HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

September 7, 2021

Trimble Jena GmbH
Carl-Zeiss-Promenade 10
Jena 07743, Germany

Dear Eyk Taege,

Enclosed is the EMC Wireless test report for compliance testing of the Trimble Comm Board Hurricane (V0013E) as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C and RSS-247, Issue 2, February 2017 for Intentional Radiators.

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. If you have any questions regarding these results or if Eurofins Electrical and Electronic Testing NA, Inc. can be of further service to you, please feel free to contact me.

Sincerely yours,

Rheine Nguyen

Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: \Virscient Limited\WIR113635-15.247-RSS247 (b mode supplemental) Rev 3

ACCREDITED
TESTINGCERT #0591.02

Electromagnetic Compatibility Criteria
Test Report

for the

Trimble Jena GmbH
Trimble Comm Board Hurricane (V0013E)

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators
and
the IC Certification Rules
contained in
RSS-247, Issue 2, February 2017 for Intentional Radiators

Report: WIR113635-15.247-RSS247 (b-mode supplemental) Rev 3

September 7, 2021

Prepared For:

Trimble Jena GmbH
Carl-Zeiss-Promenade 10
Jena 07743, Germany

Prepared By:
Eurofins Electrical and Electronic Testing NA, Inc.
3162 Belick St
Santa Clara, CA 94587

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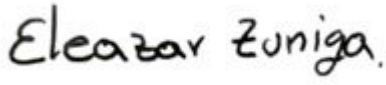
Arsalan Hasan, Project Engineer
Electromagnetic Compatibility Lab

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 and RSS247 under normal use and maintenance.



Eleazar Zuniga,
Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 2, 2021	Initial Issue.
1	August 17, 2021	Review Updates
2	August 29, 2021	TCB Review Updates
3	September 7, 2021	TCB Review Updates

Table of Contents

Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Trimble Comm Board Hurricane (V0013E), with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Trimble Comm Board Hurricane (V0013E). Trimble should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Trimble Comm Board Hurricane (V0013E), has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Trimble, purchase order number 4500012287. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247	Description	Compliance
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Not Applicable
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Band Edge	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Compliant

Executive Summary of EMC Part 15.247 ComplianceTesting

IC Reference RSS-247 Issue 2, 2017; RSS-GEN Issue 4: 2014	Description	Compliance
RSS-GEN(8.8)	Conducted Emission Limits	Not Applicable - EUT is DC powered device
RSS-GEN(6.6) & RSS-247 (5.2)	99% and -6 dB Occupied Bandwidth	Compliant
RSS-247(5.4)	Transmitter Output Power	Compliant
RSS-GEN (6.13), (8.9), & (8.10)	Radiated Spurious Emissions and Restricted Band	Compliant
RSS-247(5.5)	RF Conducted Spurious Emissions	Compliant
RSS-247(5.2)	Power Spectral Density	Compliant

Executive Summary of EMC Part 15.247 ComplianceTesting

Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by Trimble Jena GmbH to perform testing on the Trimble Comm Board Hurricane (V0013E), under Trimble Jena GmbH's purchase order number PO20210214.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Trimble Comm Board Hurricane (V0013E).

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Trimble Comm Board Hurricane (V0013E)	
Model(s) Covered:	Trimble Comm Board Hurricane (V0013E)	
EUT Specifications:	Primary Power: 5 VDC	
	FCC ID: YK5-73350046	
	IC: 9288A-73350046	
	Type of Modulations:	CCK/DSSS, OFDM
	Equipment Code:	DTS
	EUT Frequency Ranges:	2412 – 2462 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Arsalan Hasan	
Report Date(s):	September 7, 2021	

EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-247, Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 v05r02	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247
RSS-247, Issue 2, February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN, Issue 4, Dec. 2014	General Requirements and Information for the Certification of Radio Apparatus
ICES-003, Issue 5 August 2012	Information Technology Equipment (ITE) — Limits and methods of measurement
RSS-102, Issue 5, March 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

References

C. Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Eurofins Electrical and Electronic Testing NA, Inc.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Radiated Emissions, (30 MHz – 1 GHz)	±3.24	2	95%
Radiated Emissions, (1 GHz – 6 GHz)	±3.92	2	95%
Conducted Emission Voltage	±2.44	2	95%
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Uncertainty Calculations Summary

E. Equipment Overview and Test Configuration

Name of EUT/Model:	Trimble Comm Board Hurricane (V0013E)
Description of EUT and its intended use:	The Trimble Comm Board Hurricane (V0013E) is an 802.11a/b/g/n/ac 2.4 GHz and 5 GHz dual-band Wi-Fi and Bluetooth module that acts as a communication controller/bridge for use with a long-range wireless scanner. The core chipset is a Qualcomm QCA9378-7 and a Qualcomm CSR8811.
Selected Operation Mode(s):	A factory test mode for both WLAN and Bluetooth will be provided for radio-level testing, and instructions on how to operate the device in its normal mode will be provided for WLAN DFS testing. The factory test mode allows the operator to put the radio into a transmit-only or receive-only mode to aid in performing their measurements. The settings provided by the operator are the same as those used in normal operation, so any emissions will match those expected during normal operation – with the exception that normal mode will have a lower duty cycle. Once configured, the device will continue to operate in the specified manner until the operator disables the EUT. The normal operating mode for Wi-Fi allows a video to be streamed to simulate real-world traffic. During this simulation, other parameters (such as the EUT's ability to respond to radar waveforms) may be validated. As the video has a fixed length, extended testing will require the video to be restarted every 12 minutes.
Rationale for the selection of the Operation Mode(s):	This frequency of highest disturbance is expected to be emitted by the 2.4 GHz WLAN transmitter – HT20, MCS0 centered on 2437 MHz. This frequency produces the highest transmitter output power. Unintentional emissions caused by the transmitter will be subject to relevant regulatory limits and should not cause disturbances to other devices.

Monitoring Method(s):	In factory testing mode, both the WLAN and BT radios maintain communication with the host software and will display an error if the EUT stops working. During a transmit-only test, the output of the transmitter can be measured to confirm operational status. In the normal operating mode, the EUT will act as a Wi-Fi AP. Using any other Wi-Fi device, one could scan for the AP to confirm the device is operational. Alternatively, the beacon frames may be measured at the antenna port.
Emissions Class Declaration:	Class B (residential)
Configuration(s):	The RP-SMA pigtails and antennas shall be connected to the primary antenna ports of the EUT. The ribbon cable and USB adapter shall be connected to the EUT. The host system, simulated by a laptop, and a DC power supply capable of supplying 2 A shall be connected to the USB adapter. Tests which require conducted measurements to be made shall be performed by removing the antennas and cabling onto the RP-SMA pigtails.
EUT Power Requirement	
Voltage:	5V
AC or DC:	DC
Voltage Frequency:	N/A
Number of Phases:	N/A
Current:	2A
Physical Description	
EUT Arrangement:	Table top
System with Multiple Chassis?	No
Size (HxWxD - inches):	2x4x0.2 inches
Weight (lbs):	< 1 lbs
Highest Internal Frequency (MHz):	48 MHz
Other Info	
EUT Software (internal to EUT):	Firmware is provided by the host system.
Support Software (used by support PC to exercise EUT):	Qualcomm Radio Control Toolkit (QRCT) application for Wi-Fi test, and BlueTest for Bluetooth test.
Firmware:	Firmware is provided by the host system.
Transmitter Parameters	
Description of your unit:	Hybrid (DSSS and FHSS)
Modulation Type:	GFSK, pi/4 DQPSK, 8 DPSK, CCK, OFDM
Number of Channels:	47 (inc. 2.4 GHz and 5 GHz)
Frequency range (MHz):	2400 – 2483.5, 5150 – 5350, 5470 – 5835
Antenna Type:	Dual-band, Omni
Antenna Gain (db):	2.4 GHz 3 dBi, 5 GHz 5 dBi
PMN:	--
HVIN:	V0013E
FVIN:	--
HMN:	--

Data Rates:	1 Mbps – 54 Mbps, MCS0 – MCS7
Expected Power Level:	~ 10 – 30 dBm EIRP i.e. close to regulatory limit depending on modulation and channel
Number of Antenna:	2
Number of Intentional Transmitters:	1
Number of Certified Intentional Transmitter Modules:	1 - the EUT is already a certified module.

Equipment Configuration

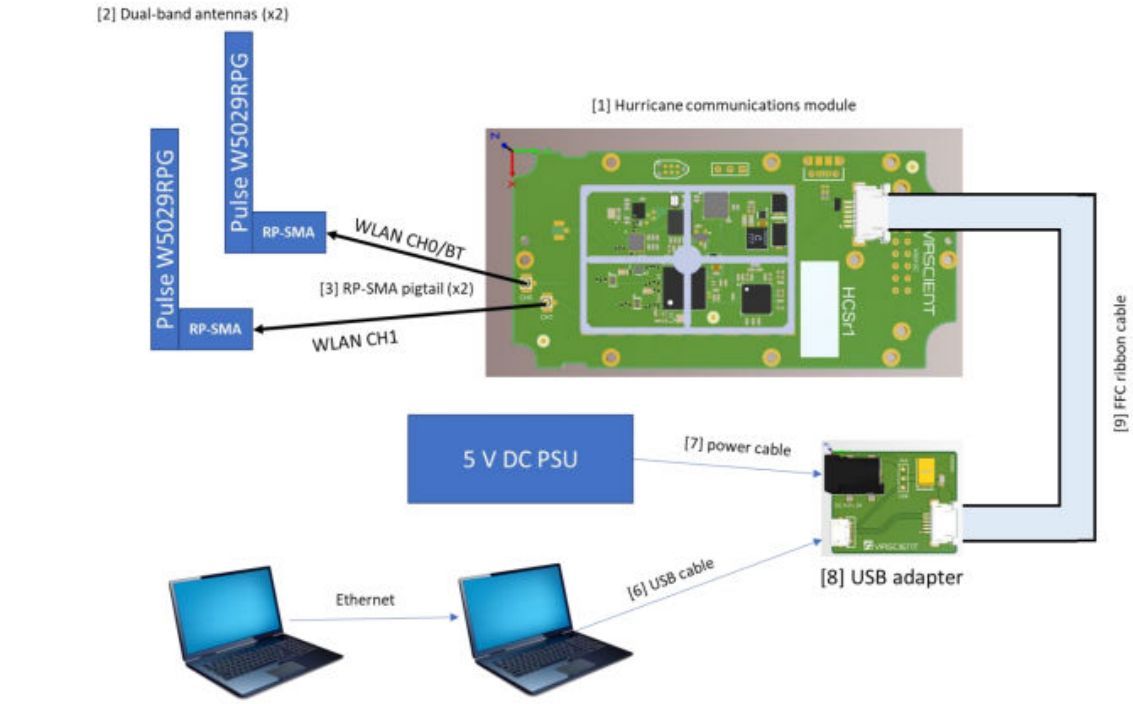
Ref.ID	Slot#	Name/Description	Model Number	Part Number	Serial Number	Rev. #
1	--	Hurricane Communications Module	V0013E	--	--	--
2	--	RP-SMA pigtails (x2)	Glyn INTCABLE58	--	--	--

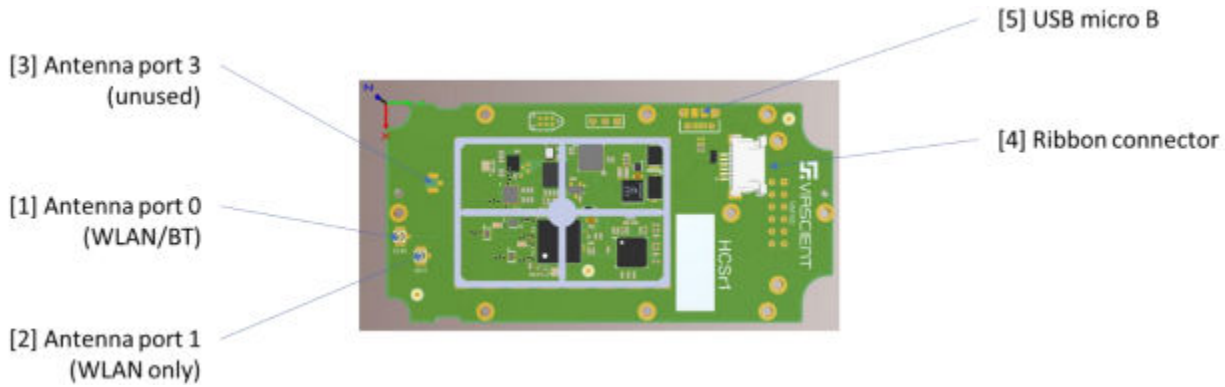
Ports and Cabling

Ref. Id	Port Name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	Antenna port 0	RP-SMA pigtail	--	0.15	0.5	Yes	--
2	Antenna port 1	RP-SMA pigtail	--	0.15	0.5	Yes	--
3	Antenna port 3	Unused	--	--	--	--	--
4	Ribbon connector	FFC ribbon	--	--	--	--	--
5	USB micro B connector	Unused	1	0.2	0.5	Yes	--

Support Equipment

Ref.ID	Name/Description	Manufacturer	Model Number	Customer Supplied Calibration Data
4	Linux Laptop	Dell		Yes. fakeboar_fcc.bin and fakeboar_etsi.bin
5	Windows Laptop	Dell		
6	USB data cable	Unknown		NA
7	Banana to jack power cable	Virscient		NA
8	USB adapter	Virscient	V0006A	NA
9	FFC ribbon cable	Molex	0982670211	NA





Block Diagram

F. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

G. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Virscient Limited upon completion of testing.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

RSS-GEN (6.8) Transmit Antenna Requirements

Requirement(s): **RSS-GEN (6.8):** The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested. For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

> *This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.*

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Results: The EUT as tested is compliant the criteria of §15.203. EUT has integral antennas.

Test Engineer(s): Arsalan Hasan

Test Date(s): July 12, 2021

Manufacturer	Name / Model	Peak Gain	Type	Polarization	Impedance
Data Alliance	ADD35RA	3.0 dBi	Omni Dipole	Linear	50 Ω

Antenna Requirement

"Note: Antenna specs are referenced from antenna datasheet provided by the antenna manufacturer. This antenna data sheet is available for review along with this test report and other exhibits in the submitted TCB package"

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using an RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results: The 6 dB Bandwidth was determined from the plots on the following pages.

RSS-GEN (6.7) 99% Occupied Bandwidth

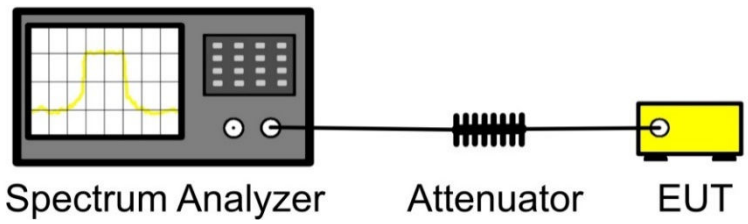
Test Requirements: **RSS-GEN (6.7):** The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% - 5% of the total emission bandwidth, VBW > RBW. The 99% Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

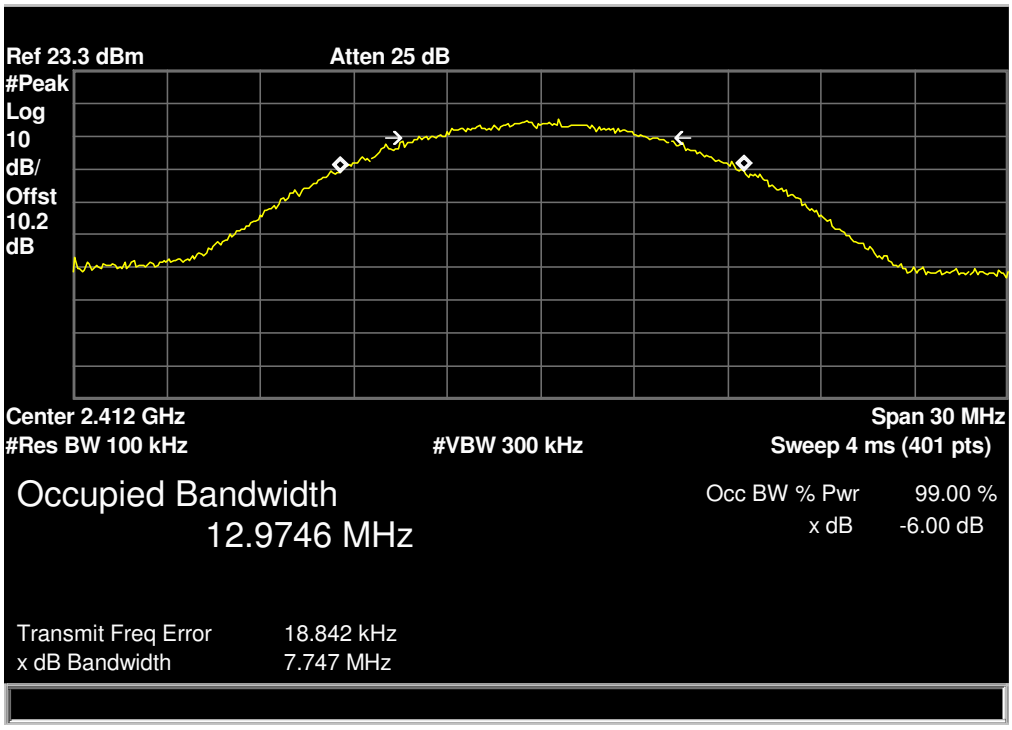
Test Results: The 99% Bandwidth was determined from the plots on the following pages.

Test Engineer: Arsalan Hasan

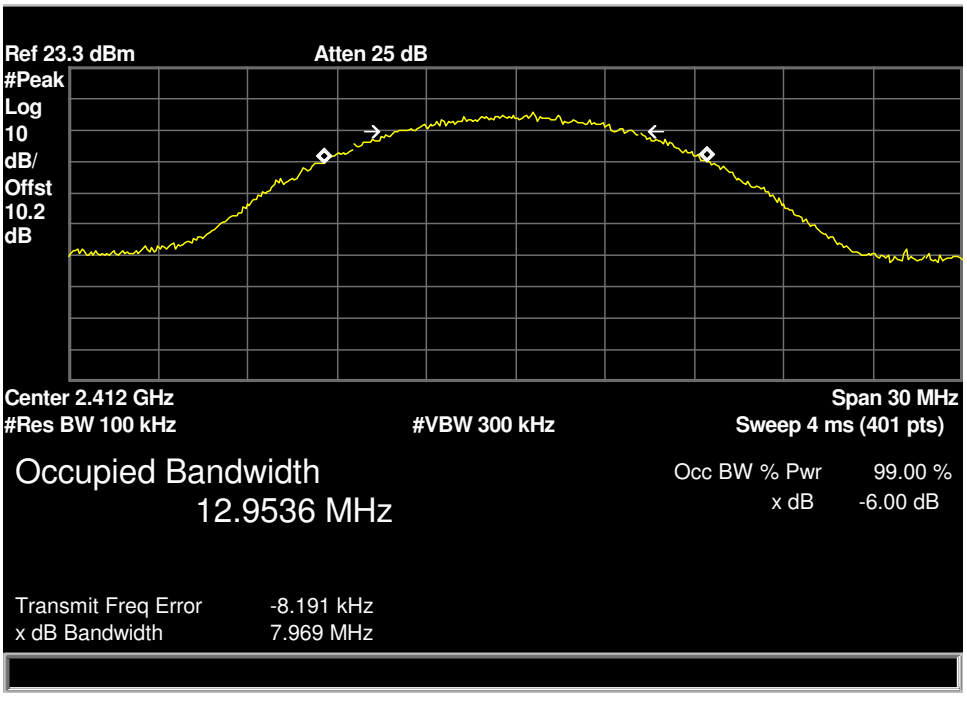
Test Date: July 27, 2021



Block Diagram, Occupied Bandwidth Test Setup



6dB Occupied Bandwidth, 2412MHz, 802.11 b Mode, Chain 0



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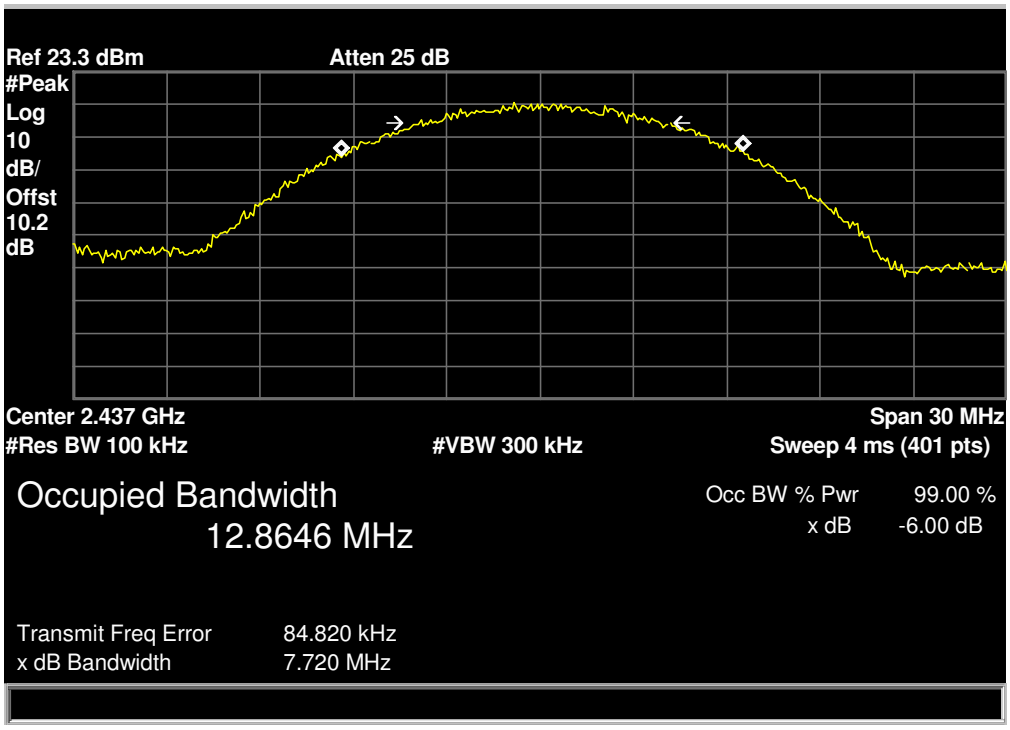
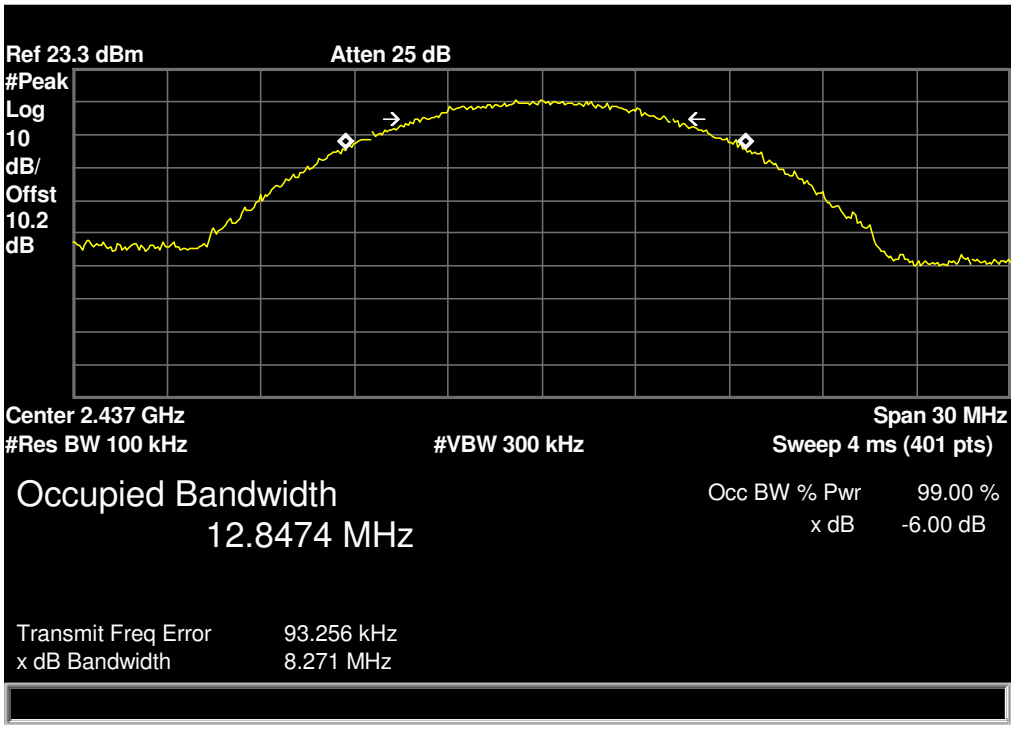


6dB Occupied Bandwidth, 2437MHz, 802.11 b Mode, Chain 0



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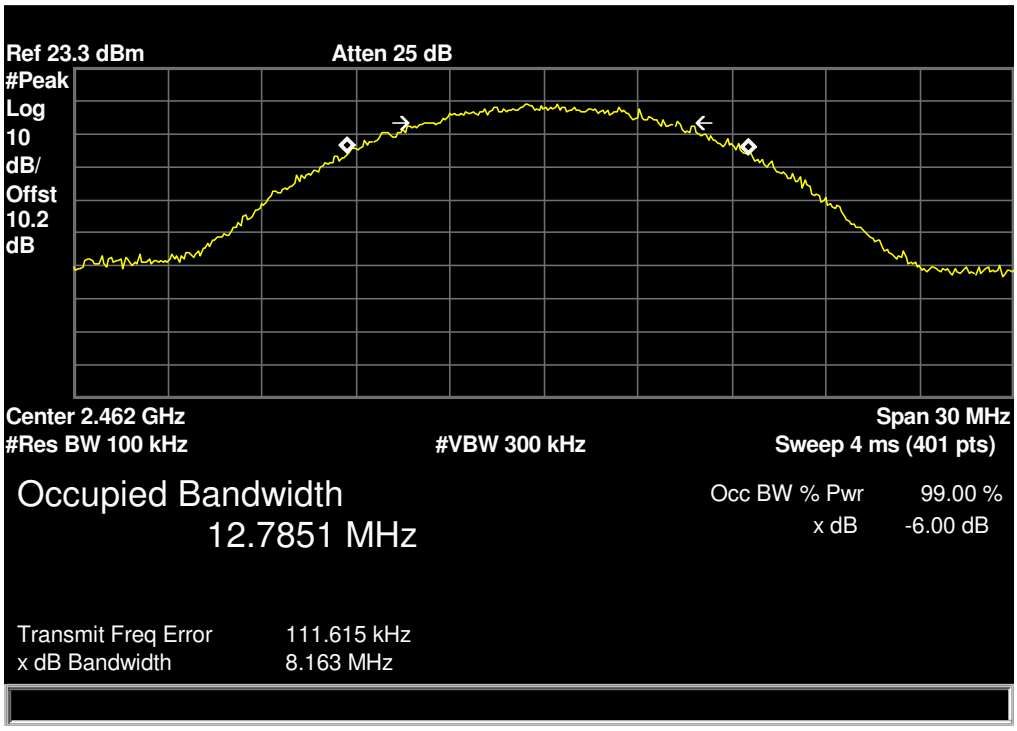
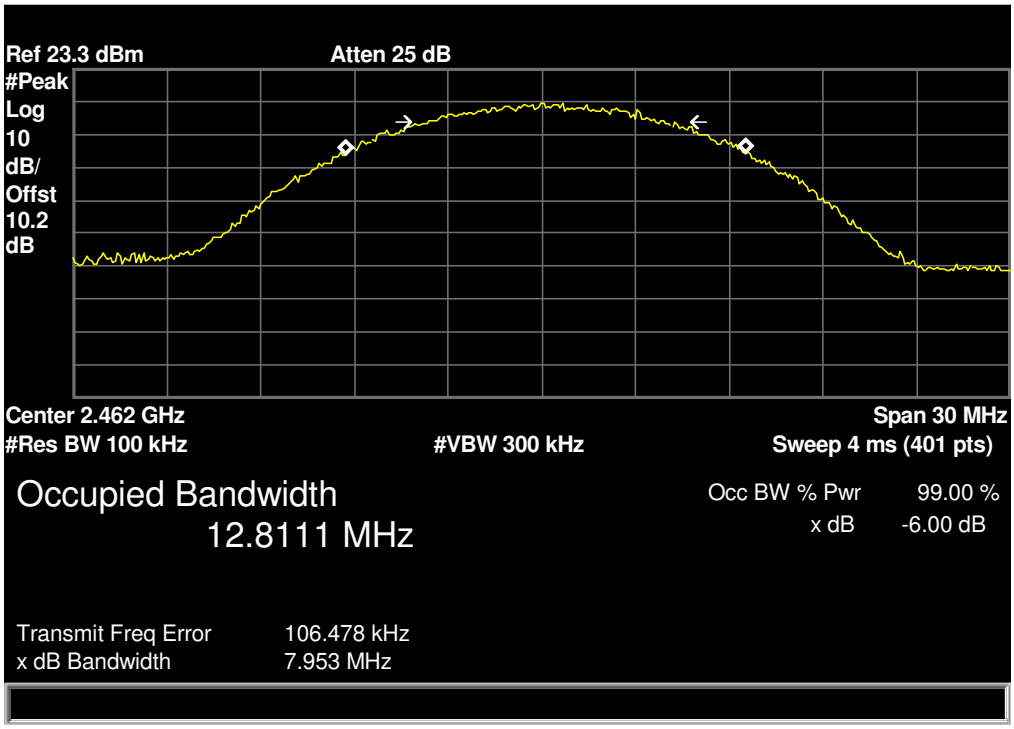
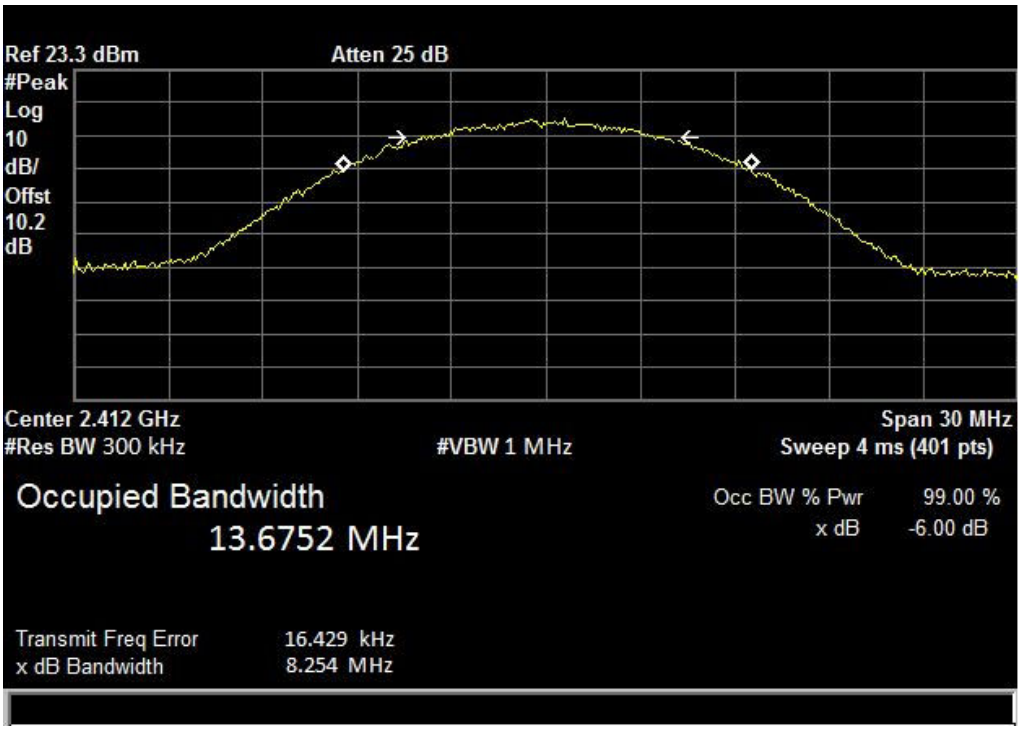


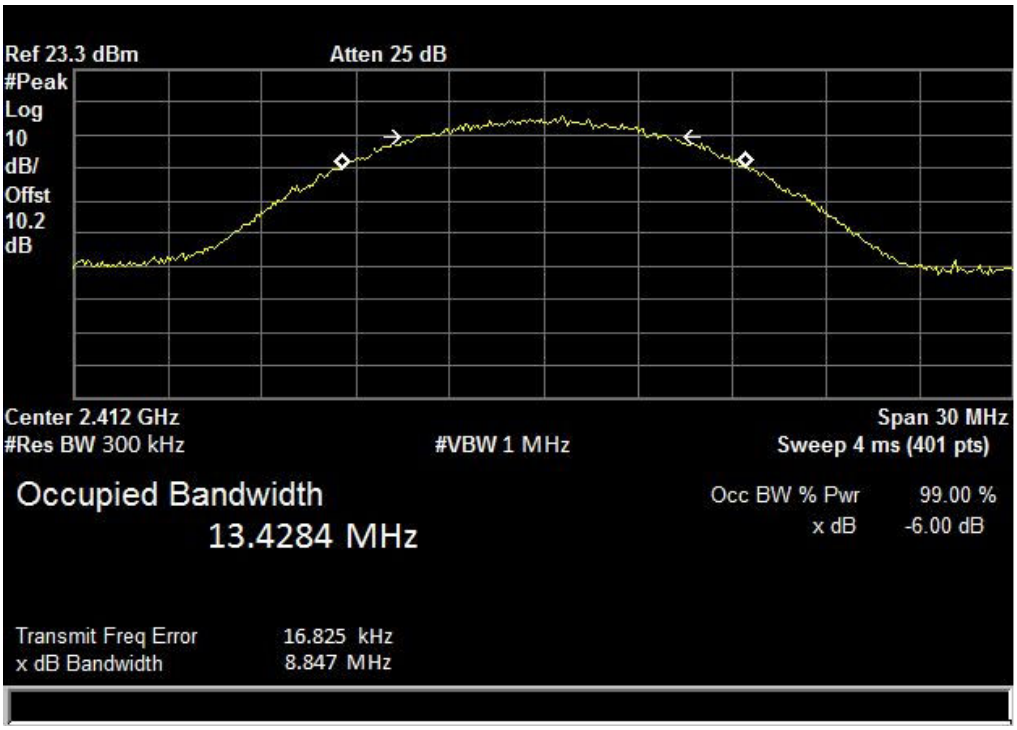
6dB Occupied Bandwidth, 2462MHz, 802.11 b Mode, Chain 0



6dB Occupied Bandwidth, 2462MHz, 802.11 b Mode, Chain 1



99% Occupied Bandwidth, 2412MHz, 802.11 b Mode, Chain 0



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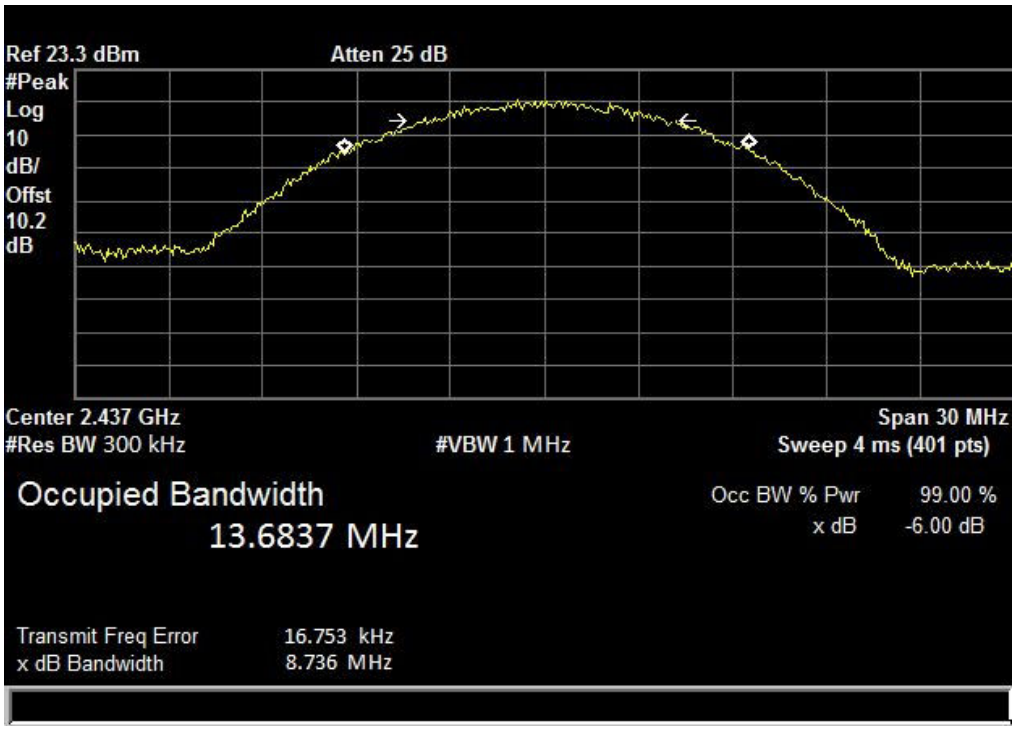

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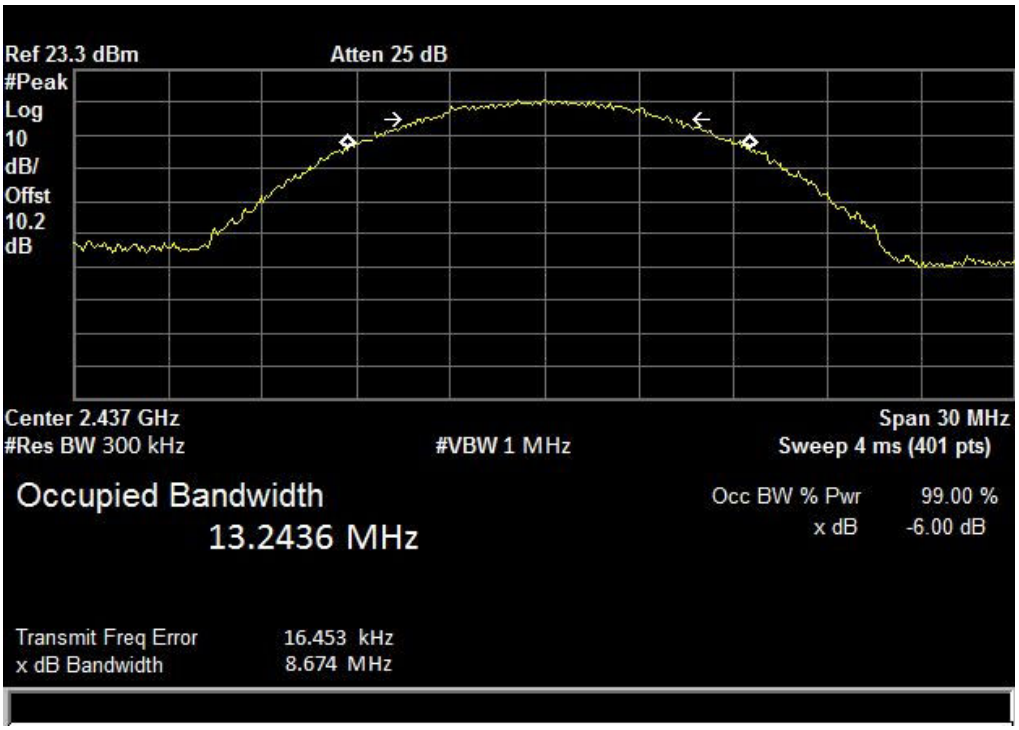
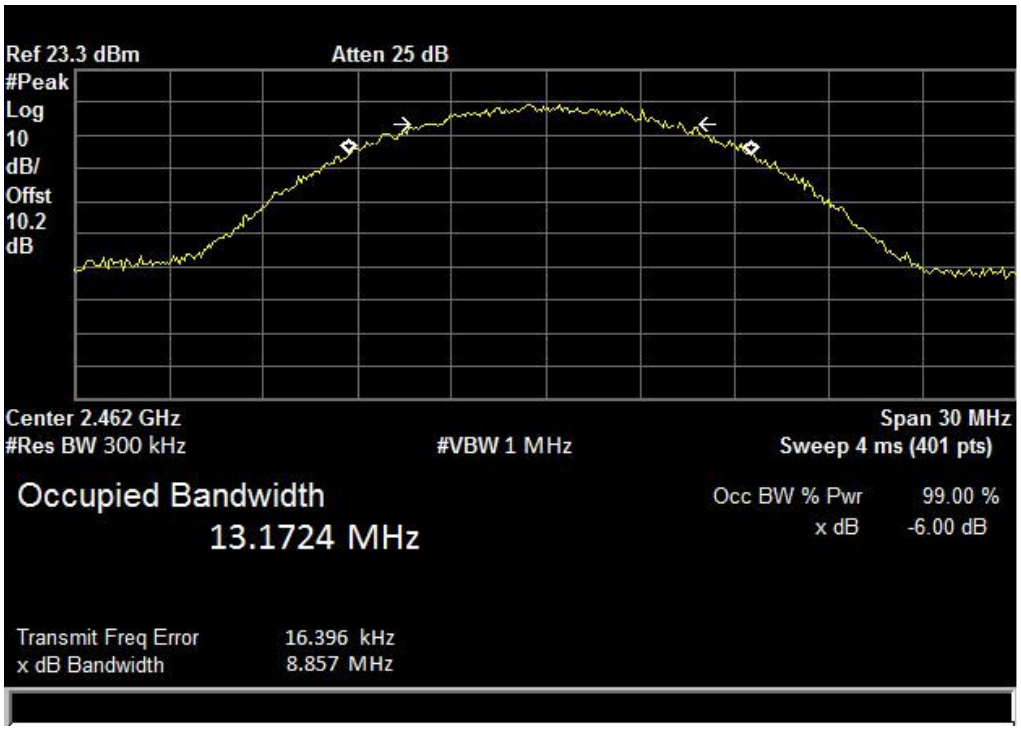


99% Occupied Bandwidth, 2437MHz, 802.11 b Mode, Chain 1



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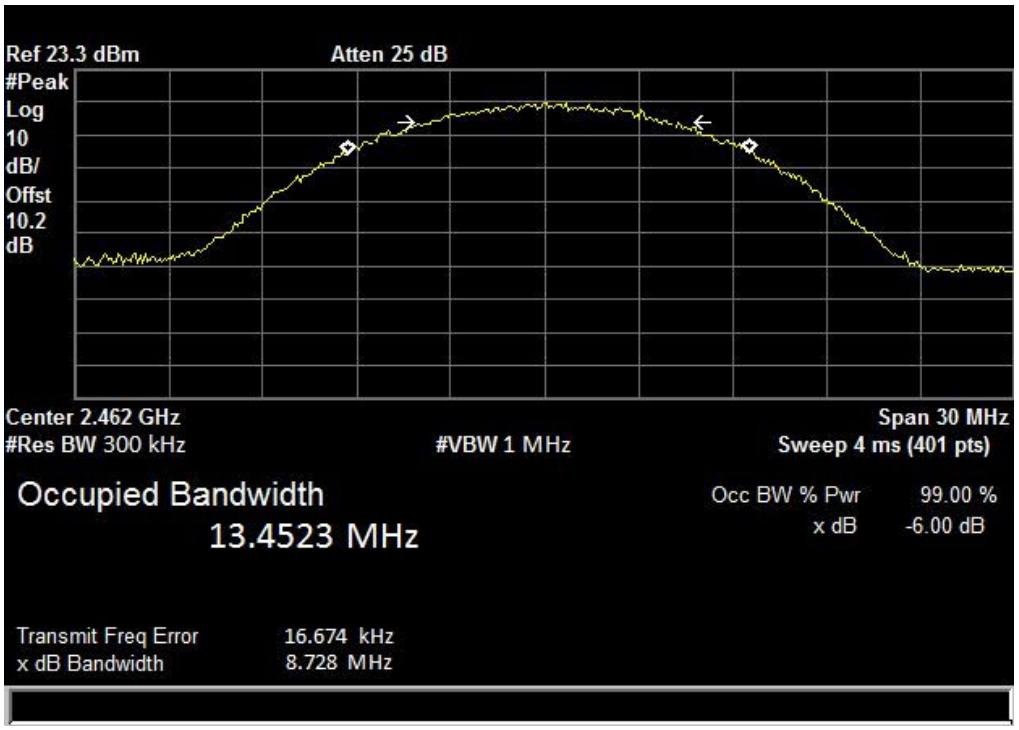


99% Occupied Bandwidth, 2462MHz, 802.11 b Mode, Chain 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 12: Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Figure 21, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, Omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT **completed testing** to the requirements of **§15.247(b)**. No anomalies noted.

RSS-247 (5.4) Transmitter Output Power

Test Requirements: **RSS-247 (5.4)(4):** For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in

the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247 (5.4)(5): Fixed point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems[1], omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

RSS-247 (5.4)(6): Transmitters may operate in the band 2400–2483.5 MHz, employing antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

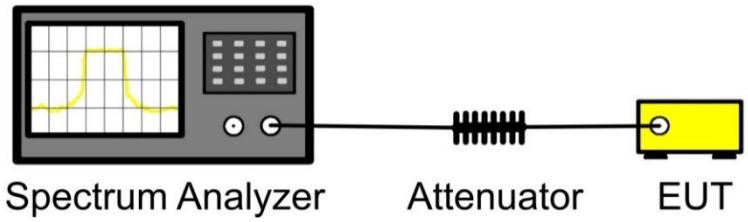
i. Different information must be transmitted to each receiver.
ii. If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4 (2) and (4).
iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4 (2) and (4). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4 (2) and (4). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4 (2) and (4) by more than 8 dB.
iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4 (2), (4) and (5).

[1] However, remote stations of point-to-multipoint systems shall be permitted to operate at an e.i.r.p. greater than 4 W under the same conditions as for point-to-point systems.

Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power was measured according to measurement method AVGSA-2, as described in ANSI C63.10-2013, section 11.9.2.2.4. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

Test Engineer: Arsalan Hasan

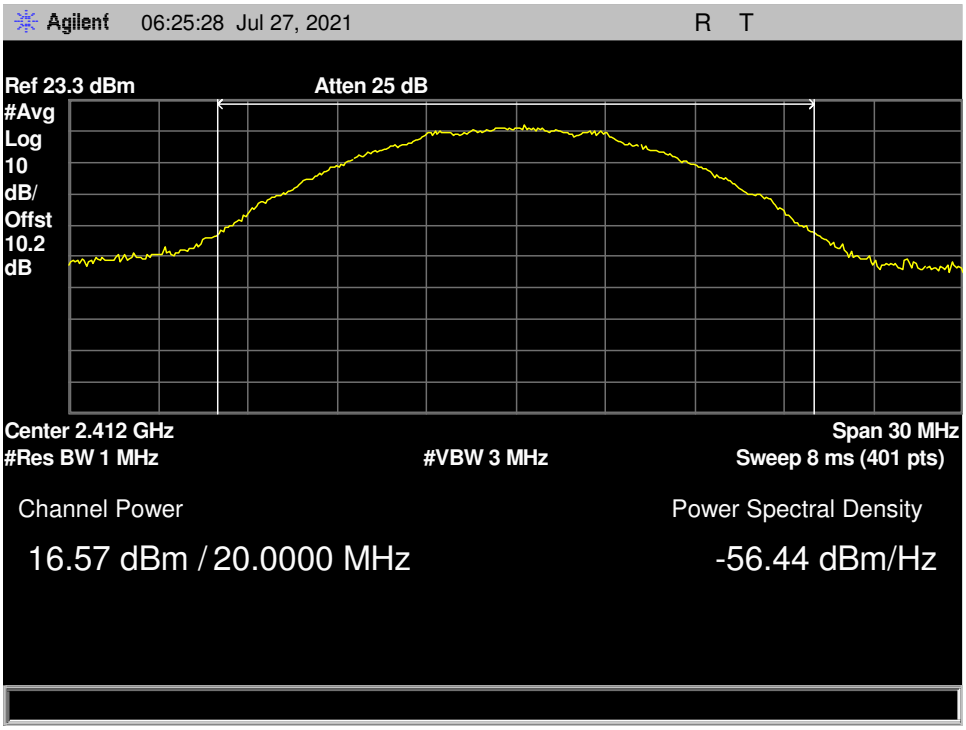
Test Date: July 27, 2021



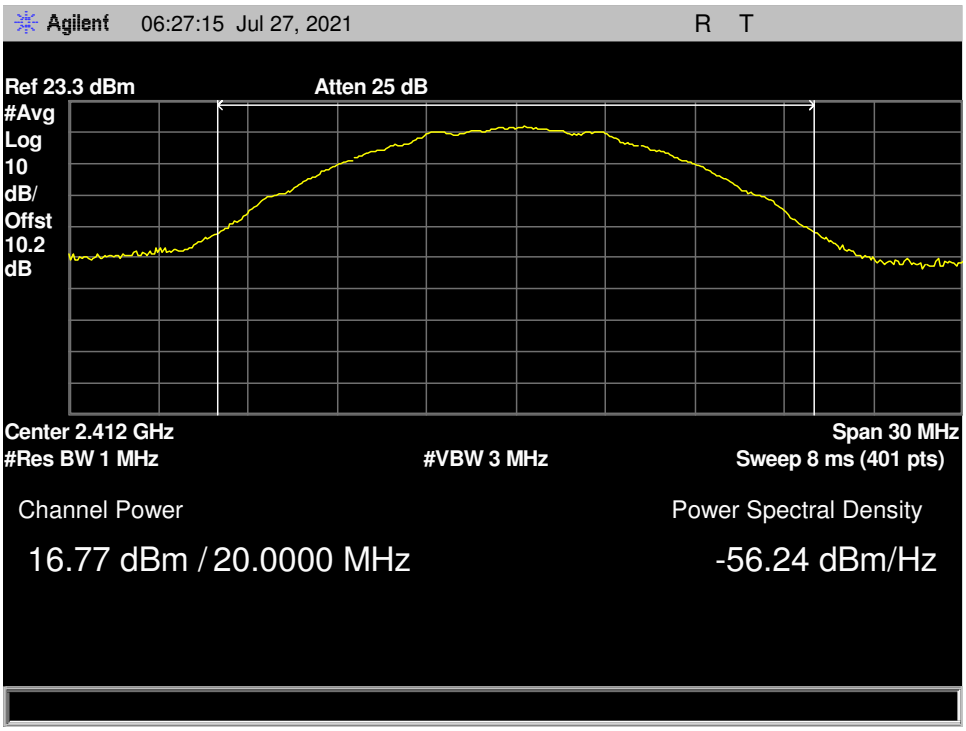
Block Diagram, Output Power Test Setup

Mode	BW	Center Frequency (MHz)	Chain 0 (dBm)	Chain 1 (dBm)	Sum (dBm)
802.11b	20	2412	16.57	16.77	19.68
		2437	19.82	19.88	22.86
		2462	16.51	16.86	19.70

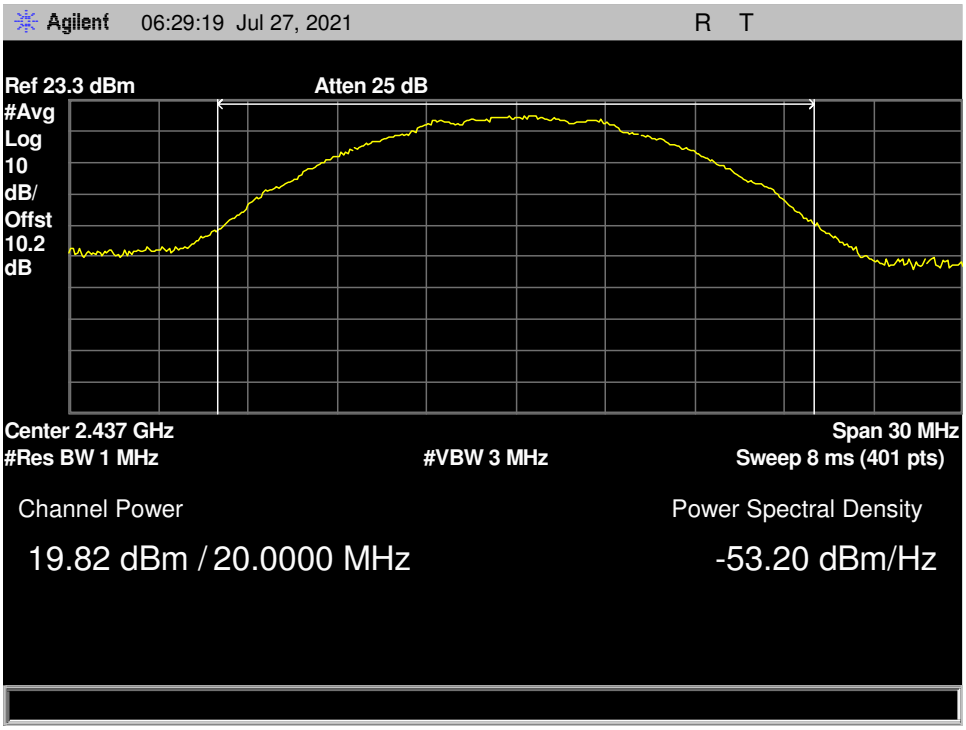
Power Output, Test Results



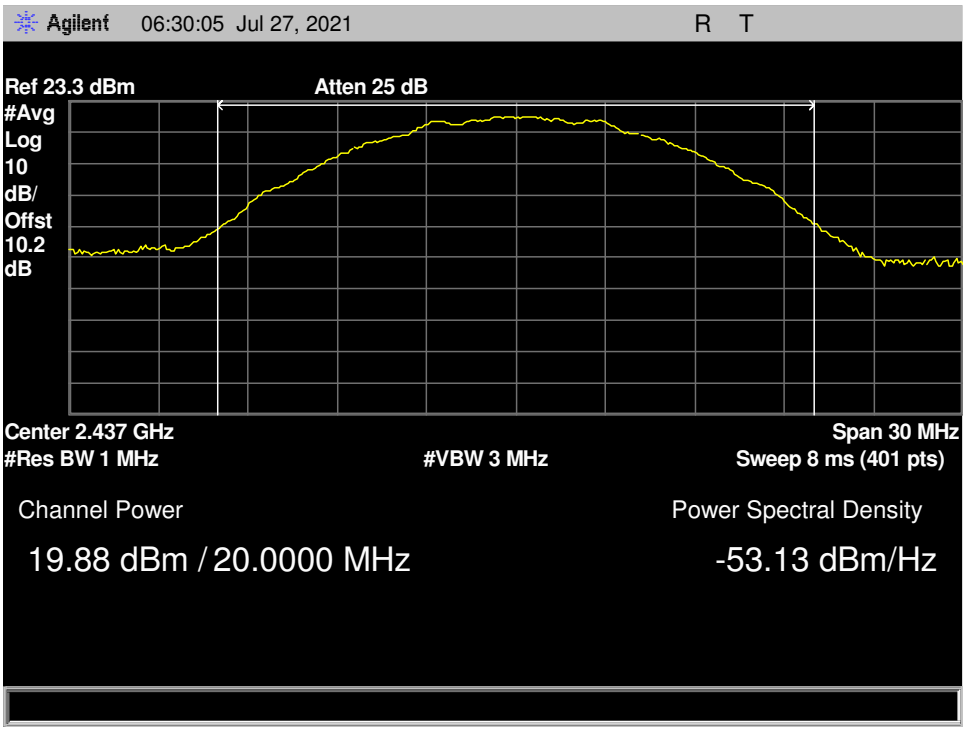
Conducted Output Power, 2412MHz, 802.11 b Mode, Chain 0



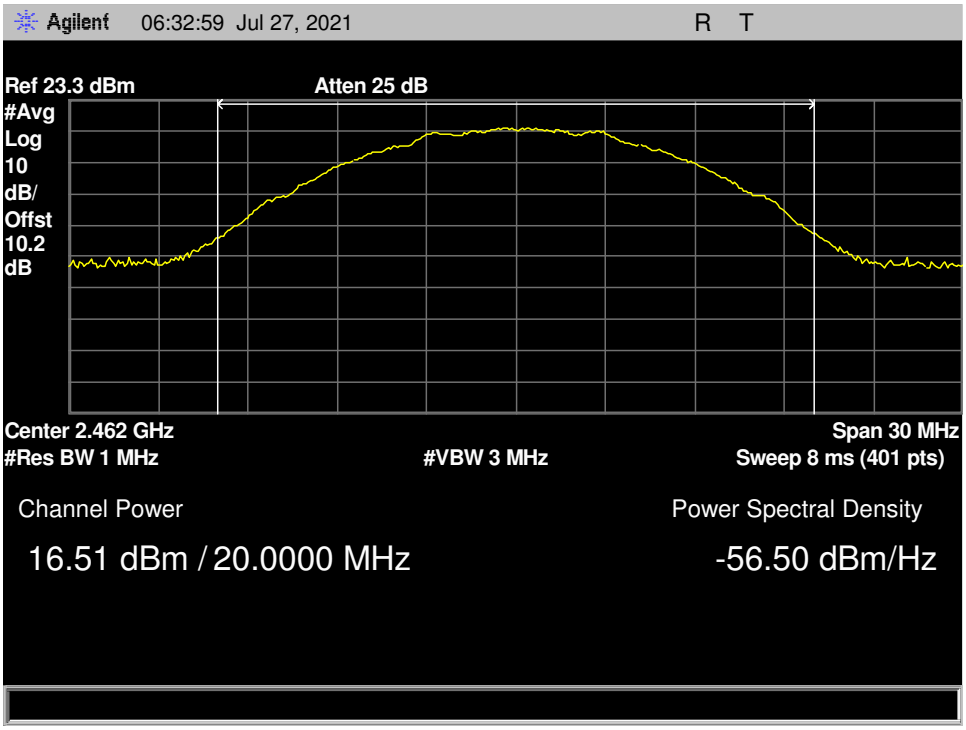
Conducted Output Power, 2412MHz, 802.11 b Mode, Chain 1



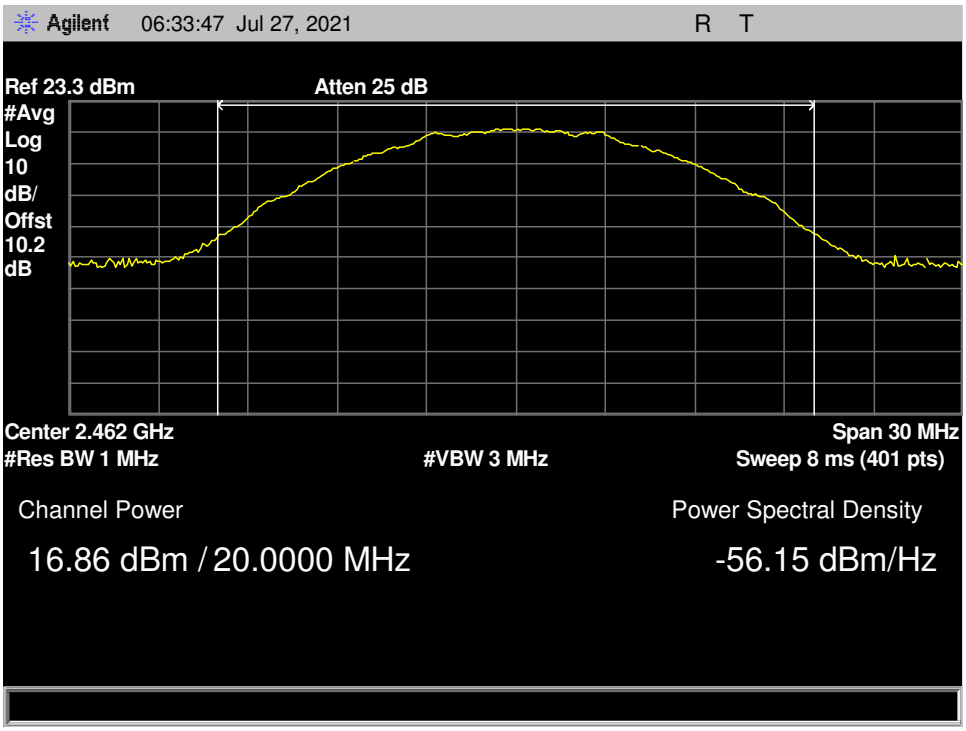
Conducted Output Power, 2437MHz, 802.11 b Mode, Chain 0



Conducted Output Power, 2437MHz, 802.11 b Mode, Chain 1



Conducted Output Power, 2462MHz, 802.11 b Mode, Chain 0



Conducted Output Power, 2462MHz, 802.11 b Mode, Chain 1

§ 15.247(e) Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level throughout each of the 100 sweeps of power averaging. The RBW was set to 3 kHz and a VBW set to 9 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

Test Results: The EUT **completed testing** to the requirements of **§ 15.247 (e)**. No anomalies noted.

The peak power spectral density was determined from plots on the following page(s).

RSS-247 (5.2) Power Spectral Density

Test Requirements: **RSS-247 (5.2):** The transmitter power spectral density conducted from the transmitter 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 Section 5.4 (d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

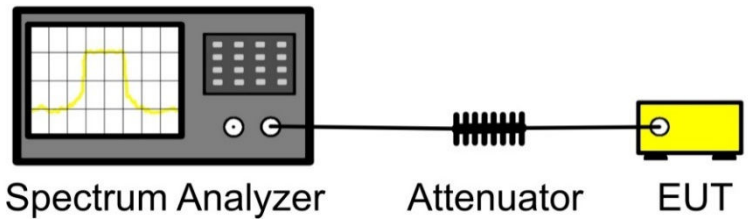
Test Procedure: The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Power spectral density was measured according to measurement method AVGPSD-2, as described in ANSI C63.10-2013, section 11.10.5. Attenuator, cable loss, and duty factor were programmed into the spectrum analyzer.

Test Results: The EUT **completed testing** to the requirements of **RSS-247 (5.2)**. No anomalies noted.

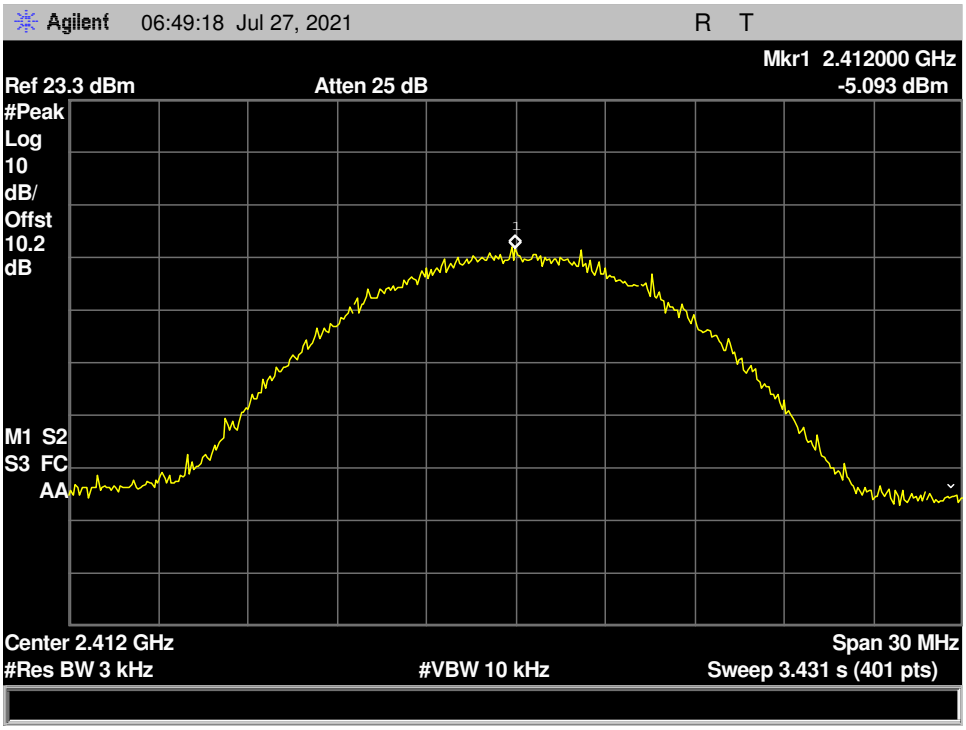
The power spectral density was determined from plots on the following page(s).

Test Engineer: Arsalan Hasan

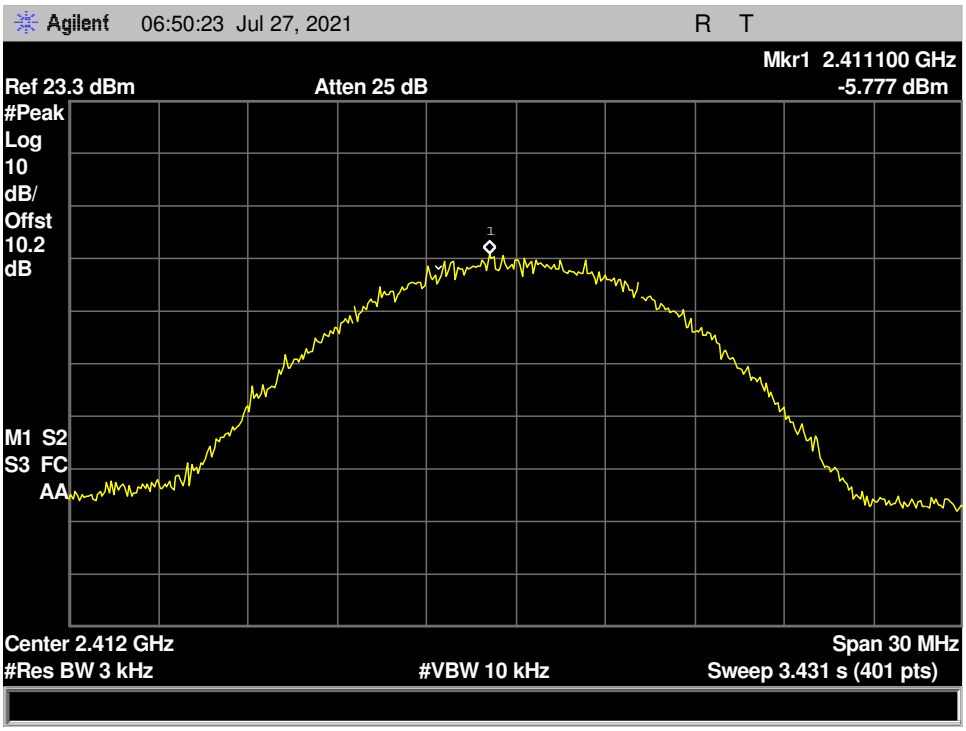
Test Date: July 27, 2021



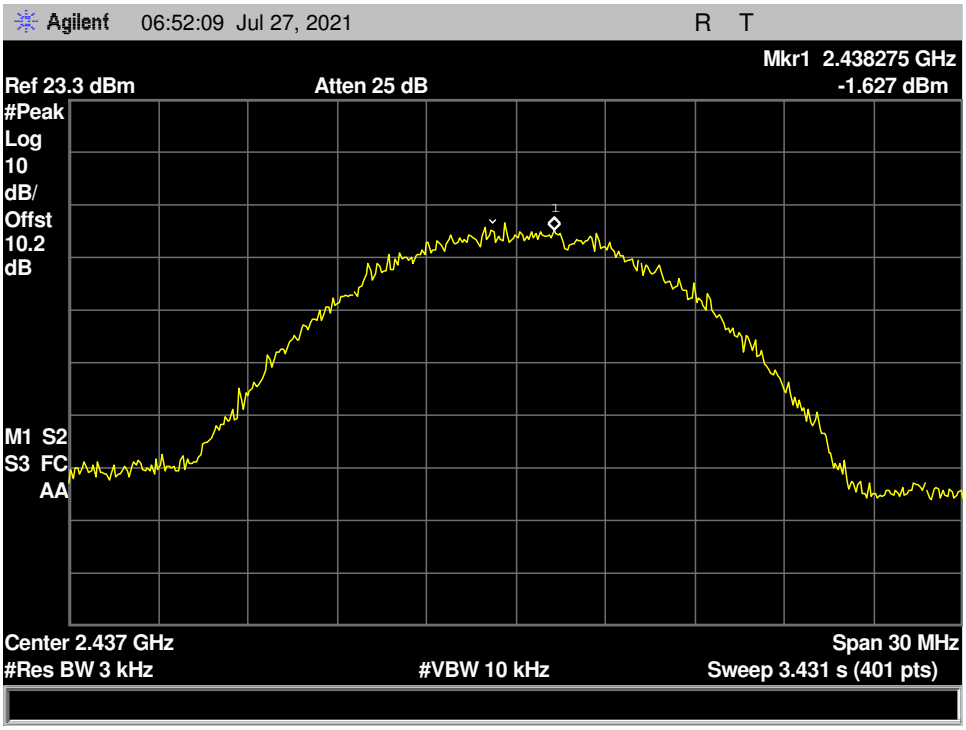
Block Diagram, Power Spectral Density Test Setup



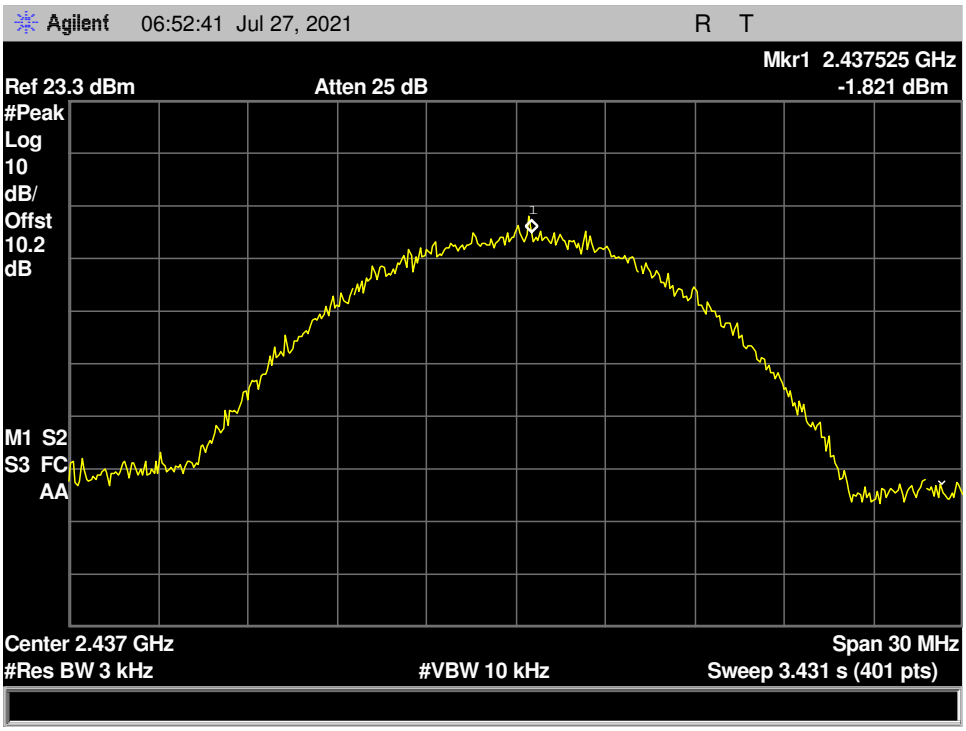
Power Spectral Density, 2412MHz, 802.11 b Mode, Chain 0



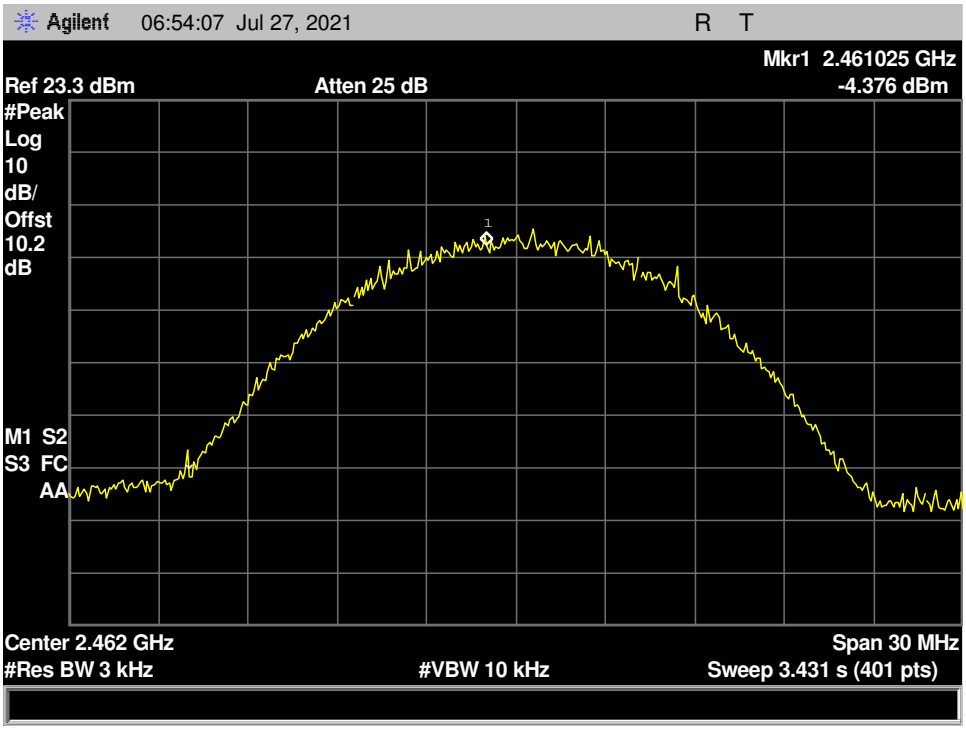
Power Spectral Density, 2412MHz, 802.11 b Mode, Chain 1



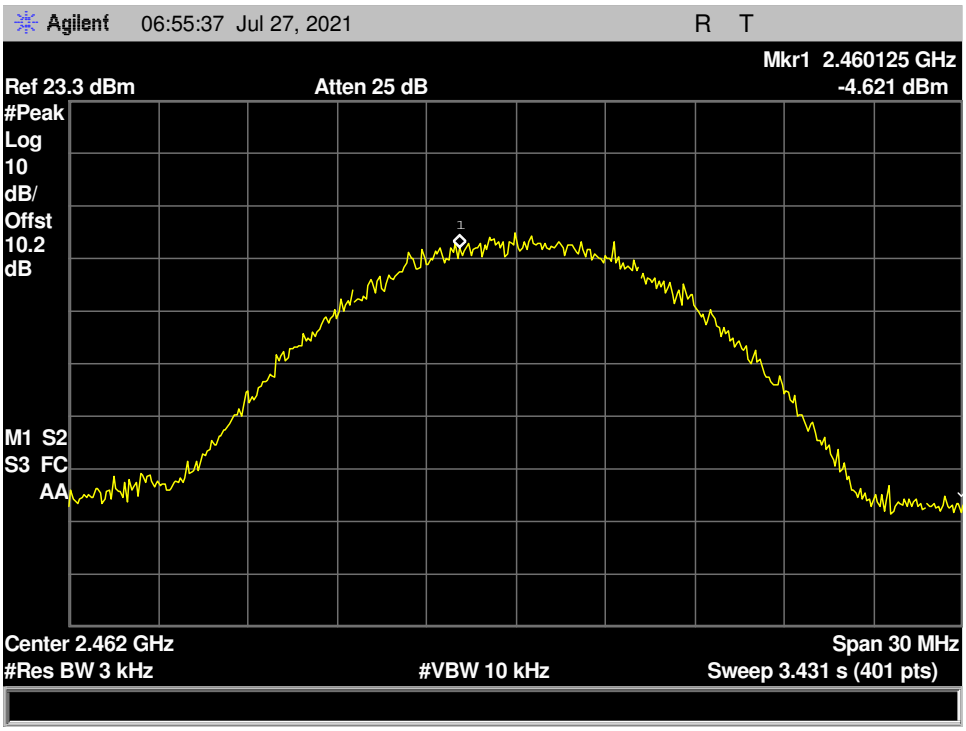
Power Spectral Density, 2437MHz, 802.11 b Mode, Chain 0



Power Spectral Density, 2437MHz, 802.11 b Mode, Chain 1



Power Spectral Density, 2462MHz, 802.11 b Mode, Chain 0



Power Spectral Density, 2462MHz, 802.11 b Mode, Chain 1

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36-13.41			

Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

RSS-GEN (6.13), (8.9), & (8.10) Radiated Spurious Emissions Requirements

Test Requirements: **RSS-GEN (6.13):** The measurement method shall be described in the test report. When the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter's output power measurement shall also be used for the unwanted emission measurements.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits below 1000 MHz shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in **Error! Reference source not found.**

Frequency (MHz)	§ 15.209(a), Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

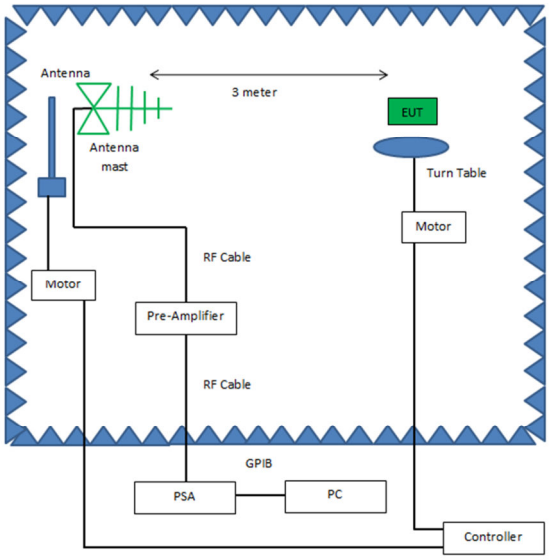
Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

RSS-GEN (8.9): Except when the requirements applicable to a given device state otherwise, emissions from license−exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

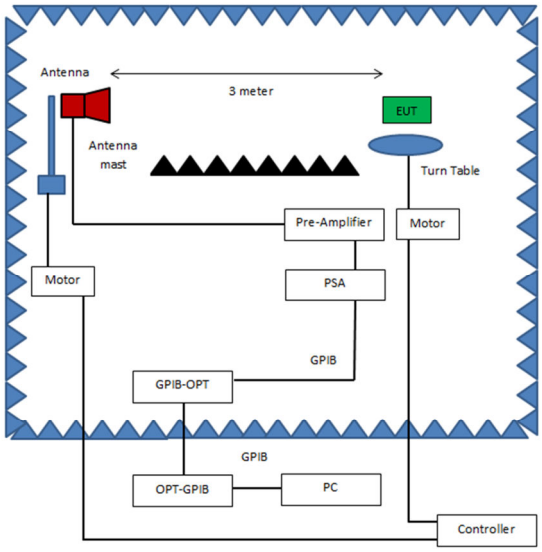
General Field Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	**Field Strength (µV/m at 3 meters)**
30 – 88	100
88 – 216	150
216 – 960	200
Above 960*	500

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.



Radiated Emissions, Below 1GHz, Test Setup



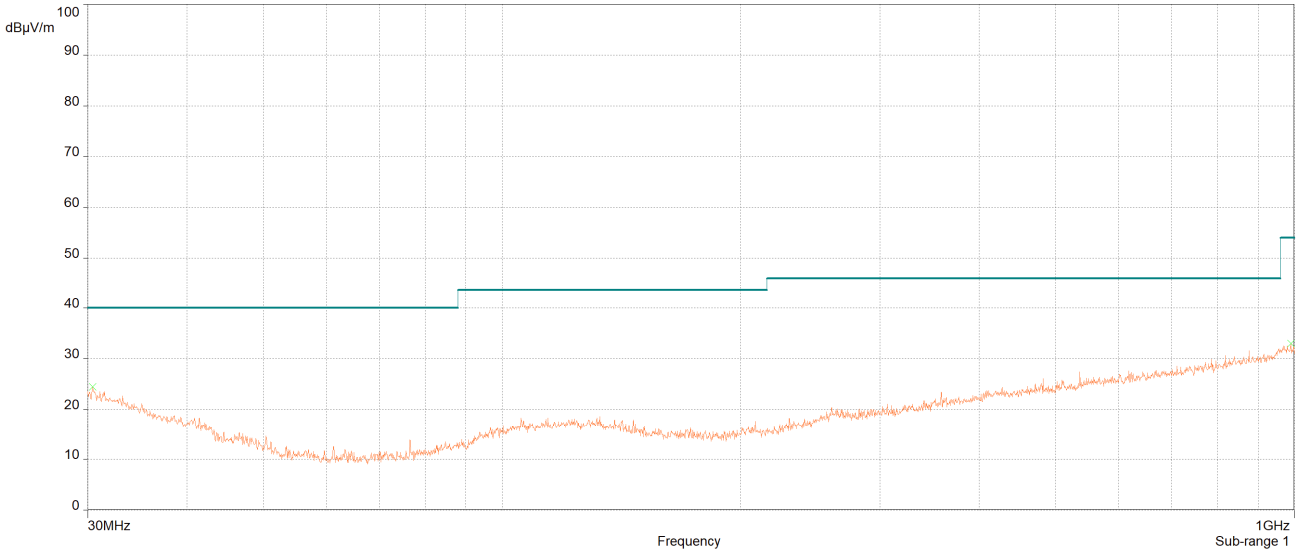
Radiated Emissions, Above 1GHz, Test Setup

Test Results: The EUT was tested is **compliant** with § 15.209 Radiated Spurious Emissions Requirements and Band Edge.

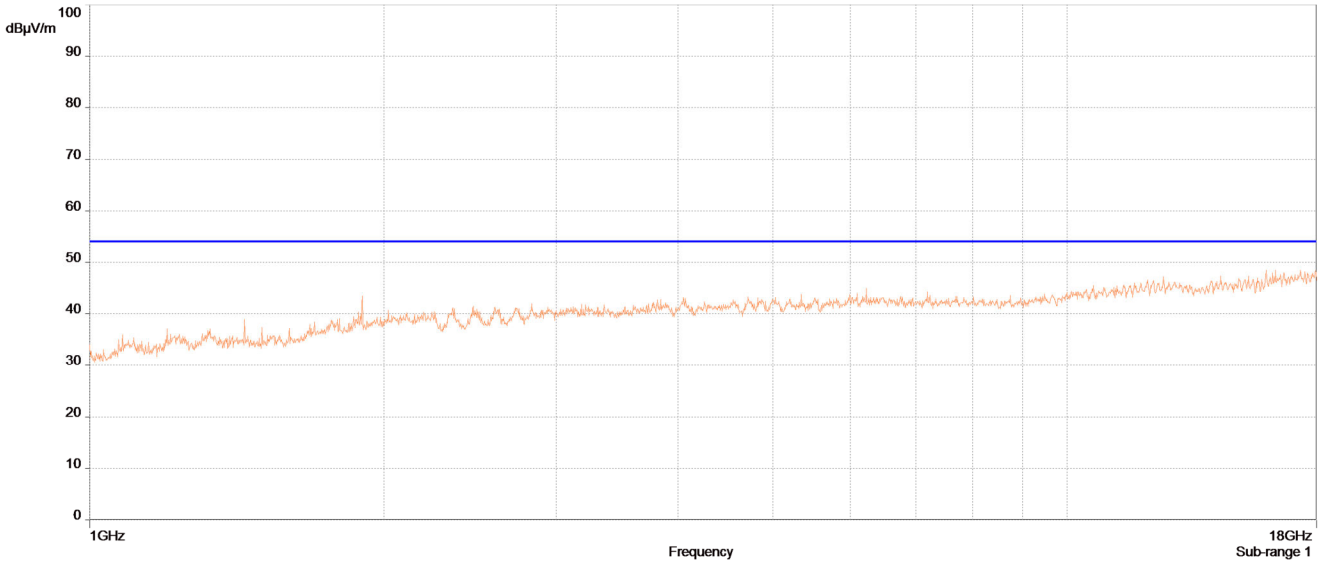
Test Engineer: Arsalan Hasan

Test Date: July 26, 2021

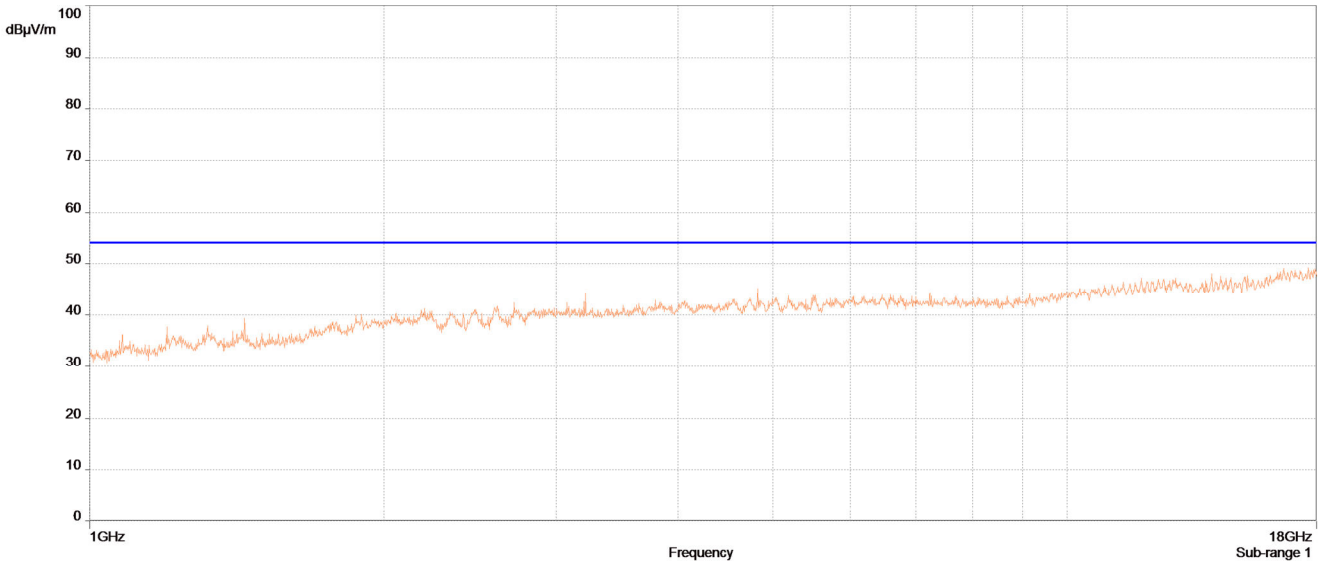
Radiated Spurious Emissions, Test Results



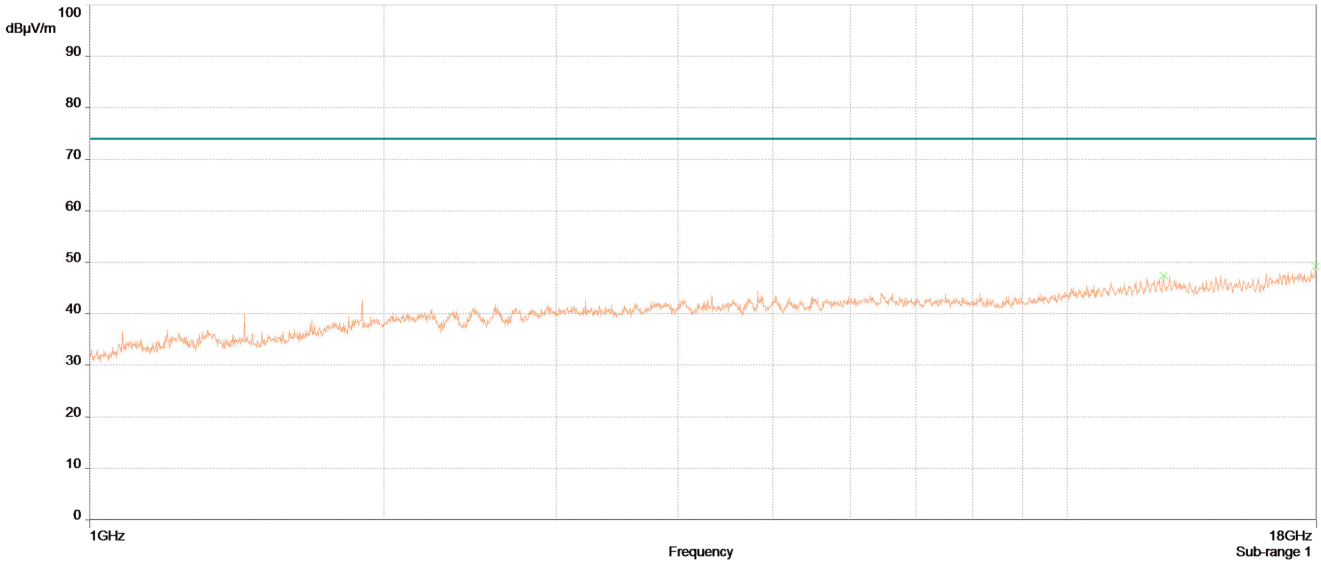
Radiated Spurious Emissions, 30MHz-1GHz, (Worst Case Pol)



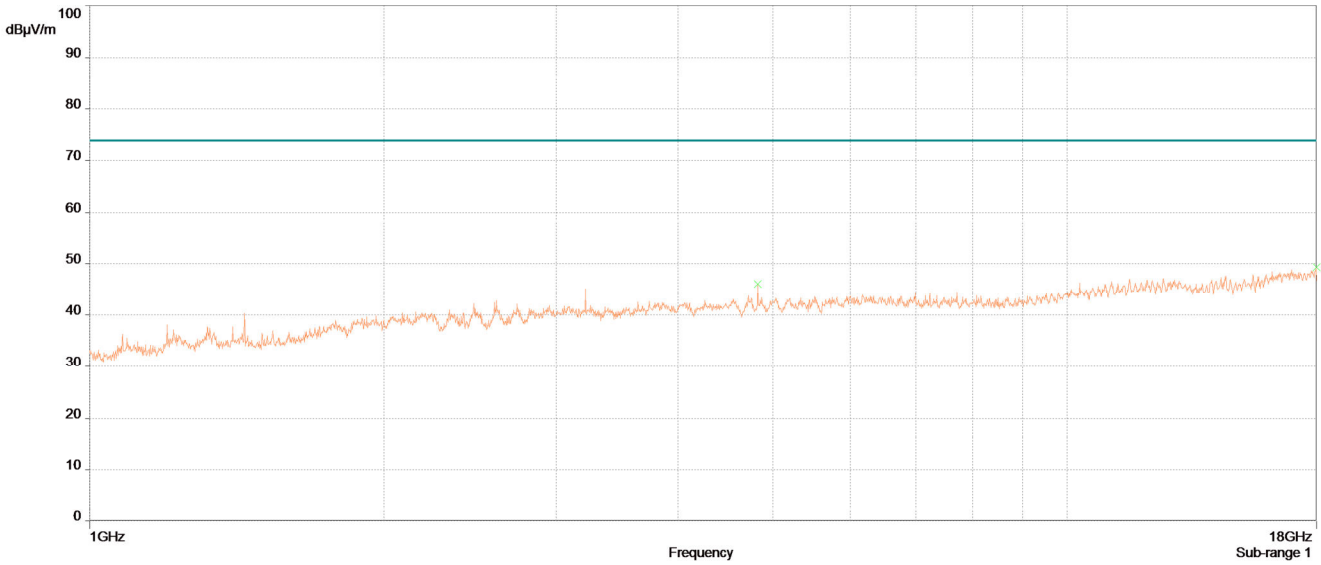
Radiated Spurious Emissions, 1GHz -18 GHz, 2412MHz 802.11 b mode, Average, Chain 0 (Worst Case Pol)



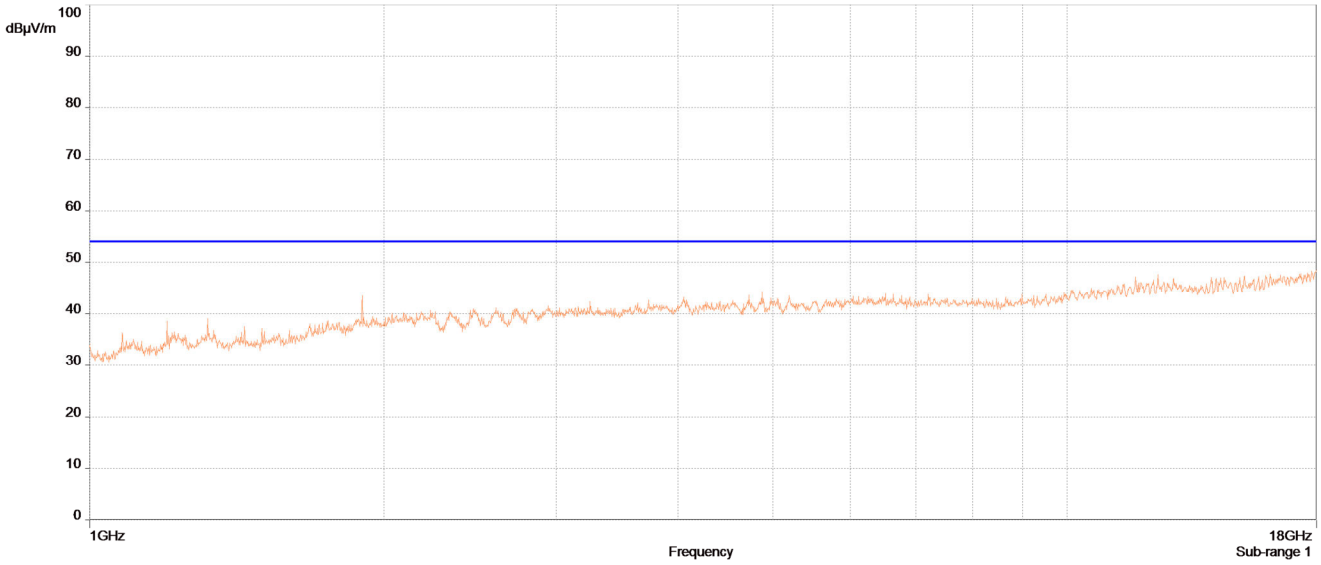
Radiated Spurious Emissions, 1GHz -18 GHz, 2412MHz 802.11 b mode, Average, Chain 1 (Worst Case Pol)



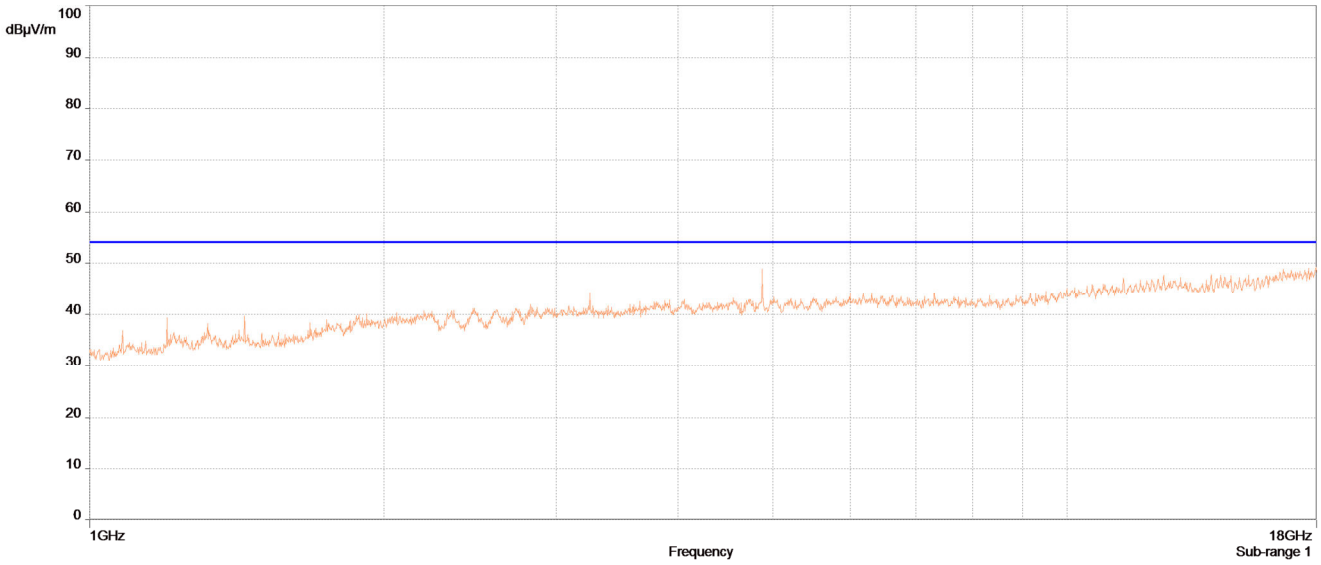
Radiated Spurious Emissions, 1GHz -18 GHz, 2412MHz 802.11 b mode, Peak, Chain 0 (Worst Case Pol)



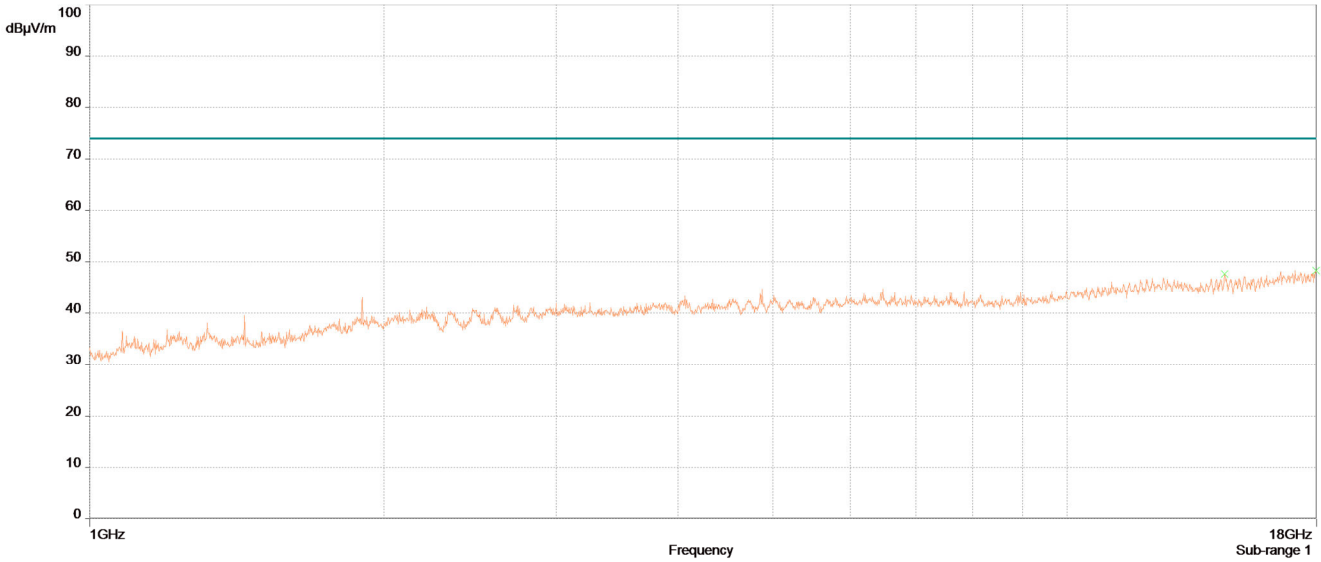
Radiated Spurious Emissions, 1GHz -18 GHz, 2412MHz 802.11 b mode, Peak, Chain 1 (Worst Case Pol)



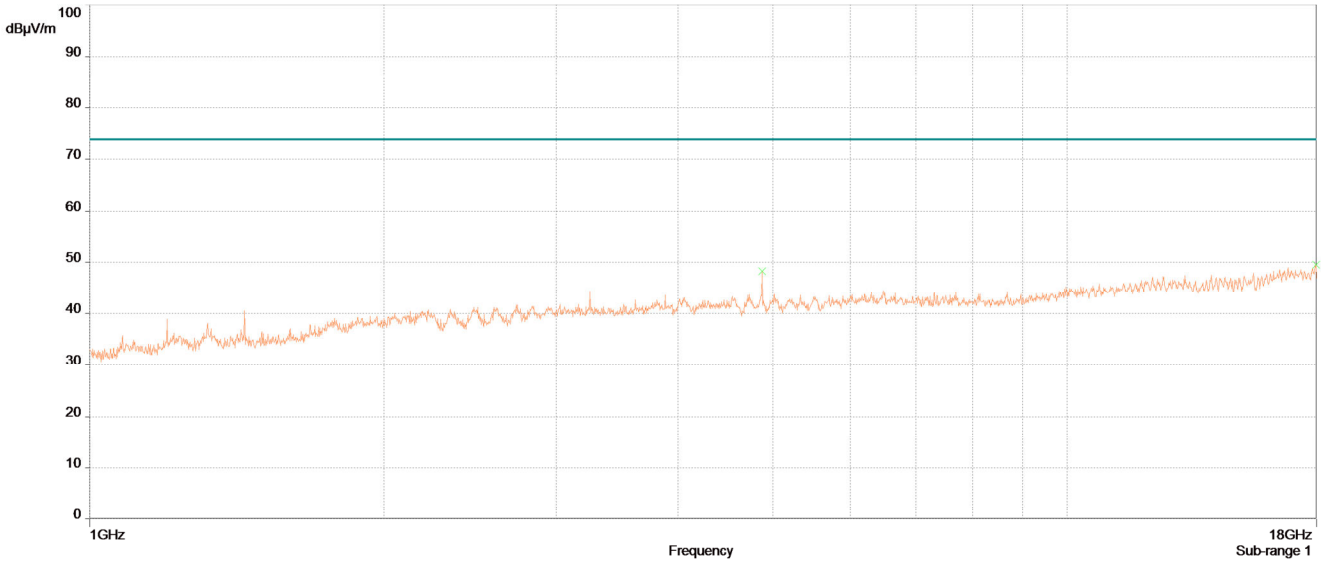
Radiated Spurious Emissions, 1GHz -18 GHz, 2437MHz 802.11 b mode, Average, Chain 0 (Worst Case Pol)



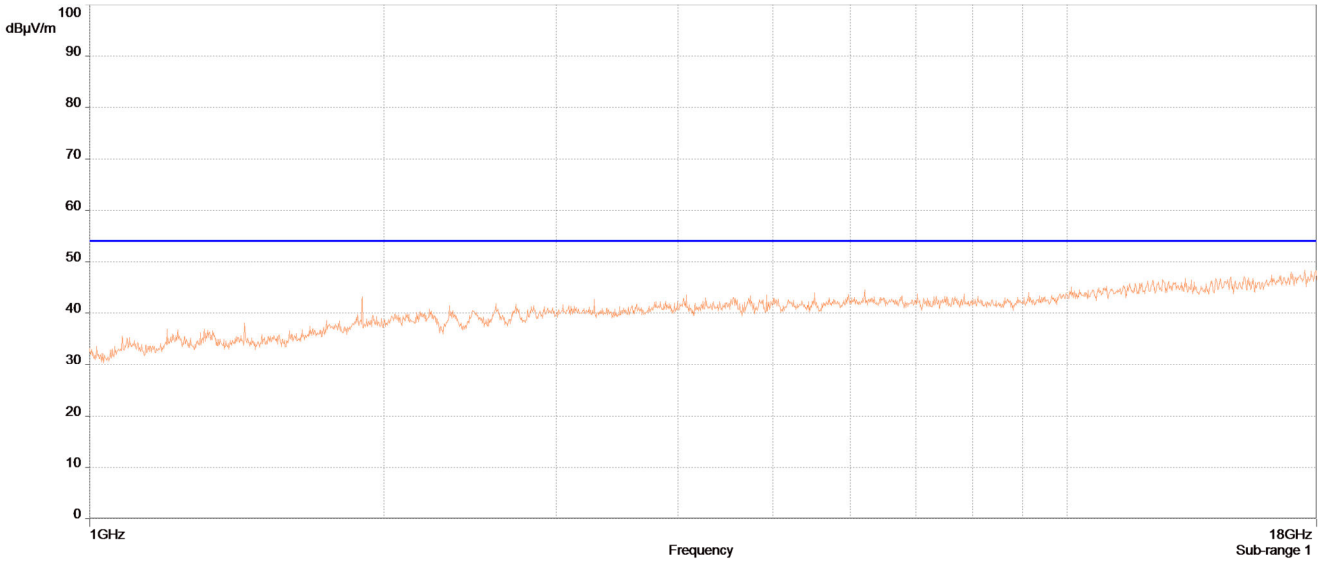
Radiated Spurious Emissions, 1GHz -18 GHz, 2437MHz 802.11 b mode, Average, Chain 1 (Worst Case Pol)



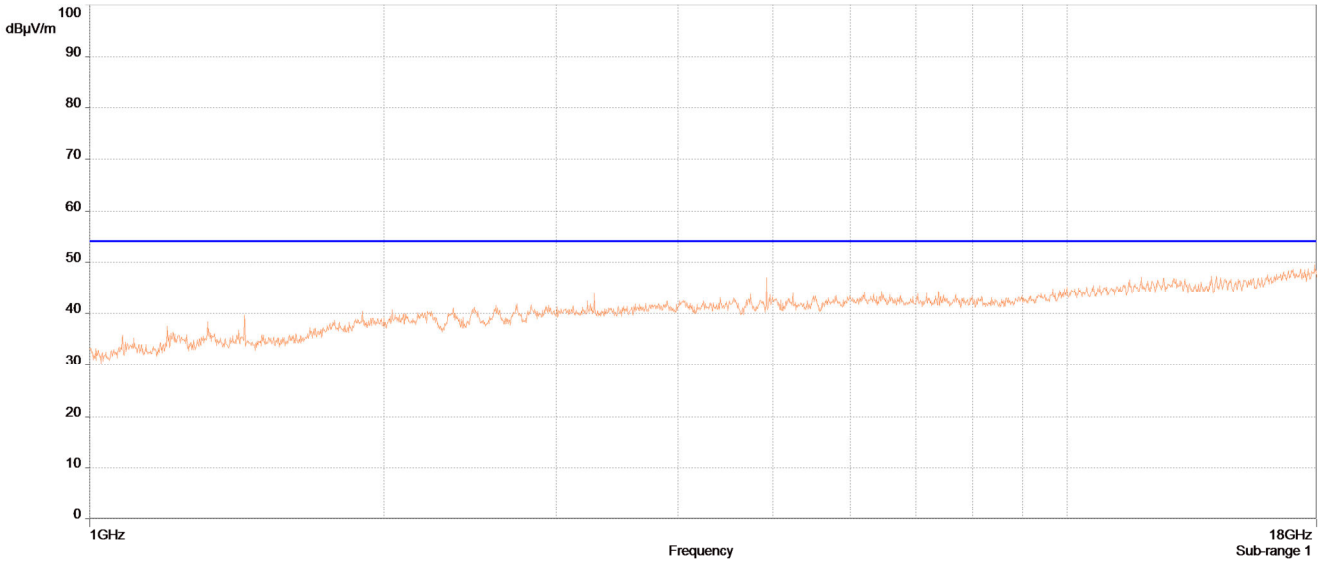
Radiated Spurious Emissions, 1GHz -18 GHz, 2437MHz 802.11 b mode, Peak, Chain 0 (Worst Case Pol)



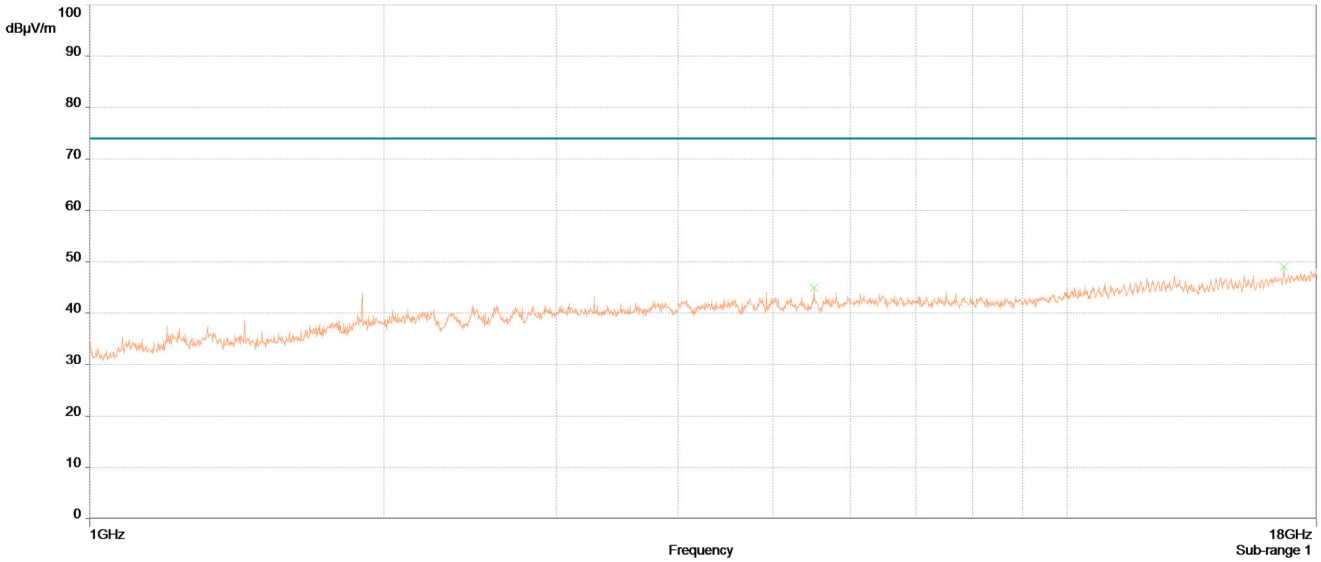
Radiated Spurious Emissions, 1GHz -18 GHz, 2437MHz 802.11 b mode, Peak, Chain 1 (Worst Case Pol)



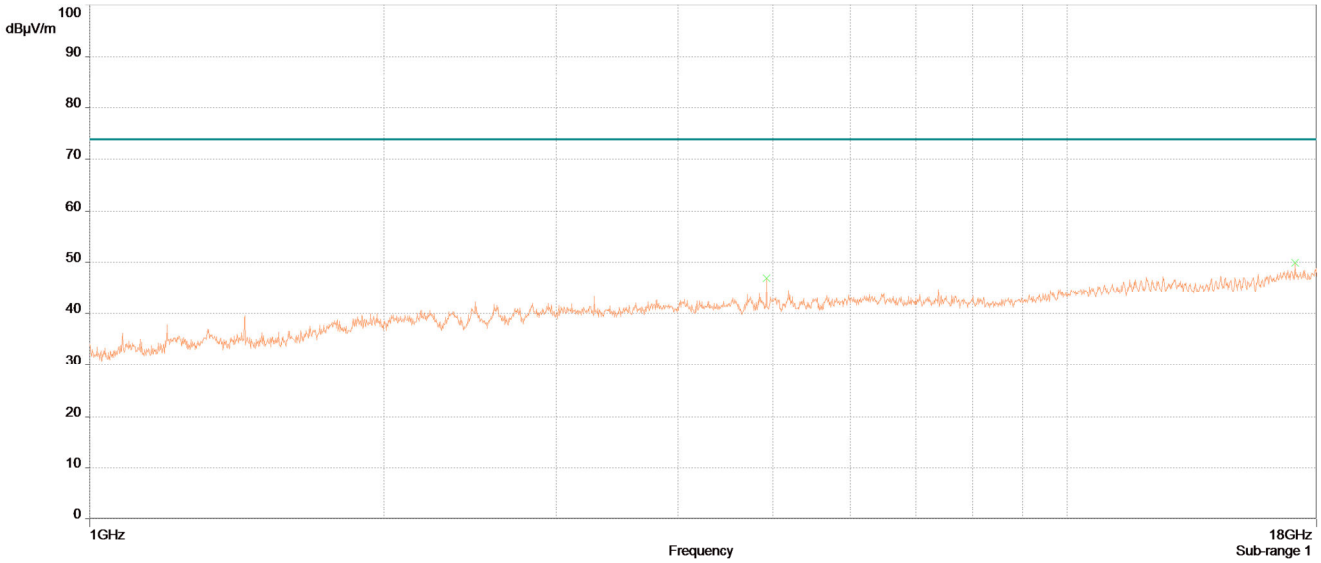
Radiated Spurious Emissions, 1GHz -18 GHz, 2462MHz 802.11 b mode, Average, Chain 0 (Worst Case Pol)



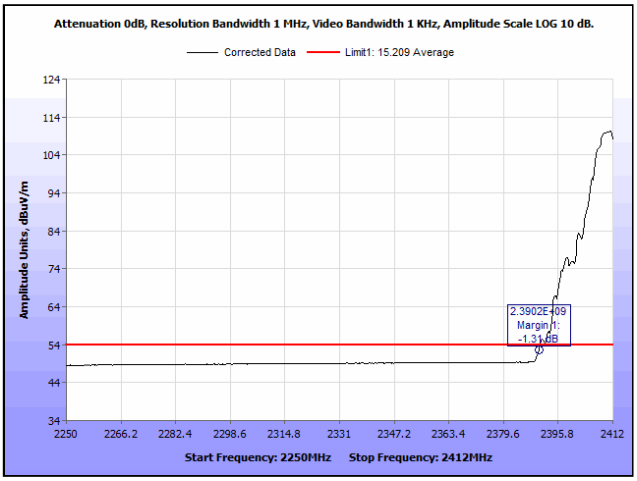
Radiated Spurious Emissions, 1GHz -18 GHz, 2462MHz 802.11 b mode, Average, Chain 1 (Worst Case Pol)



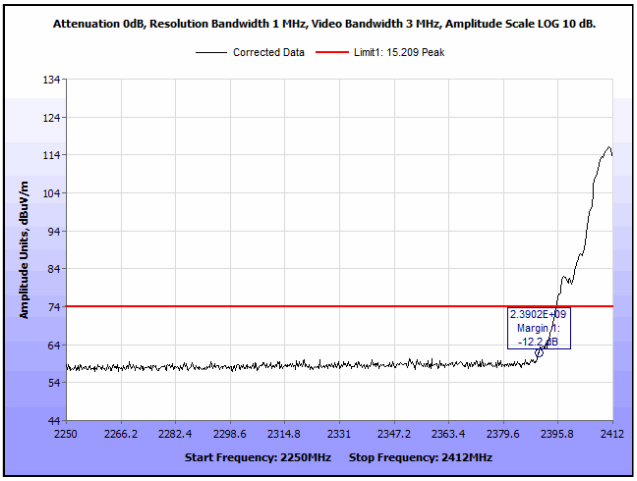
Radiated Spurious Emissions, 1GHz -18 GHz, 2462MHz 802.11 b mode, Peak, Chain 0 (Worst Case Pol)



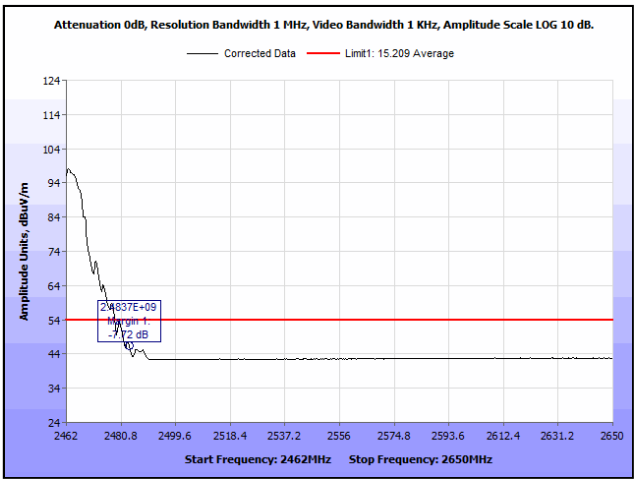
Radiated Spurious Emissions, 1GHz -18 GHz, 2462MHz 802.11 b mode, Peak, Chain 1 (Worst Case Pol)



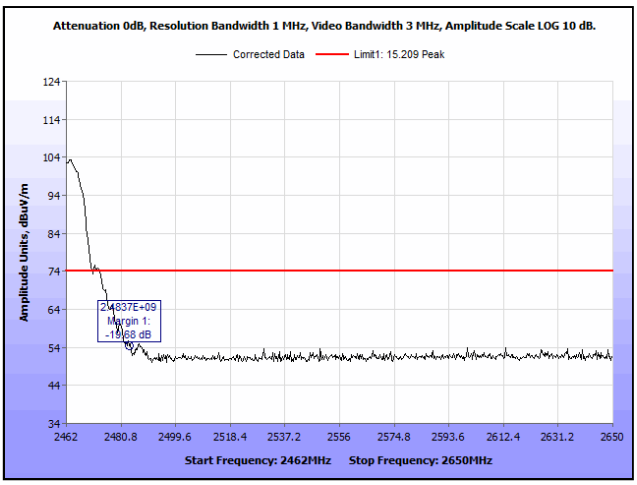
Radiated Restricted Band Edge, 2412MHz, 802.11b mode, Average, Both Chains



Radiated Restricted Band Edge, 2412MHz, 802.11b mode, Peak, Both Chains



Radiated Restricted Band Edge, 2462MHz, 802.11b mode, Average, Both Chains



Radiated Restricted Band Edge, 2462MHz, 802.11b mode, Peak, Both Chains

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT **completed testing** to the requirements of **§15.247(d)**. No anomalies noted.

RSS-247 (5.5) RF Conducted Spurious Emissions

Test Requirements: **RSS-247 (5.5):** Out-of-Band Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

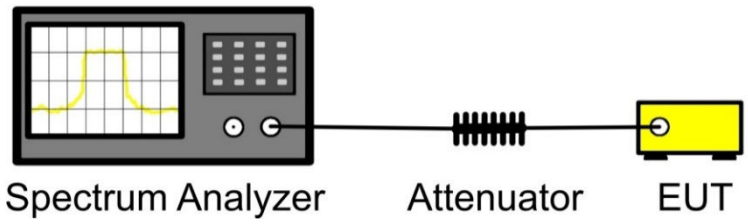
Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per section 5.5 of ANSI C63.10-2013; i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The EUT was connected to a spectrum analyzer through a cable and an attenuator. Measurements were taken with the EUT set to transmit continuously on its low, mid, and high channels for all its bandwidths at maximum power. Conducted spurious emissions were measured according to sections 11.11.2 and 11.11.3 of ANSI C63.10-2013.

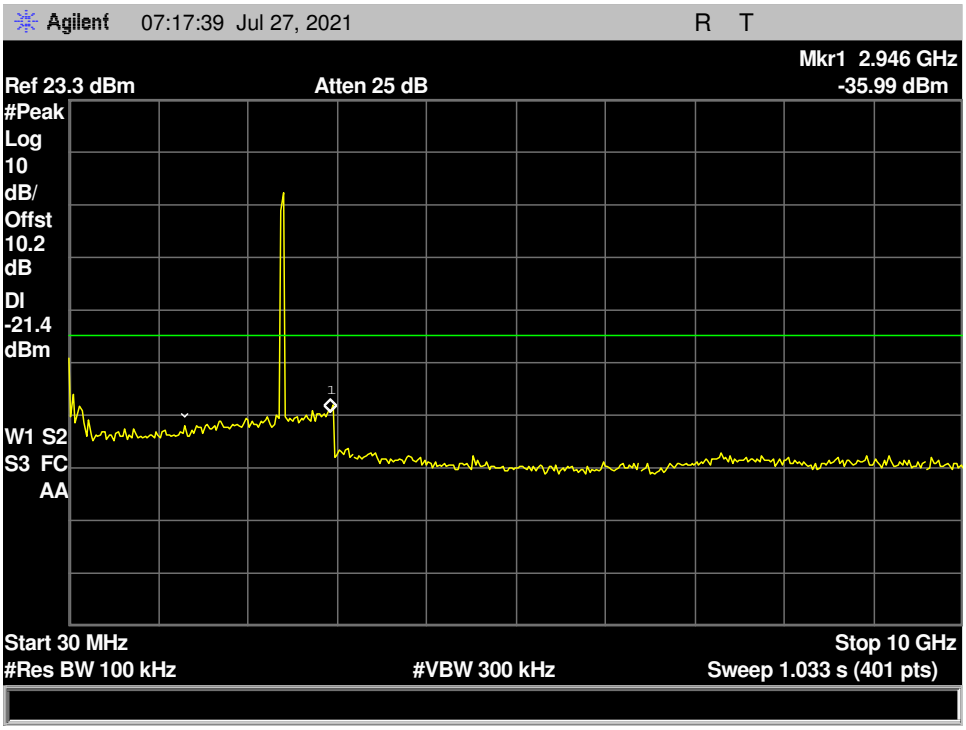
Test Results: The EUT **completed testing** to the requirements of **RSS-247 (5.5)**. No anomalies noted.

Test Engineer: Arsalan Hasan

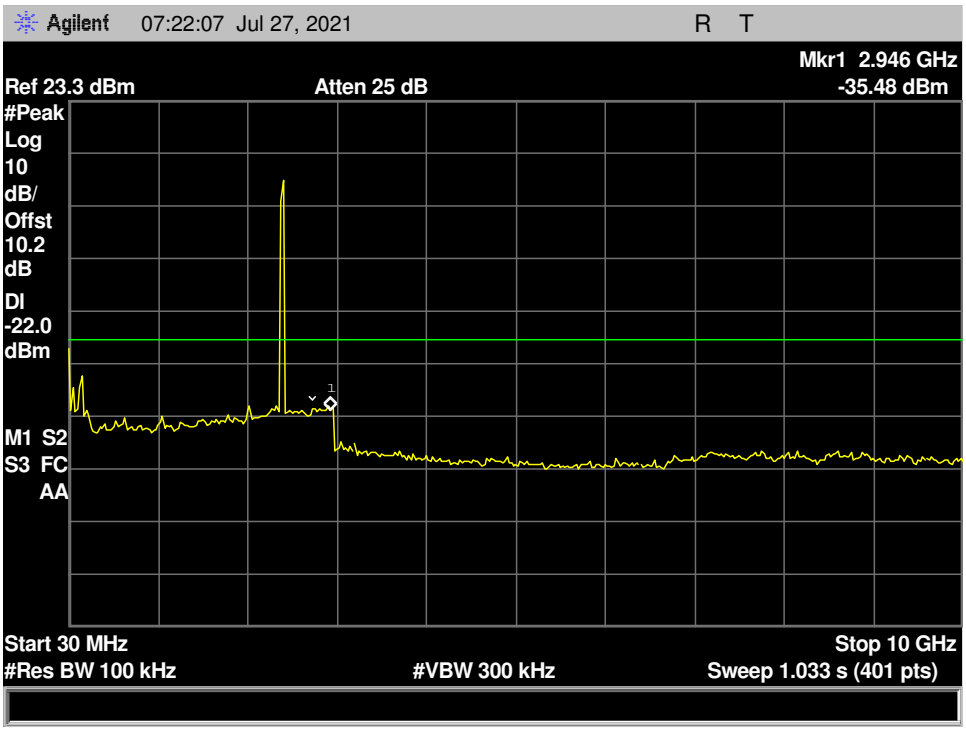
Test Date: July 27, 2021



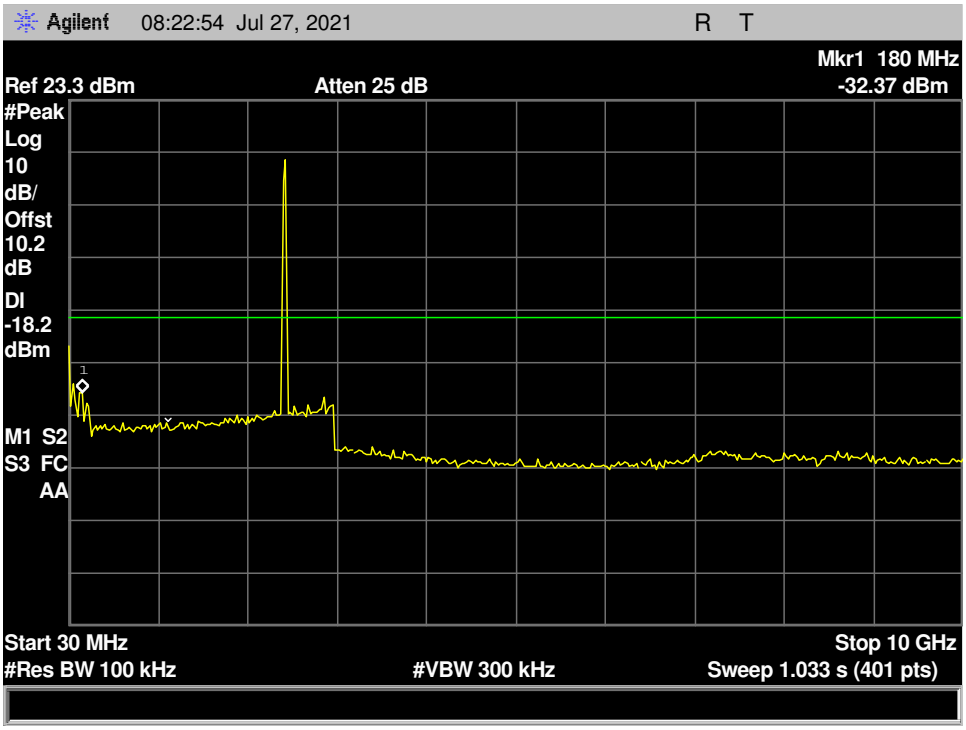
Block Diagram, Power Spectral Density Test Setup



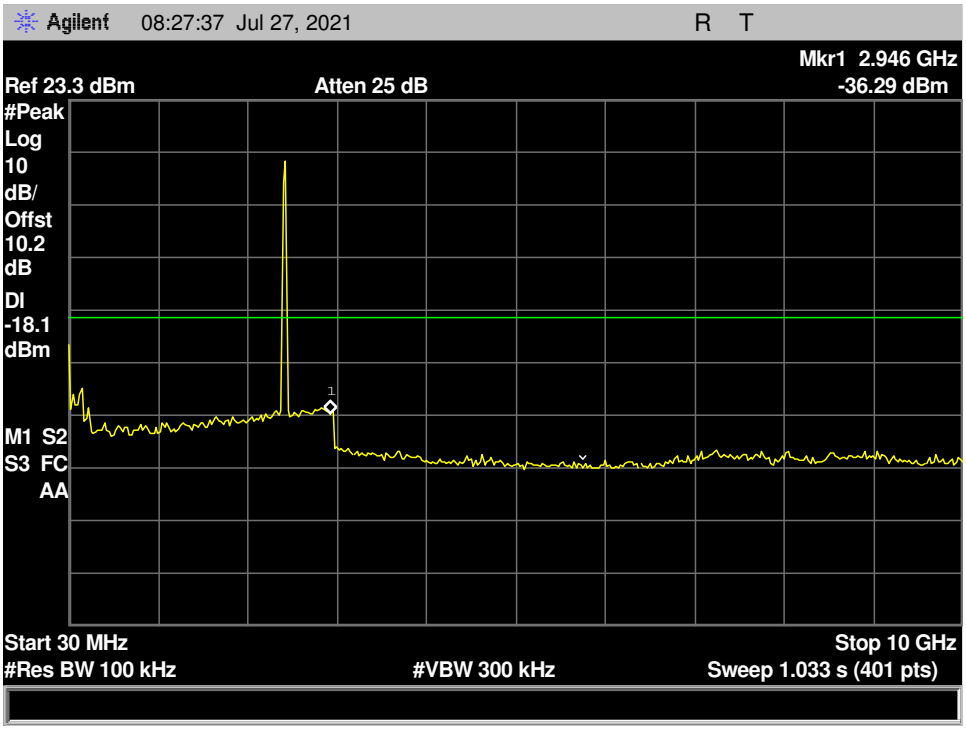
Conducted Spurious Emission, 30MHz - 10GHz, 2412MHz, 802.11 b Mode, Chain 0



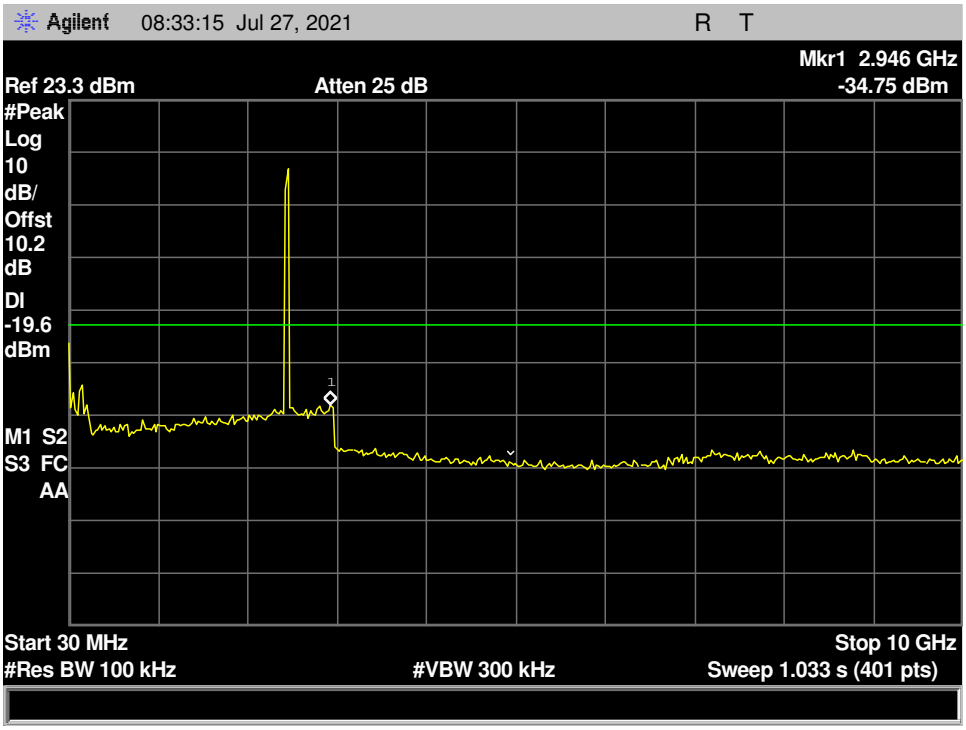
Conducted Spurious Emission, 30MHz - 10GHz, 2412MHz, 802.11 b Mode, Chain 1



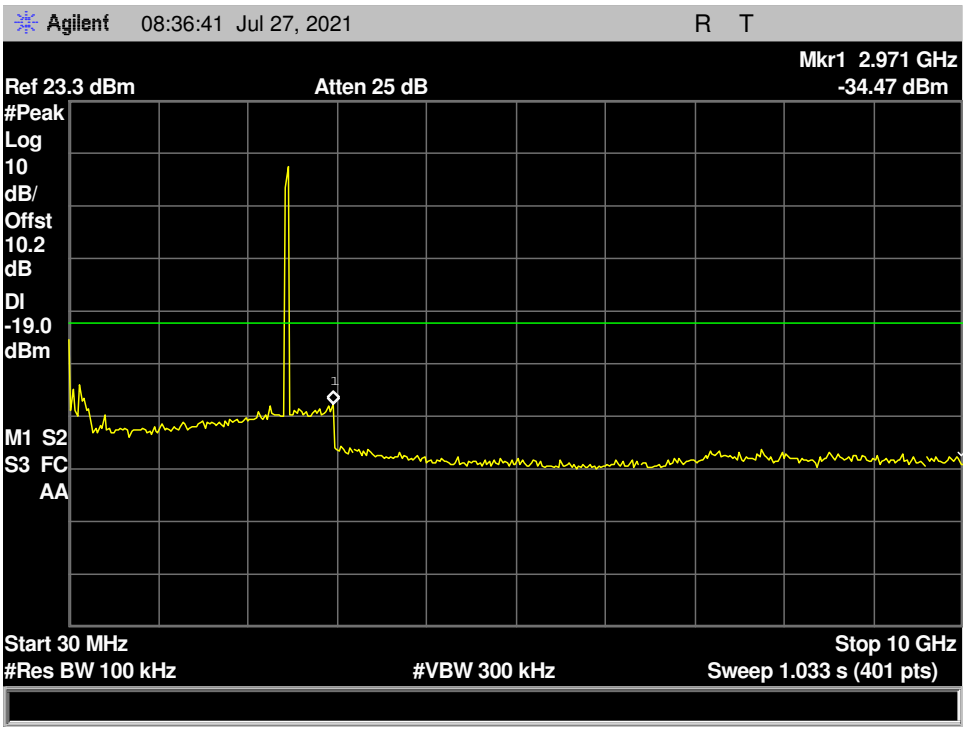
Conducted Spurious Emission, 30MHz - 10GHz, 2437MHz, 802.11 b Mode, Chain 0



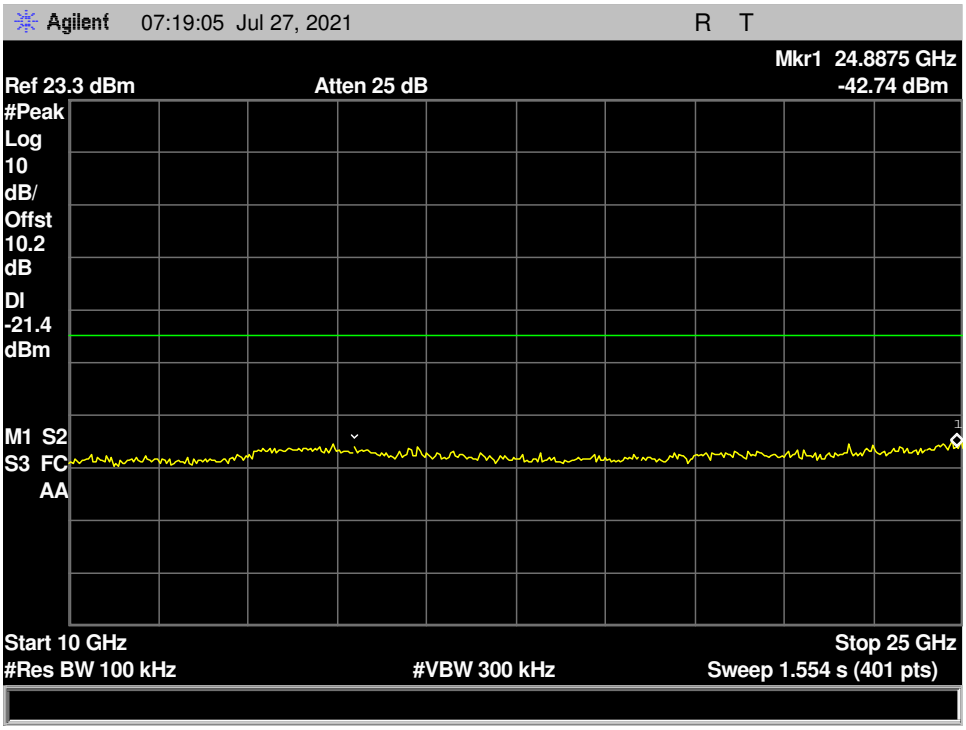
Conducted Spurious Emission, 30MHz - 10GHz, 2437MHz, 802.11 b Mode, Chain 1



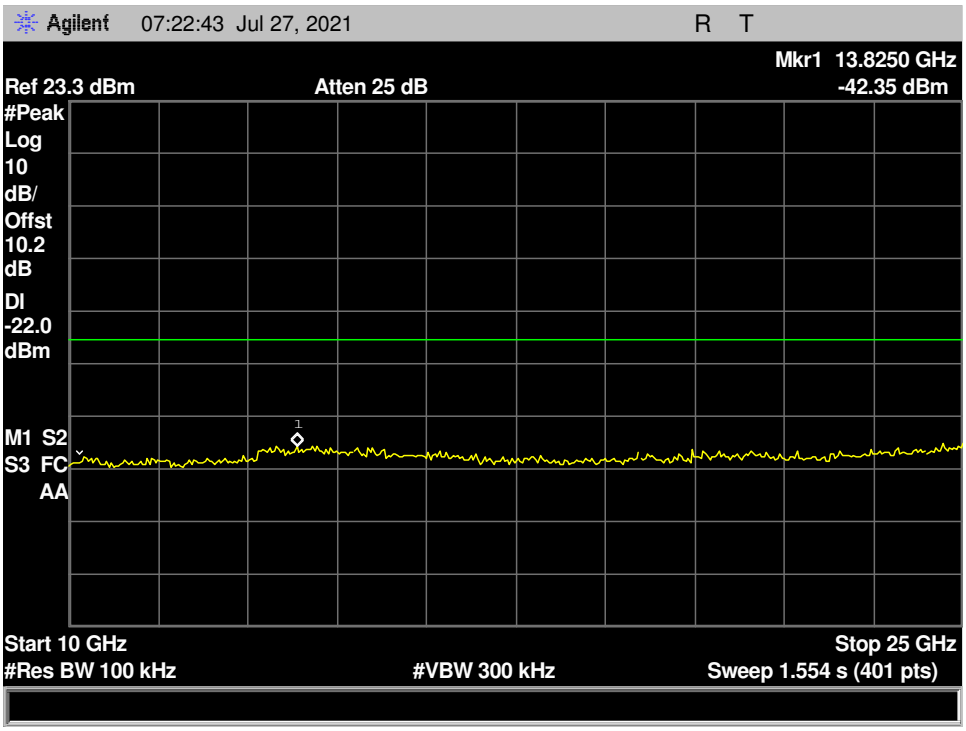
Conducted Spurious Emission, 30MHz - 10GHz, 2462MHz, 802.11 b Mode, Chain 0



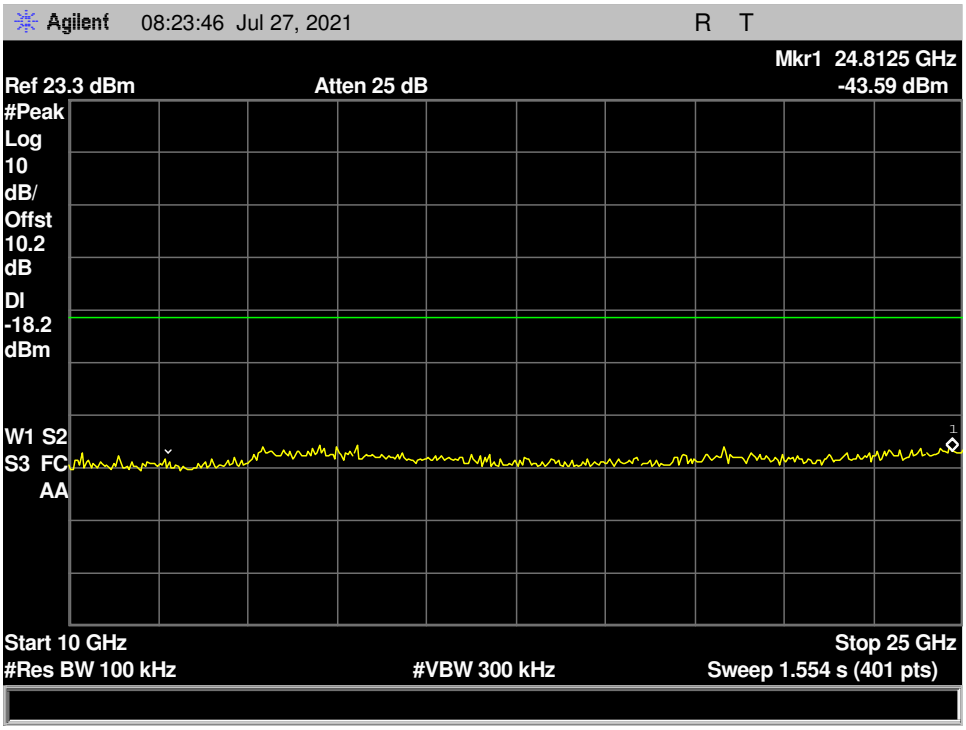
Conducted Spurious Emission, 30MHz - 10GHz, 2462MHz, 802.11 b Mode, Chain 1



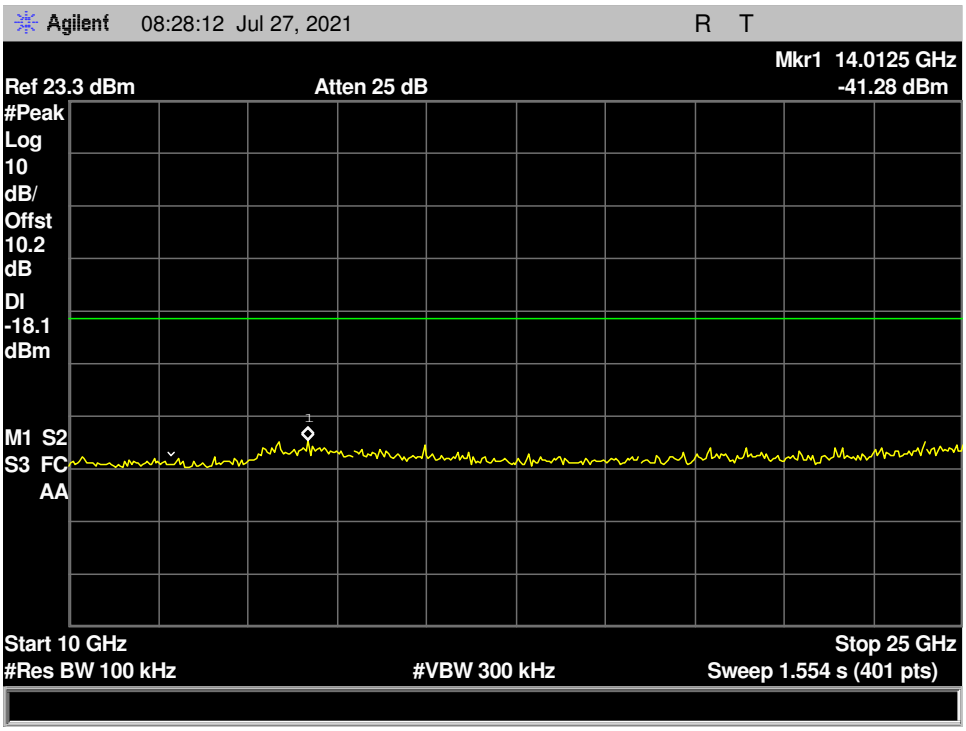
Conducted Spurious Emission, 10GHz - 25GHz, 2412MHz, 802.11 b Mode, Chain 0



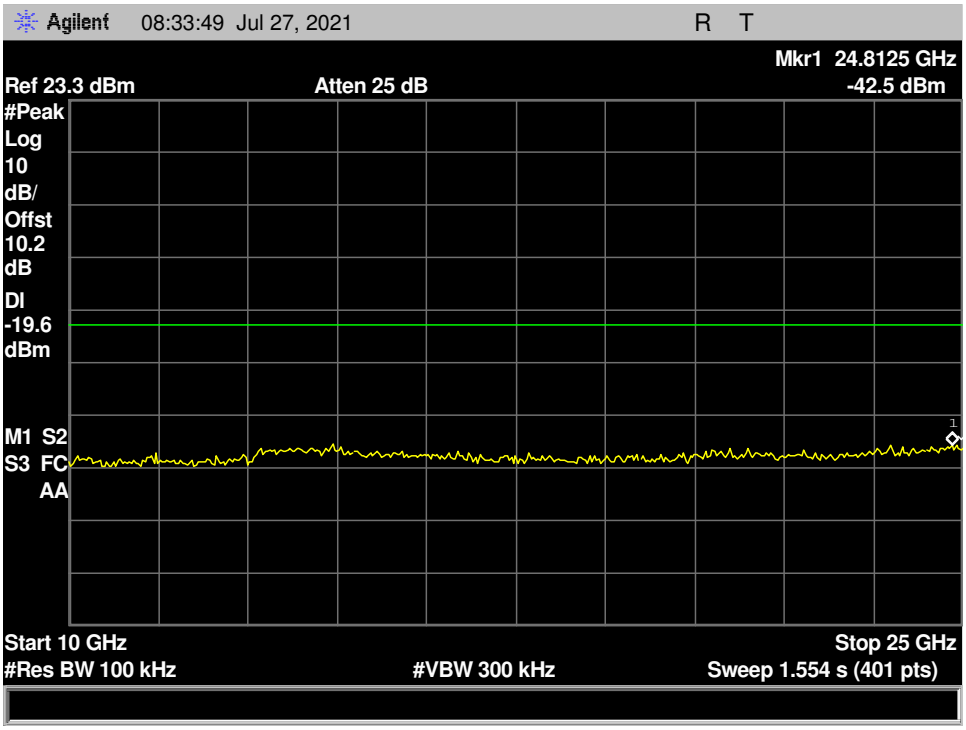
Conducted Spurious Emission, 10GHz - 25GHz, 2412MHz, 802.11 b Mode, Chain 1



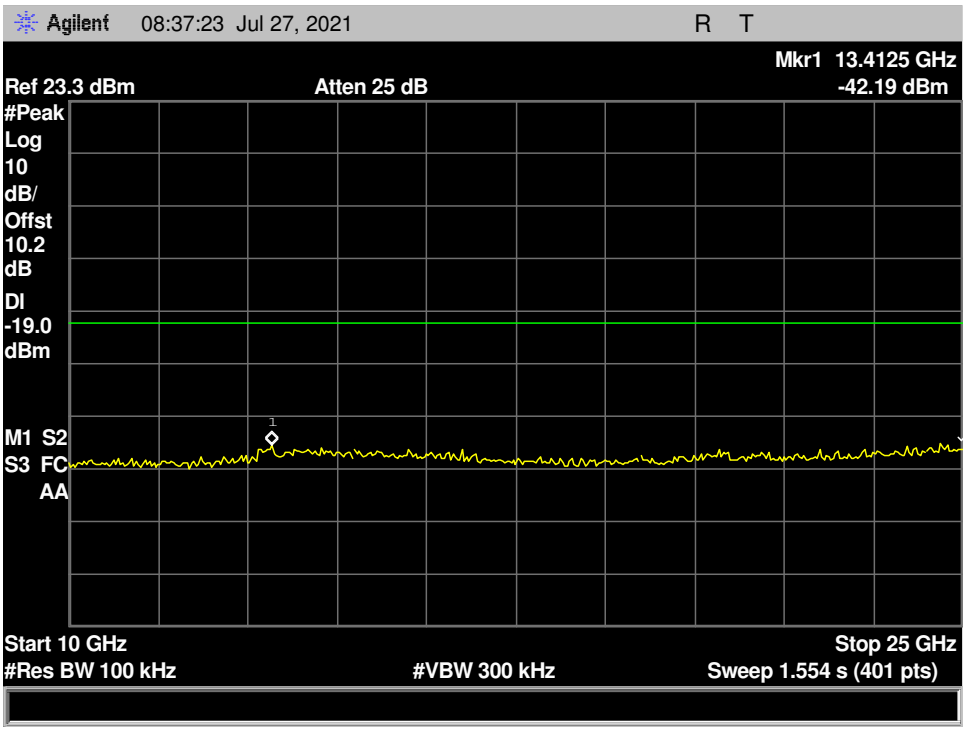
Conducted Spurious Emission, 10GHz - 25GHz, 2437MHz, 802.11 b Mode, Chain 0



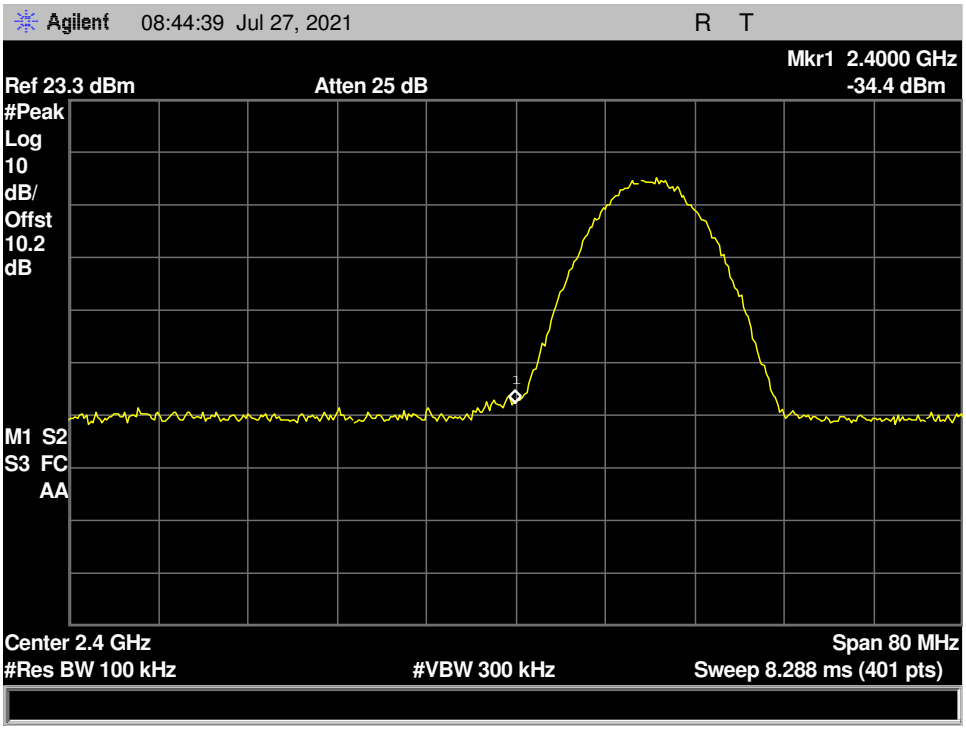
Conducted Spurious Emission, 10GHz - 25GHz, 2437MHz, 802.11 b Mode, Chain 1



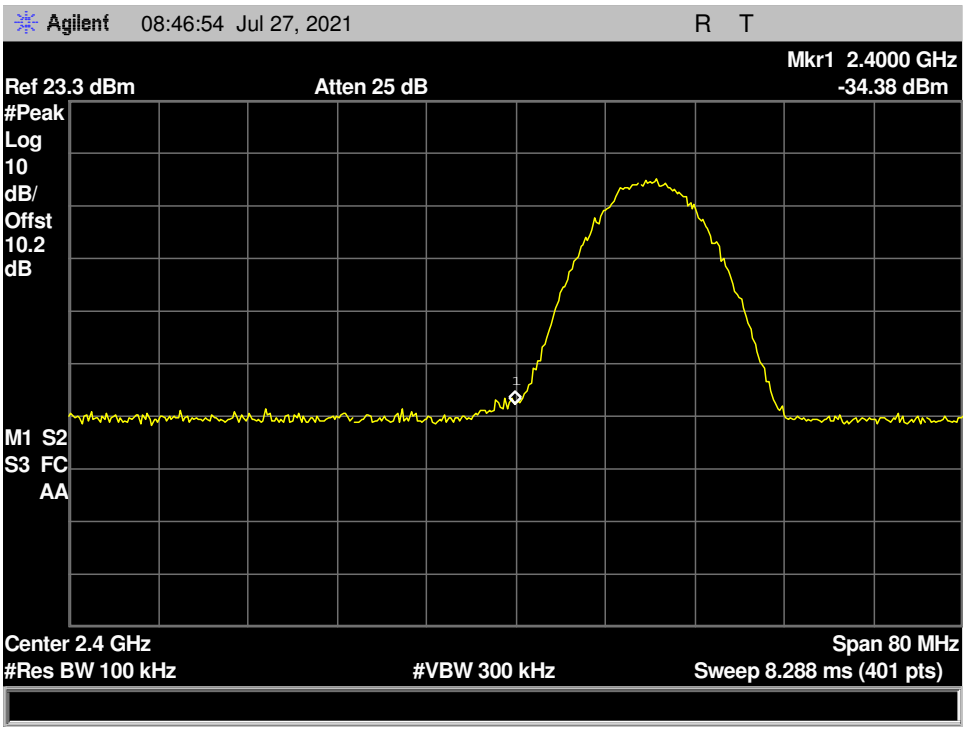
Conducted Spurious Emission, 10GHz - 25GHz, 2462MHz, 802.11 b Mode, Chain 0



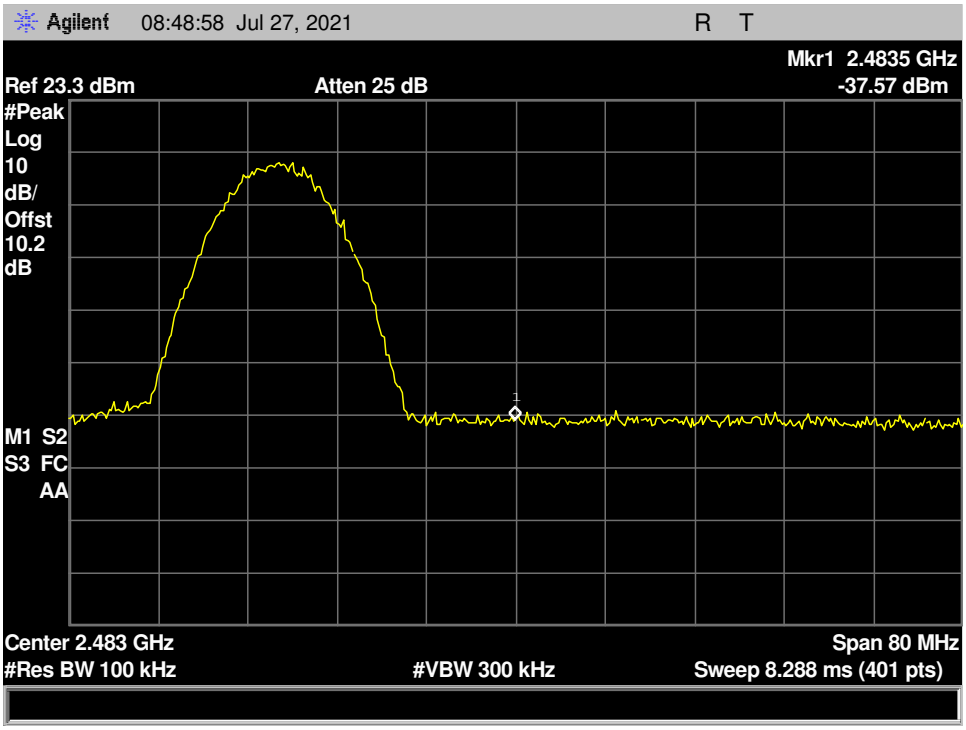
Conducted Spurious Emission, 10GHz - 25GHz, 2462MHz, 802.11 b Mode, Chain 1



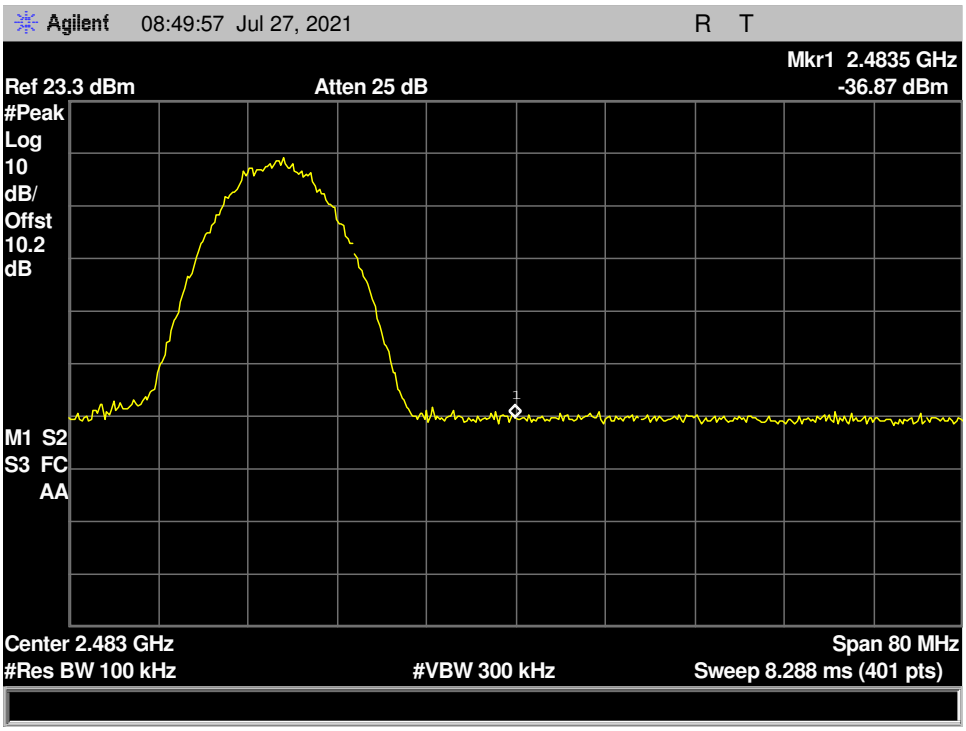
Conducted Spurious Emission, Band Edge, 2412MHz, 802.11 b Mode, Chain 0



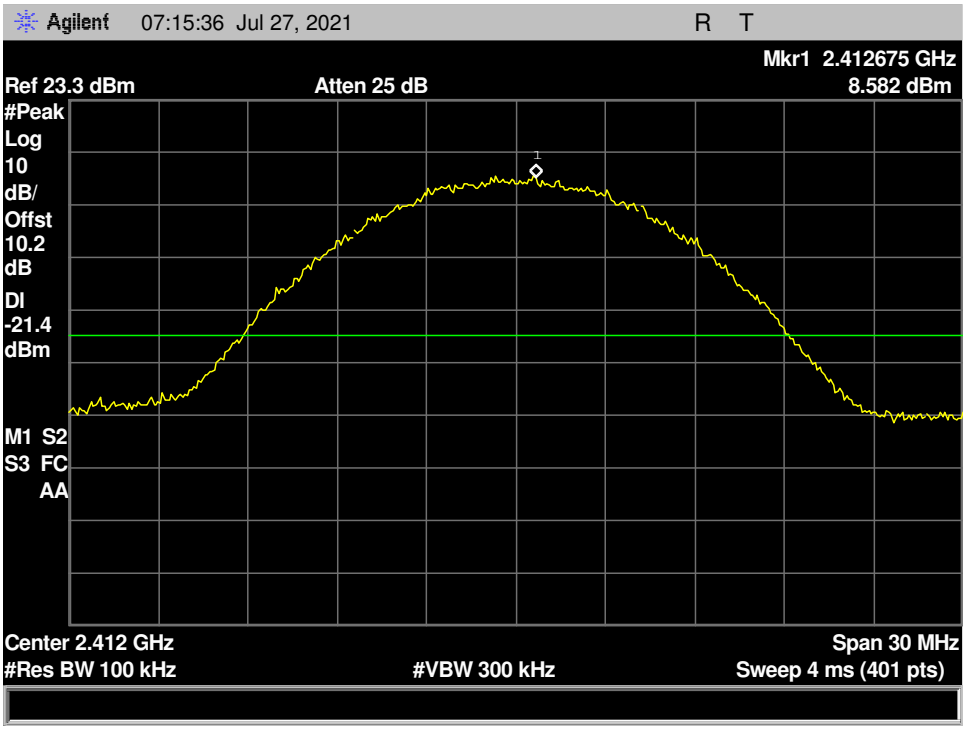
Conducted Spurious Emission, Band Edge, 2412MHz, 802.11 b Mode, Chain 1



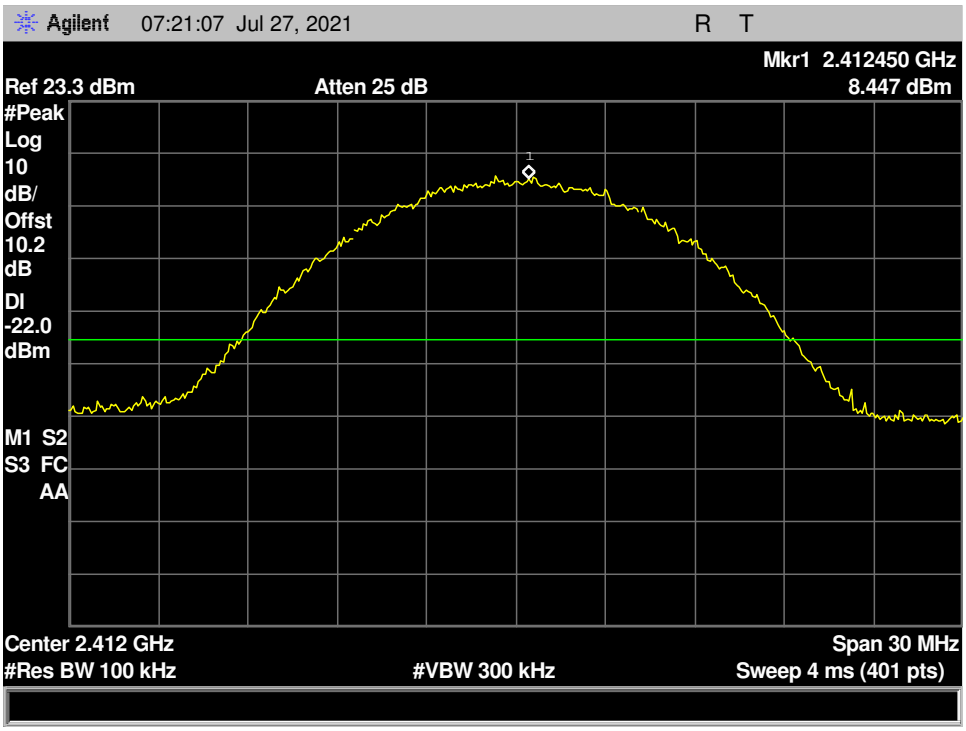
Conducted Spurious Emission, Band Edge, 2462MHz, 802.11 b Mode, Chain 0



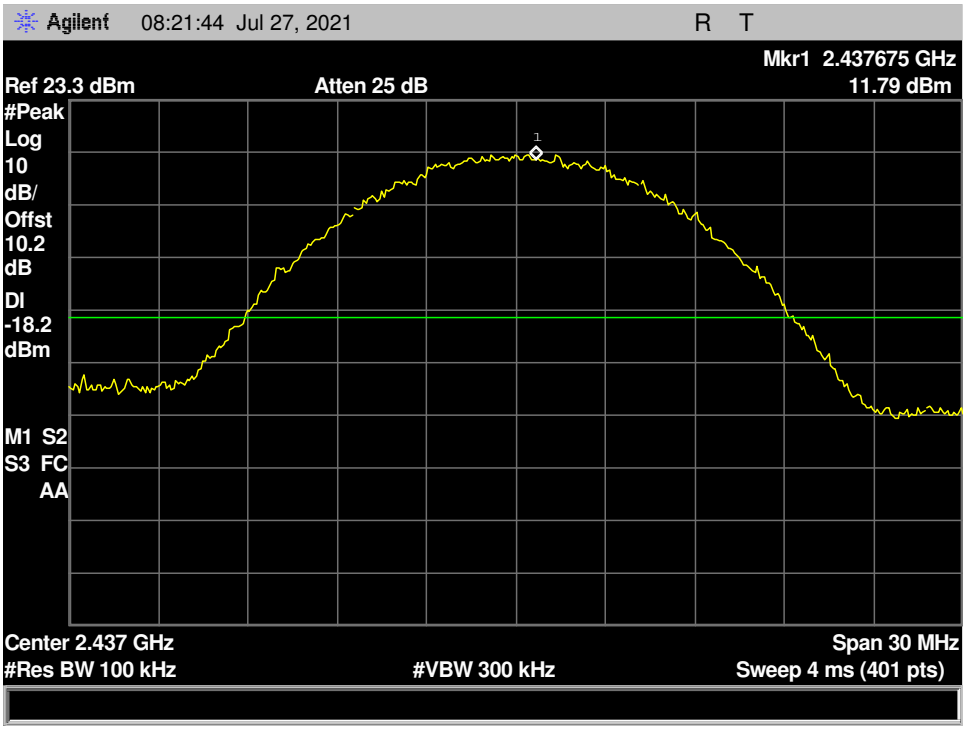
Conducted Spurious Emission, Band Edge, 2462MHz, 802.11 b Mode, Chain 1



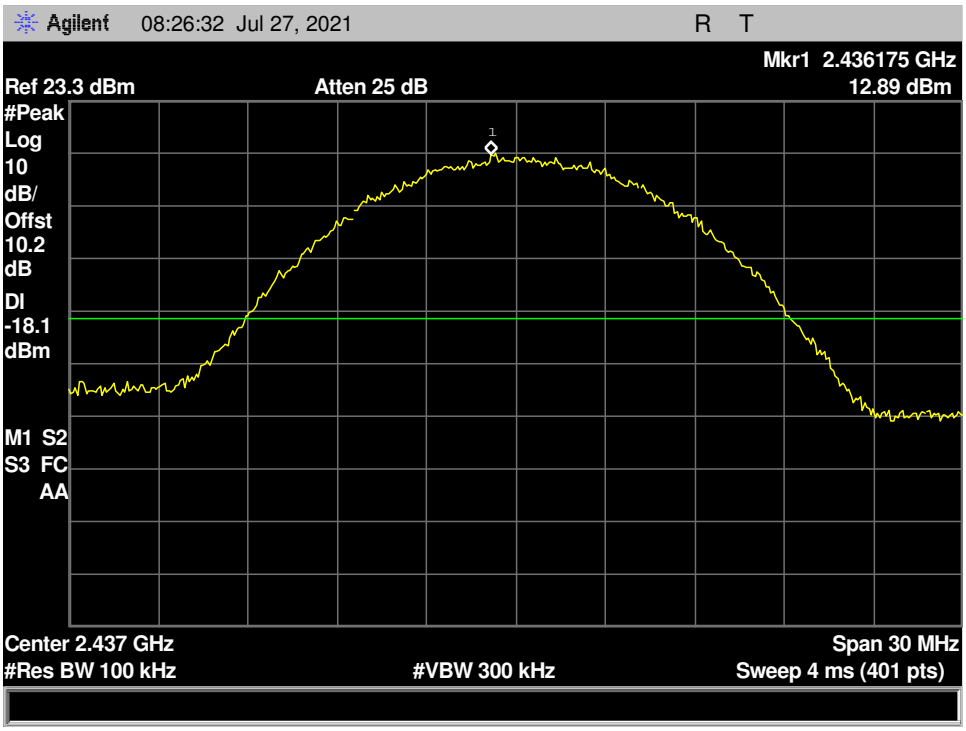
Conducted Spurious Emission, Reference Level, 2412MHz, 802.11 b Mode, Chain 0



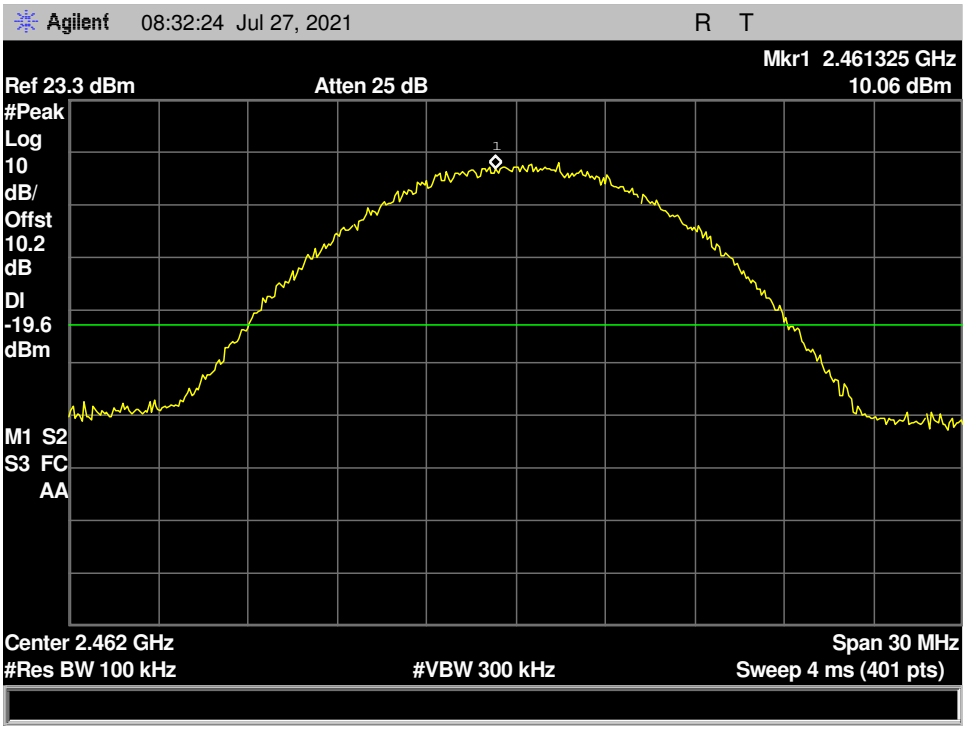
Conducted Spurious Emission, Reference Level, 2412MHz, 802.11 b Mode, Chain 1



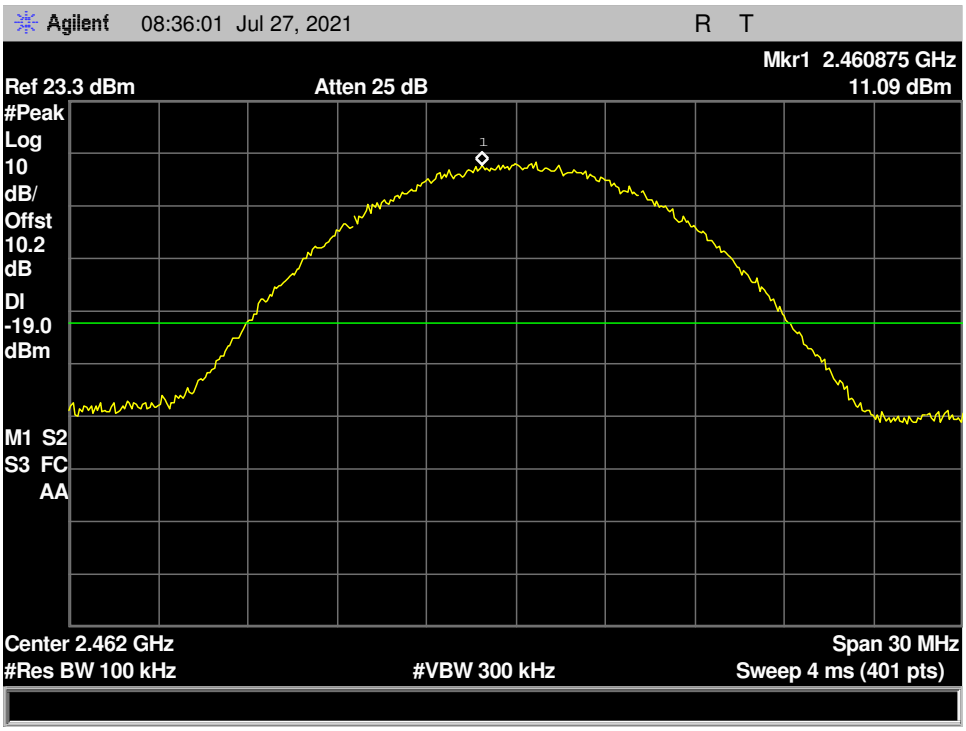
Conducted Spurious Emission, Reference Level, 2437MHz, 802.11 b Mode, Chain 0



Conducted Spurious Emission, Reference Level, 2437MHz, 802.11 b Mode, Chain 1



Conducted Spurious Emission, Reference Level, 2462MHz, 802.11 b Mode, Chain 0



Conducted Spurious Emission, Reference Level, 2462MHz, 802.11 b Mode, Chain 1

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2399	Turntable/Mast Controller	Sunol Sciences	SC99V	See Note[1]	
1S2600	Bilog Antenna	Teseq	CBL6112D	03/19/2021	03/19/2022
1S3826	Drg Horn Antenna	Ets-Lindgren	3117	12/03/2020	12/03/2022
1S2003	Pxa Signal Analyzer	Keysight	N9030B	09/15/2020	09/15/2021
1S2587	Pre Amplifier	Aml Communications	AML0126L3801	See Note[1]	
1S2653	Amplifier	Sonoma Instrument	310 N	See Note[1]	
1S2486	5 Meter Chamber	Panashield - Ets	5M	See Note[2]	
Note 1: Functionally tested equipment is verified using calibrated instrumentation at the time of testing. Note 2: Latest NSA and VSWR data available upon request.					

Test Equipment List

End of Report