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

8/16/2024

HP Inc.
Tony Griffiths
1501 Page Mill Road
Palo Alto, CA, 943041126
USA

Dear Tony Griffiths,

Enclosed is the EMC Wireless test report for compliance testing of the HP Inc. model PATX-STX-72R as tested to the requirements of FCC Part 15.247 and RSS-247 Issue 3 for Intentional Radiators.

Thank you for using the services of Eurofins MET Labs. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS MET LABS

Nancy LaBrecque
Documentation Department

Reference: WIRA131254-FCC 247 RSS247 DTS BLE_R2

Bluetooth Low Energy
Test Report

for the

HP Inc.
PATX-STX-72R

Tested under
FCC Part 15.247 and RSS-247 Issue 3
For Intentional Radiators

Bryan Taylor, Wireless Team Lead
Electromagnetic Compatibility Lab

Nancy LaBrecque
Documentation Department

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.

Matthew Hinojosa
EMC Manager, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	6/11/2024	Initial Issue.
1	7/11/2024	Changes requested by client
2	8/16/2024	Changes requested by client

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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**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
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 model PATX-STX-72R, with the requirements of FCC Part 15.247 and RSS-247 Issue 3. HP Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the model PATX-STX-72R, 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 FCC Part 15.247 and RSS-247 Issue 3, in accordance with HP, Inc. purchase order number 3700139236. All tests were conducted using measurement procedures ANSI C63.4-2014 and ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-247 Issue 3 RSS-GEN Issue 5	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	---	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN(8.8)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	RSS-247 (5.2)	6dB Occupied Bandwidth	Compliant
---	RSS-GEN(6.7)	99% Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-247(5.4)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	RSS-GEN (6.13), (8.9), & (8.10)	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RSS-247(5.5)	RF Conducted Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-247(5.2)	Peak Power Spectral Density	Compliant

Figure 1. Executive Summary

II. Equipment Configuration

A. Overview

Eurofins MET Labs was contracted by HP, Inc. to perform testing on the model PATX-STX-72R, under HP, Inc.'s purchase order number 3700139236.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the model PATX-STX-72R.

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

Product Marketing Name Tested:	Poly Studio X72	
Product Marketing Name Included by Similarity:	Poly Studio V72 (Note: this is a software depopulated version of the Poly Studio X72)	
Model(s) Number:	PATX-STX-72R	
FCCID:	M72-STX72R	
ICID:	1849C-STX72R	
EUT Specifications:	Primary Power: 100 – 230VAC	
	Frequency Range: 50Hz / 60Hz	
	Type of Modulations:	GFSK
	Equipment Code:	DTS
	Peak RF Output Power:	-0.68dBm
	EUT Frequency Ranges:	2402-2480 MHz
	Antenna Gain (declared by HP, Inc.)	3.1dBi
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Bryan Taylor	
Report Date(s):	8/16/2024	

Description	Model Number	Part Number	Serial Number	Rev #
Poly Studio X72 (Conducted Radio System)	PATX-STX-72R	2215-88502-001	8G241085CDA0FZ	HWv3
Poly Studio X72 (Radiated Radio System)	PATX-STX-72R	2215-88502-001	8G24098E9084FZ	HWv3
Mass Power AC/DC PSU	S065 1A1205 00B3	N/A	N/A	N/A

Figure 2. EUT List

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 3, August 2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN, Issue 5, March 2019	General Requirements and Information for the Certification of Radio Apparatus
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

Figure 3. References

C. Test Site

All testing was performed at Eurofins MET Labs, 13501 McCallen Pass, Austin, TX 78753. 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 10 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 MET Laboratories.

ISED Lab Info:
CAB Identifier: US0004
Company Number: 2043D

FCC Lab Info:
Designation Number: US1127

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
Occupied Bandwidth Measurements	±4.52 Hz	2	95%
Conducted Power Measurements	±2.74 dB	2	95%
Power Spectral Density Measurements	±2.74 dB	2	95%
Conducted Spurious Emissions	±2.80 dB	2	95%
Conducted Emissions (Mains)	±2.97 dB	2	95%
Radiated Spurious Emissions (9kHz – 1GHz)	±2.95 dB	2	95%
Radiated Spurious Emissions (1GHz - 40GHz)	±3.54 dB	2	95%

Figure 4. Uncertainty Calculations Summary

E. Description of Test Sample

The HP Inc. model PATX-STX-72R (marketed as Poly Studio X72 or Poly Studio V72), is a video conferencing bar designed to act as a video endpoint over LAN networks. The device is powered by an external AC/DC power supply and the top-level model the PATX-STX-72R contains 2.4GHz / 5GHz Wi-Fi (6) and Bluetooth radio interfaces.

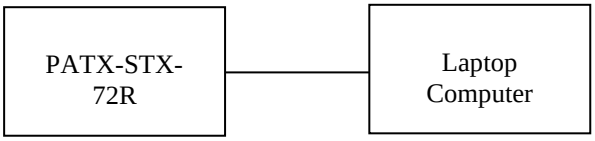


Figure 5. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 5, Block Diagram of Test Setup. The laptop computer was used to send test commands to force the transmitters to operate in the appropriate test mode.

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Name/Description	Manufacturer	Model Number	Customer Supplied Calibration Data
3mm Audio Headset and Mic	N/A	N/A	N/A
Poly External RJ11 Mic	Poly	2201-87610-001	N/A
HP USB Keyboard	HP	KU-0316	N/A
Dell Inspiron Laptop	Dell	P107F	N/A
Bluetooth remote Controller	Poly/Remotec	P010	N/A
Poly External IP Mic (RJ45)	Poly	P013	N/A
Delta Midspan POE Injector	Delta	ADH-45AR-F	N/A
HP 4K Monitor	HP	1B9T0AA	N/A
HP 4K Monitor	HP	1B9T0AA	N/A
CISCO AIR Wi-Fi Router	CISCO	AIR-LAP1142N-A-K9	N/A
CISCO WAN Wired Router	CISCO	RV042G	N/A
Poly Studio X30	Poly	P018	N/A
LG Monitor	LG	24UD58-B	N/A

Figure 6. Support Equipment

A. Ports and Cabling Information

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
Stereo Line IN	Wired 3mm		1m	1m	No	Headset
Stereo Line OUT	Wired 3mm		1m	1m	No	Mic
Mic Port	RJ11 Cable		5m	5m	Yes	Poly External Microphone
RJ45 Corporate	Cat 5e		4.5	4.5	Yes	Cloud/Router
RJ45 LLN	Cat 5e		4.5	4.5	Yes	IP Mic via POE Injector
HDMI Aux Out	HDMI		2m	2m	Yes	4K Monitor
HDMI Primary Out	HDMI		2m	2m	Yes	4K Monitor
HDMI Content Input	HDMI		2m	2m	Yes	Dell Laptop
USB 3.0	USB		2m	2m	Yes	USB Mouse
USB 3.0	USB		2m	2m	Yes	USB Keyboard
USB 3.1 Type C					No	Service port only

Figure 7. Ports and Cabling Information

B. Mode of Operation

The support laptop provided a direct means of controlling transmitter parameters. Unless otherwise stated or shown, all tests were performed at worst-case modulation and data rates on the following channels.

Transmit Band	Operating Mode	Channel Frequencies Tested	Test Tool Power Setting
2400 – 2483.5MHz	1Mbps	2402MHz / 2440MHz / 2480MHz	9.0dBm
	2Mbps	2402MHz / 2440MHz / 2480MHz	9.0dBm

Figure 8. Test Channels Utilized

C. Method of Monitoring EUT Operation

A spectrum analyzer was used to confirm proper transmitter operation.

D. 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.

E. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to HP 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 as tested is compliant the criteria of §15.203. The TX antenna is not accessible by the end user.

Test Engineer(s): Bryan Taylor

Test Date(s): 4/17/2024

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

Figure 9. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

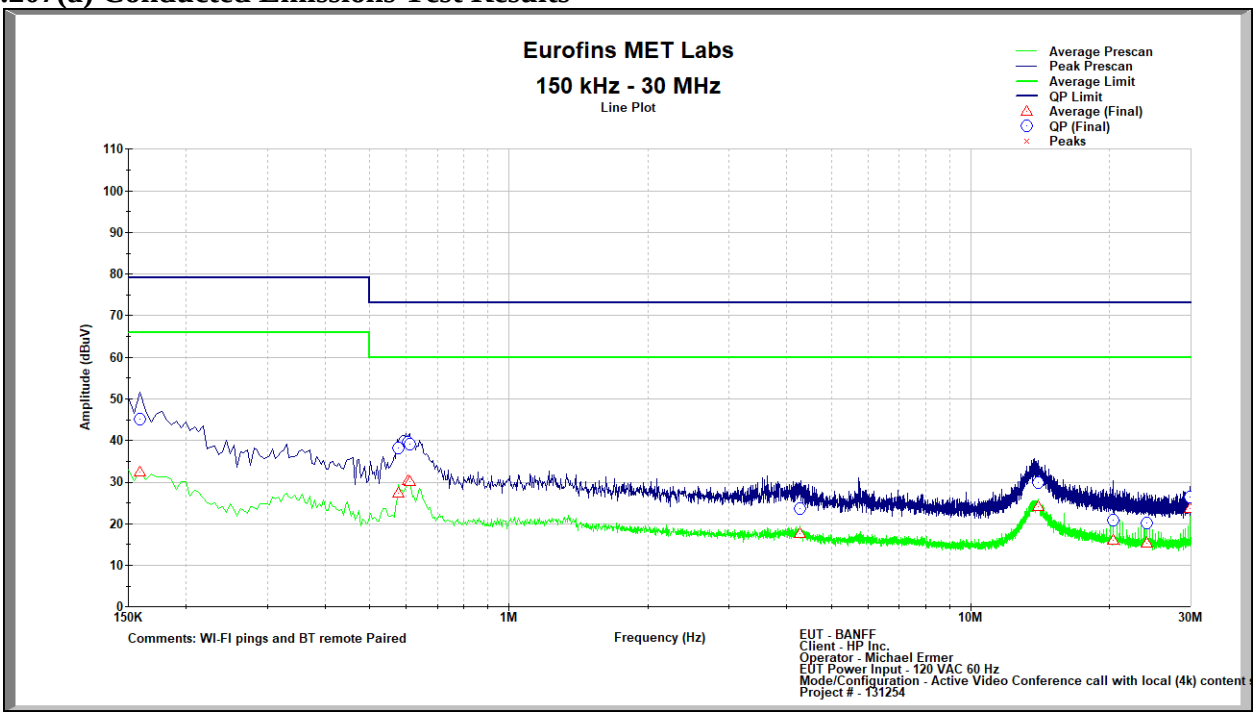
Test Procedure: The EUT was placed on a 0.8 m-high wooden table. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 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 C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed using a 50 Ω/50 μH LISN as the input transducer to an EMI receiver. For the purpose of this testing, the transmitter was turned on.

Test Results: The EUT was compliant with this requirement.

Test Engineer(s): Michael Ermer

Test Date(s): 4/15/2024

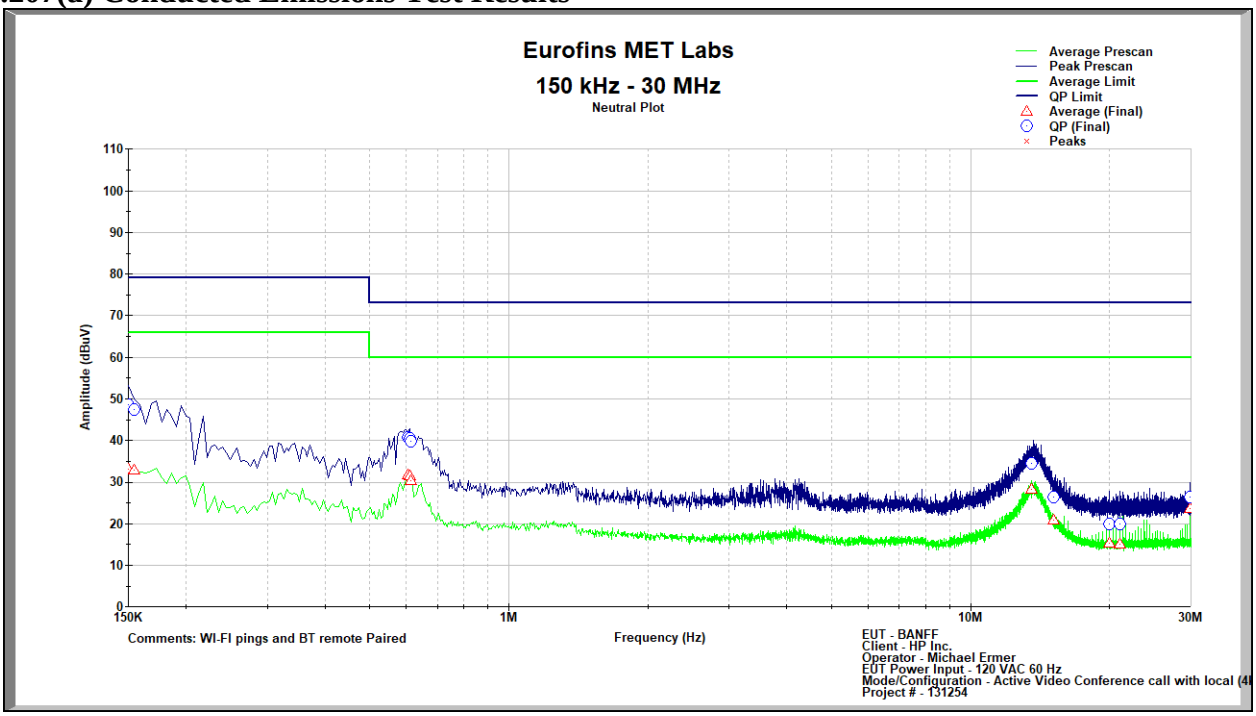
15.207(a) Conducted Emissions Test Results



Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)
0.159	45.101	79.000	33.899	32.382	66.000	33.618
0.578	38.186	73.000	34.814	27.347	60.000	32.653
0.605	39.510	73.000	33.490	30.445	60.000	29.555
0.609	39.216	73.000	33.784	30.170	60.000	29.830
4.264	23.631	73.000	49.369	17.609	60.000	42.391
14.034	29.815	73.000	43.185	24.198	60.000	35.802
20.378	20.756	73.000	52.244	16.011	60.000	43.989
24.111	20.113	73.000	52.887	15.369	60.000	44.631
29.828	26.338	73.000	46.662	23.569	60.000	36.431

Figure 10. Conducted Emissions, 15.207(a), Phase, Test Results

15.207(a) Conducted Emissions Test Results



Frequency (MHz)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)	Average (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)
0.150	48.532	79.000	30.468	33.043	66.000	32.957
0.154	47.515	79.000	31.485	32.825	66.000	33.175
0.605	40.702	73.000	32.298	31.615	60.000	28.385
0.609	40.488	73.000	32.512	31.533	60.000	28.467
0.614	39.855	73.000	33.145	30.279	60.000	29.721
13.543	34.453	73.000	38.547	28.332	60.000	31.668
15.120	26.472	73.000	46.528	20.810	60.000	39.190
20.000	19.879	73.000	53.121	15.234	60.000	44.766
21.017	19.832	73.000	53.168	15.092	60.000	44.908
29.828	26.316	73.000	46.684	23.562	60.000	36.438

Figure 11. Conducted Emissions, 15.207(a), Neutral, Test Results

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 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% of the total emission bandwidth, and the VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

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

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

Test Engineer(s): Bryan Taylor

Test Date(s): 5/8/2024

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN (6.7) 99% Bandwidth

Test Requirements: The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency rang between two points, one above and the other blow 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 connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth, and the VBW > RBW. The 99% Bandwidth was measured and recorded.

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

Test Engineer(s): Bryan Taylor

Test Date(s): 5/8/2024

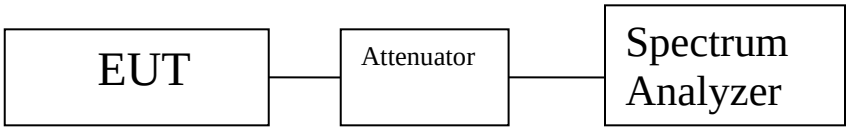


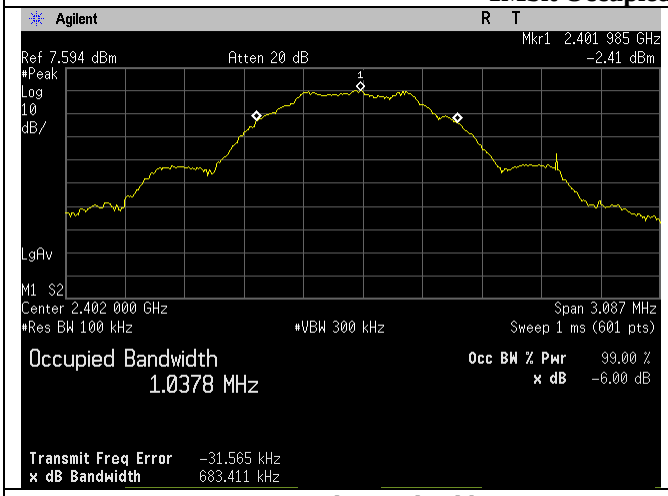
Figure 12. Block Diagram, Occupied Bandwidth Test Setup

Configuration / Channel Tested	-6dB BW (MHz)	99% BW (MHz)
BLE_Low Ch_2402MHz_1MBit	0.683	1.027
BLE_Mid Ch_2440MHz_1MBit	0.696	1.023
BLE_High Ch_2480MHz_1MBit	0.670	1.017
BLE_Low Ch_2402MHz_2MBit	1.128	2.017
BLE_Mid Ch_2440MHz_2MBit	1.276	2.003
BLE_High Ch_2480MHz_2MBit	1.147	2.017

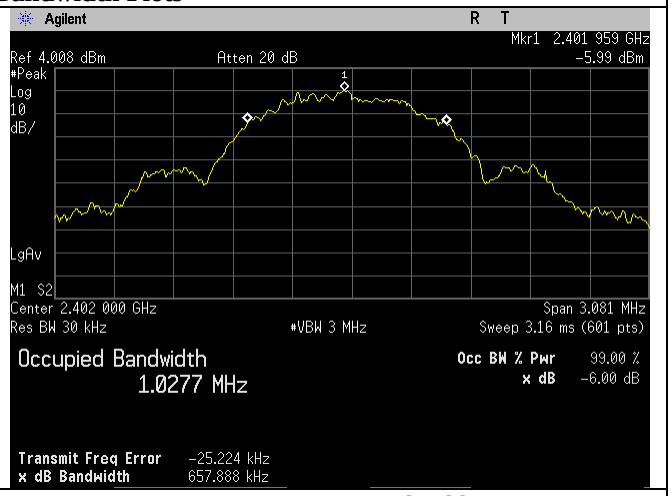
Figure 13. 99% and 6 dB Occupied Bandwidth, Test Results

Occupied Bandwidth Test Results

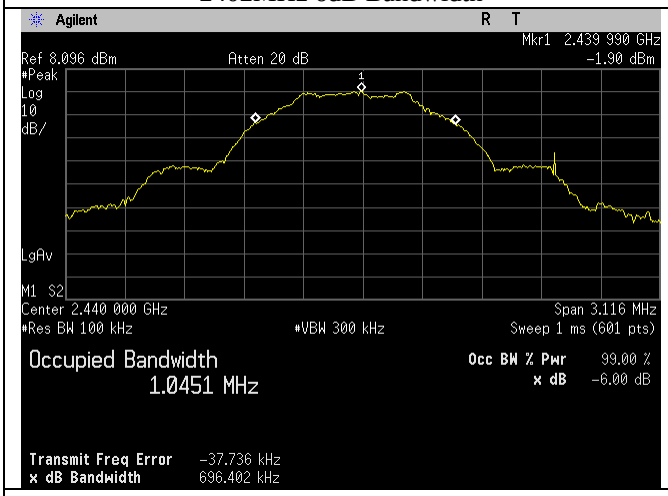
1Mbit Occupied Bandwidth Plots



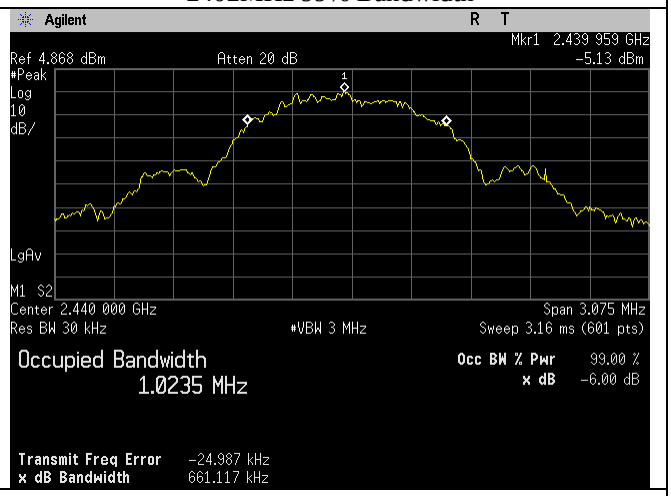
2402MHz 6dB Bandwidth



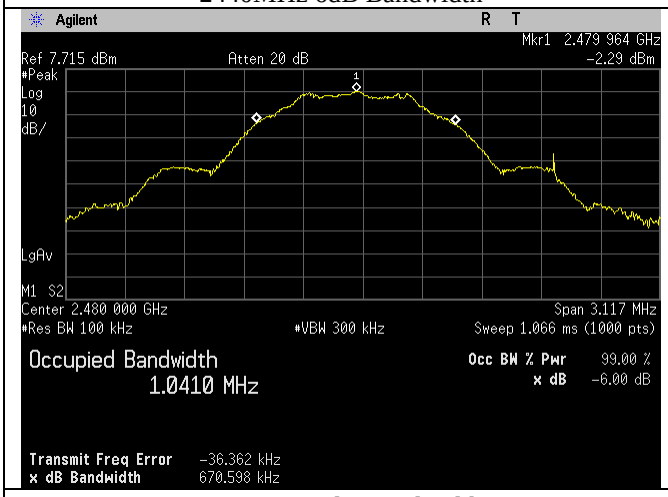
2402MHz 99% Bandwidth



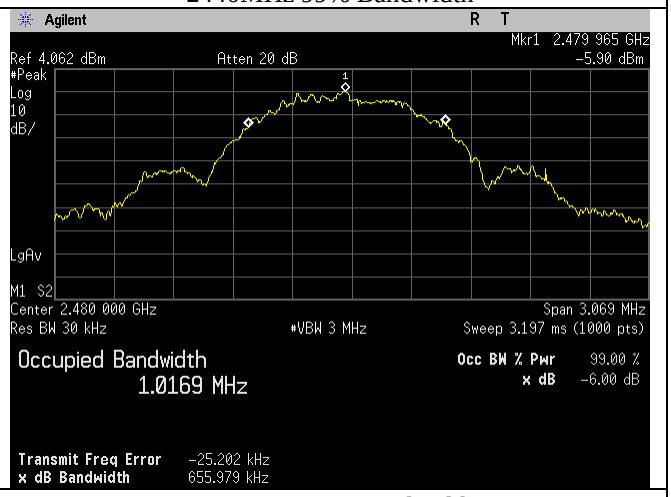
2440MHz 6dB Bandwidth



2440MHz 99% Bandwidth

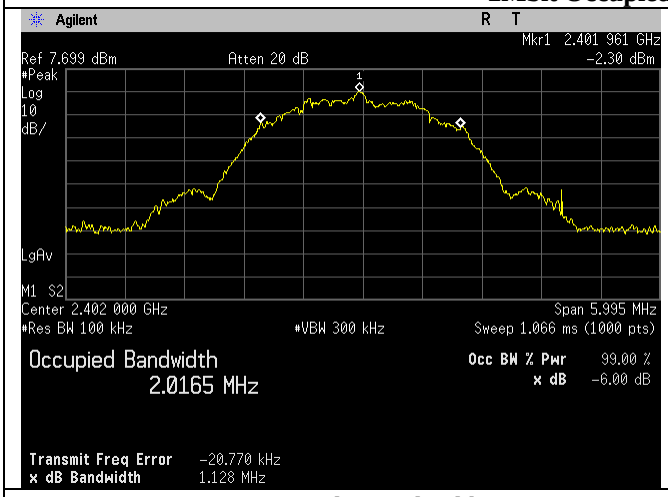


2480MHz 6dB Bandwidth

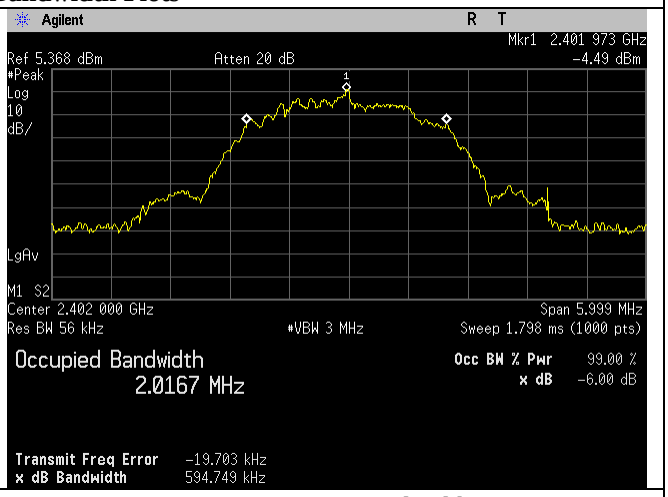


2480MHz 99% Bandwidth

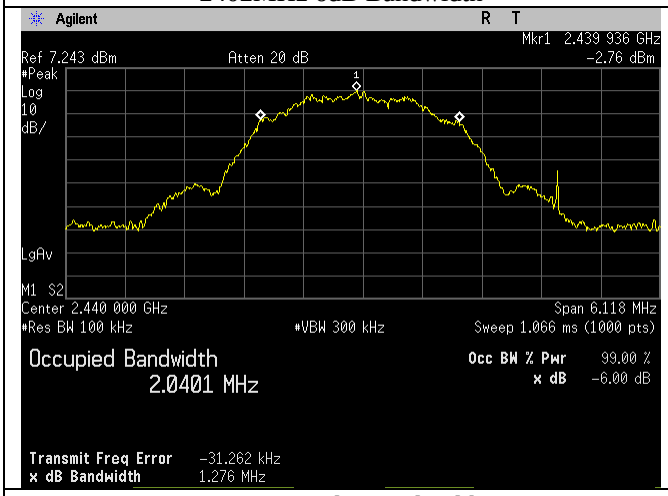
2Mbit Occupied Bandwidth Plots



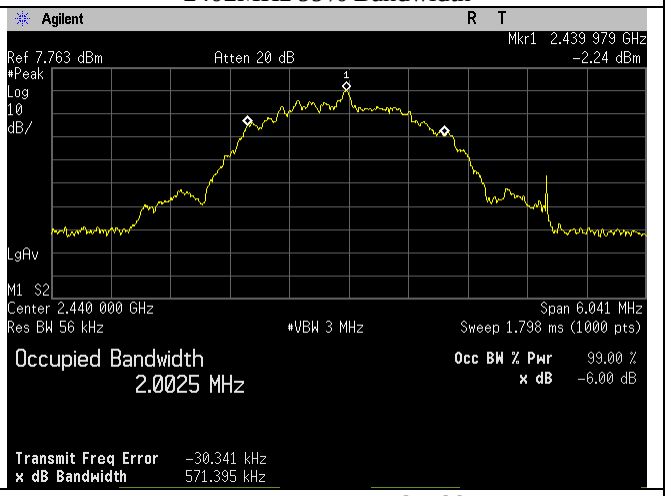
2402MHz 6dB Bandwidth



2402MHz 99% Bandwidth

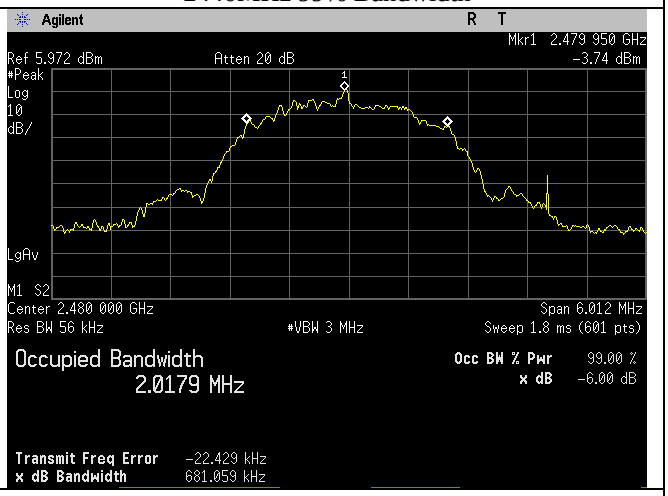


2440MHz 6dB Bandwidth



2440MHz 99% Bandwidth

2480MHz 6dB Bandwidth



2480MHz 99% Bandwidth

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

Figure 14. 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 **Error! Reference source not found.**, 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.

RSS-247 EIRP Limit: 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 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The analyzer reference level was offset by cable loss connecting to the test sample. The peak power was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)** and the EIRP limits from RSS-247.

Test Engineer(s): Bryan Taylor

Test Date(s): 5/8/2024

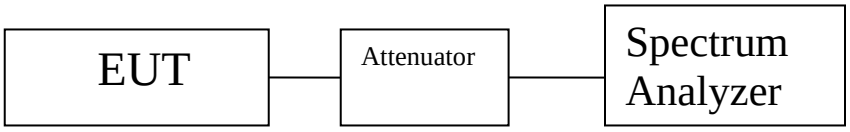


Figure 15. Peak Power Output Test Setup

Test Results

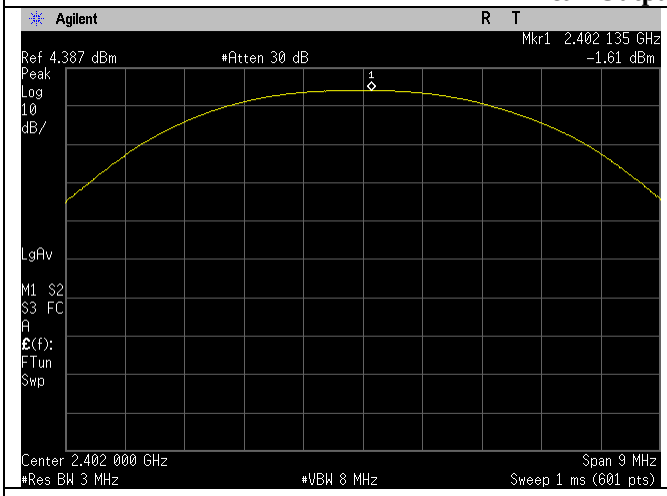
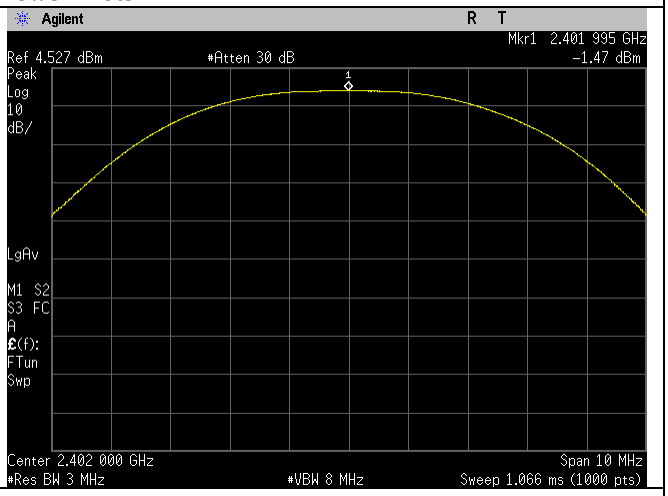
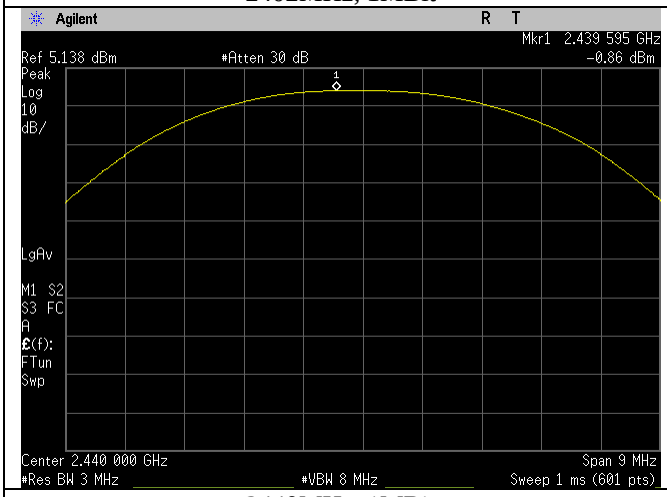
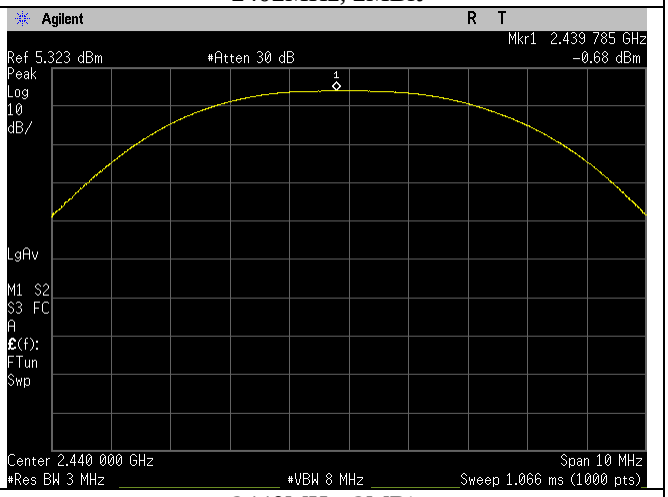
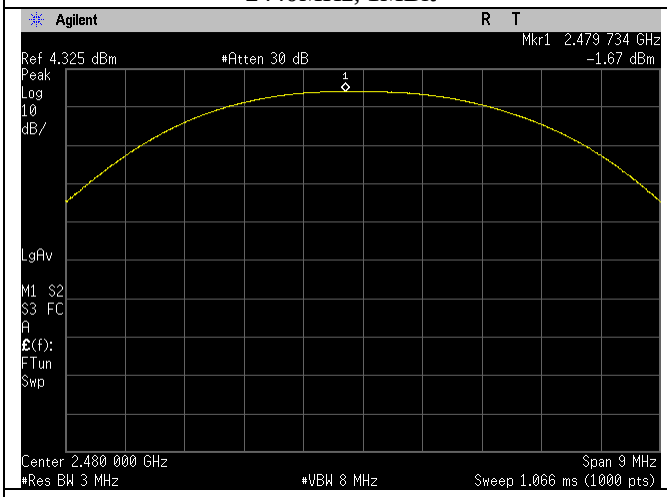
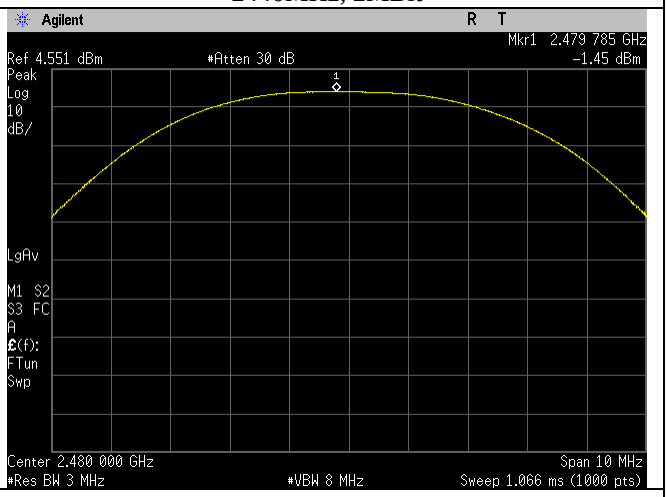
Configuration / Channel Tested	Pk. Conducted Power (dBm)	Limit (dBm)	Margin dB
BLE_Low Ch_2402MHz_1MBit	-1.61	30	31.61
BLE_Mid Ch_2440MHz_1MBit	-0.86	30	30.86
BLE_High Ch_2480MHz_1MBit	-1.67	30	31.67
BLE_Low Ch_2402MHz_2MBit	-1.47	30	31.47
BLE_Mid Ch_2440MHz_2MBit	-0.68	30	30.68
BLE_High Ch_2480MHz_2MBit	-1.45	30	31.45

Figure 16. Peak Power Output, Test Results

Configuration / Channel Tested	Pk. Conducted Power (dBm)	Antenna Gain (dBi)	EIRP	Limit (dBm)	Margin dB
BLE_Low Ch_2402MHz_1MBit	-1.61	3.1	1.49	36	34.51
BLE_Mid Ch_2440MHz_1MBit	-0.86	3.1	2.24	36	33.76
BLE_High Ch_2480MHz_1MBit	-1.67	3.1	1.43	36	34.57
BLE_Low Ch_2402MHz_2MBit	-1.47	3.1	1.63	36	34.37
BLE_Mid Ch_2440MHz_2MBit	-0.68	3.1	2.42	36	33.58
BLE_High Ch_2480MHz_2MBit	-1.45	3.1	1.65	36	34.35

Figure 17. EIRP, Test Results

Peak Power Output Test Results

Peak Output Power Plots	
	
2402MHz, 1MBit	2402MHz, 2MBit
	
2440MHz, 1MBit	2440MHz, 2MBit
	
2480MHz, 1MBit	2480MHz, 2MBit

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak 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. The RBW was set between 3kHz and 100 kHz. The VBW was set to 3x the RBW. 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 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: Bryan Taylor

Test Date: 5/8/2024

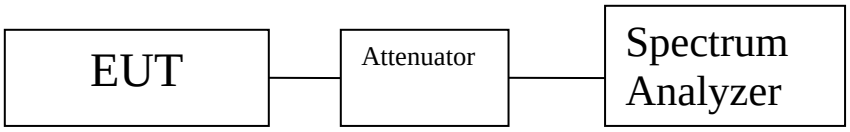


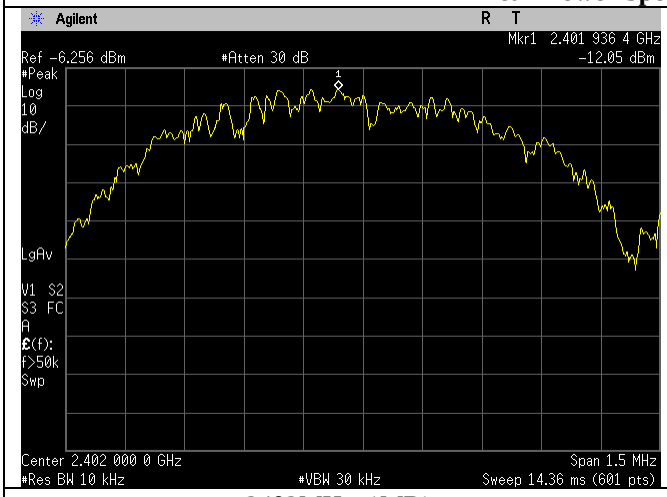
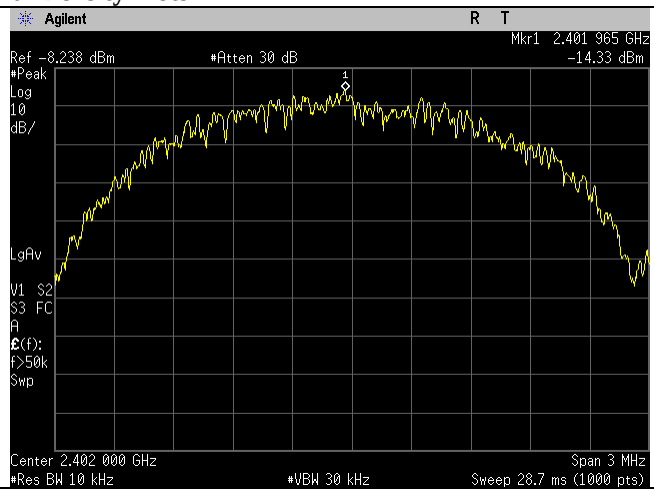
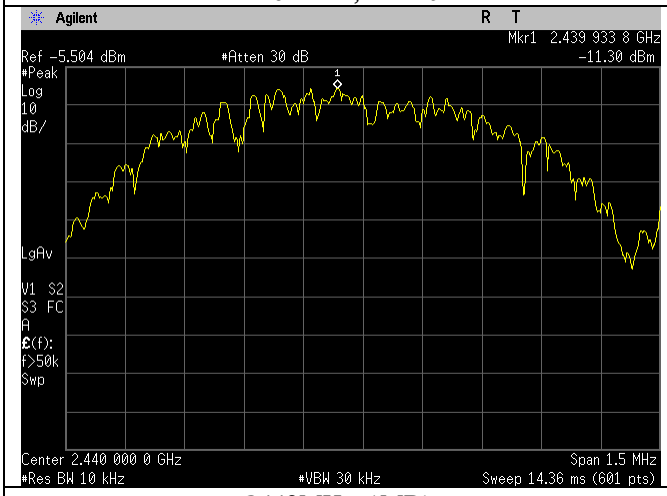
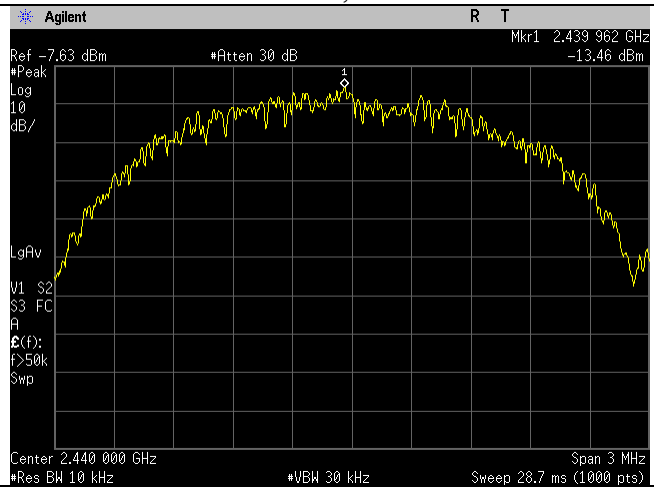
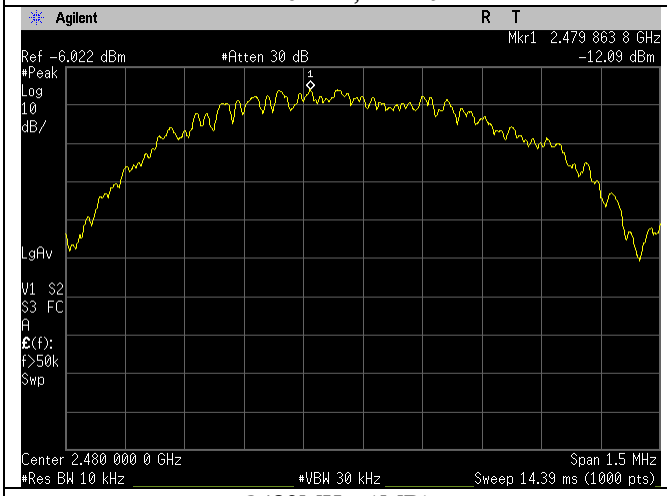
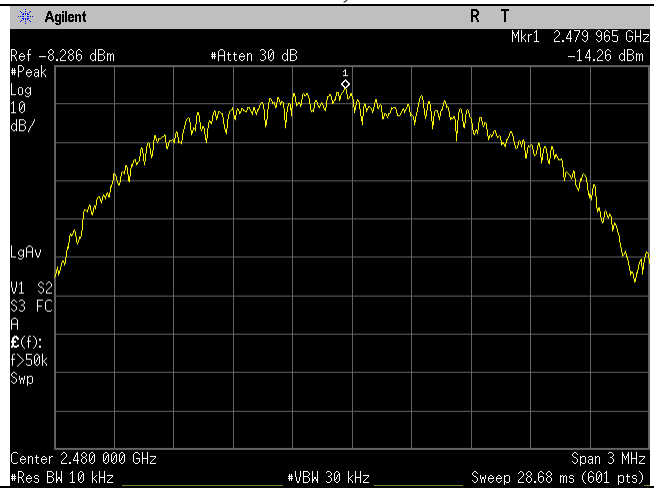
Figure 18. Block Diagram, Peak Power Spectral Density Test Setup

Configuration / Channel Tested	Peak PSD (dBm/10kHz)	RBW Adjustment 10log(3/10)*	Peak PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
BLE_Low Ch_2402MHz_1MBit	-12.05	-5.22	-17.27	8	25.27
BLE_Mid Ch_2440MHz_1MBit	-11.3	-5.22	-16.52	8	24.52
BLE_High Ch_2480MHz_1MBit	-12.09	-5.22	-17.31	8	25.31
BLE_Low Ch_2402MHz_2MBit	-14.33	-5.22	-19.55	8	27.55
BLE_Mid Ch_2440MHz_2MBit	-13.46	-5.22	-18.68	8	26.68
BLE_High Ch_2480MHz_2MBit	-14.26	-5.22	-19.48	8	27.48

*The measured power density used a resolution bandwidth of 10kHz. A factor of -5.22 was added to the measured power density to transform the reading to units of dBm/3kHz.

Figure 19. Peak Power Spectral Density, Test Results

Peak Power Spectral Density

Peak Power Spectral Density Plots	
	
2402MHz, 1MBit	2402MHz, 2MBit
	
2440MHz, 1MBit	2440MHz, 2MBit
	
2480MHz, 1MBit	2480MHz, 2MBit

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements

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 transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. The RBW was set to 100 kHz. The VBW was set to 3x the RBW. 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.

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

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

Test Engineer(s): Bryan Taylor

Test Date(s): 5/8/2024

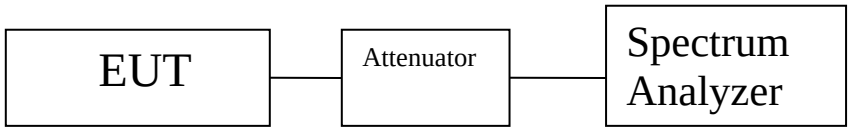
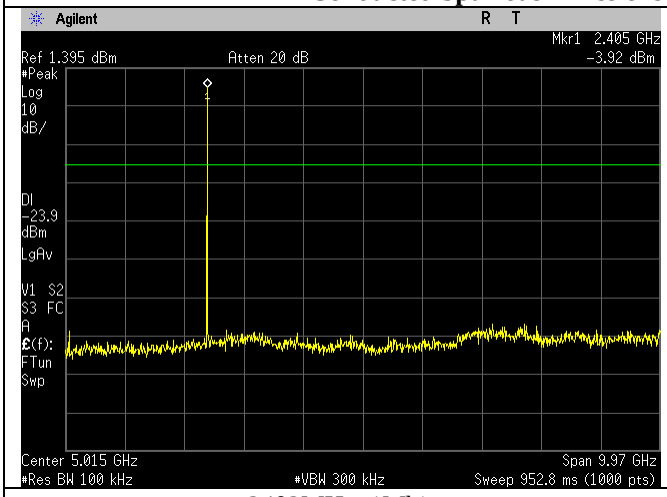


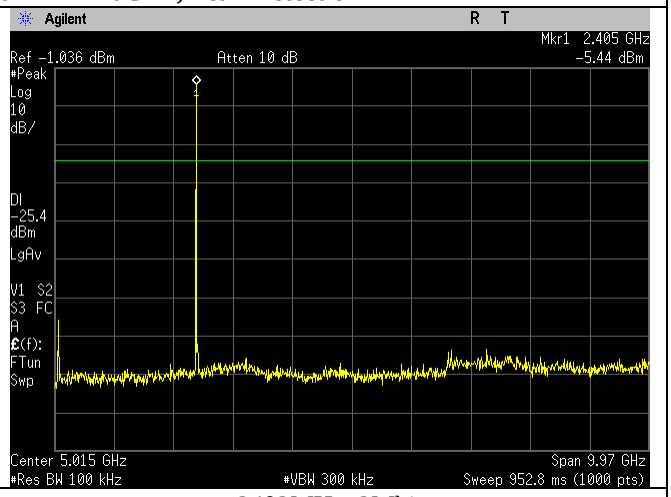
Figure 20. Block Diagram, Conducted Spurious Emissions Test Setup

Conducted Spurious Emissions Test Results

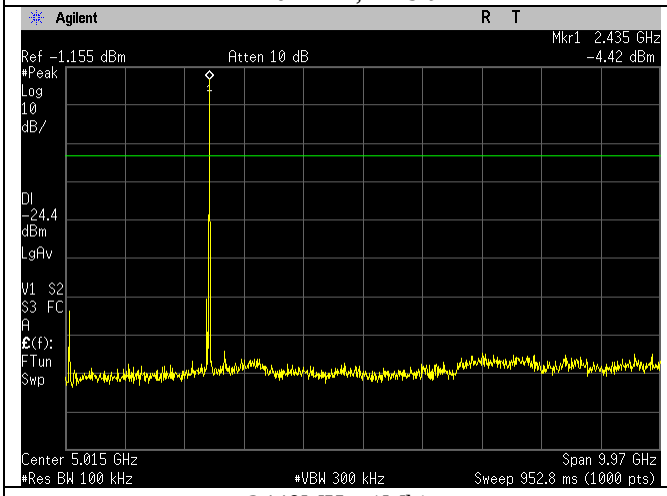
Conducted Spurious Emissions 30MHz – 10GHz, Peak Detection



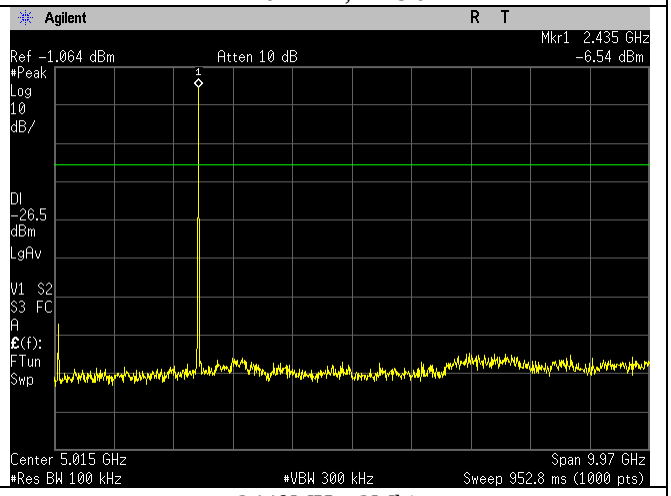
2402MHz, 1Mbit



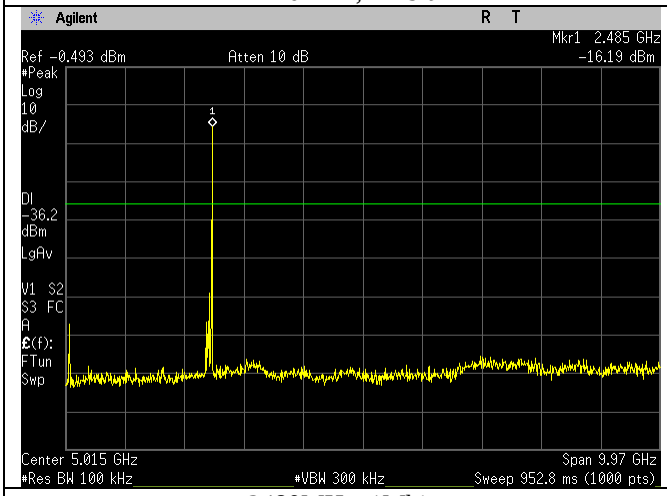
2402MHz, 2Mbit



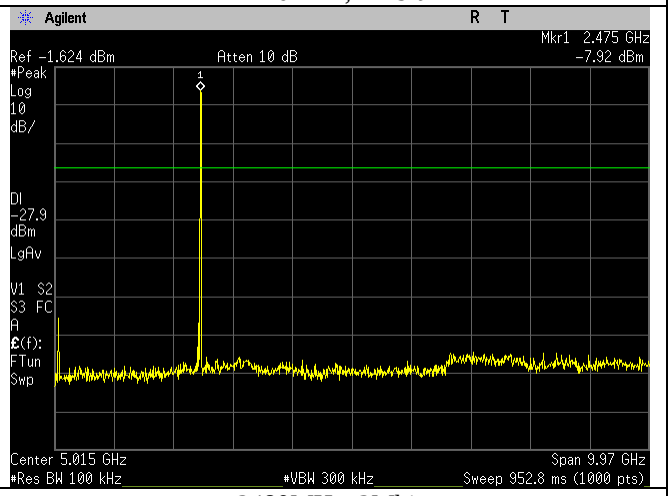
2440MHz, 1Mbit



2440MHz, 2Mbit

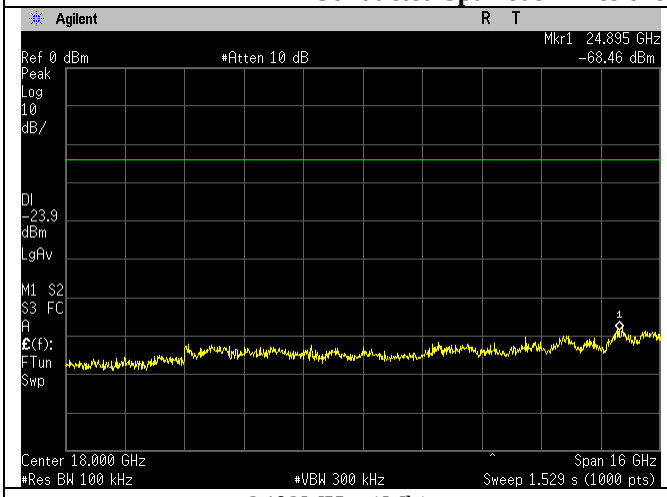


2480MHz, 1Mbit

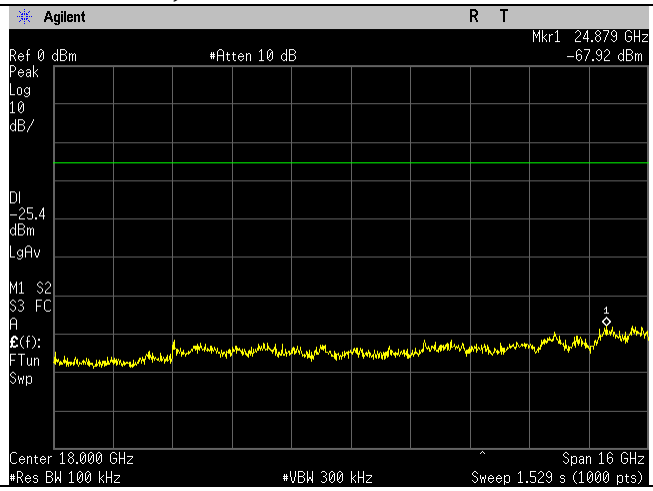


2480MHz, 2Mbit

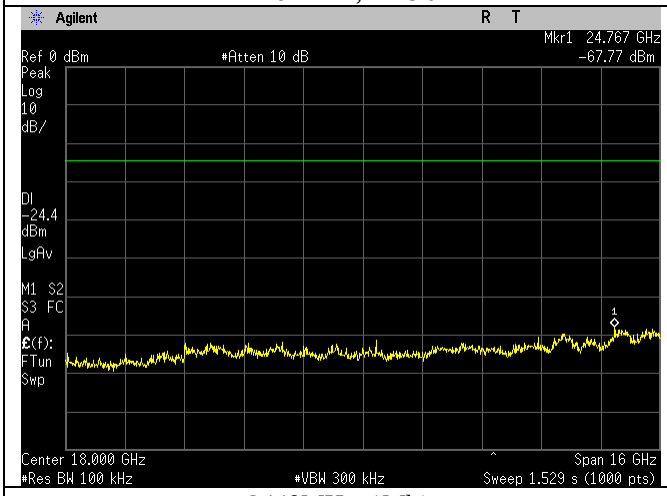
Conducted Spurious Emissions 10GHz – 26GHz, Peak Detection



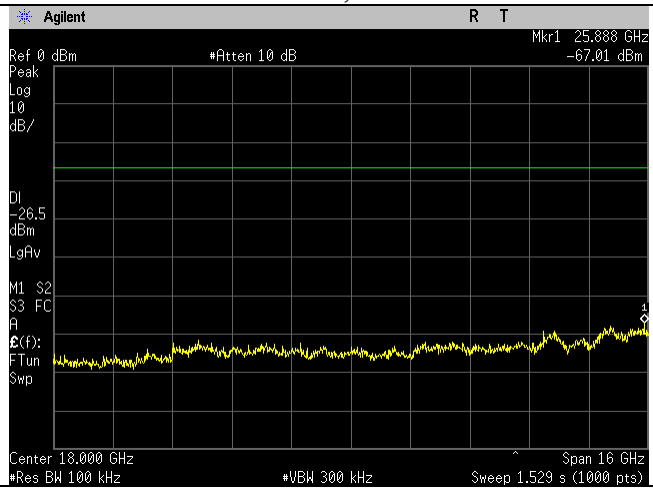
2402MHz, 1Mbit



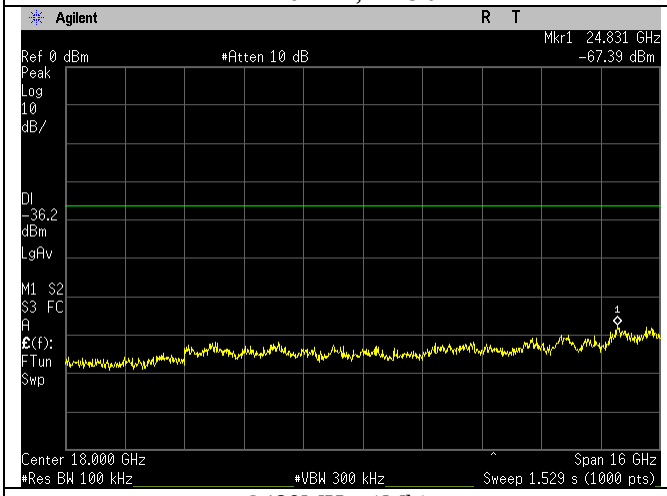
2402MHz, 2Mbit



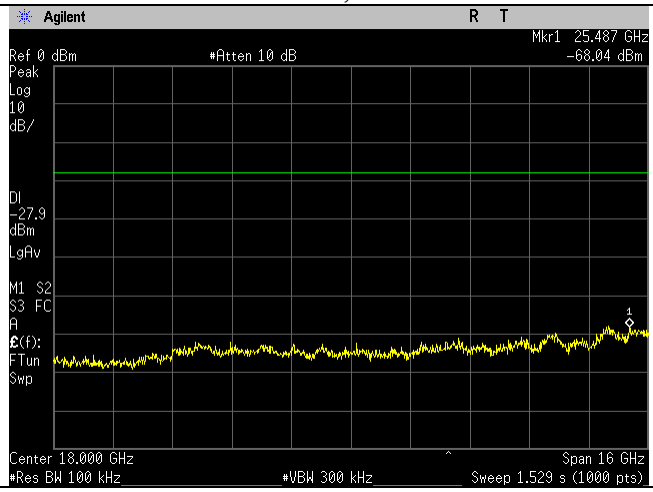
2440MHz, 1Mbit



2440MHz, 2Mbit

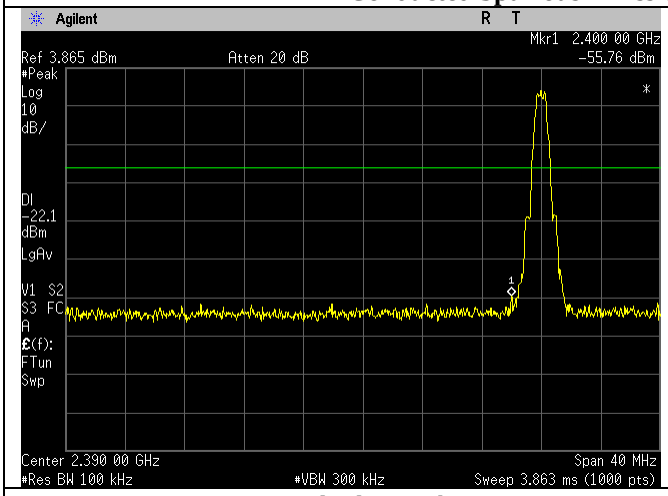


2480MHz, 1Mbit

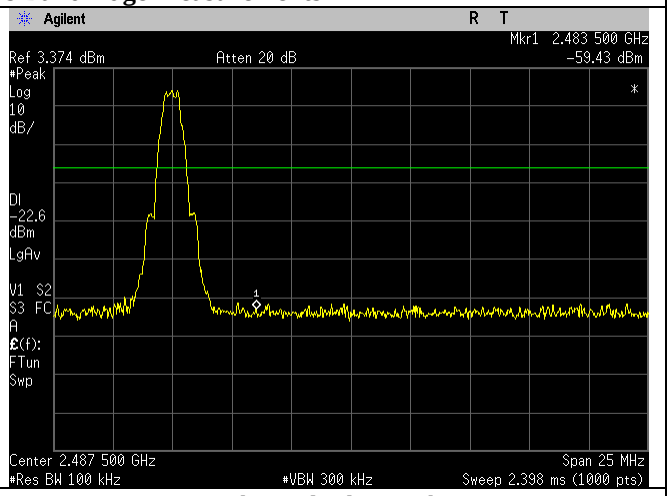


2480MHz, 2Mbit

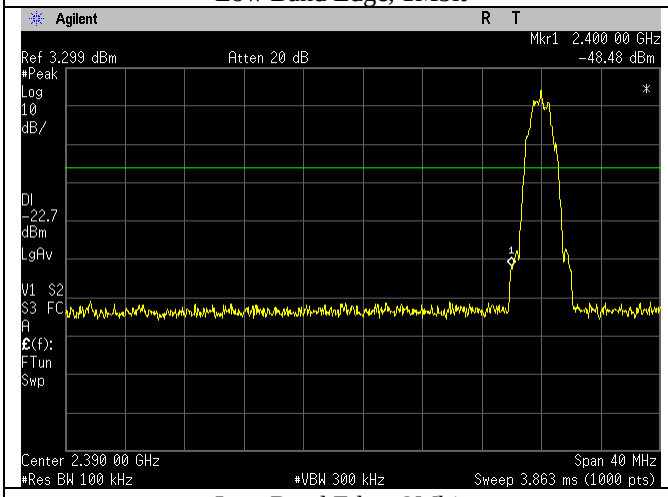
Conducted Spurious Emissions Band Edge Measurements



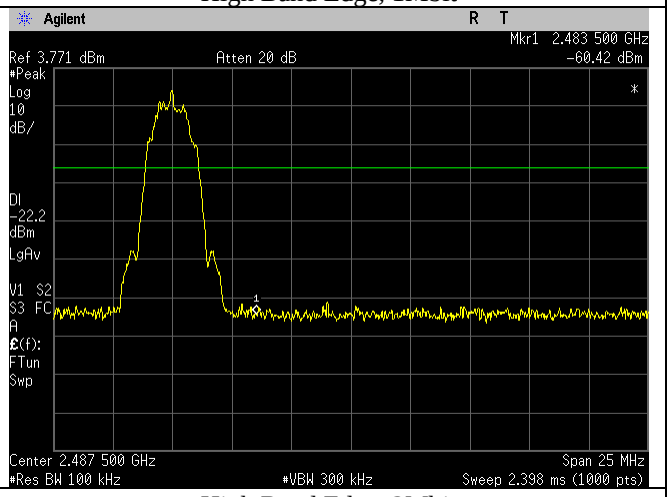
Low Band Edge, 1Mbit



High Band Edge, 1Mbit



Low Band Edge, 2Mbit



High Band Edge, 2Mbit

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

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

§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. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§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])

Figure 21. 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

Figure 22. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The antenna-port methodology form ANSI C63.10: 2013 Section 11.12.2 was utilized as an alternative to radiated emissions in the restricted bands.

The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level. For frequencies below 1GHz, the RBW was set to 100 kHz and the VBW was set to 3x the RBW. For frequencies above 1GHz the RBW was set to 1MHz and the VBW was set to 3x the RBW. The spectrum analyzer was set to an auto sweep time and a peak detector was used. The maximum antenna gain was added to the measurement trace as was the appropriate maximum ground reflection factor as outlined in section 11.12.2 of ANSI C63.10. The resultant EIRP was then converted to an equivalent electric field strength which is shown on the graphical plots which follow. Measurements were carried out at the low, mid and high channels.

In order to assess the cabinet radiated spurious emissions, a radiated scan was performed with the antenna of proper impedance installed. The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes if multiple mounting orientations are supported. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

Radiated measurements below 30MHz were performed in a semi-anechoic chamber that has been correlated to an open area site.

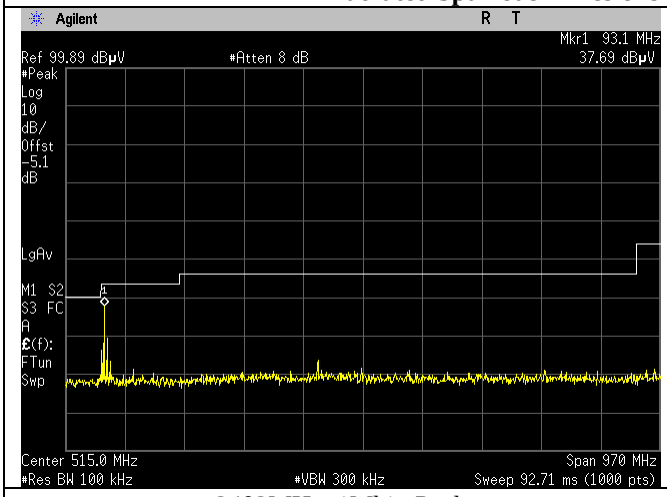
Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

Test Engineer(s): Bryan Taylor, Sergio Gutierrez

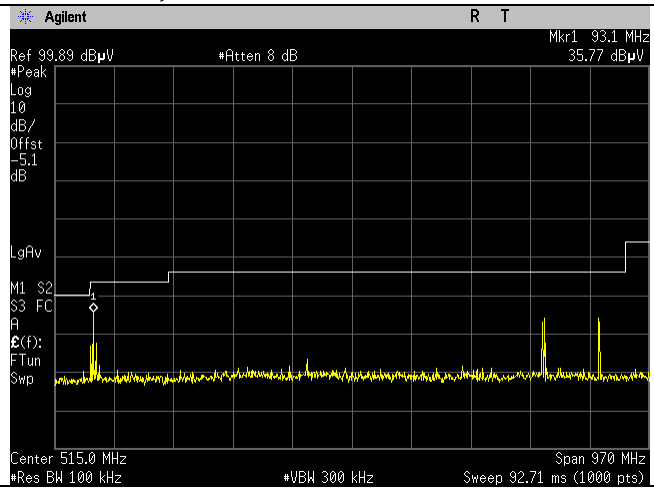
Test Date(s): 4/18/2022 – 5/8/2024

Radiated Spurious Emissions Test Results

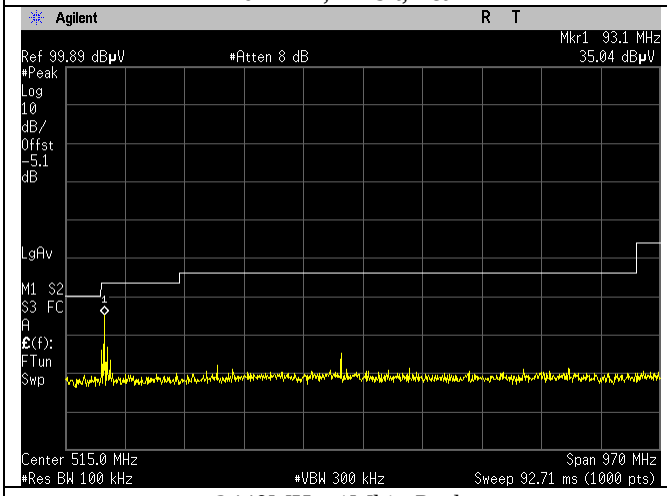
Radiated Spurious Emissions 30MHz – 1GHz, Peak Detection



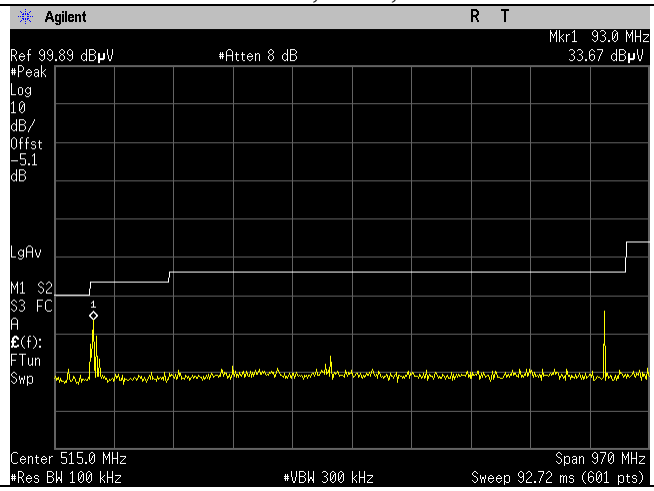
2402MHz, 1Mbit, Peak



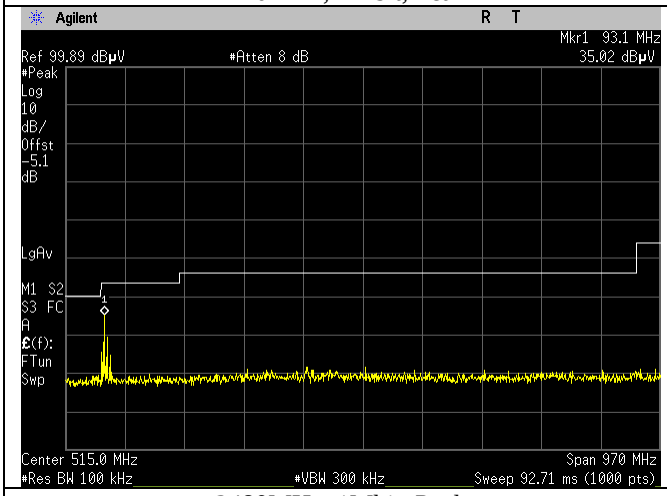
2402MHz, 2Mbit, Peak



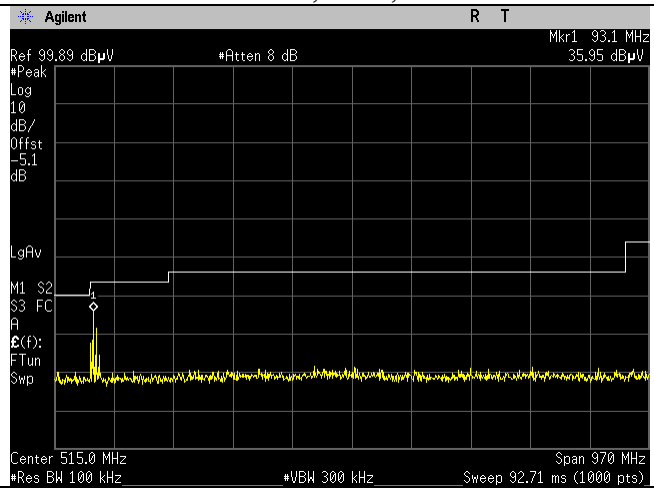
2440MHz, 1Mbit, Peak



2440MHz, 2Mbit, Peak

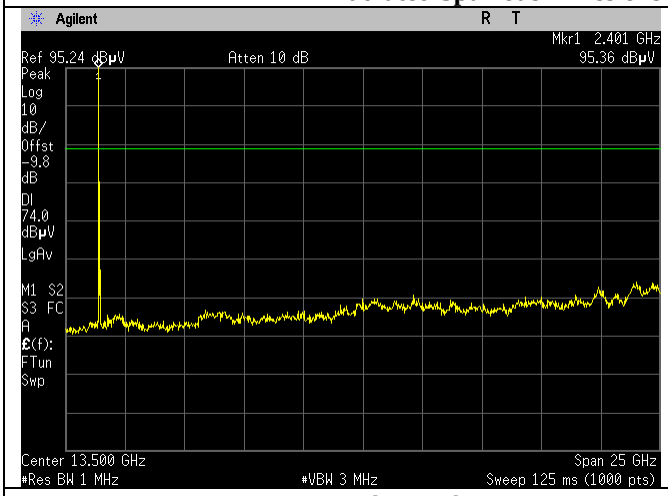


2480MHz, 1Mbit, Peak

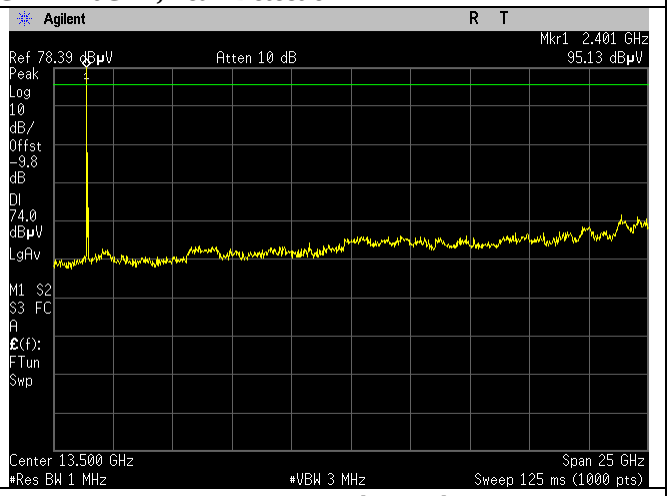


2480MHz, 2Mbit, Peak

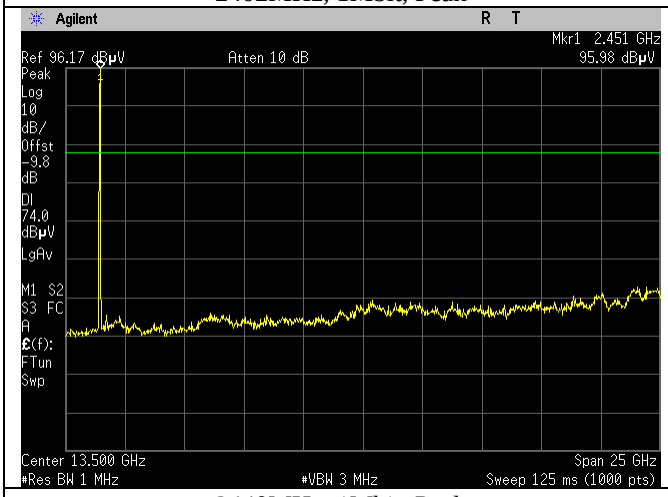
Radiated Spurious Emissions 1GHz – 26GHz, Peak Detection



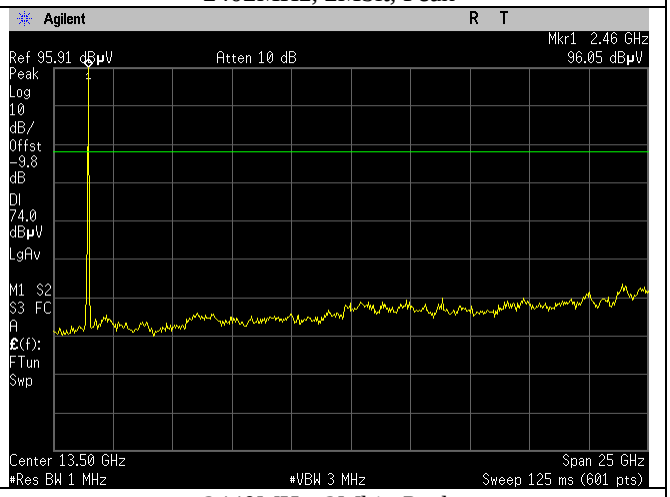
2402MHz, 1Mbit, Peak



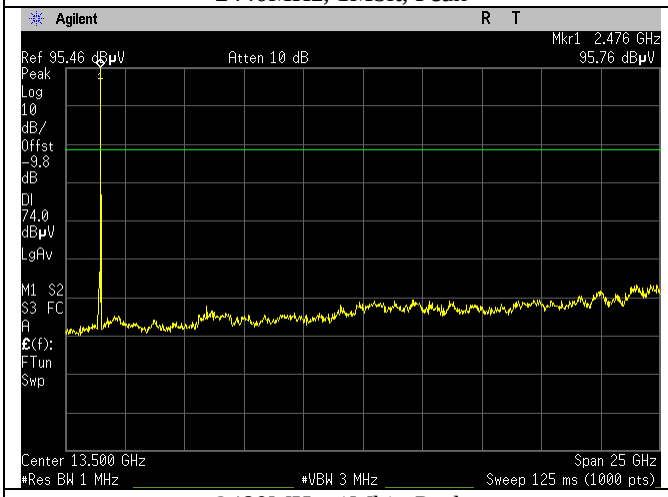
2402MHz, 2Mbit, Peak



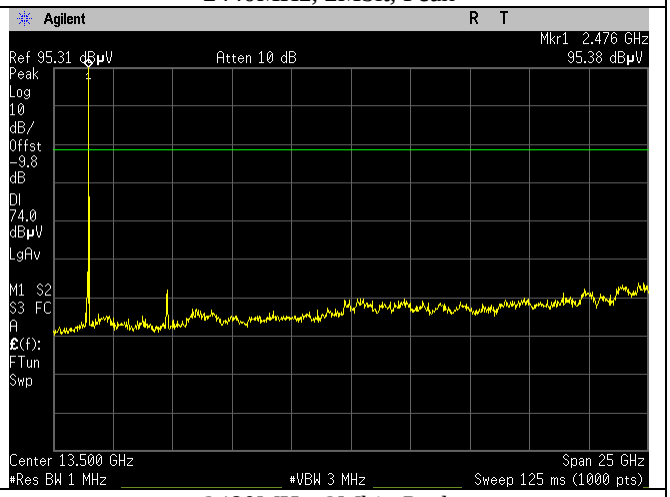
2440MHz, 1Mbit, Peak



2440MHz, 2Mbit, Peak

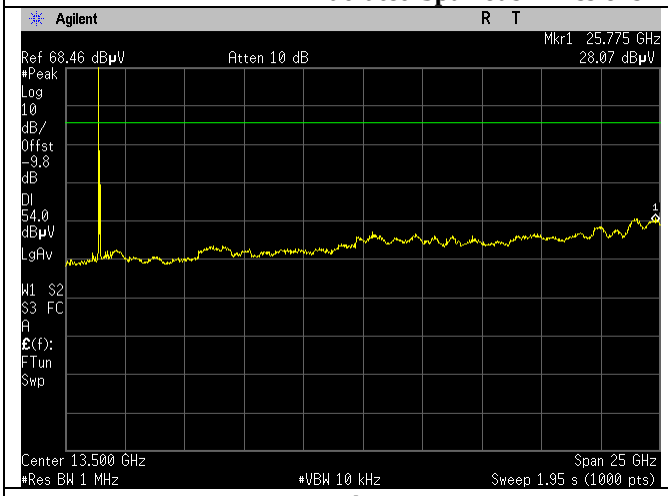


2480MHz, 1Mbit, Peak

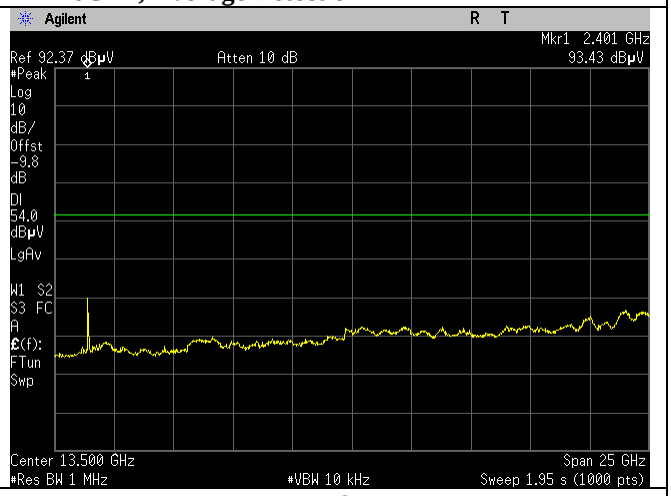


2480MHz, 2Mbit, Peak

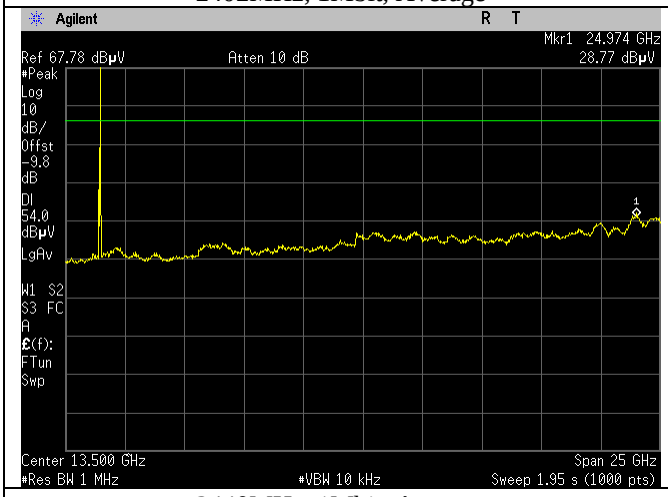
Radiated Spurious Emissions 1GHz – 26GHz, Average Detection



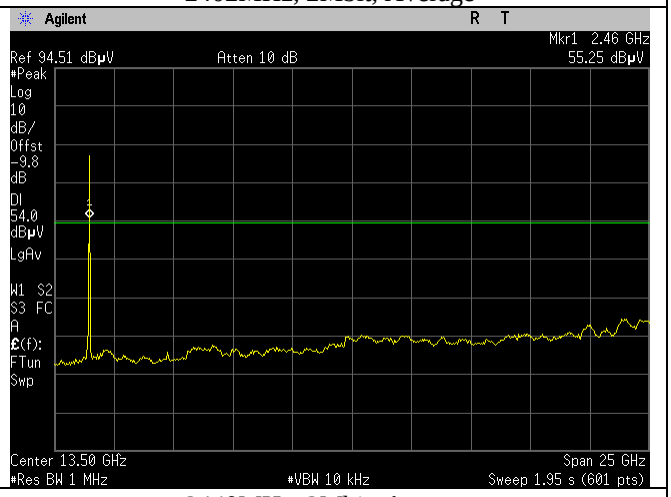
2402MHz, 1Mbit, Average



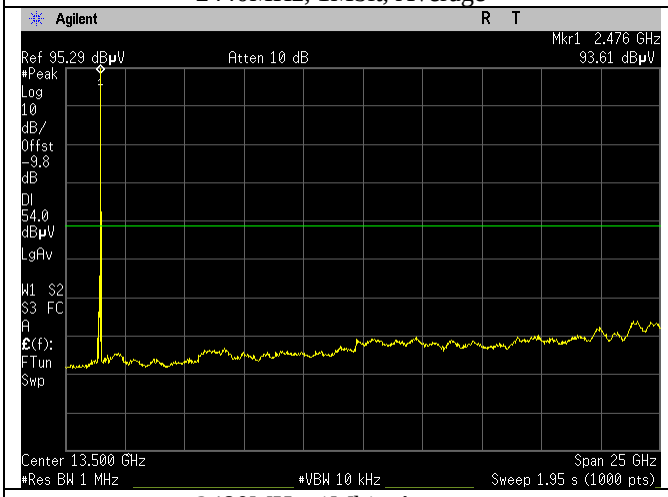
2402MHz, 2Mbit, Average



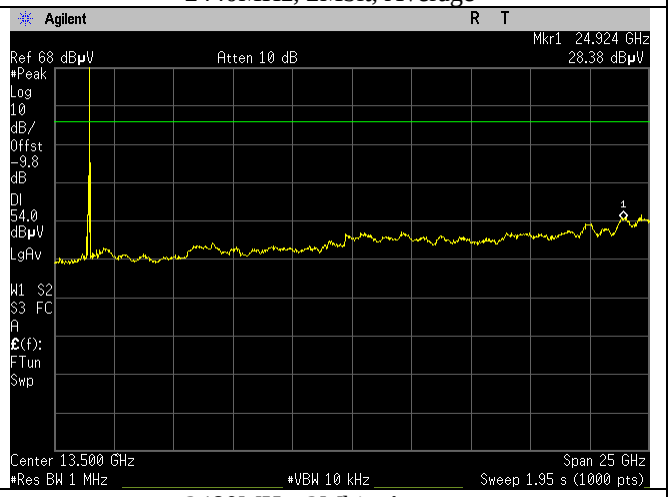
2440MHz, 1Mbit, Average



2440MHz, 2Mbit, Average

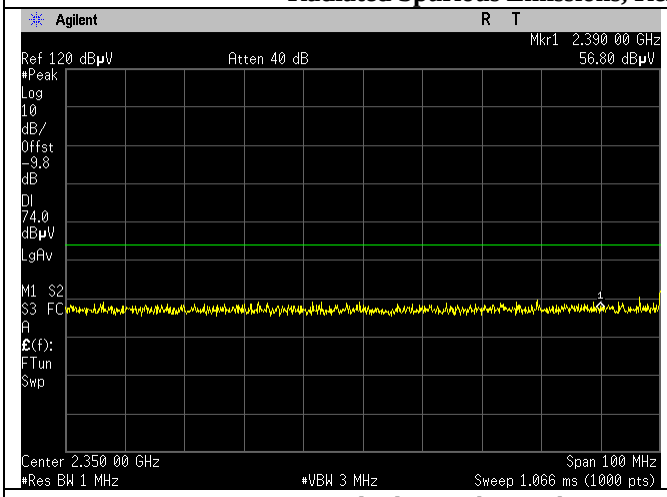


2480MHz, 1Mbit, Average

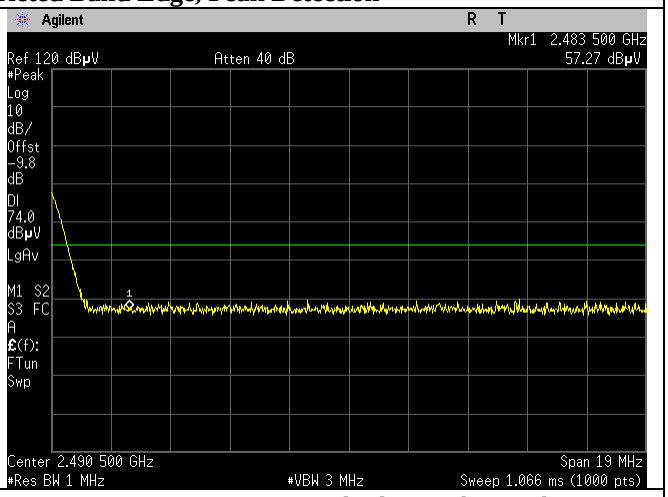


2480MHz, 2Mbit, Average

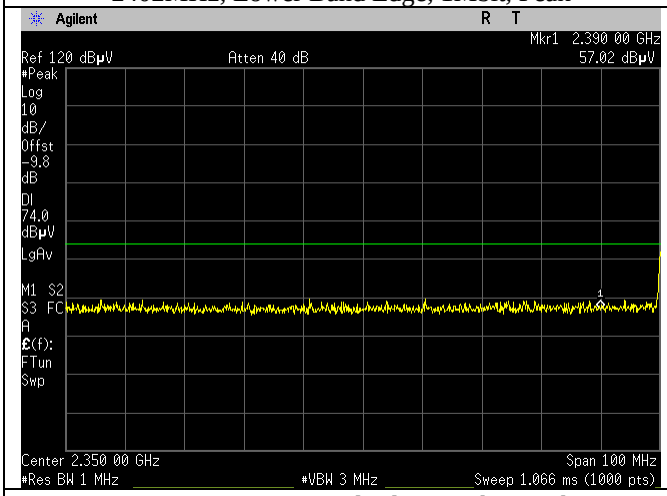
Radiated Spurious Emissions, Restricted Band Edge, Peak Detection



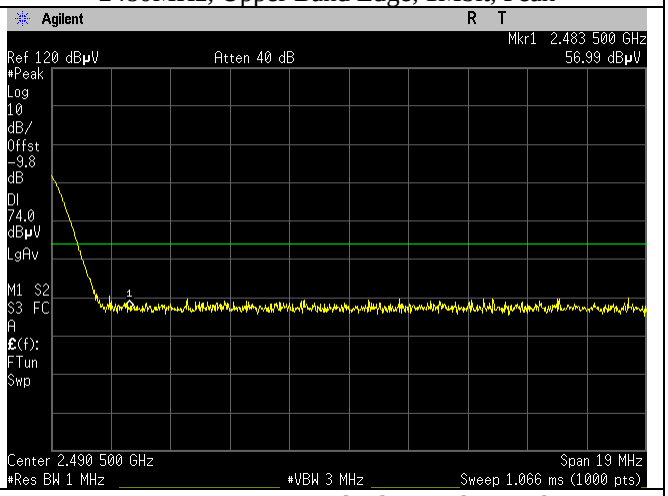
2402MHz, Lower Band Edge, 1Mbit, Peak



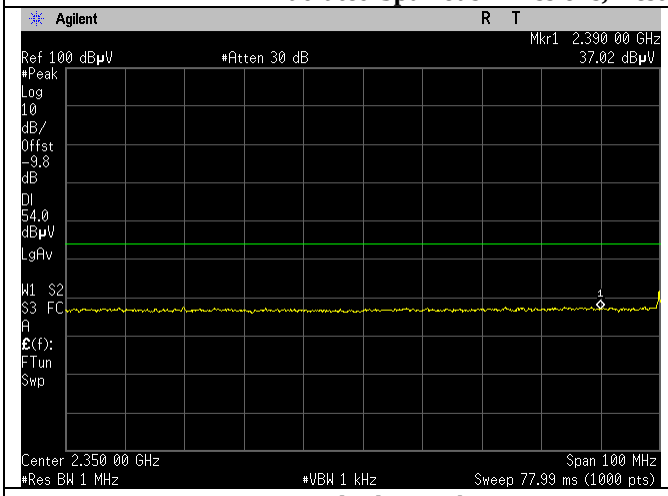
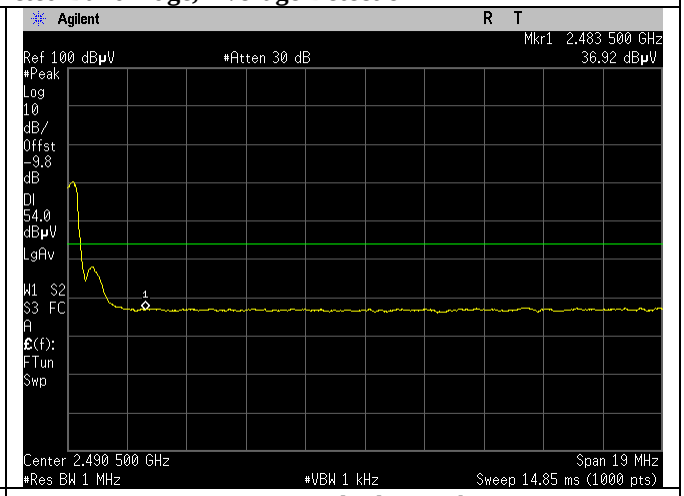
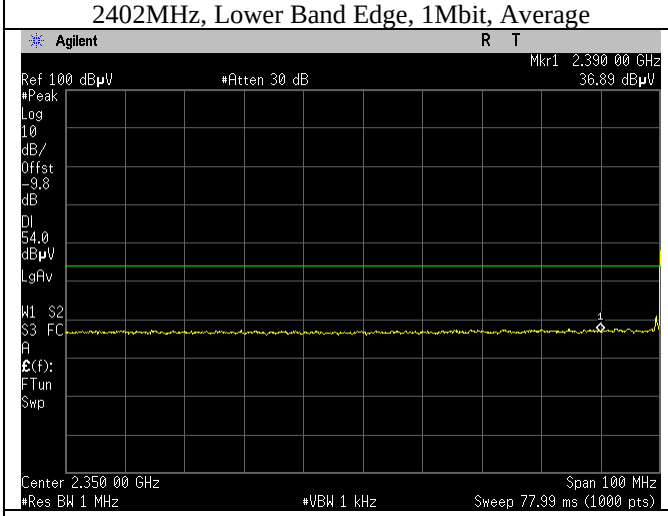
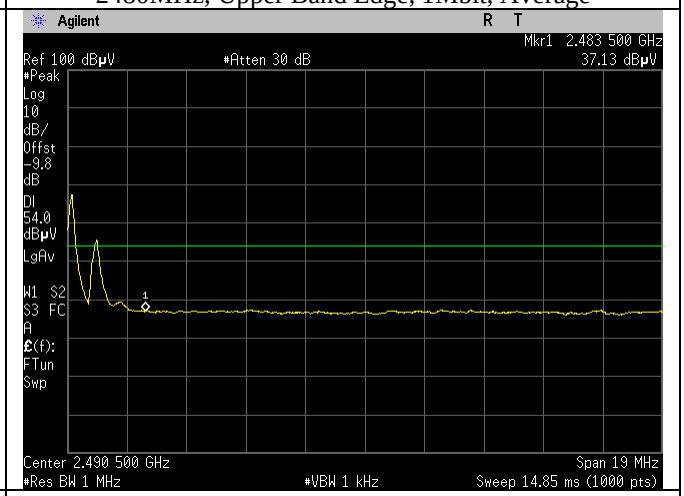
2480MHz, Upper Band Edge, 1Mbit, Peak



2402MHz, Lower Band Edge, 2Mbit, Peak



2480MHz, Upper Band Edge, 2Mbit, Peak

Radiated Spurious Emissions, Restricted Band Edge, Average Detection	
	
2402MHz, Lower Band Edge, 1Mbit, Average	2480MHz, Upper Band Edge, 1Mbit, Average
	
2402MHz, Lower Band Edge, 2Mbit, Average	2480MHz, Upper Band Edge, 2Mbit, Average

Worst Case Cabinet Spurious Emissions

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.094	41.37	108.19	66.82	11.57	H	360.5	1	0.200	Pass
0.096	40.98	107.92	66.95	11.45	V	197.6	1	0.200	Pass
0.510	46.19	73.54	27.35	11.35	H	122.7	1	9.000	Pass
0.510	46.19	73.54	27.35	11.35	V	300.4	1	9.000	Pass

Figure 23. Worst Case Cabinet Radiation, Below 30MHz (1Mbps)

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
0.095	41.87	108.02	66.15	11.50	H	360.4	1	0.200	Pass
0.106	40.65	107.11	66.46	11.33	V	279.1	1	0.200	Pass
0.501	46.22	73.69	27.48	11.27	H	268.8	1	9.000	Pass
0.501	46.91	73.69	26.78	11.27	V	350.4	1	9.000	Pass

Figure 24. Worst Case Cabinet Radiation, Below 30MHz (2Mbps)

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
73.920	23.43	40.00	16.57	-12.21	V	216.7	2	120.000	Pass
120.000	27.59	43.52	15.93	-6.37	H	42.6	3.89	120.000	Pass
120.000	30.09	43.52	13.43	-6.77	V	152.1	0.99	120.000	Pass
261.600	21.09	46.02	24.93	-6.84	H	39	2.91	120.000	Pass
266.400	21.82	46.02	24.20	-6.16	V	206.4	1.2	120.000	Pass

Figure 25. Worst Case Cabinet Radiation, 30MHz – 1GHz (1Mbps)

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Result
120.000	27.38	43.52	16.14	-6.37	H	55.1	3.78	120.000	Pass
120.000	29.57	43.52	13.95	-6.77	V	101.5	1.11	120.000	Pass
261.600	20.27	46.02	25.75	-6.84	H	19.5	2.5	120.000	Pass
271.200	23.77	46.02	22.25	-6.05	V	194.3	1.1	120.000	Pass

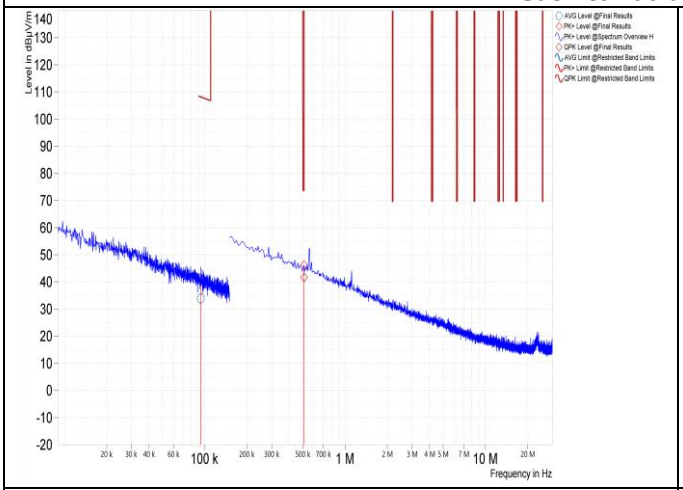
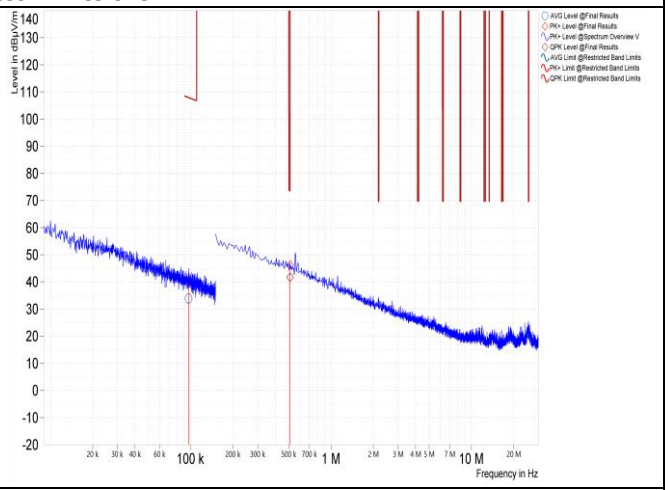
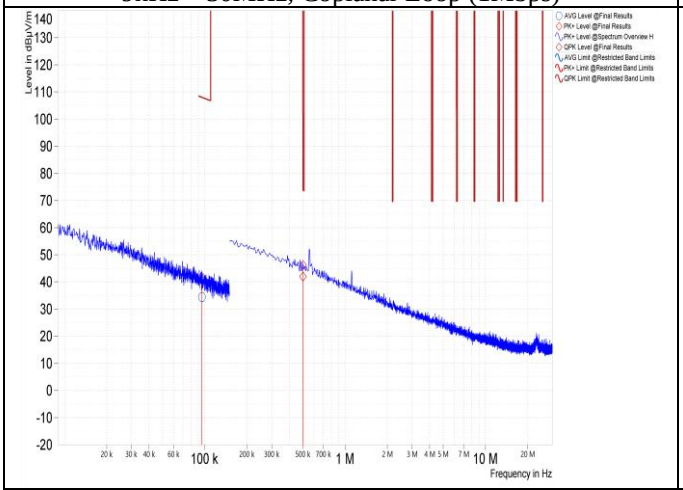
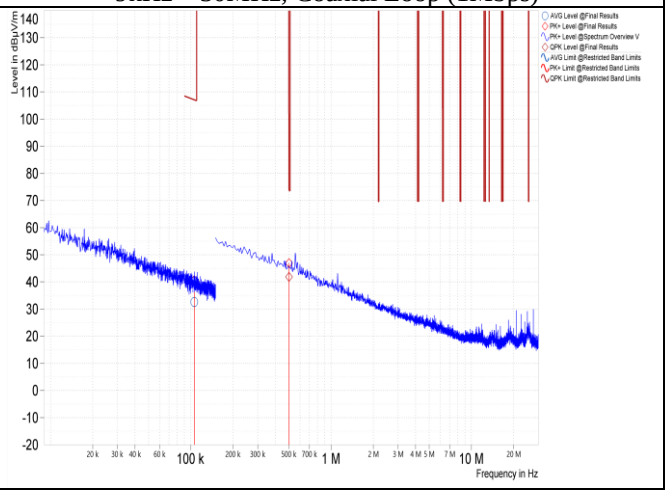
Figure 26. Worst Case Cabinet Radiation, 30MHz – 1GHz (2Mbps)

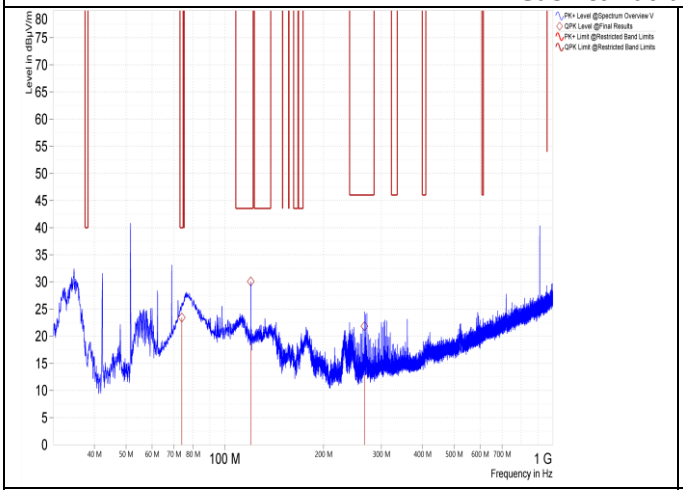
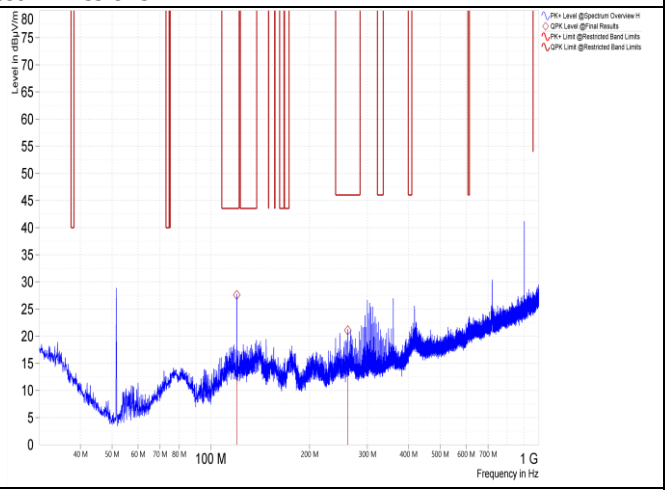
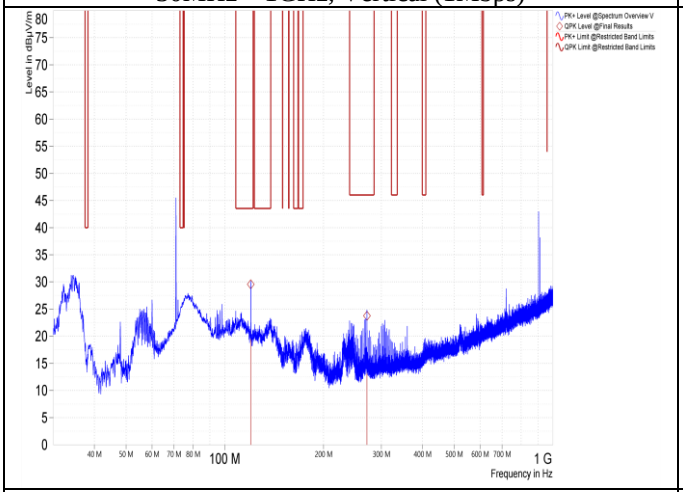
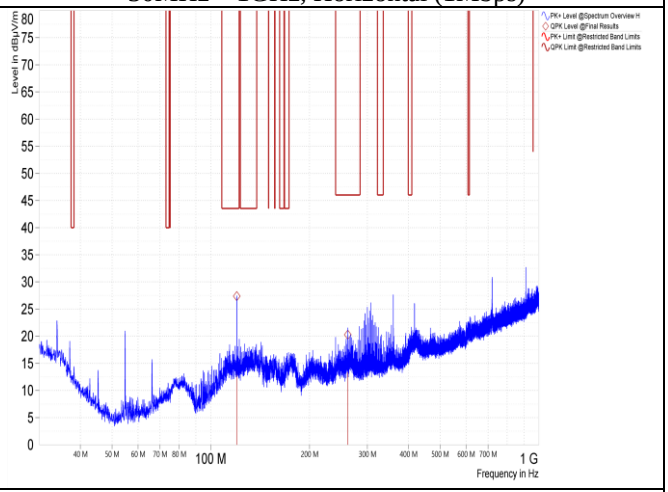
Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Result
4,875.000	42.43	74.00	31.57	29.35	54.00	24.65	-3.43	V	323.2	2.14	Pass
4,891.000	41.86	74.00	32.14	28.88	54.00	25.12	-3.16	H	89.39999	1.69	Pass
7,301.500	42.03	74.00	31.97	29.46	54.00	24.54	-2.89	H	196.3	1.56	Pass
7,394.500	43.46	74.00	30.54	30.59	54.00	23.41	-2.48	V	152.7	1.29	Pass
12,220.000	44.90	74.00	29.10	31.91	54.00	22.09	-1.95	H	131.5	1.12	Pass
12,225.500	44.67	74.00	29.33	31.82	54.00	22.18	-1.97	V	42.7	1.78	Pass
19,520.000	52.18	74.00	21.82	39.66	54.00	14.34	12.35	H	75.5	1.5	Pass
19,520.000	51.36	74.00	22.64	38.65	54.00	15.35	12.35	V	111.5	2.14	Pass
23,978.000	51.39	74.00	22.61	38.09	54.00	15.91	14.49	H	351.1	1.6	Pass
23,979.500	51.03	74.00	22.97	37.88	54.00	16.12	14.49	V	3.7	3.5	Pass

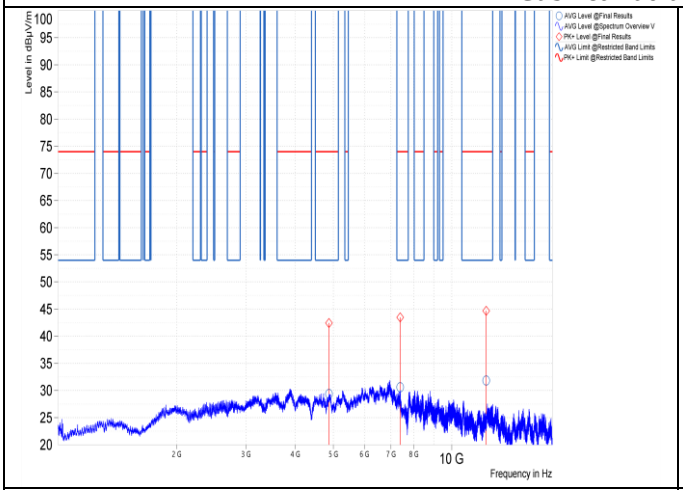
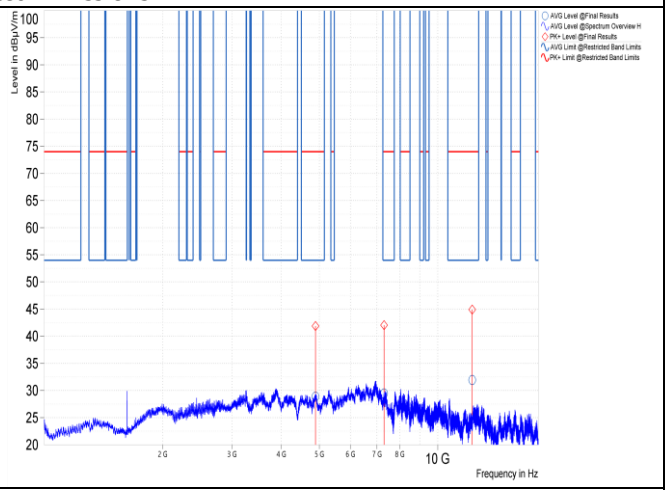
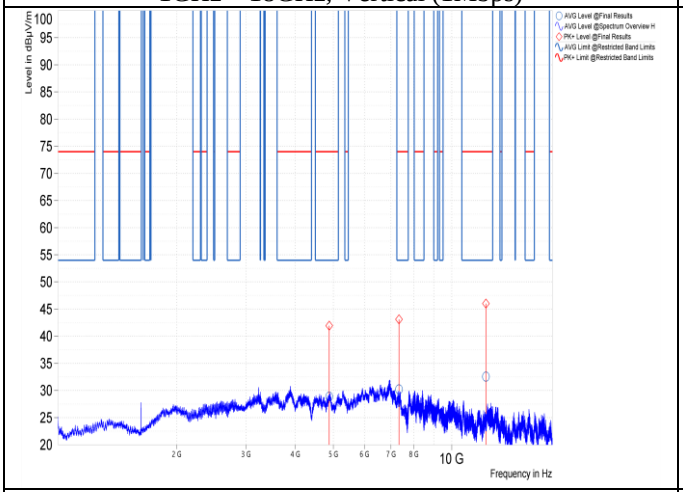
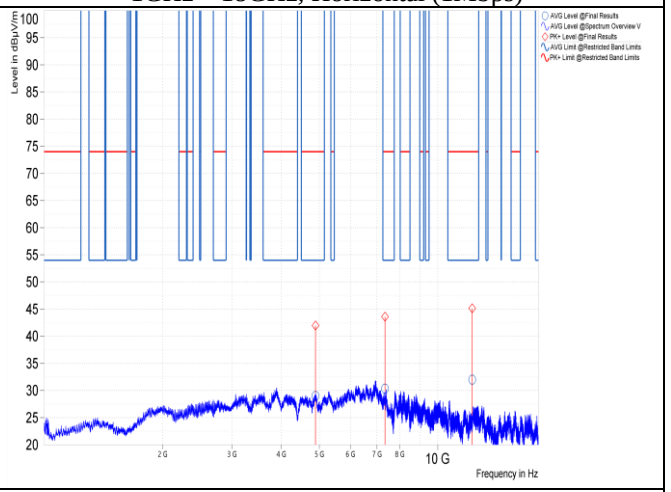
Figure 27. Worst Case Cabinet Radiation, Above 1GHz (1Mbps)

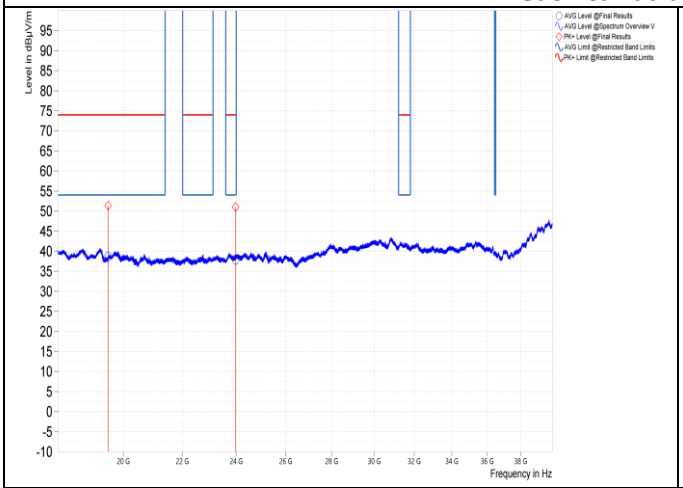
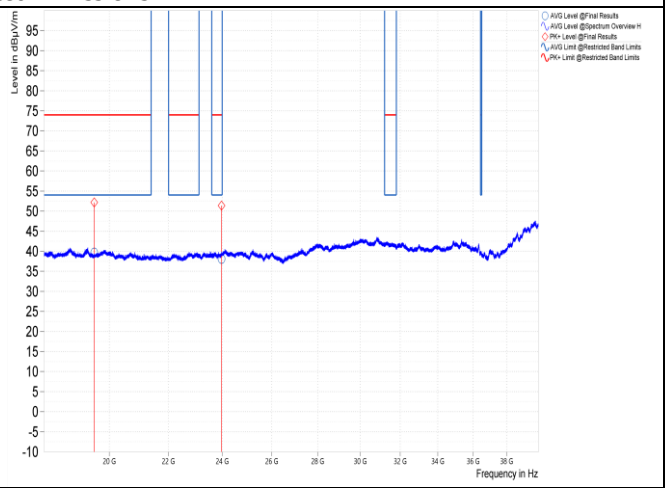
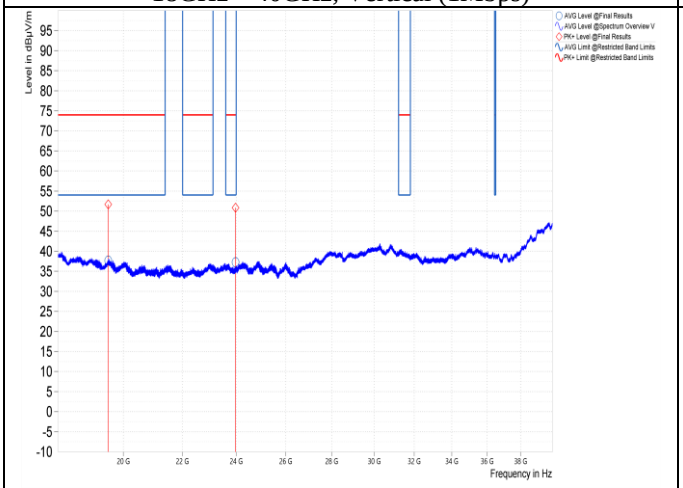
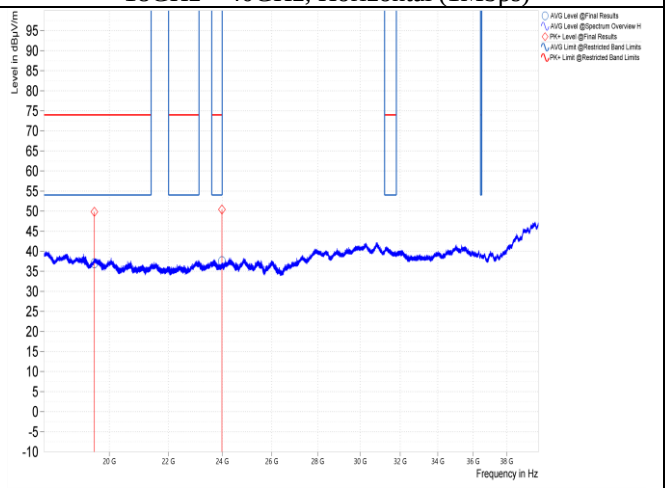
Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Result
4,881.500	41.93	74.00	32.07	28.86	54.00	25.14	-3.32	H	38.4	1.27	Pass
4,889.500	41.98	74.00	32.02	29.01	54.00	24.99	-3.19	V	241.6	1.49	Pass
7,343.500	43.11	74.00	30.89	30.21	54.00	23.79	-2.68	H	8.7	1.12	Pass
7,343.500	43.60	74.00	30.40	30.32	54.00	23.68	-2.68	V	191.5	1.65	Pass
12,209.000	46.00	74.00	28.00	32.54	54.00	21.46	-1.93	H	243	1.65	Pass
12,225.500	45.12	74.00	28.88	31.99	54.00	22.01	-1.97	V	232.8	1.59	Pass
19,520.000	51.68	74.00	22.32	37.65	54.00	16.35	12.35	V	292.5	3.8	Pass
19,522.000	49.83	74.00	24.17	37.00	54.00	17.00	12.34	H	338.9	2.8	Pass
23,975.000	50.86	74.00	23.14	37.28	54.00	16.72	14.49	V	57	2.84	Pass
23,991.500	50.38	74.00	23.62	37.53	54.00	16.47	14.51	H	135.3	1.33	Pass

Figure 28. Worst Case Cabinet Radiation, Above 1GHz (2Mbps)

Cabinet Radiated Emissions	
	
9kHz – 30MHz, Coplanar Loop (1Mbps)	9kHz – 30MHz, Coaxial Loop (1Mbps)
	
9kHz – 30MHz, Coplanar Loop (2Mbps)	9kHz – 30MHz, Coaxial Loop (2Mbps)

Cabinet Radiated Emissions	
	
30MHz – 1GHz, Vertical (1Mbps)	30MHz – 1GHz, Horizontal (1Mbps)
	
30MHz – 1GHz, Vertical (2Mbps)	30MHz – 1GHz, Horizontal (2Mbps)

Cabinet Radiated Emissions	
	
1GHz – 18GHz, Vertical (1Mbps)	1GHz – 18GHz, Horizontal (1Mbps)
	
1GHz – 18GHz, Vertical (2Mbps)	1GHz – 18GHz, Horizontal (2Mbps)

Cabinet Radiated Emissions	
	
18GHz – 40GHz, Vertical (1Mbps)	18GHz – 40GHz, Horizontal (1Mbps)
	
18GHz – 40GHz, Vertical (2Mbps)	18GHz – 40GHz, Horizontal (2Mbps)

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.

MET Asset #	Description	Manufacturer	Model	Last Cal Date	Cal Due Date
MY46180897	Spectrum Analyzer	Keysight	E4448A	7/27/2023	7/27/2024
1A1083	Receiver	Rohde & Schwarz	ESU40	11/20/2023	11/20/2024
1A1176	Active Loop Antenna (9KHz-30MHz)	ETS-Lindgren	6502	7/13/2023	7/13/2024
1A1147	Bilog Antenna	Sunol Sciences Corp	JB3	4/6/2023	4/6/2025
1A1047	Horn Antenna (1-18GHz)	ETS - Lindgren	3117	6/16/2022	6/16/2024
1A1161	Horn Antenna (18GHz – 40GHz)	ETS Lindgren	3116C	7/11/2023	7/11/2024
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	8/4/2023	8/4/2024
1A1087	Pulse Limiter	Rohde & Schwarz	ESH3Z2	12/21/2023	12/21/2024
1A1122	LISN	Teseq	NNB 51	9/19/2023	9/19/2024
1A1123	LISN	Teseq	NNB 51	12/20/2023	12/20/2024
1A1149	DC Milliohm Meter	GW Instek	GOM-802	9/20/2023	9/20/2024
1A1099	Generator	Com-Power	CGO-51000	See Note	
1A1088	Preamplifier	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	Com-Power	CG-520	See Note	
1A1073	Multi Device Controller	ETS	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1080	Multi-Device	ETS	2090	See Note	
1A1180	Preamplifier	Miteq	AMF-7D-01001800-22-10P	See Note	

Figure 29. Test Equipment List

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

End of Report