40.75	-18.39
128.1 MHz	-55.48	-55.24	0.24	-40.75	-14.49
336.06 MHz	-59.59	-59.15	0.45	-40.75	-18.39
Final = Raw + Path Loss					
Margin = Final - Limit					

Emissions in Restricted Frequency Bands

Engineer: Aaron S. Froehlich
Test Date: 11/15/21

Test Procedure: 30-1000 MHz

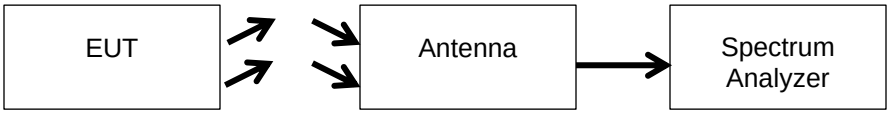
Per ANSI C63.10 Clause 5.6.2.2 b) the worst case modes to be tested for spurious emissions is BLE 1Mbps. A simultaneous transmission of LoRa SF12 at 907.8 MHz was also active during all radiated tests below. The option to perform Antenna-port conducted measurements paired with cabinet case radiated measurements per ANSI C63.10 Clause 11.2.1 have been utilized. Testing below 1 GHz was performed with the appropriate antennas transmit antennas in place.

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation, as well as frequency hopping, at the maximum power level. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions.

All emissions from 30 MHz to 1 GHz were examined.
Measured Level includes antenna and receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz
VBW = 300 KHz
Detector – Quasi Peak

Test Setup



Test Procedure: ≥ 1 GHz

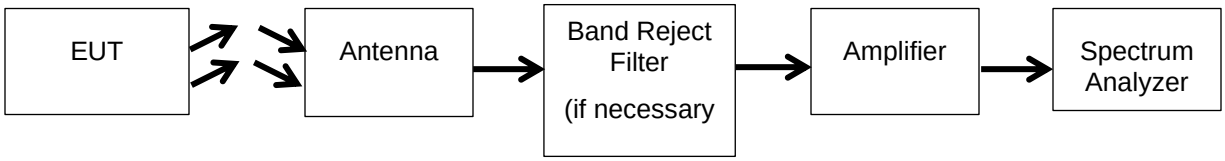
Per ANSI C63.10 Clause 5.6.2.2 b) the worst case modes to be tested for spurious emissions is BLE 1Mbps. A simultaneous transmission of LoRa SF12 at 907.8 MHz was also active during all radiated tests below.

Testing above 1 GHz was performed with the antenna ports terminated to comply with the cabinet case emission requirements. Emissions seen at 1.8 GHz are not within a restricted band and are therefore subject to the 100 kHZ 30 dBc requirements and are compliant.

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The EUT was set to transmit on the lowest, middle and highest frequency of operation at the maximum power level. The EUT was tested, in 3 orthogonal axis, by rotating it 360° with the receive antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the TX signal levels were maximized. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. No emissions were seen above 18 GHz.

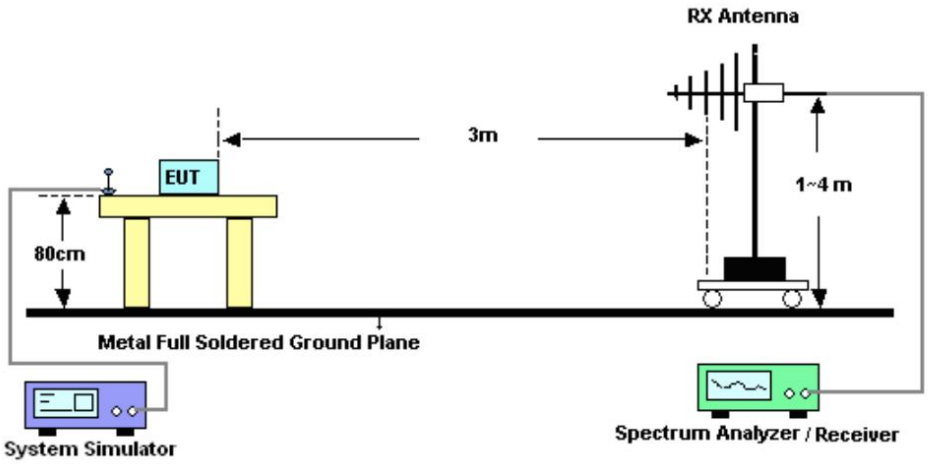
RBW = 1 MHz
VBW = 3 MHz
Detector – Peak

Test Setup

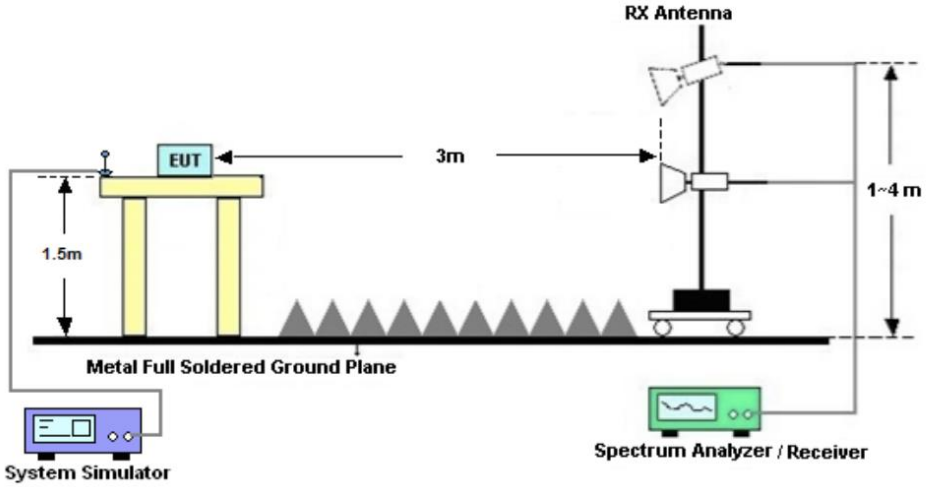


Chamber Setup Diagrams

For radiated emissions from 30MHz to 1GHz

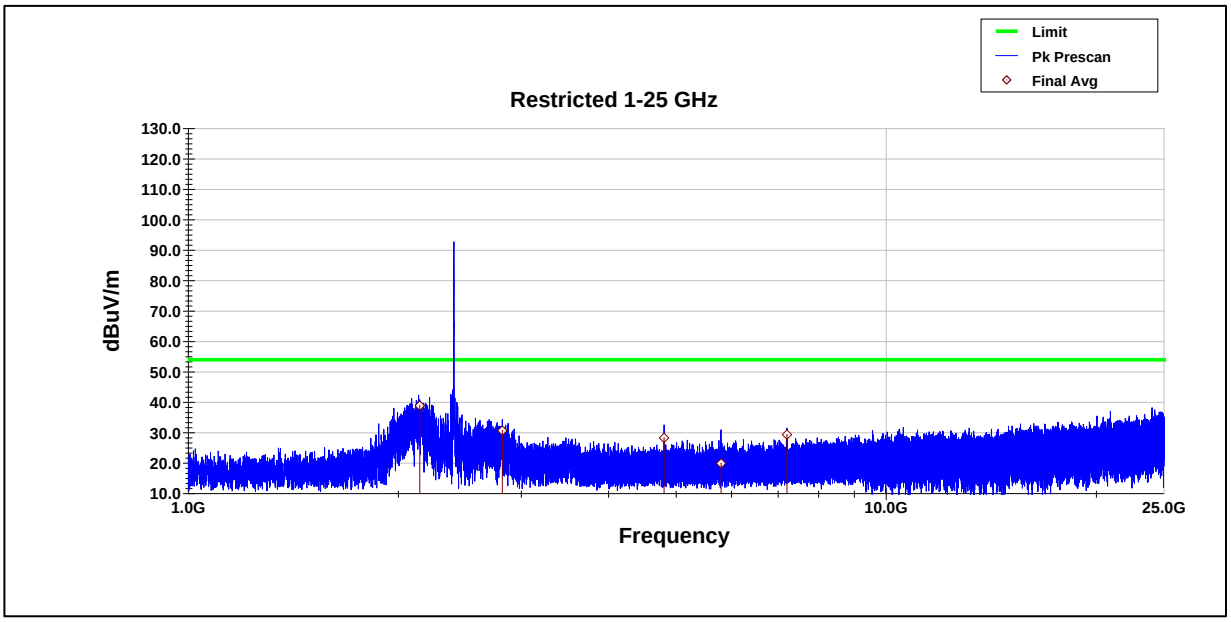


For radiated emissions above 1GHz



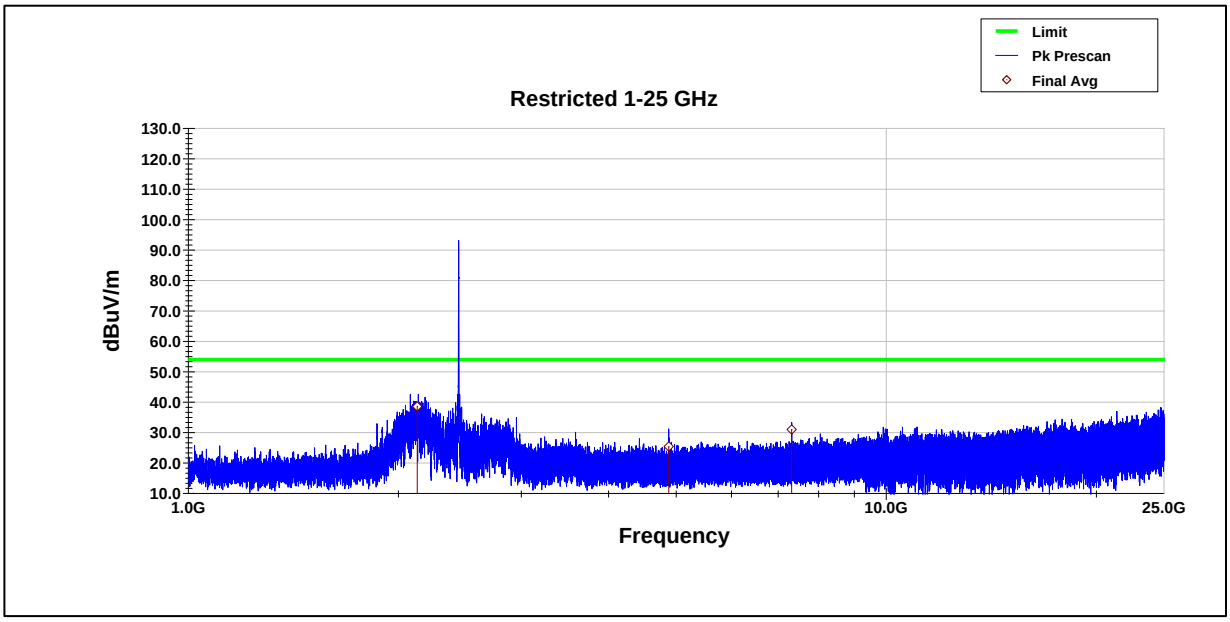
Antenna Port Conducted Test Data

BLE 1M Low Ch



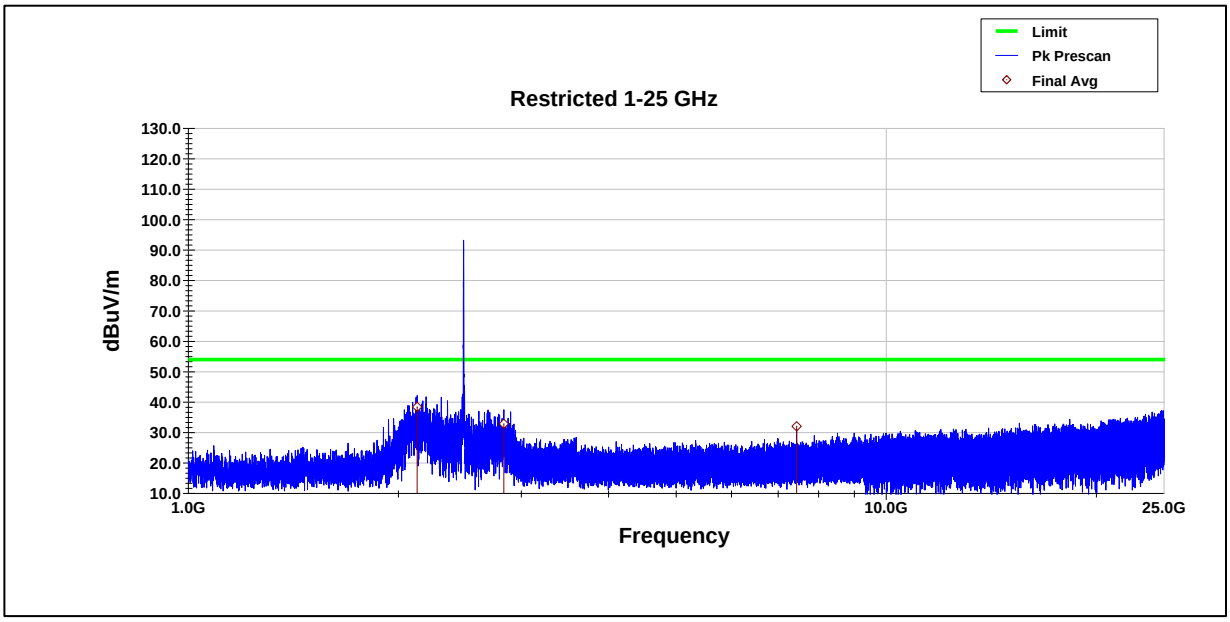
Frequency	Raw Avg	Path Loss	onverstio	Final Avg	Limit	Margin
MHz	dBm	dB	dB	dBuV/m	dBuV/m	dB
2145.994	-60.00	3.60	95.30	38.90	54.00	-15.10
2818.079	-68.40	3.80	95.30	30.70	54.00	-23.30
4804.431	-71.40	4.40	95.30	28.30	54.00	-25.70
5800.614	-79.90	4.60	95.30	19.90	54.00	-34.00
7206.776	-70.70	4.80	95.30	29.40	54.00	-24.60
Final = Raw + Path Los + Conversion						
Margin = Final - Limit						

BLE 1M Mid Ch



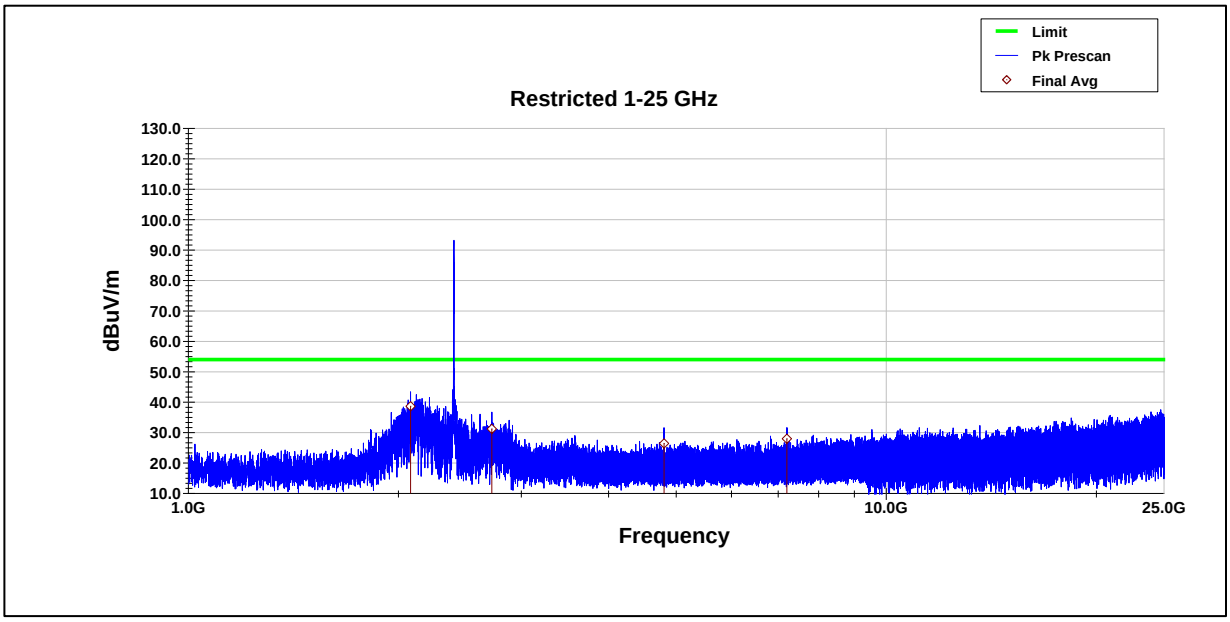
Frequency	Raw Avg	Path Loss	Converstion	Final Avg	Limit	Margin
MHz	dBm	dB	dB	dBuV/m	dBuV/m	dB
2128.095	-60.30	3.60	95.30	38.60	54.00	-15.40
4880.483	-74.20	4.30	95.30	25.40	54.00	-28.60
7320.686	-69.10	4.80	95.30	31.00	54.00	-23.00
Final = Raw + Path Loss + Conversion						
Margin = Final - Limit						

BLE 1M High Ch



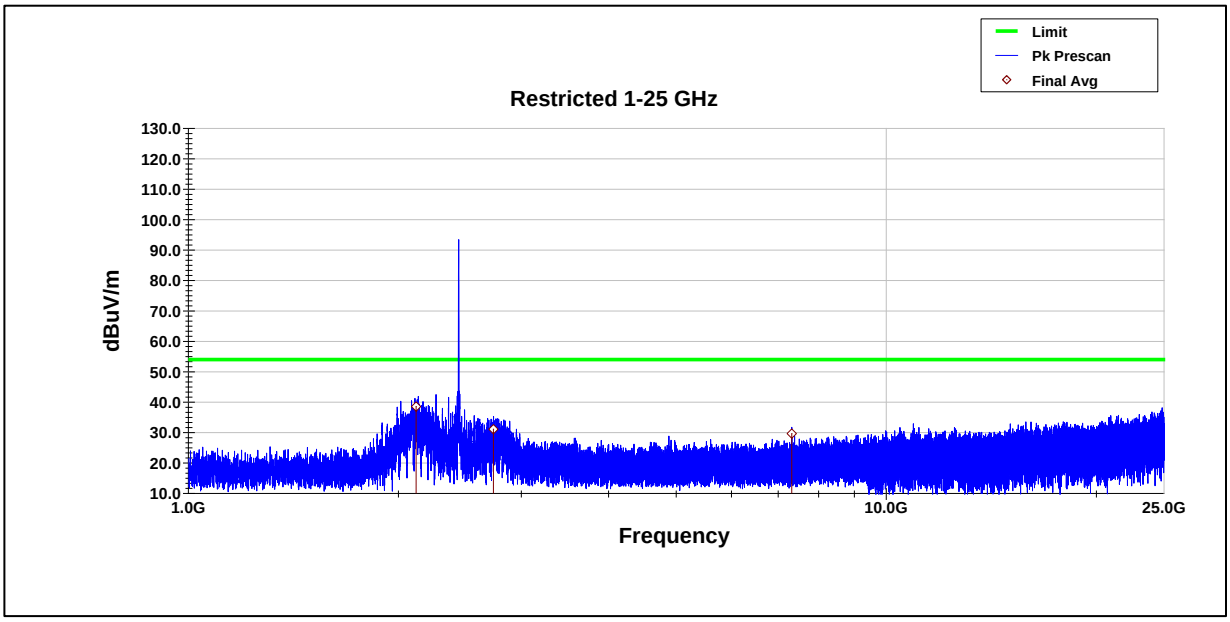
Frequency	Raw Avg	Path Loss	Converstion	Final Avg	Limit	Margin
MHz	dBm	dB	dB	dBuV/m	dBuV/m	dB
2127.992	-60.40	3.60	95.30	38.40	54.00	-15.60
2832.116	-66.20	3.80	95.30	32.80	54.00	-21.10
7441.001	-68.20	5.00	95.30	32.00	54.00	-21.90
Final = Raw + Path Loss + Conversion						
Margin = Final - Limit						

BLE 2M Low Ch



Frequency	Raw Avg	Path Loss	Converstion	Final Avg	Limit	Margin
MHz	dBm	dB	dB	dBuV/m	dBuV/m	dB
2082.171	-60.20	3.60	95.30	38.60	54.00	-15.40
2722.247	-67.80	3.80	95.30	31.20	54.00	-22.80
4804.797	-73.30	4.40	95.30	26.40	54.00	-27.60
7204.958	-72.10	4.80	95.30	27.90	54.00	-26.00
Final = Raw + Path Loss + Conversion						
Margin = Final - Limit						

BLE 2M Mid Ch



Frequency	Raw Avg	Path Loss	Converstion	Final Avg	Limit	Margin
MHz	dBm	dB	dB	dBuV/m	dBuV/m	dB
2120.452	-60.30	3.60	95.30	38.50	54.00	-15.40
2736.291	-67.90	3.80	95.30	31.10	54.00	-22.90
7321.679	-70.50	4.80	95.30	29.60	54.00	-24.30
Final = Raw + Path Loss + Conversion						
Margin = Final - Limit						