eurofins | E&E

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

August 4, 2021

Geotab, Inc
2440 Winston Park Drive
Oakville, Onatario L6H7V2

Dear Hassan Noor,

Enclosed is the EMC Wireless test report for class II permissive change testing of the Geotab, Inc, GP9-LTE as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C 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,
EUROFINS ELECTRICAL AND ELECTRONIC TESTING NA, INC.

Joel Huna
Documentation Department

Reference: (\Geotab, Inc\WIRS111663-FCC247 DTS Rev 3)

ACCREDITED
TESTING CERT #0591.02

Electromagnetic Compatibility Criteria
Test Report

for the

Geotab, Inc
GP9-LTE

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

Report: WIRS111663-FCC247 DTS Rev 3

August 4, 2021

Prepared For:

Geotab, Inc
2440 Winston Park Drive
Oakville, Onatario L6H7V2

Prepared By:
Eurofins Electrical and Electronic Testing NA, Inc.
3162 Belick St., Santa Clara, CA 95054

Electromagnetic Compatibility Criteria
Test Report

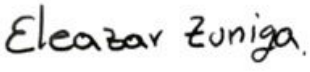
for the

Geotab, Inc
GP9-LTE

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

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 under normal use and maintenance.



Eleazar Zuniga,
Manager, Wireless Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 14, 2021	Initial Issue.
1	September 28, 2021	TCB Updates
2	August 1, 2021	TCB Updates
3	August 4, 2021	TCB Updates

Table of Contents

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ertz
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ertz
kPa	**k**ilo**pa**scal
kV	**k**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micro**seconds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Geotab, Inc GP9-LTE, 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 GP9-LTE. Geotab, Inc should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the GP9-LTE, 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 Geotab, Inc, purchase order number PO20559. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Not Applicable – EUT is DC powered
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(c)	Spurious Emissions in Non-restricted Bands	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(e)	Peak Power Spectral Density	Compliant

Executive Summary of EMC Part 15.247 ComplianceTesting

Note: Duty cycle for testing purposes was set to 100%.

II. Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by Geotab, Inc to perform testing on the GP9-LTE, under Geotab, Inc's purchase order number PO20559.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Geotab, Inc, GP9-LTE.

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

Model(s) Tested:	GP9-LTE	
Model(s) Covered:	GP9-LTE	
Filing Status:	CIIPC	
EUT Specifications:	Primary Power: 12 VDC	
	FCC ID: 2AV57GP9LTE	
	Type of Modulations:	OFDM, DSSS
	Equipment Code:	DTS
	Peak RF Output Power:	22.38 dBm
	EUT Frequency Ranges:	2412 MHz – 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	
Duty Cycle for Testing:	100%	
Evaluated by:	Arsalan Hasan	
Report Date(s):	August 4, 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
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

References

C. Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 3162 Belick St., 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 5 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.

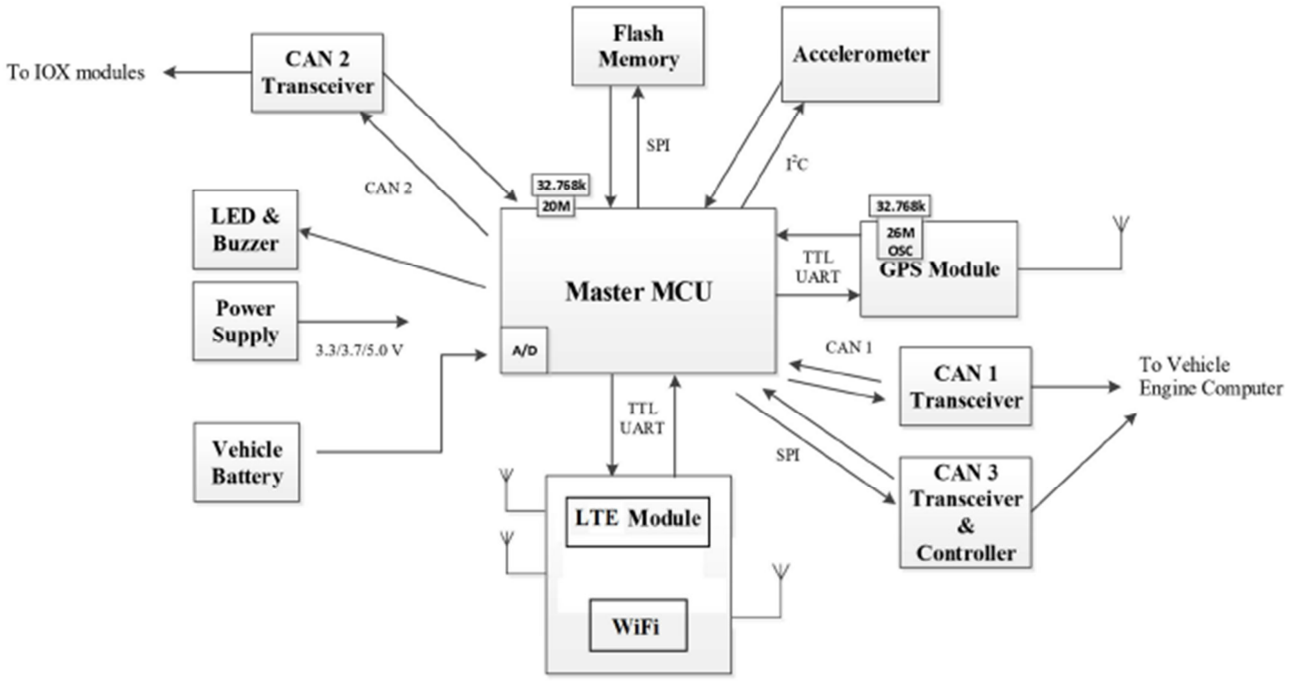
D. Measurement Uncertainty

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. Description of Test Sample

The Geotab, Inc GP9-LTE, Equipment Under Test (EUT), is GO9 Telematics device with on-board Wi-Fi hotspot functionality.



Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in **Error! Reference source not found.**, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
NA	NA	GO9+	GP9-LTE	NA	G9-PB3-8ZR-4S42	NA
NA	NA	GO9+	GP9-LTE	NA	G9-1Z0-PZD-8MWT	NA
NA	NA	GO9+	GP9-LTE	NA	G9-W7D-WXB-J62A	NA
NA	NA	GO9+	GP9-LTE	NA	G9-U51-ZB2-244P	NA

Equipment Configuration

G. Support Equipment

The EUT did not require support equipment for testing or monitoring.

H. Ports and Cabling Information

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
NA	OBDII	Harness cable	1	**1**	NA	No	NA

Ports and Cabling Information

I. Mode of Operation

Cellular was tested on Low, Mid and High Channels at the maximum power, simultaneous transmission with Wi-Fi 2.4 GHz. Cellular was configured using AT commands, through serial terminal. "QRCT 4" software tool was provided by the client, to configure the Wi-Fi 2.4GHz radio for b/g/ (n20/40) transmit mode, continuous TX, duty cycle of 100%

Mode	Software Setting
802.11 b	17
802.11 g	16
802.11 n20	15
802.11 n40	15

J. Method of Monitoring EUT Operation

The LEDs on the front of the unit denote active/inactive functionality.

K. 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.

L. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators

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.

Results: The EUT is compliant with the criteria of §15.203.

Test Engineer(s): Arsalan Hasan

Test Date(s): 03/29/2021

Peak Gain	Frequency Range	Type	Polarization	Impedance
4.20 dBi	2.4 – 2.5 GHz	LDS	Linear	50 Ω

Antenna List

"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"

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBµV)	
	Quasi-Peak	Average
* 0.15- 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 µH LISN as the input transducer to an EMC/field intensity meter.

Test Results: The EUT was not applicable with this requirement. EUT is DC powered.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 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:

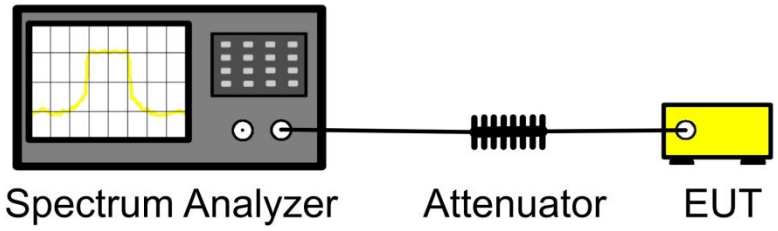
For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The 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. The 6dB bandwidth was measured according to measurement method 11.8.2 Option 2 of ANSI C63.10-2013.

Test Results The EUT was compliant with § 15.247 (a)(2).

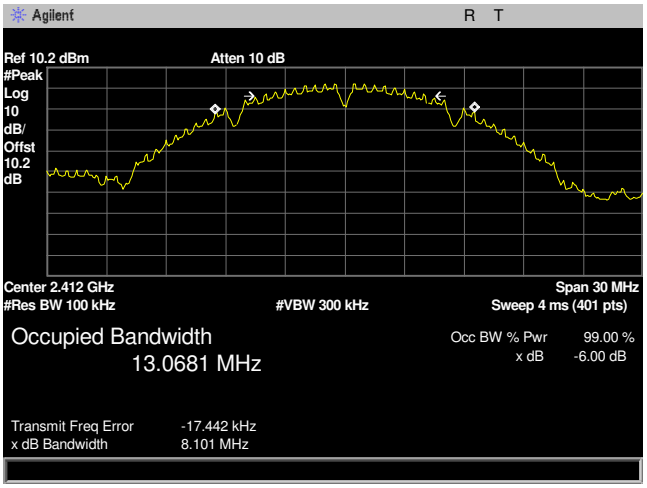
Test Engineer(s): Arsalan Hasan

Test Date(s): 03/29/2021

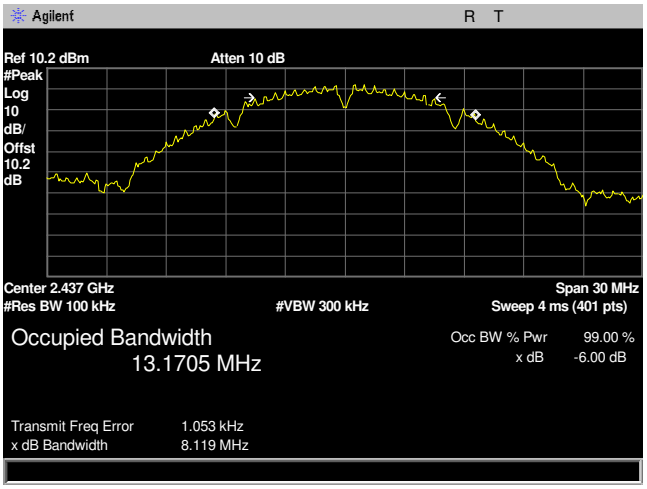


Block Diagram, Occupied Bandwidth Test Setup

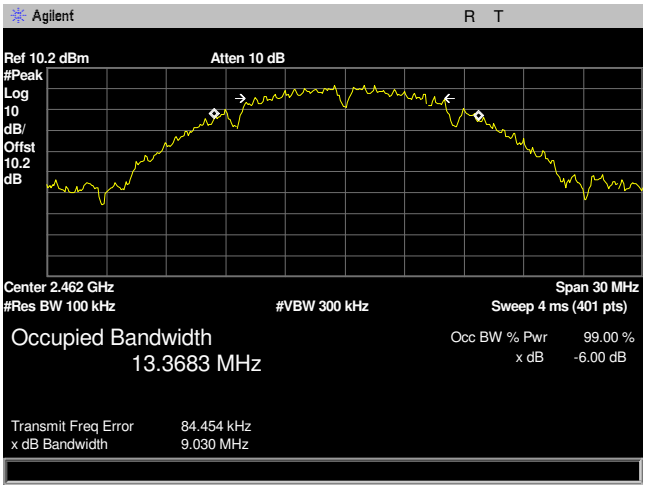
6 dB Occupied Bandwidth Test Results



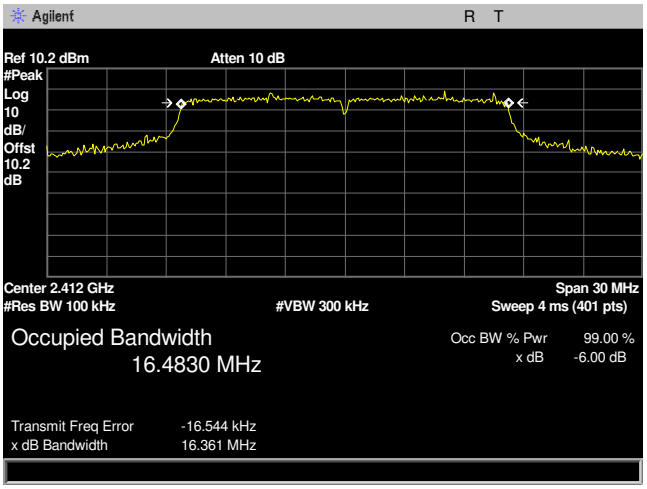
6dB Occupied Bandwidth, B mode, 20MHz, Low 2412



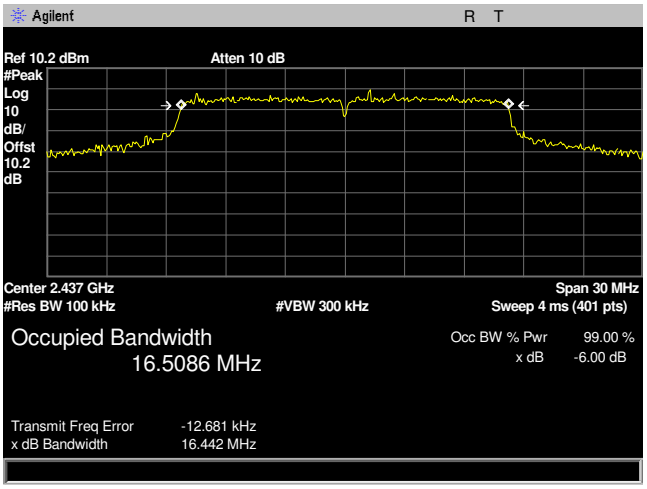
6dB Occupied Bandwidth, B mode, 20MHz, Mid 2437.



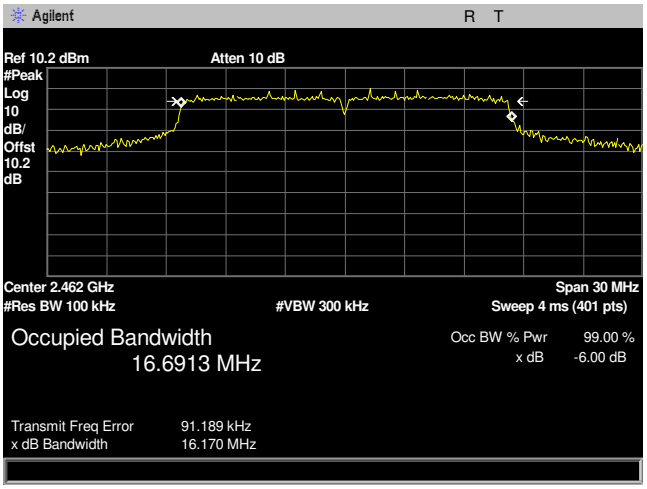
6dB Occupied Bandwidth, B mode, 20MHz, High 2462.



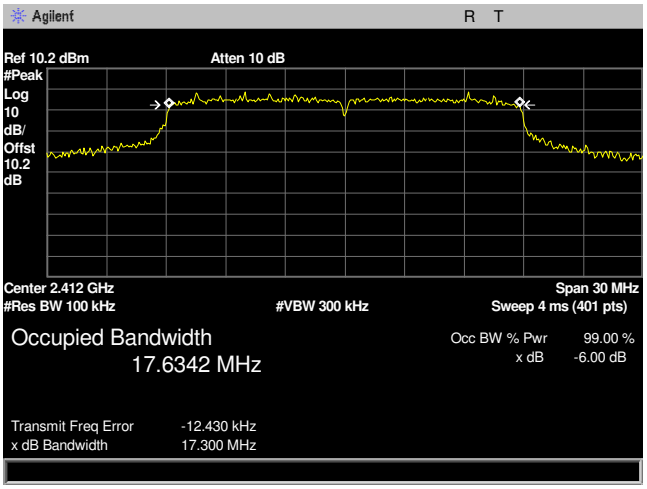
6dB Occupied Bandwidth, G mode, 20MHz, Low 2412.



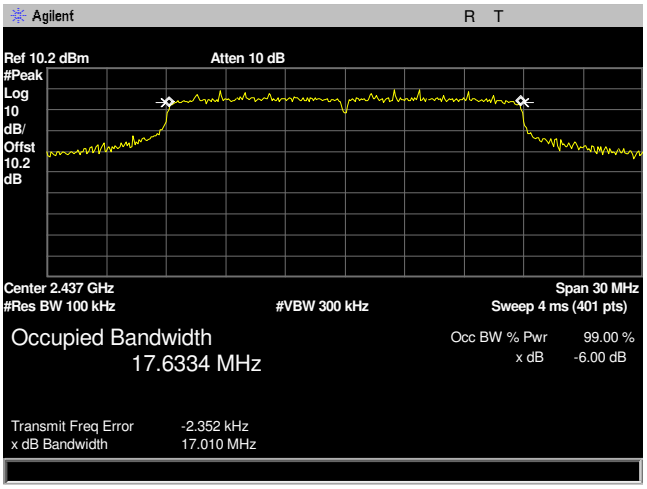
6dB Occupied Bandwidth, G mode, 20MHz, Mid 2437.



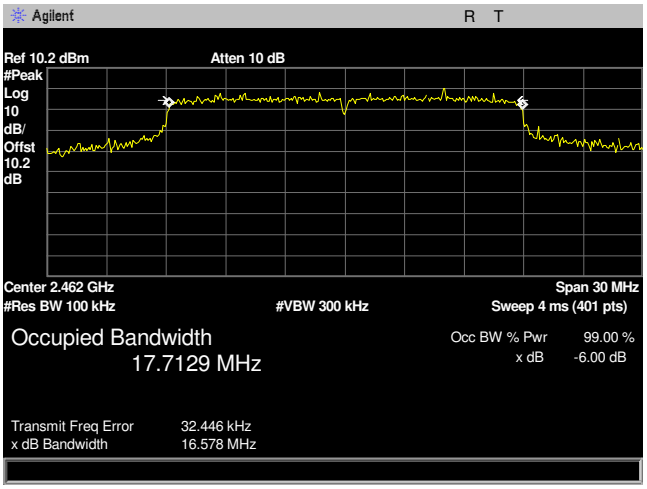
6dB Occupied Bandwidth, G mode, 20MHz, High 2462.



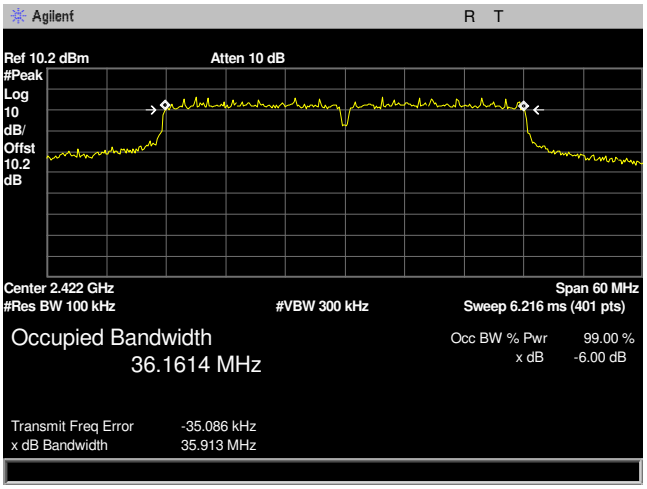
6dB Occupied Bandwidth, N mode, 20MHz, Low 2412.



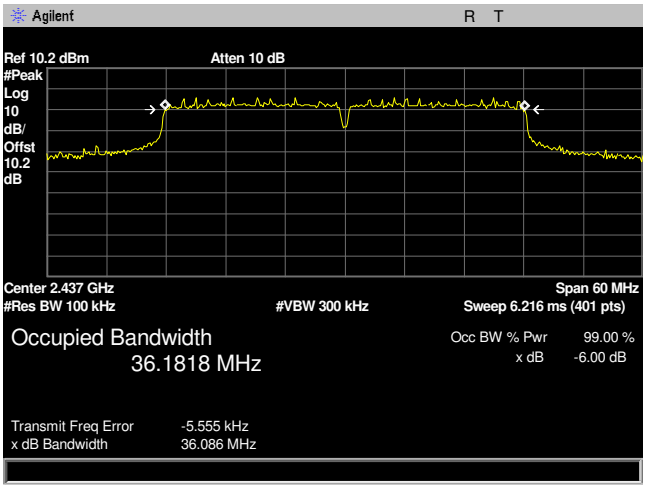
6dB Occupied Bandwidth, N mode, 20MHz, Mid 2437.



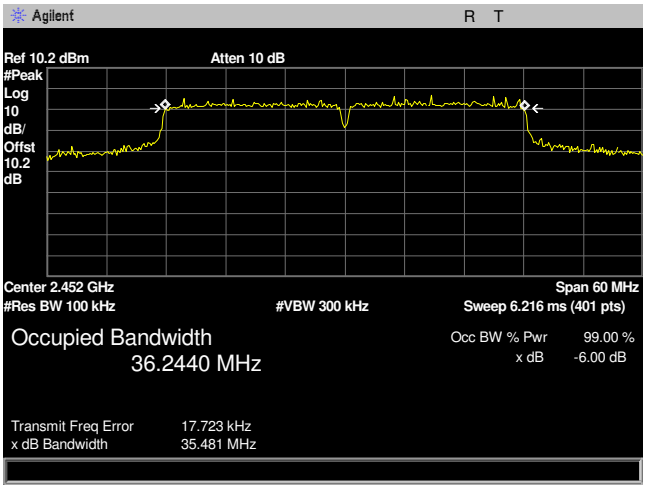
6dB Occupied Bandwidth, N mode, 20MHz, High 2462.



6dB Occupied Bandwidth, N mode, 40MHz, Low 2422.



6dB Occupied Bandwidth, N mode, 40MHz, Mid 2437.



6dB Occupied Bandwidth, N mode, 40MHz, High 2452

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Conducted Power Output

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

§15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as 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 is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

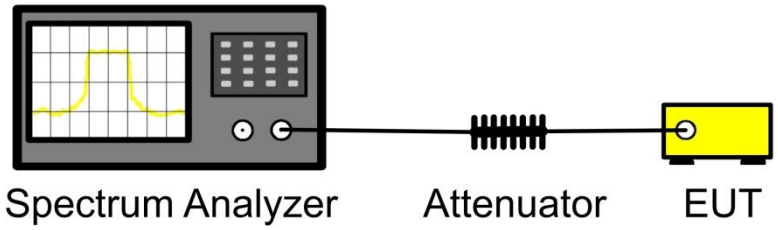
§15.247(c)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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 Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

Test Engineer(s): Arsalan Hasan

Test Date(s): 03/29/2021



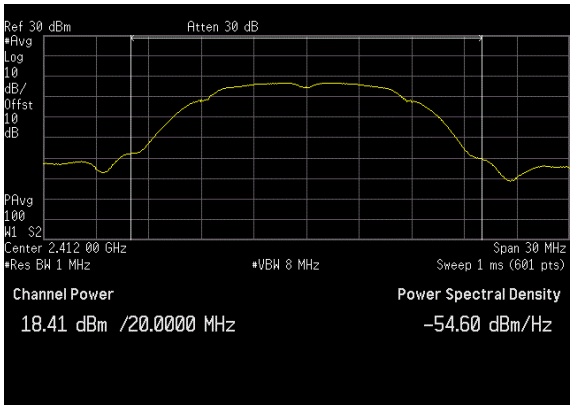
Power Output Test Setup

Maximum Conducted Power Output Test Results

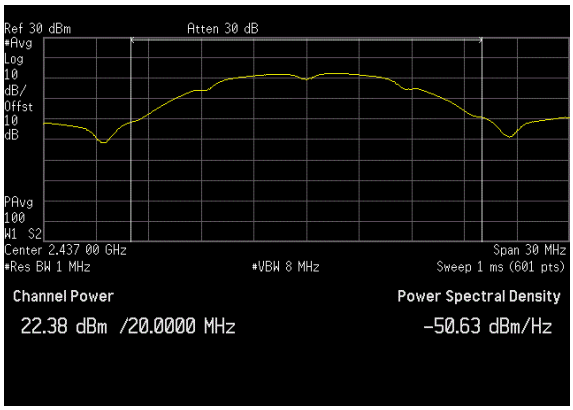
Output Power				
Mode	**Channel**	**Frequency (MHz)**	**Measured Conducted Power (dBm)**	**Limit (dBm)**
B 20MHz	Low	2412	18.41	≤30
B 20MHz	Mid	2437	22.38	≤30
B 20MHz	High	2462	22.20	≤30
G 20MHz	Low	2412	16.98	≤30
G 20MHz	Mid	2437	21.47	≤30
G 20MHz	High	2462	21.16	≤30
N 20MHz	Low	2412	16.21	≤30
N 20MHz	Mid	2437	21.10	≤30
N 20MHz	High	2462	17.10	≤30
N 40MHz	Low	2422	12.90	≤30
N 40MHz	Mid	2437	18.38	≤30
N 40MHz	High	2452	15.99	≤30

Maximum Conducted Power Output, Test Results

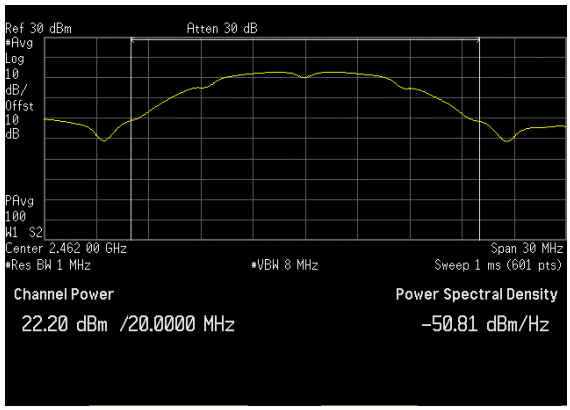
Maximum Conducted Power Output Test Results



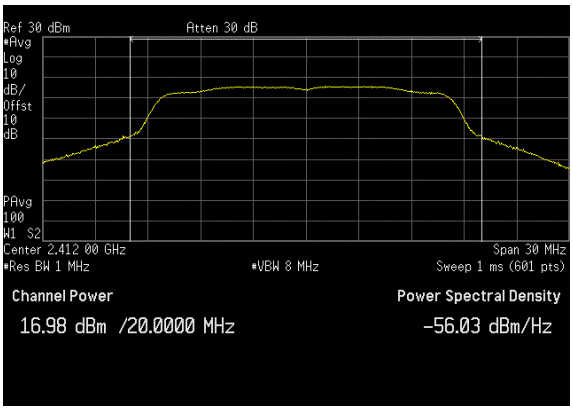
Maximum Conducted Power Output, B mode, 20MHz, Low 2412.



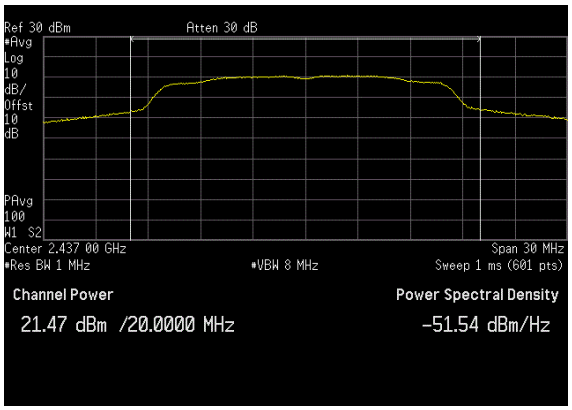
Maximum Conducted Power Output, B mode, 20MHz, Mid 2437.



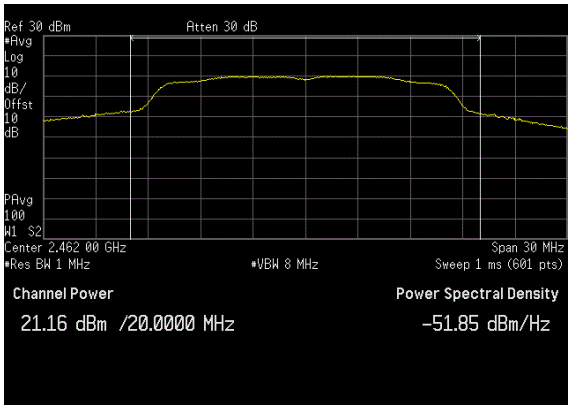
Maximum Conducted Power Output, B mode, 20MHz, High 2462.



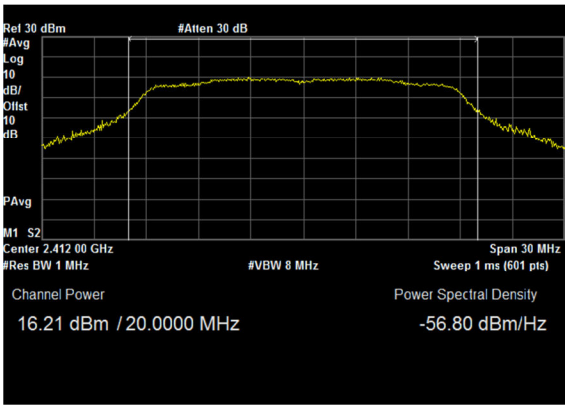
Maximum Conducted Power Output, G mode, 20MHz, Low 2412.



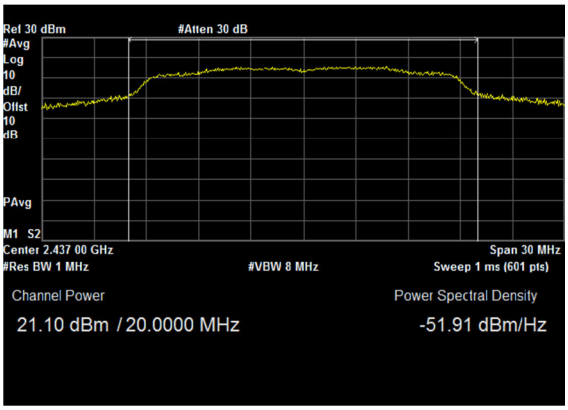
Maximum Conducted Power Output, G mode, 20MHz, Mid 2437.



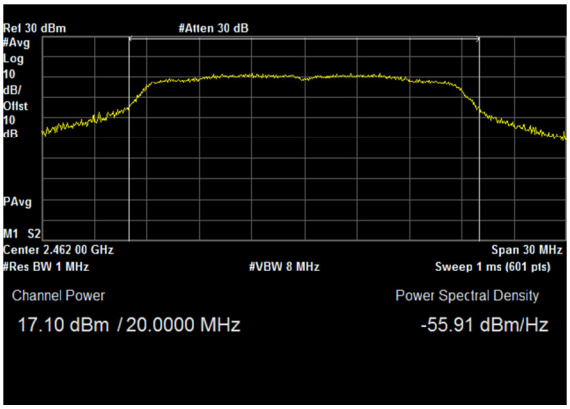
Maximum Conducted Power Output, G mode, 20MHz, High 2462.



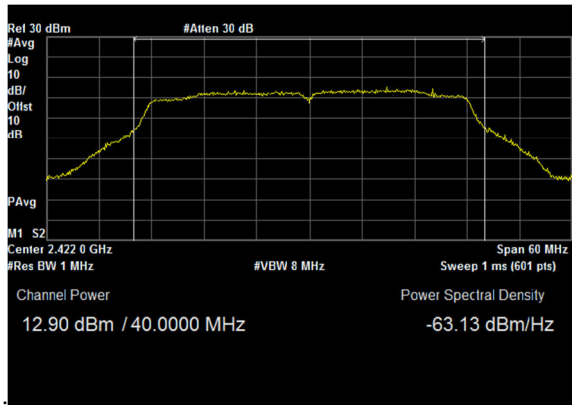
Maximum Conducted Power Output, N mode, 20MHz, Low 2412



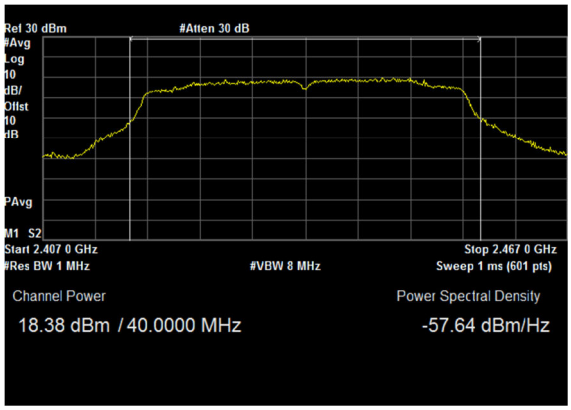
Maximum Conducted Power Output, N mode, 20MHz, Mid 2437



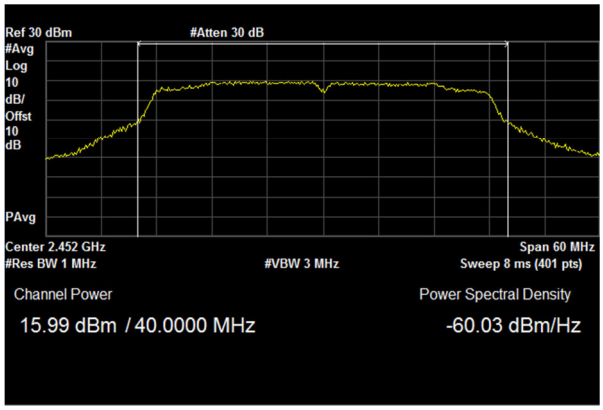
Maximum Conducted Power Output, N mode, 20MHz, High 2462



Maximum Conducted Power Output, N mode, 40MHz, Low 2422



Maximum Conducted Power Output, N mode, 40MHz, Mid 2437



Maximum Conducted Power Output, N mode, 40MHz, High 2452

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements and Band Edge

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

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

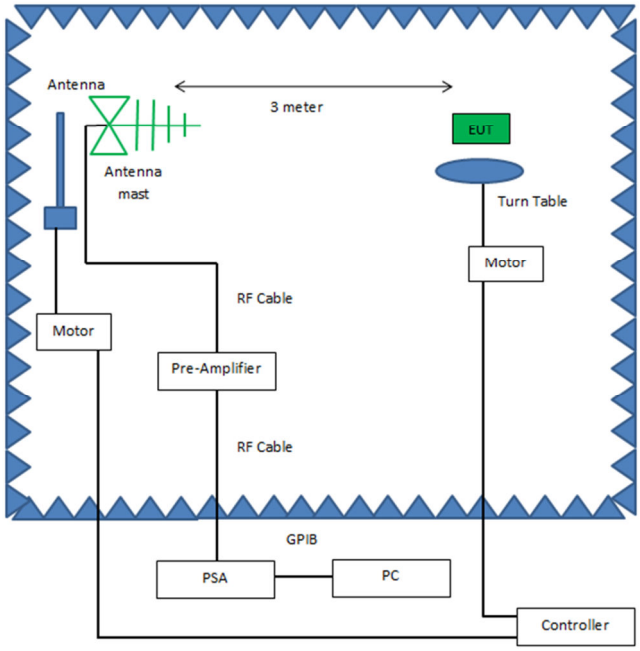
Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

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.

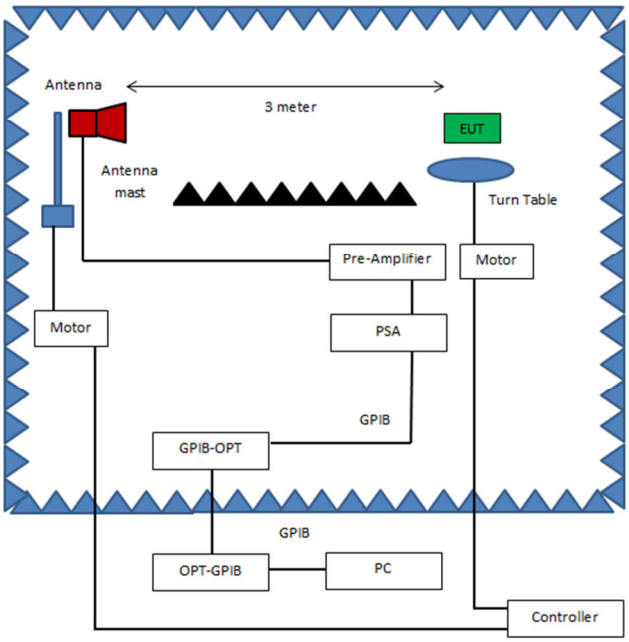
Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d) and § 15.209**.

Test Engineer(s): Arsalan Hasan

Test Date(s): 04/08/2021

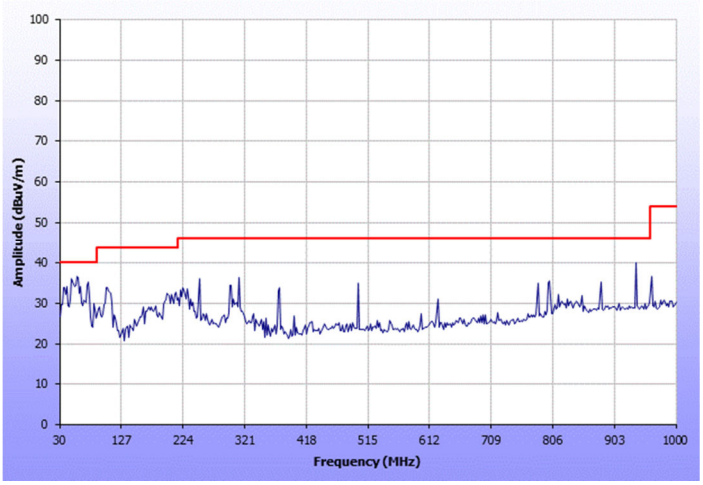


Radiated Emissions, Below 1GHz, Test Setup

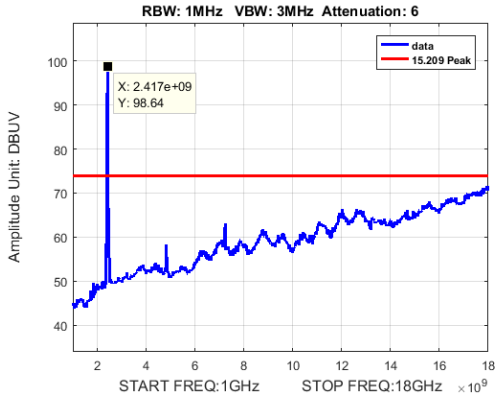


Radiated Emissions, Above 1GHz, Test Setup

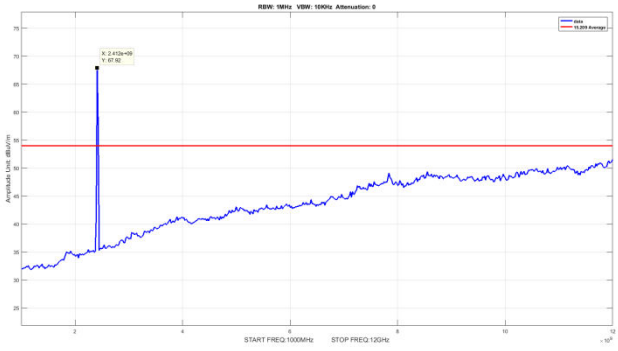
Radiated Spurious Emissions, Test Results



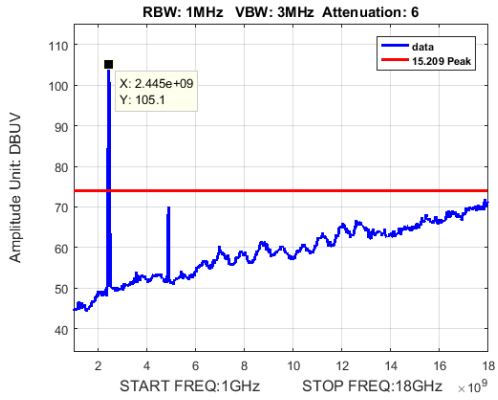
Radiated Spurious Emissions, 3-MHz-1GHz, Worst Case



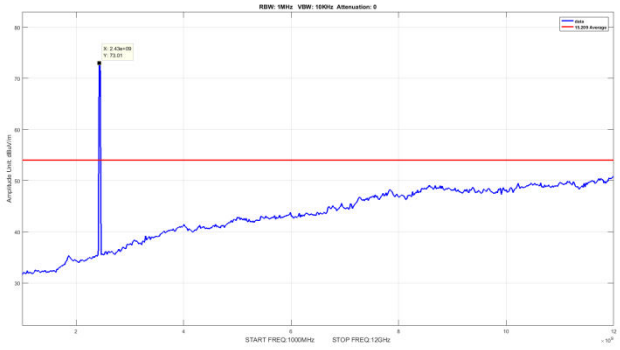
Radiated Spurious Emissions, B mode, 20MHz, Low 2412, Peak



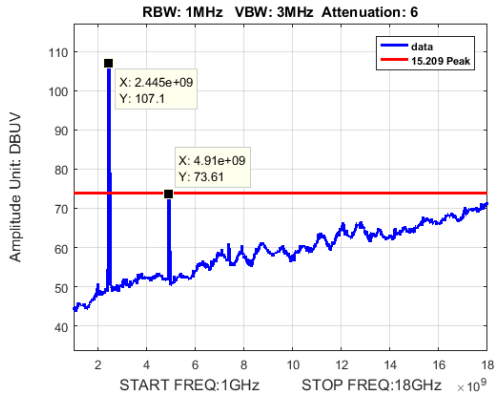
Radiated Spurious Emissions, B mode, 20MHz, Low 2412, Average



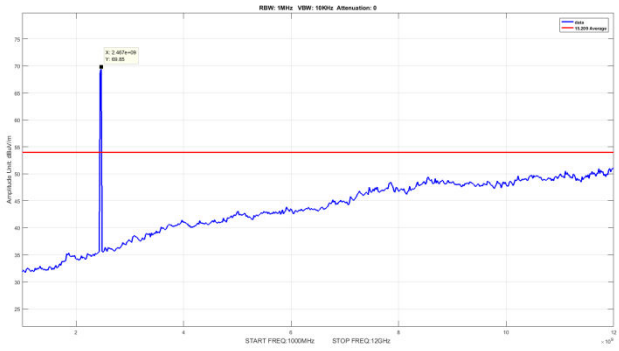
Radiated Spurious Emissions, B mode, 20MHz, Mid 2437, Peak



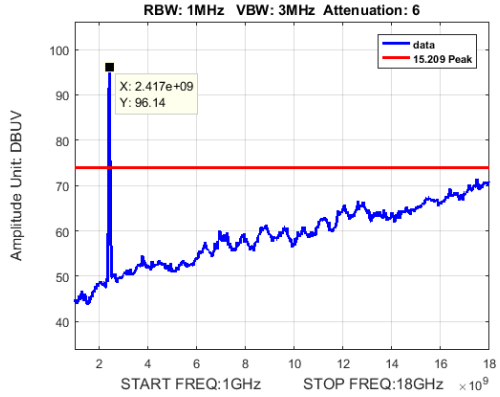
Radiated Spurious Emissions, B mode, 20MHz, Mid 2437, Average



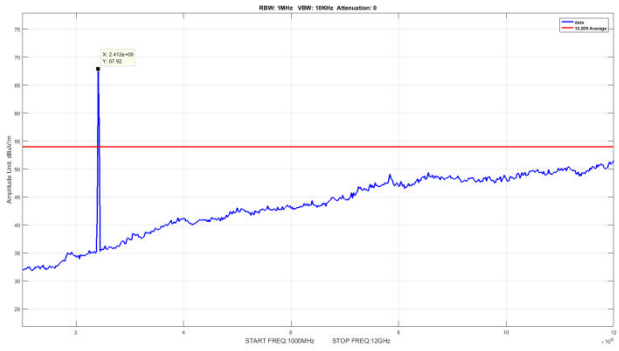
Radiated Spurious Emissions, B mode, 20MHz, High 2462, Peak



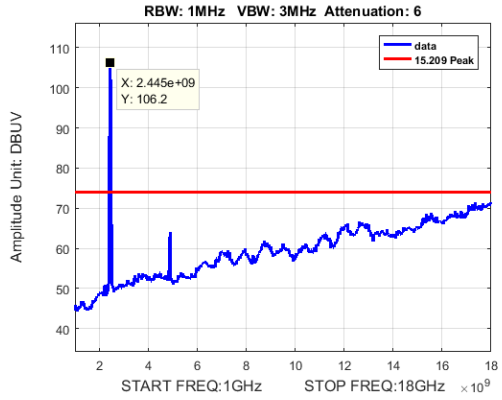
Radiated Spurious Emissions, B mode, 20MHz, High 2462, Average



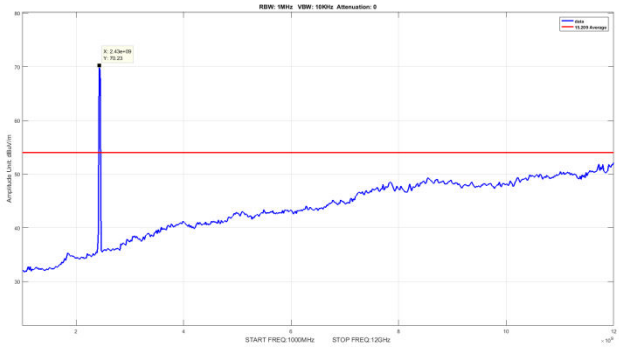
Radiated Spurious Emissions, G mode, 20MHz, Low 2412, Peak



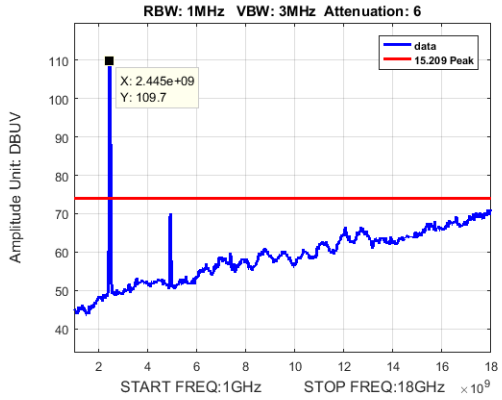
Radiated Spurious Emissions, G mode, 20MHz, Low 2412, Average



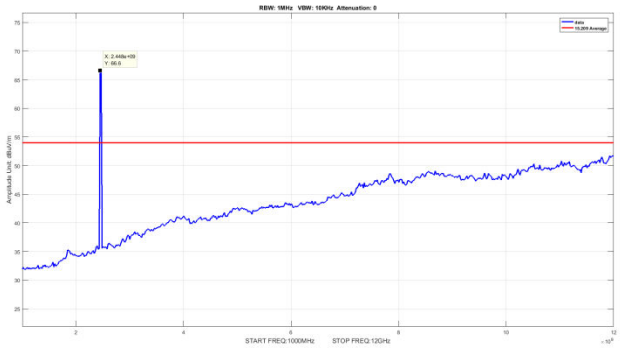
Radiated Spurious Emissions, G mode, 20MHz, Mid 2437, Peak



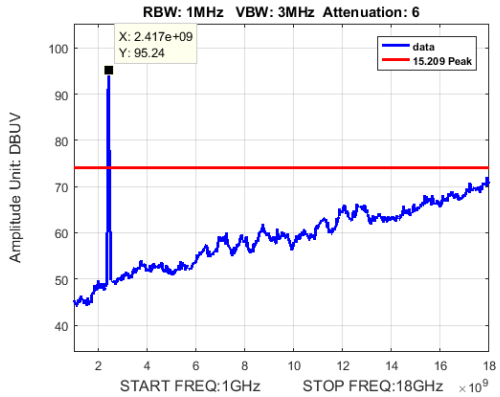
Radiated Spurious Emissions, G mode, 20MHz, Mid 2437, Average



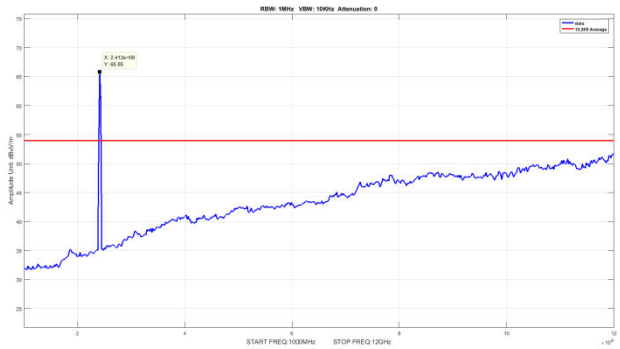
Radiated Spurious Emissions, G mode, 20MHz, High 2462, Peak



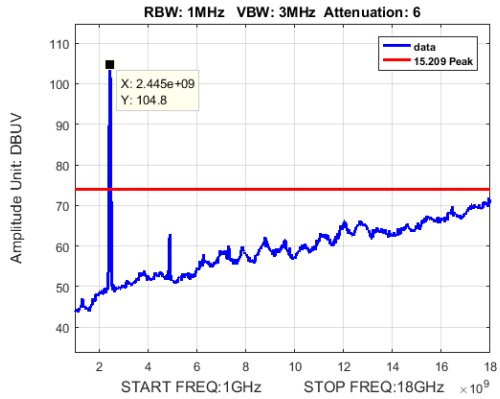
Radiated Spurious Emissions, G mode, 20MHz, High 2462, Average



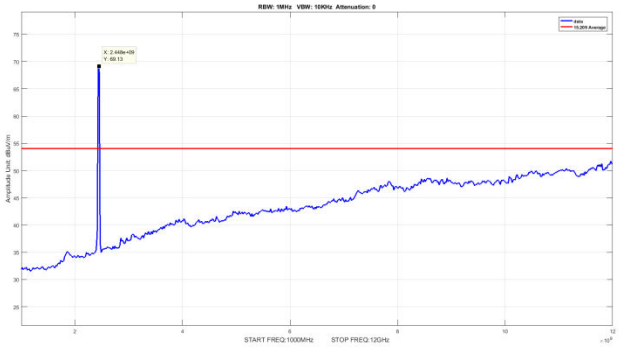
Radiated Spurious Emissions, N mode, 20MHz, Low 2412, Peak



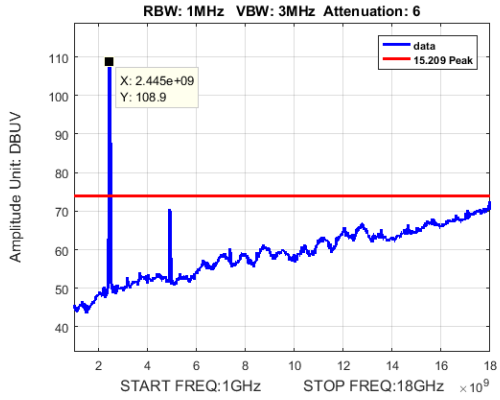
Radiated Spurious Emissions, N mode, 20MHz, Low 2412, Average



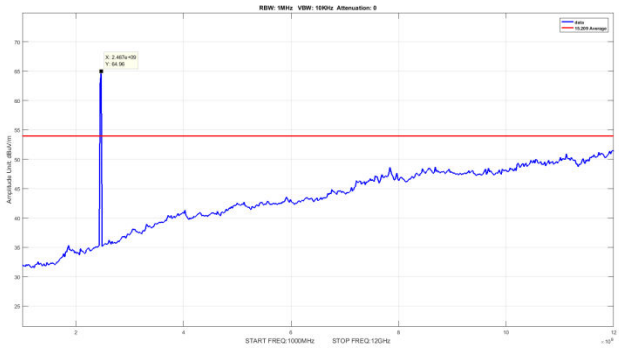
Radiated Spurious Emissions, N mode, 20MHz, Mid 2437, Peak



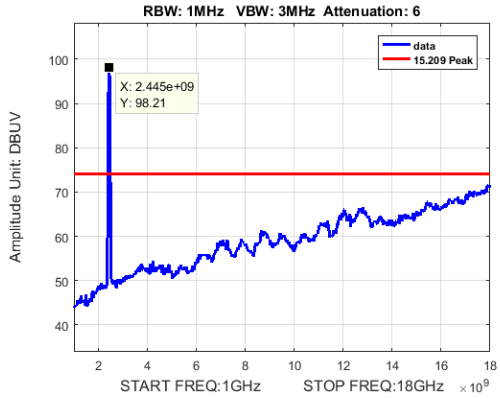
Radiated Spurious Emissions, N mode, 20MHz, Mid 2437, Average



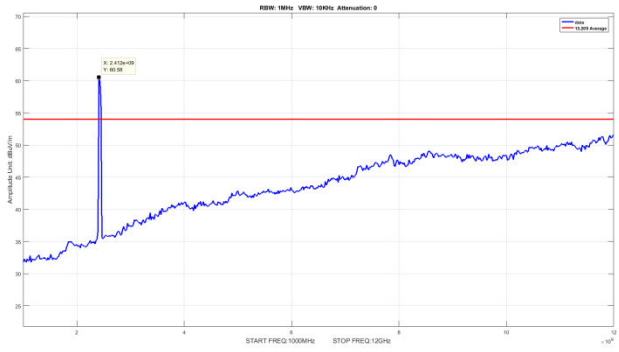
Radiated Spurious Emissions, N mode, 20MHz, High 2462, Peak



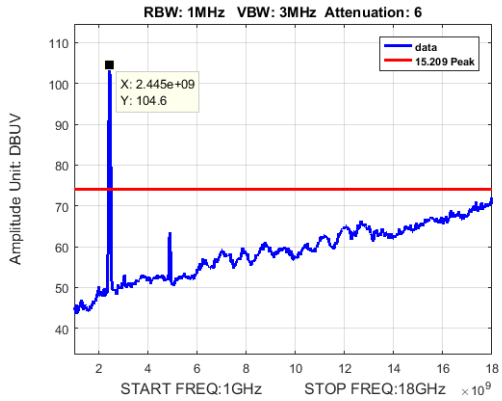
Radiated Spurious Emissions, N mode, 20MHz, High 2462, Average



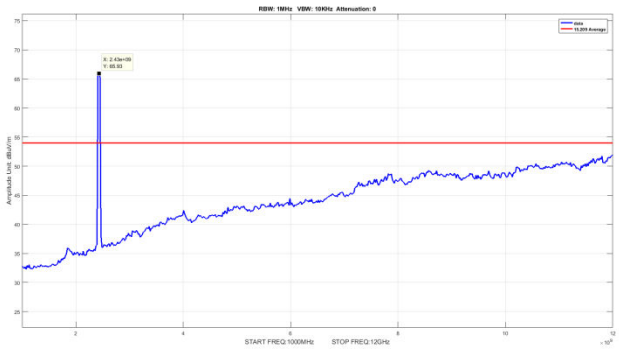
Radiated Spurious Emissions, N mode, 40MHz, Low 2422, Peak



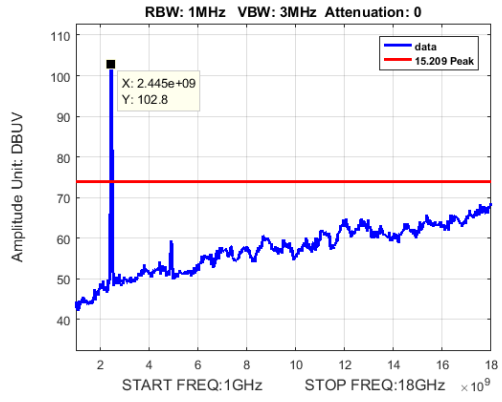
Radiated Spurious Emissions, N mode, 40MHz, Low 2422, Average



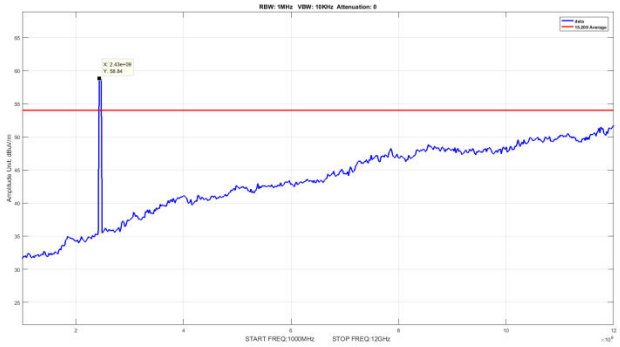
Radiated Spurious Emissions, N mode, 40MHz, Mid 2437, Peak



Radiated Spurious Emissions, N mode, 40MHz, Mid 2437, Average



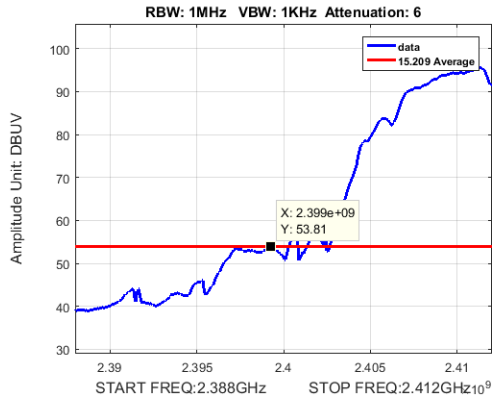
Radiated Spurious Emissions, N mode, 40MHz, High 2452, Peak



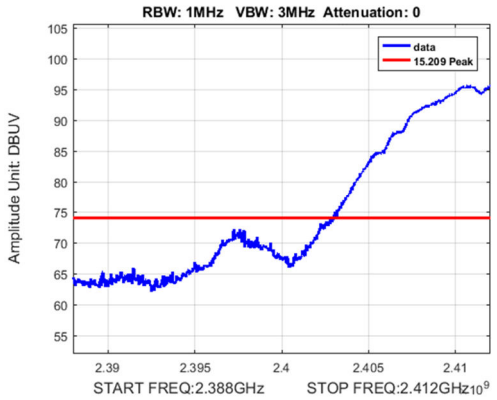
Radiated Spurious Emissions, N mode, 40MHz, High 2452, Avearge

Radiated Band Edge Measurements

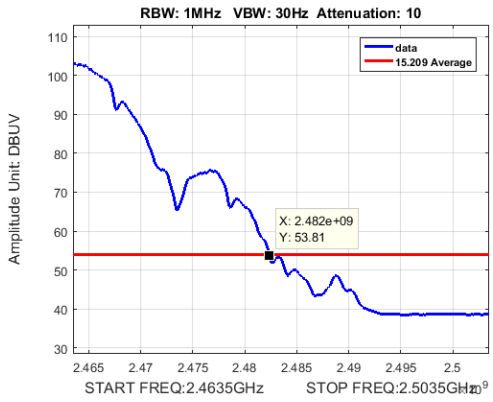
Test Procedures: The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



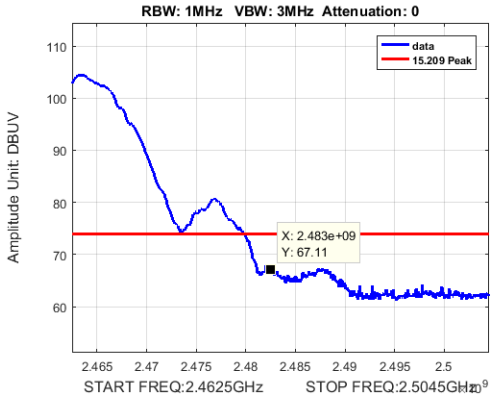
Radiated Band Edge, B mode, 20MHz, Low 2412, Avearge



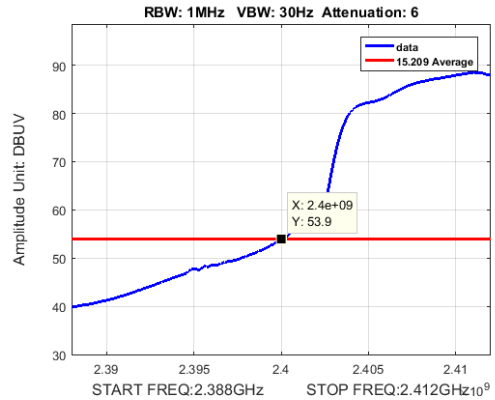
Radiated Band Edge, B mode, 20MHz, Low 2412, Peak



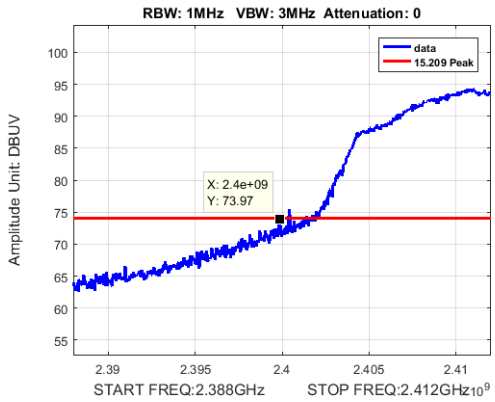
Radiated Band Edge, B mode, 20MHz, High 2462, Avearge



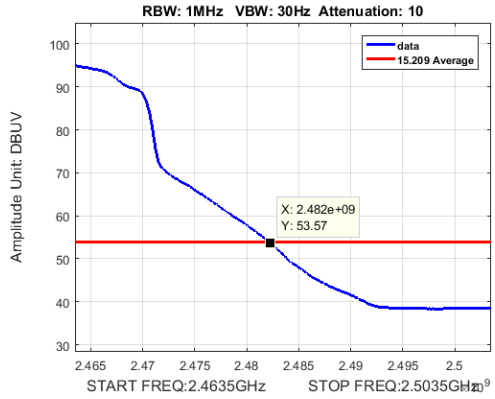
Radiated Band Edge, B mode, 20MHz, High 2462, Peak



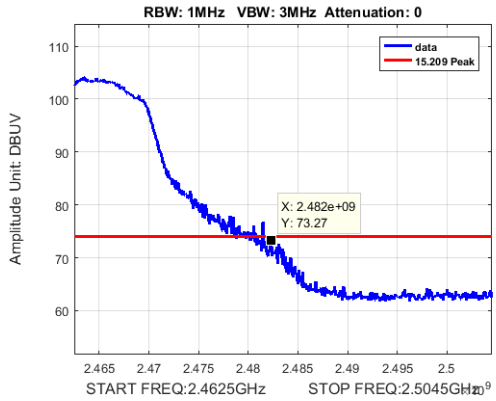
Radiated Band Edge, G mode, 20MHz, Low 2412, Avearge



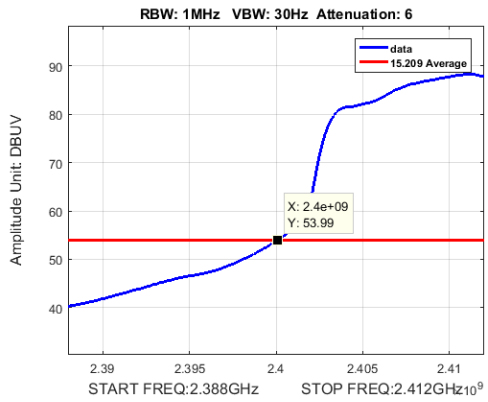
Radiated Band Edge, G mode, 20MHz, Low 2412, Peak



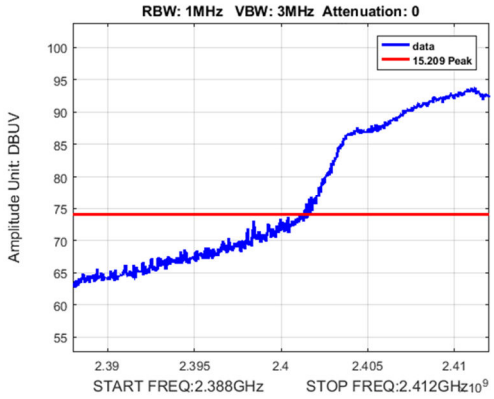
Radiated Band Edge, G mode, 20MHz, High 2462, Avearge



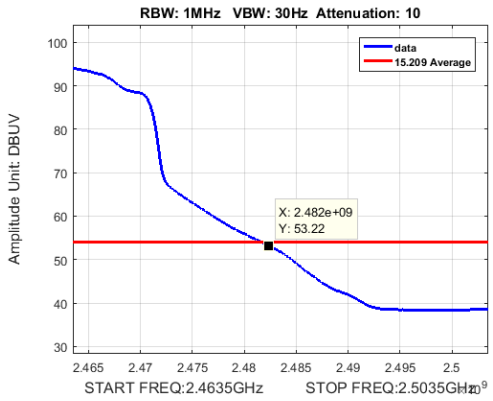
Radiated Band Edge, G mode, 20MHz, High 2462, Peak



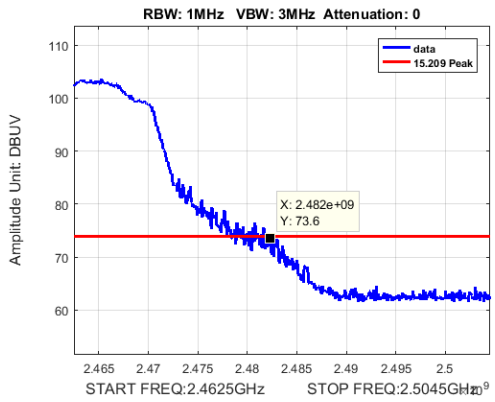
Radiated Band Edge, N mode, 20MHz, Low 2412, Avearge



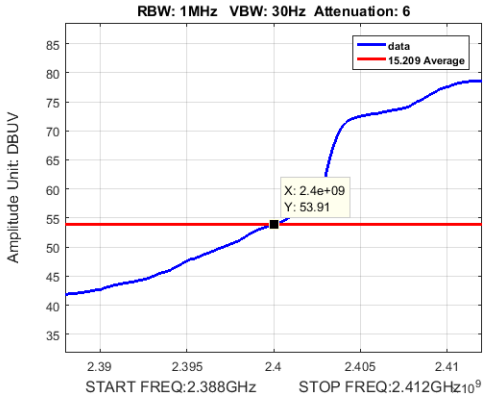
Radiated Band Edge, N mode, 20MHz, Low 2412, Peak



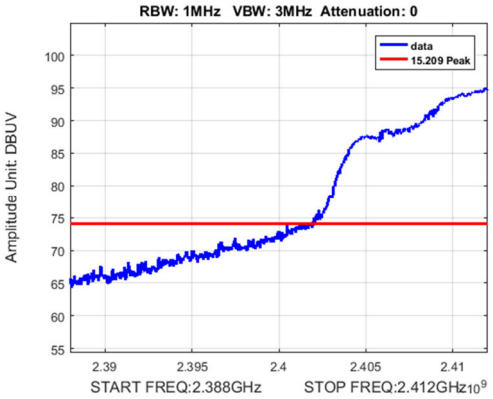
Radiated Band Edge, N mode, 20MHz, High 2462, Avearge



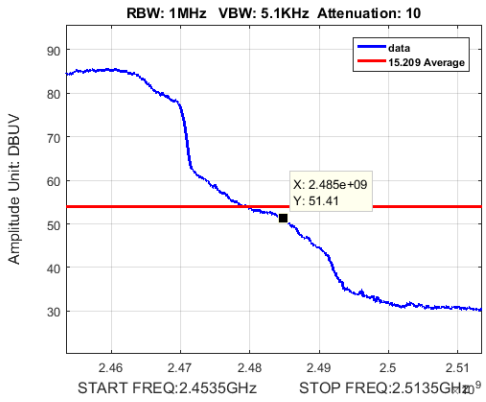
Radiated Band Edge, N mode, 20MHz, High 2462, Peak



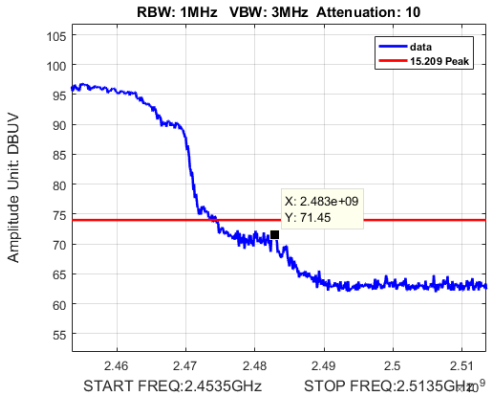
Radiated Band Edge, N mode, 40MHz, Low 2422, Avearge



Radiated Band Edge, N mode, 40MHz, Low 2422, Peak



Radiated Band Edge, N mode, 40MHz, Low 2452, Avearge



Radiated Band Edge, N mode, 40MHz, High 2452, Peak

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Spurious Emissions in Non-restricted Bands

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.

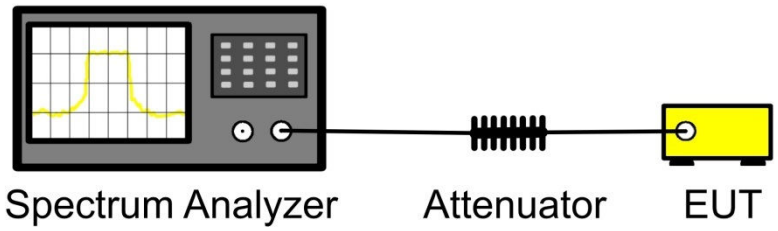
Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz,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

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 was compliant with the Spurious Emission limits of **§15.247(d)**.

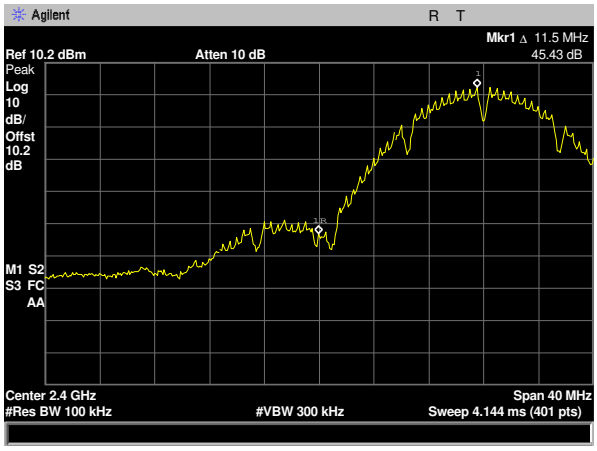
Test Engineer(s): Arsalan Hasan

Test Date(s): 04/08/2021

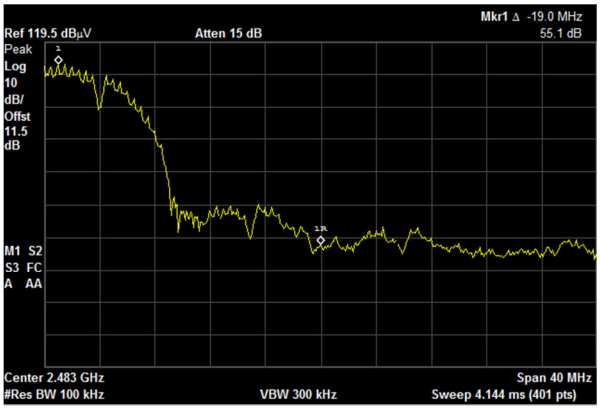


Conducted Spurious Emissions

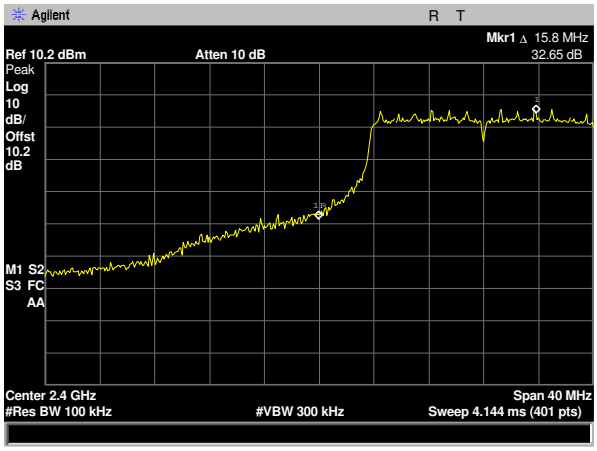
Spurious Emissions in Non-restricted Bands, Test Results



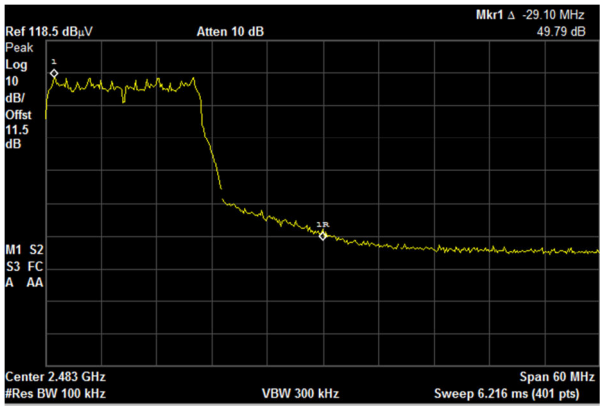
Conducted BandEdge, B mode, 20MHz, Low 2412



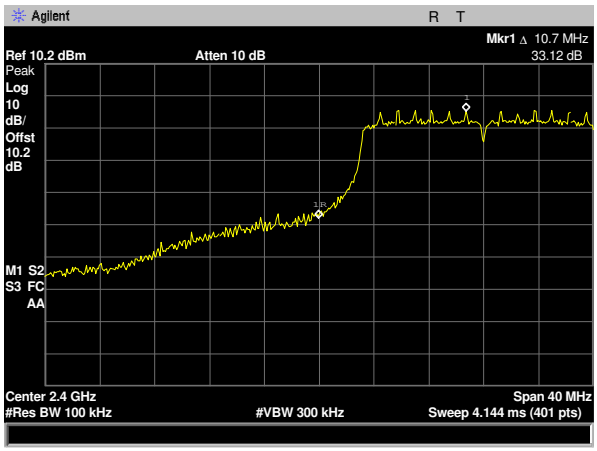
Conducted BandEdge, B mode, 20MHz, High 2462



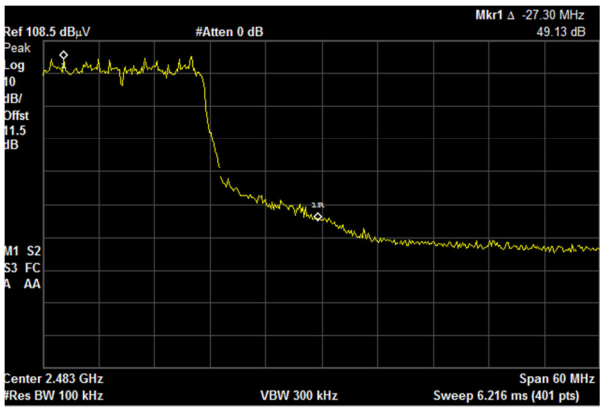
Conducted BandEdge, G mode, 20MHz, Low 2412



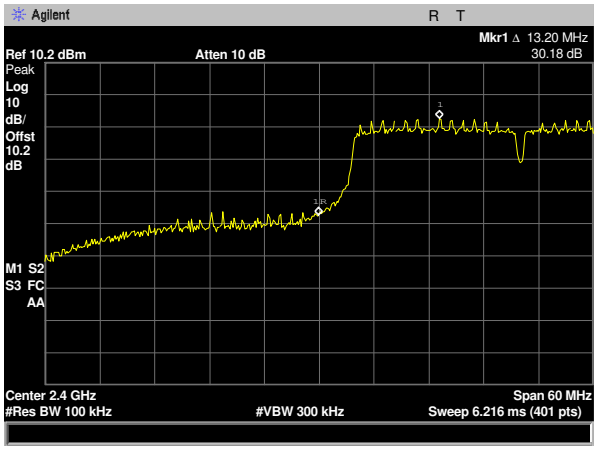
Conducted BandEdge, G mode, 20MHz, High 2462



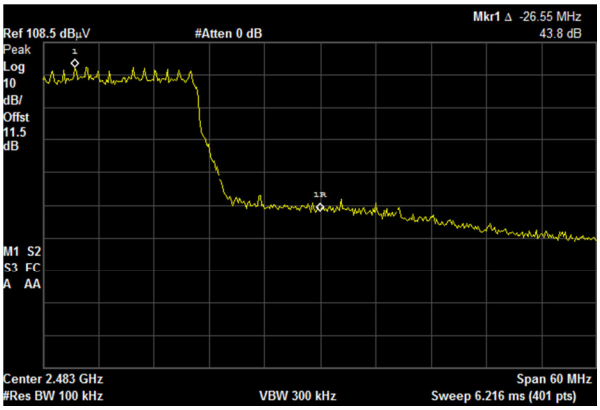
Conducted BandEdge, N mode, 20MHz, Low 2412



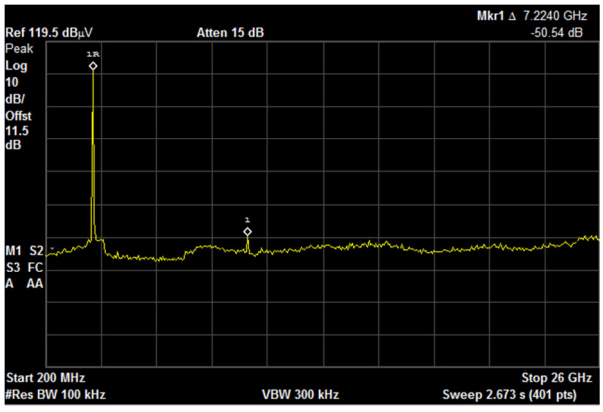
Conducted BandEdge, N mode, 20MHz, High 2462



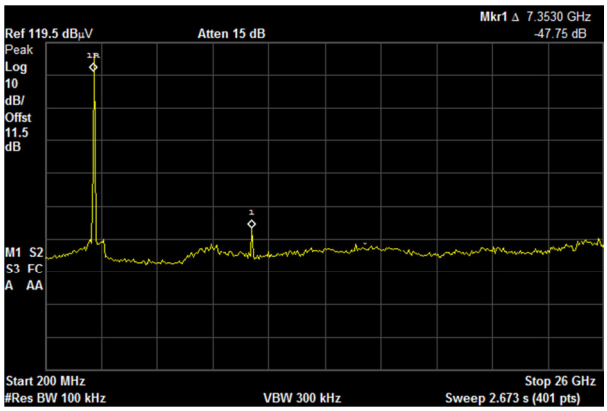
Conducted BandEdge, N mode, 40MHz, Low 2422



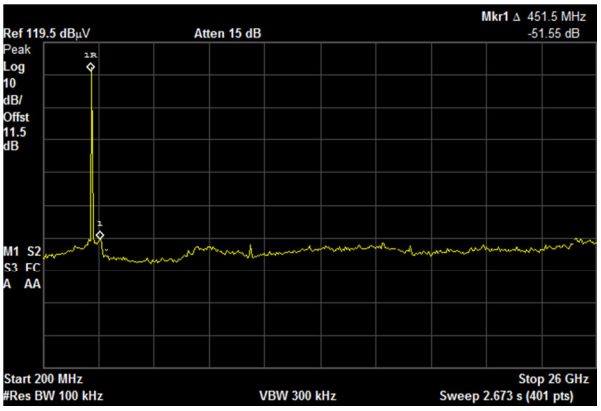
Conducted BandEdge, N mode, 40MHz, High 2452



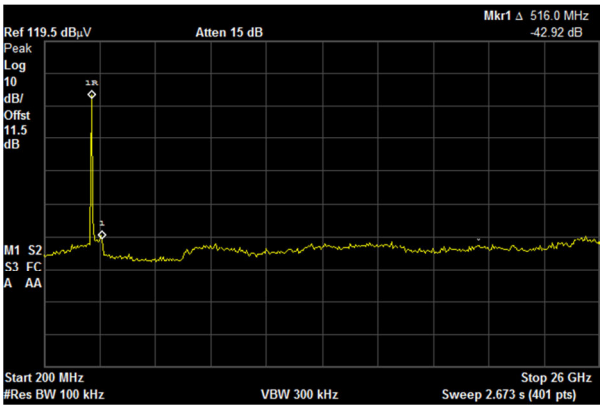
Spurious Conducted Emissions, B mode, 20MHz, Low 2412



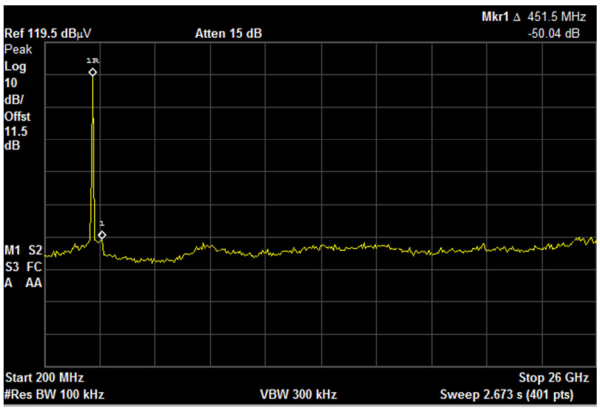
Spurious Conducted Emissions, B mode, 20MHz, Mid 2437



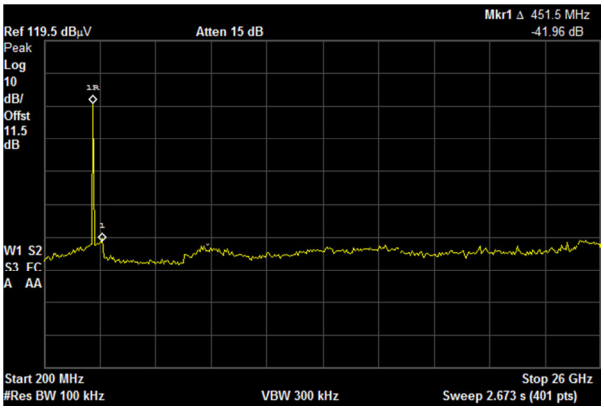
Spurious Conducted Emissions, B mode, 20MHz, High 2462



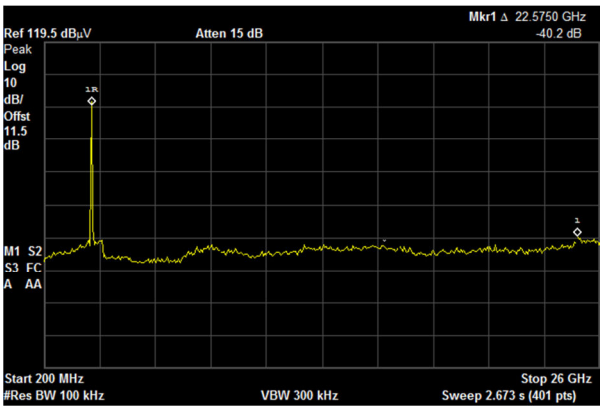
Spurious Conducted Emissions, G mode, 20MHz, Low 2412



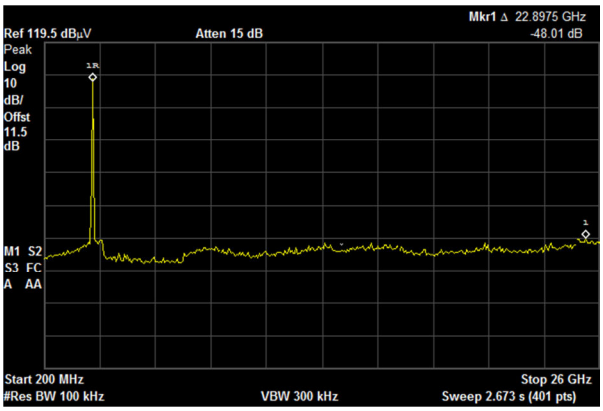
Spurious Conducted Emissions, G mode, 20MHz, Mid 2437



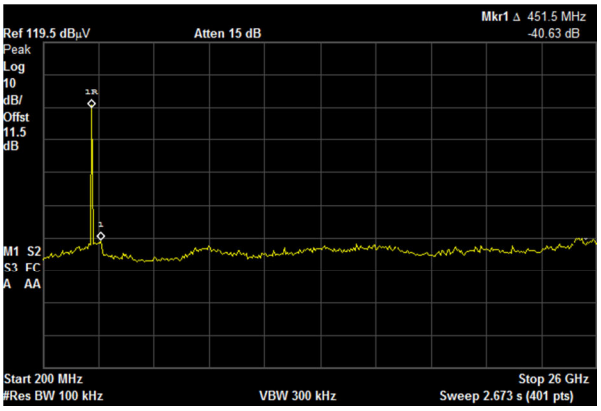
Spurious Conducted Emissions, G mode, 20MHz, High 2462



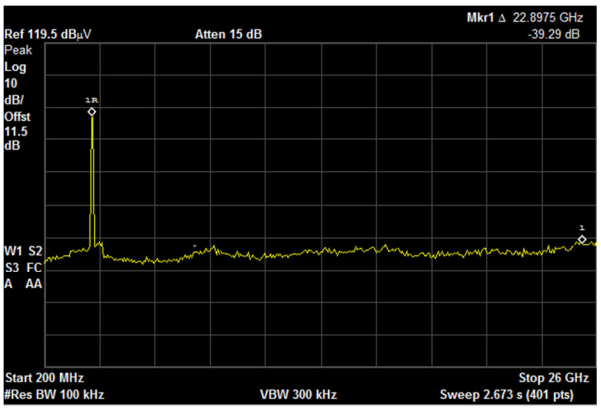
Spurious Conducted Emissions, N mode, 20MHz, Low 2412



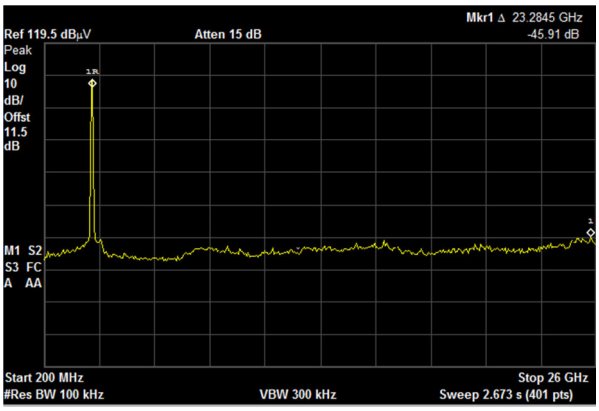
Spurious Conducted Emissions, N mode, 20MHz, Mid 2437



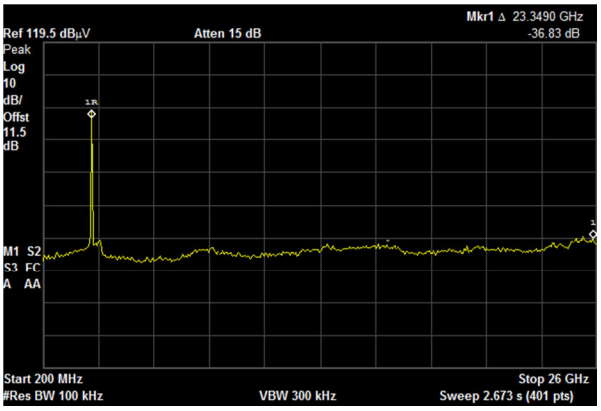
Spurious Conducted Emissions, N mode, 20MHz, High 2462



Spurious Conducted Emissions, N mode, 40MHz, Low 2422



Spurious Conducted Emissions, N mode, 40MHz, Low 2437



Spurious Conducted Emissions, N mode, 40MHz, High 2452

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 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 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 was Compliant with the peak power spectral density limits of **§ 15.247 (e)**.

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

Test Engineer: Arsalan Hasan

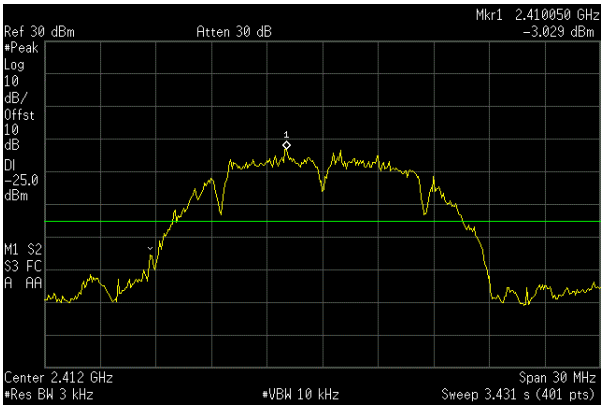
Test Date: 03/29/2021

Peak Power Spectral Density Test Results

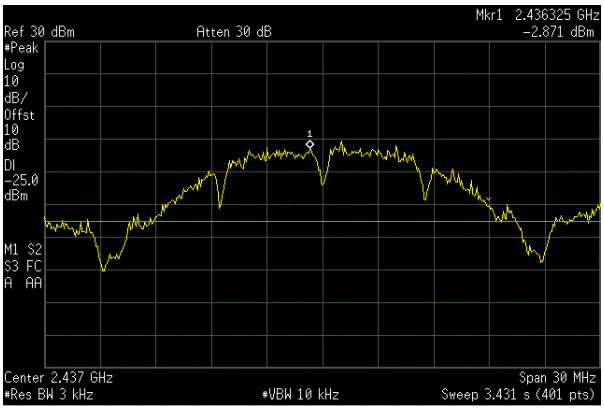
Power Spectral Density				
Mode	**Channel**	**Frequency (MHz)**	**Measured Conducted Power (dBm)**	**Limit (dBm)**
B 20MHz	Low	2412	-3.029	≤8
B 20MHz	Mid	2437	-2.871	≤8
B 20MHz	High	2462	-1.865	≤8
G 20MHz	Low	2412	-7.878	≤8
G 20MHz	Mid	2437	-4.490	≤8
G 20MHz	High	2462	-4.762	≤8
N 20MHz	Low	2412	-6.688	≤8
N 20MHz	Mid	2437	-3.570	≤8
N 20MHz	High	2462	-2.999	≤8
N 40MHz	Low	2422	-8.816	≤8
N 40MHz	Mid	2437	-7.920	≤8
N 40MHz	High	2452	-9.092	≤8

Power Spectral Density, Test Results

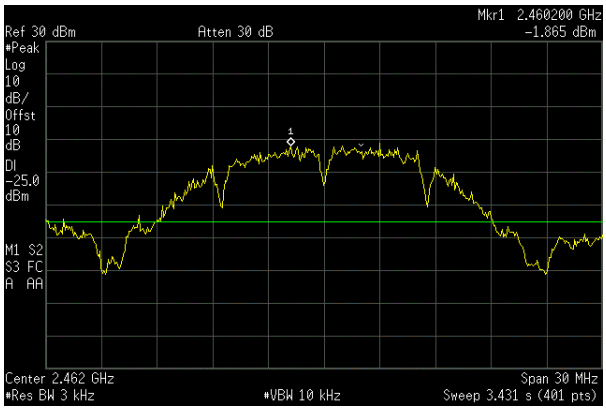
Power Spectral Density



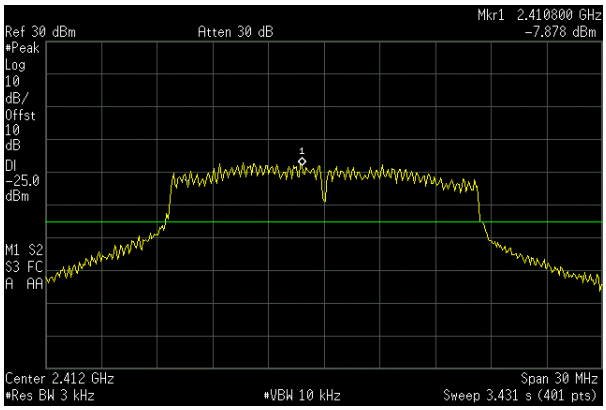
Peak Spectral Density, B mode, 20MHz, Low 2412.



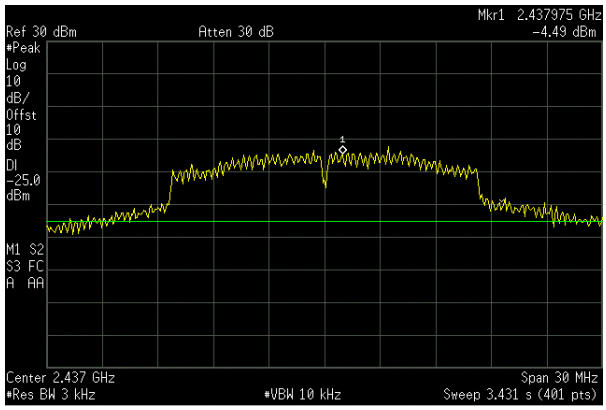
Peak Spectral Density, B mode, 20MHz, Mid 2437.



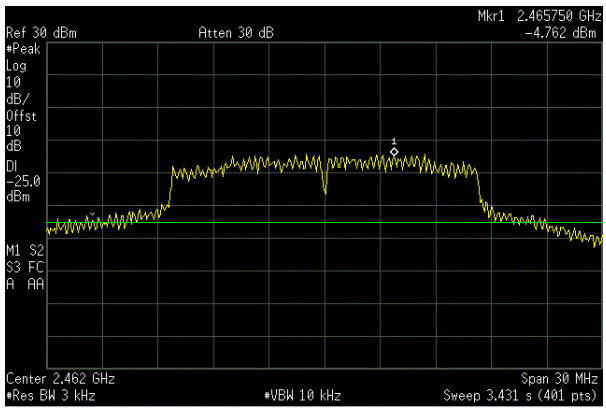
Peak Spectral Density, B mode, 20MHz, High 2462.



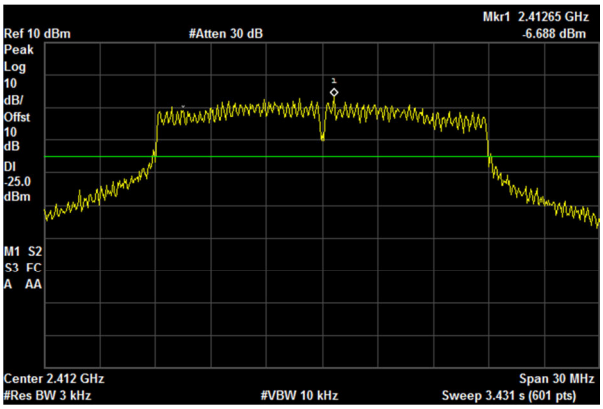
Peak Spectral Density, G mode, 20MHz, Low 2412.



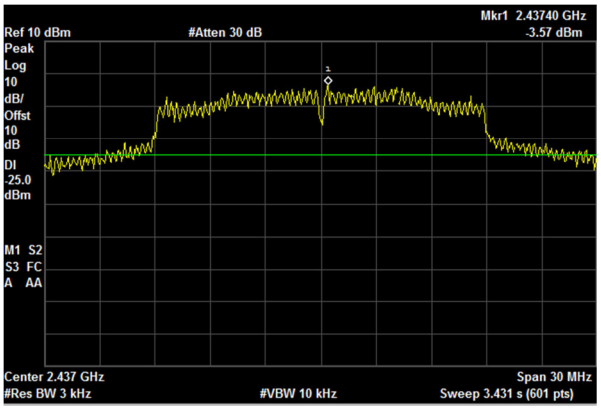
Peak Spectral Density, G mode, 20MHz, Mid 2437.



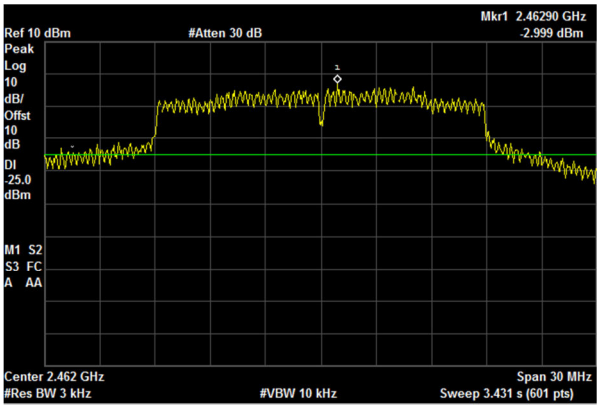
Peak Spectral Density, G mode, 20MHz, High 2462.



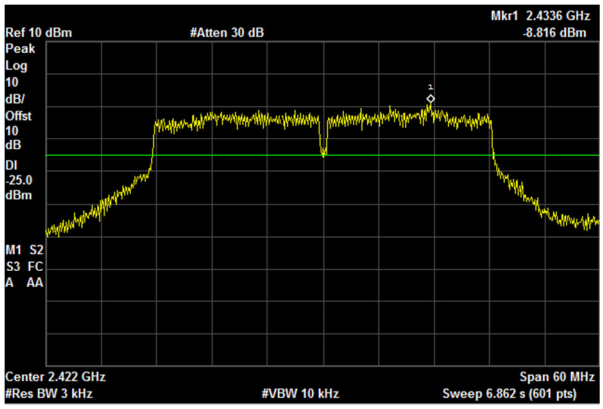
Peak Spectral Density, N mode, 20MHz, Low 2412



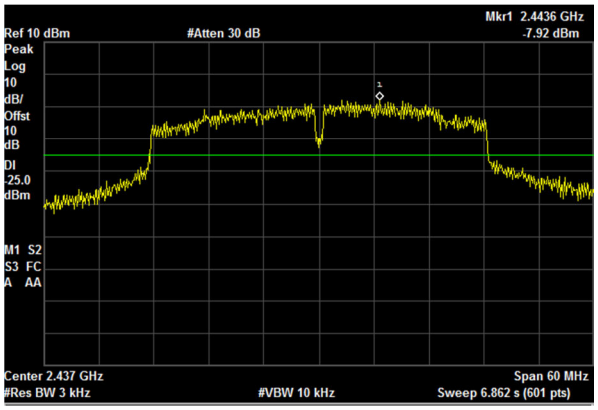
Peak Spectral Density, N mode, 20MHz, Mid 2437



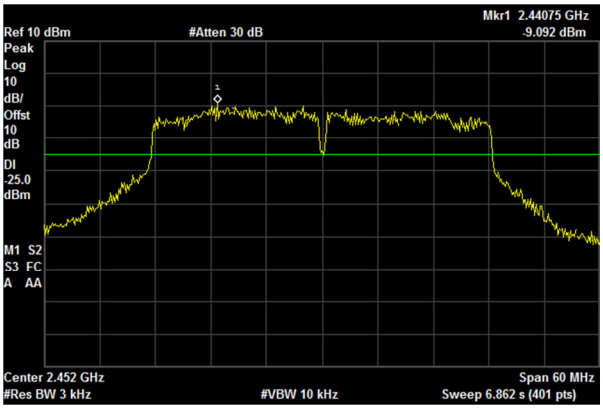
Peak Spectral Density, N mode, 20MHz, High 2462



Peak Spectral Density, N mode, 40MHz, Low 2422



Peak Spectral Density, N mode, 40MHz, Mid 2437



Peak Spectral Density, N mode, 40MHz, High 2452

IV. Test Equipment

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
1S4075	RADIO COMMUNICATION TESTER	ROHDE & SCHWARZ	CMW500	09/20/2020	09/20/2022
1S2399	TURNTABLE/MAST CONTROLLER	SUNOL SCIENCES	SC99V	SEE NOTE 1	
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	03/19/2021	06/19/2022
1S2733	BILOG ANTENNA	TESEQ	CBL6112D	06/05/2019	06/05/2021
1S3826	DRG HORN ANTENNA	ETS-LINDGREN	3117	12/03/2020	12/03/2022
1S2198	DRG HORN ANTENNA	ETS-LINDGREN	3117	10/07/2019	10/07/2021
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	
1S3824	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMA100B	11/06/2019	05/06/2021

Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

End of Report