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December 16, 2020

Novus Automation Inc.
201 South Biscayne Blvd, Suite 1200
Miami, FL 33131

Dear Giuliano Guarese,

Enclosed is the EMC Wireless test report for compliance testing of the Novus Automation Inc., NOVUS-Air IEEE 802.15.4 Module 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 E&E North America. If you have any questions regarding these results or if we can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS E&E NORTH AMERICA

Michelle Tawmging
Documentation Department

Reference: (\Novus Automation Inc.\WIRA109388-FCC247 DTS Rev. 1)

Electromagnetic Compatibility Criteria
Test Report

for the

Novus Automation Inc.
NOVUS Air IEEE 802.15.4 Module

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

Report: WIRA109388-FCC247 DTS Rev. 1

December 16, 2020

Prepared For:

Novus Automation Inc.
201 South Biscayne Blvd, Suite 1200
Miami, FL 33131

Prepared By:
Eurofins E&E North America
13501 McCallen Pass,
Austin, TX 78753

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15.247 Subpart C for Intentional Radiators

Adan Arab, Project Engineer
Wireless Lab

Michelle Tawmging
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.

Jonathan Tavira,
Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	October 1, 2020	Initial Issue (Draft).
0	November 2, 2020	Updated Data Rates in Figure 2; Updated Typos in Antenna Requirement results section; Updated Block Diagram; Added FCC ID
1	December 16, 2020	TCB Corrections.

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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

Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Novus Automation Inc. NOVUS Air IEEE 802.15.4 Module, 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 NOVUS Air IEEE 802.15.4 Module. Novus Automation Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the NOVUS Air IEEE 802.15.4 Module , 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 Novus Automation Inc., purchase order number 210820ENG-2. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference 47 CFR Part 15.247:2020	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	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Band Edge	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Completed

Figure 1: Executive Summary of EMC Part 15.247 ComplianceTesting

Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Novus Automation Inc. to perform testing on the NOVUS Air IEEE 802.15.4 Module, under Novus Automation Inc.'s purchase order number 210820ENG-2.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Novus Automation Inc., NOVUS Air IEEE 802.15.4 Module.

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

Model(s) Tested:	NOVUS Air IEEE 802.15.4 Module	
Model(s) Covered:	NOVUS Air IEEE 802.15.4 Module	
EUT Specifications:	Primary Power: 3v3	
	FCC ID: 2AXVW-NOVUSAIR	
	Type of Modulations:	O-QPSK
	Equipment Code:	DTS
	Peak RF Output Power:	20.10 dBm
	EUT Frequency Ranges:	2400 to 2483.5 MHz
	Channels:	15
	Antenna Type:	Omni-directional
	Antenna Gain:	2.54 dBi
	Data Rates:	250 kbps
	Firmware Version:	embedded certification firmware 0.4.106
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:	Adan Arab	
Report Date(s):	December 16, 2020	

Figure 2: 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 v0502	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

Figure 3: References

C. Test Site

All testing was performed at MET Laboratories, Inc., 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.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Line Conducted Emissions.	±2.97 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Figure 4: Uncertainty Calculations Summary

E. Description of Test Sample

Result of an advanced technological development, the NOVUS Air IEEE 802.15.4 module was developed by NOVUS to meet the demands of NOVUS's wireless products based on IEEE 802.15.4 standard. With this module is possible to develop any application protocol based on IEEE 802.15.4 standard.

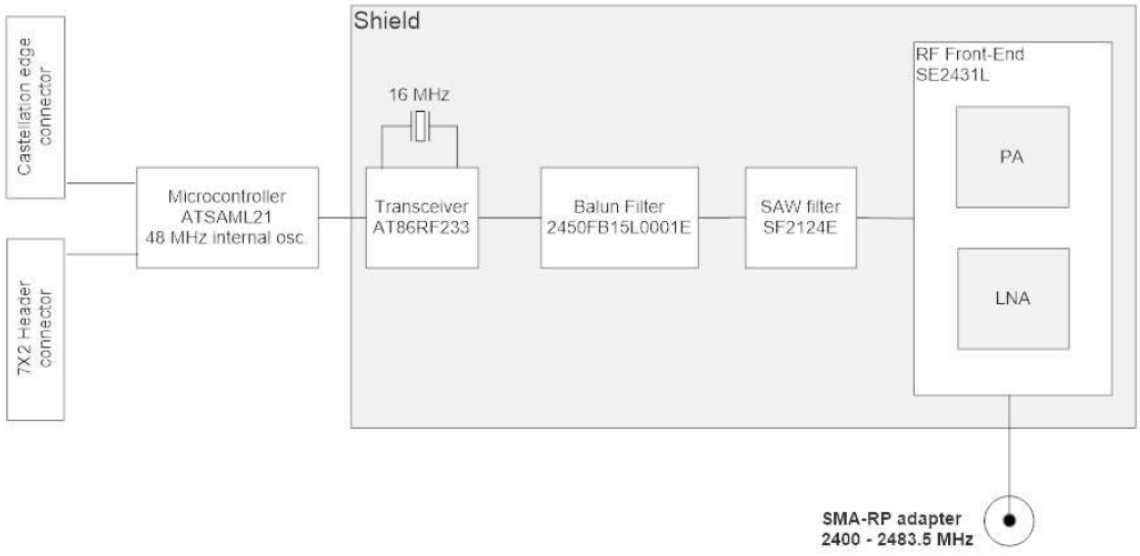

Figure 5: Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 5.

Ref.ID	Name/Description	Manufacturer	Model Number
1	NOVUS-Air IEEE 802.15.4 Module	Novus Automation	N/A

Figure 6: Equipment Under Test

G. Support Equipment

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

Ref.ID	Name/Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
2	PC	Dell	Inspiron 15	N/A
The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Figure 7: Support Equipment

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
3	USB serial interface	Data and Power	1	<1	N/A	No	PC USB port

Figure 6: Ports and Cabling

I. Mode of Operation

For certification propose the module is with an embedded firmware that implements all necessary requirements for simulate the module in a specific channel, put it in continuous transmission and change in different Transmission Powers. For certification propose the module is connected to a board that provide power supply from USB 5V to 3v3 and creates an USB interface for the serial interface of the module.

J. Method of Monitoring EUT Operation

NOVUS Air IEEE 802.15.4 module with the certification propose firmware it is possible to check if the module is operational by measuring the RF signal level of the IEEE 802.15.4 interface in the RP-SMA connector in accordance as configured through the serial interface.

For the RF tests, EUT parameters were controlled though a serial terminal software Tera Term. Communication Parameters: Baud rate 115200, Parity none, Stop bits 2, flow control none. Eeach command should give an OK confirmation when parameter is changed. If not, repeat the command. To apply each configuration, commands in the sequence: at + pibconfstore and at + armreset are used.

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 Novus Automation Inc. upon completion of testing.

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 EUT uses an external antenna that couples to the EUT through a unique RP-SMA connector.

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 15.203.

Test Engineer: Adan Arab

Test Date: September 18, 2020

Electromagnetic Compatibility Criteria for Intentional Radiators

ANSI C63.10-2013 (11.6) Duty Cycle

Test Procedure: The EUT was connected to a spectrum analyzer and was ran at the maximum achievable duty cycle for all modes. The duty cycle was measured in accordance with section 11.6 of ANSI C63.10-2013.

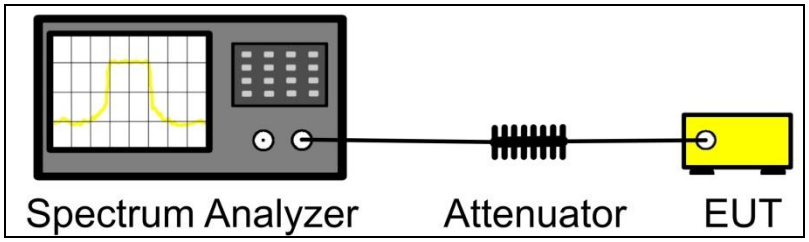

Figure 8: Block Diagram, Duty Cycle Measurement Test Setup

Test Engineer(s): Adan Arab

Test Date(s): 08/04/2020

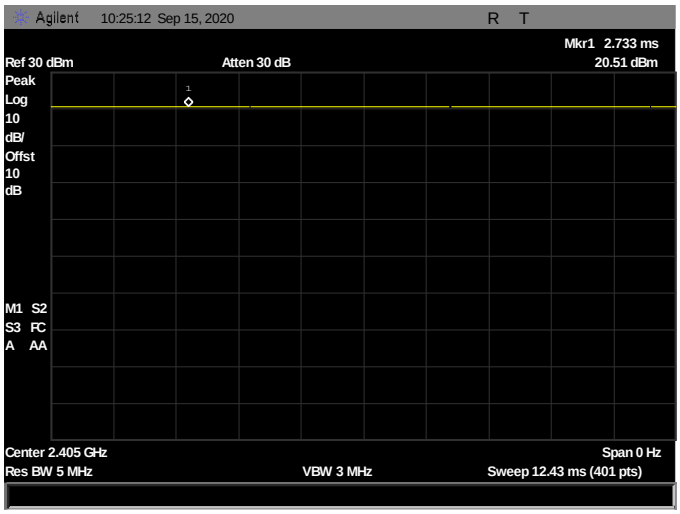

Figure 9: Duty Cycle, DC, 2405 MHz - ZigBee >98%

§ 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 Σ 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- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Figure 10: Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane and 40 cm away from the vertical reference ground plane**.** The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50μH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate. Any measured frequency that exhibits a margin of compliance that is less than 3 dB below the specification limit is marked.

Sample Calculation:

$$R_F - S = M$$

where:

R_F = Receiver Reading in dBuV
S = Specification Limit in dBuV
M = Margin to Specification in +/- dB

Sample formula for calculating the Corrected Data for the Conducted Emissions Measurements:

Line	Freq (MHz)	Uncorrected QP** Amplitude (dBuV)	LISN IL (dB)	CBL (dB)	Corrected QP** Amplitude (dBuV)	QP** Limit (dBuV)	Margin (dB)	Results
XYZ	0.18	42.65	10	0.58	53.23	79	-25.77	Pass

*Corrected QP** Amplitude (dBμV) = Uncorrected Amplitude (dBμV) +LISN IL (dB) + CBL (dB) =42.65+10+0.58=53.23*
*** Same Calculation applies to Corrected Avg. amplitude as well.*

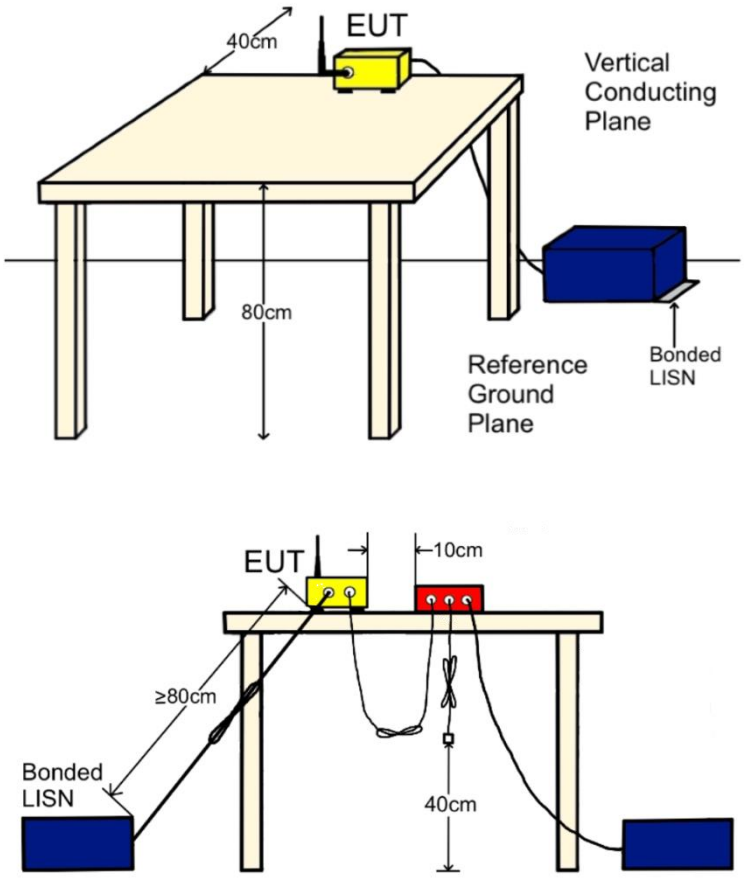

Figure 11: CEV Test Setup

Test Results:	The EUT was **compliant** with this requirement. Measured emissions were below applicable limits.
Test Engineer(s):	Adan Arab
Test Date(s):	September 16, 2020

15.207(a) Conducted Emissions Test Results

Meas. Location	Meas. m	Limit	Pass/Fail
Bonding measurement from LISN ground to ground plane	1.330 mΩ	< 2.5 mΩ	Pass

Line	Freq (MHz)	QP Amplitude (dBµV)	QP Limit (dBµV)	Delta (dB)	Pass/Fail	Average Amplitude (dBµV)	Average Limit (dBµV)	Delta (dB)	Pass/Fail
Line_120VAC 60Hz	0.162	56.8	79	-22.2	Pass	42.4	66	-23.6	Pass
Line_120VAC 60Hz	0.218	46.5	79	-32.5	Pass	33.1	66	-32.9	Pass
Line_120VAC 60Hz	0.234	43.7	79	-35.3	Pass	29.3	66	-36.7	Pass
Line_120VAC 60Hz	0.342	38.8	79	-40.2	Pass	27.6	66	-38.4	Pass
Line_120VAC 60Hz	0.270	40.7	79	-38.3	Pass	29.2	66	-36.8	Pass
Line_120VAC 60Hz	0.178	53	79	-26	Pass	34.5	66	-31.5	Pass

Figure 12: Conducted Emissions, Line, Test Data

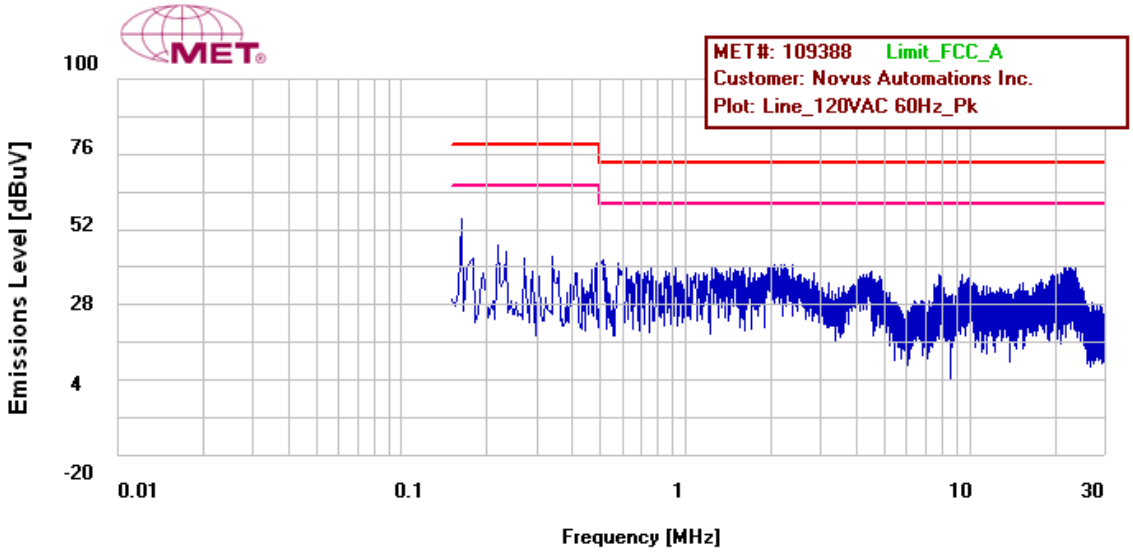

Figure 13: Conducted Emissions, Line, Prescan

Line	Freq (MHz)	QP Amplitude (dBµV)	QP Limit (dBµV)	Delta (dB)	Pass/Fail	Average Amplitude (dBµV)	Average Limit (dBµV)	Delta (dB)	Pass/Fail
Neutral_120VAC 60Hz	23.238	37.1	73	-35.9	Pass	30.2	60	-29.8	Pass
Neutral_120VAC 60Hz	7.810	34.1	73	-38.9	Pass	28.9	60	-31.1	Pass
Neutral_120VAC 60Hz	0.310	36.9	79	-42.1	Pass	26.5	66	-39.5	Pass
Neutral_120VAC 60Hz	0.254	39.8	79	-39.2	Pass	28.8	66	-37.2	Pass
Neutral_120VAC 60Hz	0.274	38.4	79	-40.6	Pass	28.4	66	-37.6	Pass
Neutral_120VAC 60Hz	1.874	33.8	73	-39.2	Pass	27.6	60	-32.4	Pass

Figure 14: Conducted Emissions, Neutral, Test Data

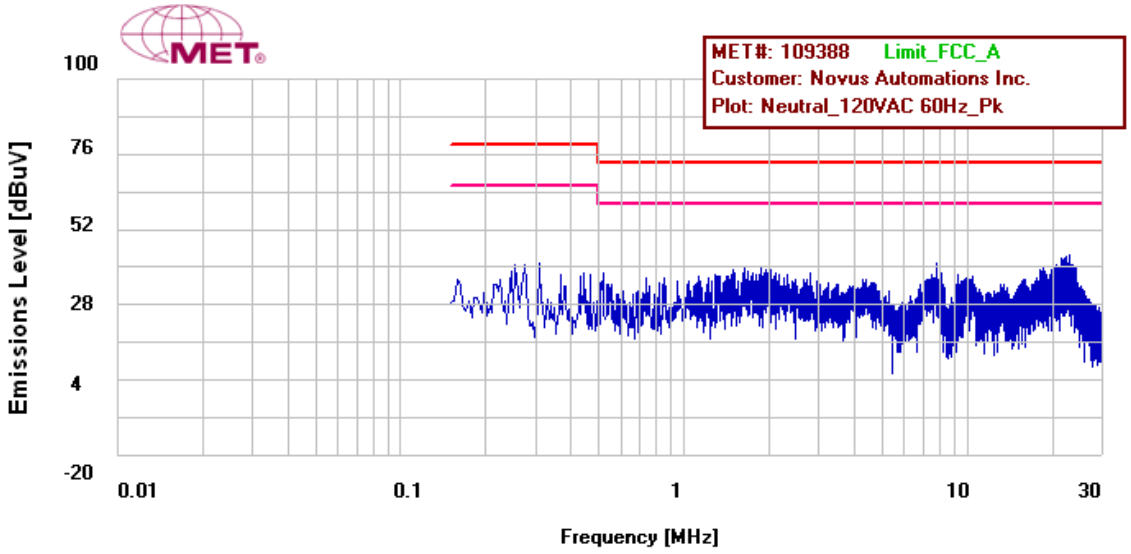

Figure 15: Conducted Emissions, Neutral, Prescan

Figure 16: Conducted Emissions, Setup Front View

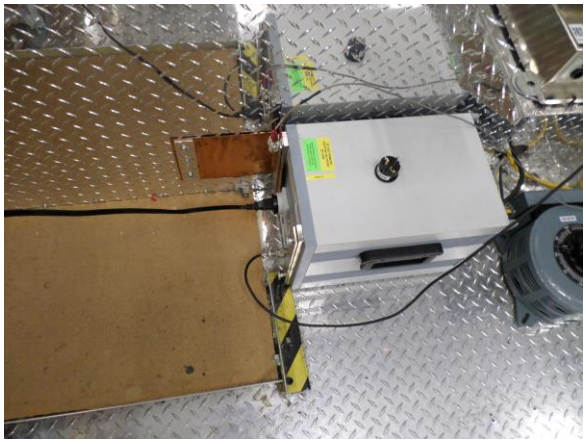

Figure 17: Conducted Emissions, Setup LISN View

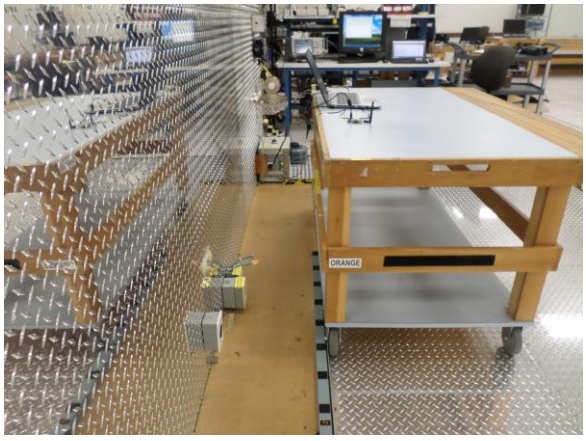

Figure 18: Conducted Emissions, Setup Rear View

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, 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). No anomalies noted.

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

Test Engineer(s): Adan Arab

Test Date(s): September 15, 2020

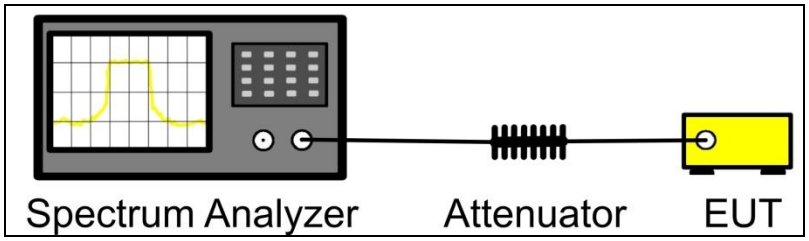

Figure 19: Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results:

Occupied Bandwidth		
Channel (MHz)	**6 dB Bandwidth (MHz)**	**Limit (MHz)**
2405	1.314	≥0.500
2440	1.524	≥0.500
2475	1.537	≥0.500

Figure 20: 6 dB Occupied Bandwidth, Test Results

6dB Bandwidth

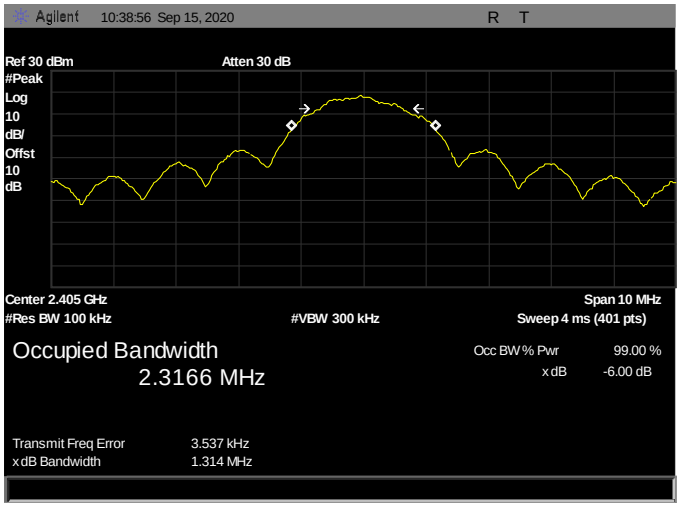

Figure 21: 6dB Bandwidth, 2405 MHz - 1.314 MHz

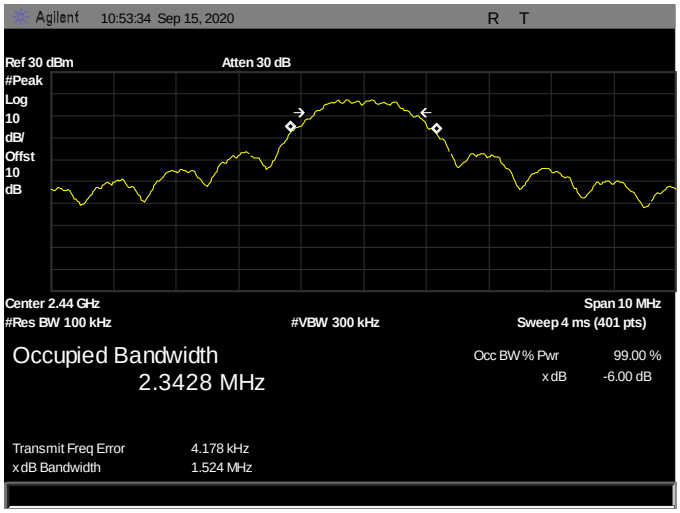

Figure 22: 6dB Bandwidth, 2440 MHz - 1.524 MHz

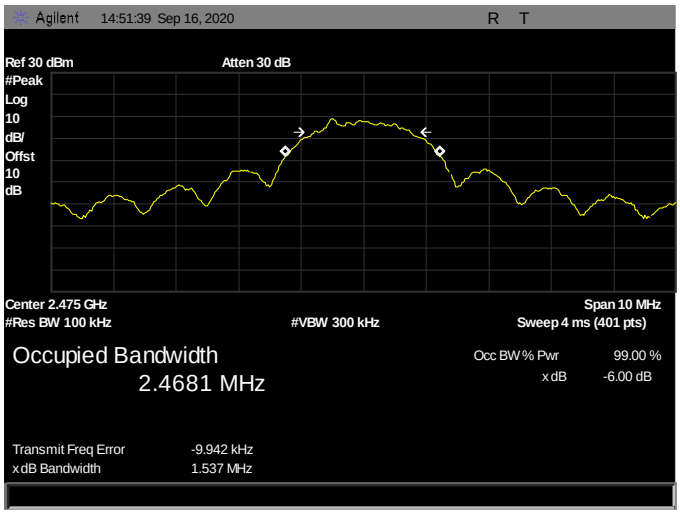

Figure 23: 6dB Bandwidth, 2475 MHz - 1.537 MHz

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 24: Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Figure 24, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

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

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

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

Test Results: The EUT was **compliant** with the Peak Power Output limits of **§15.247(b)**. No anomalies noted.

Test Engineer(s): Adan Arab

Test Date(s): September 16, 2020

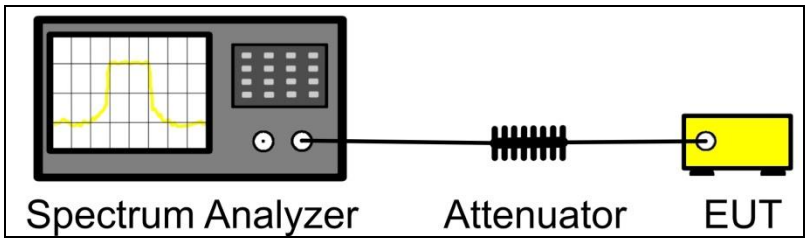

Figure 25: Peak Power Output Test Setup

Peak Power Output Test Results:

Peak Conducted Output Power		
Channel (MHz)	**Peak Output Power (dBm)**	**Limit (dBm)**
2405	20.10	30
2440	19.64	30
2475	10.44	30

Figure 26: Peak Power Output, Test Results

Peak Power Output

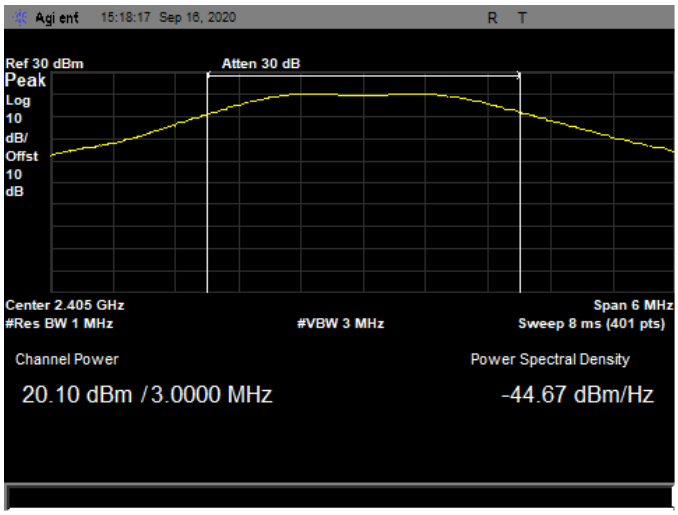

Figure 27: Output Power - Ch. 11 (2405 MHz) - 20.10 dBm

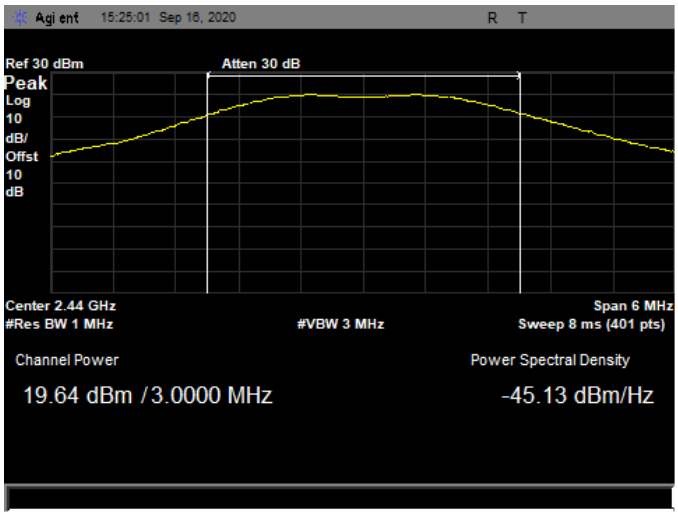

Figure 28: Output Power - Ch. 18 (2440 MHz) - 19.64 dBm

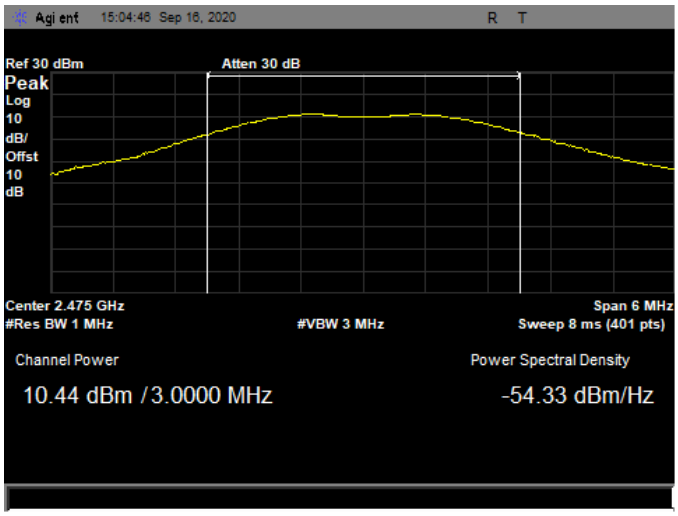

Figure 29: Output Power - Ch. 25 (2475 MHz) - 10.44 dBm

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 30: 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 Figure 31:

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 31: 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.

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

Test Engineer(s): Adan Arab

Test Date(s): September 18, 2020

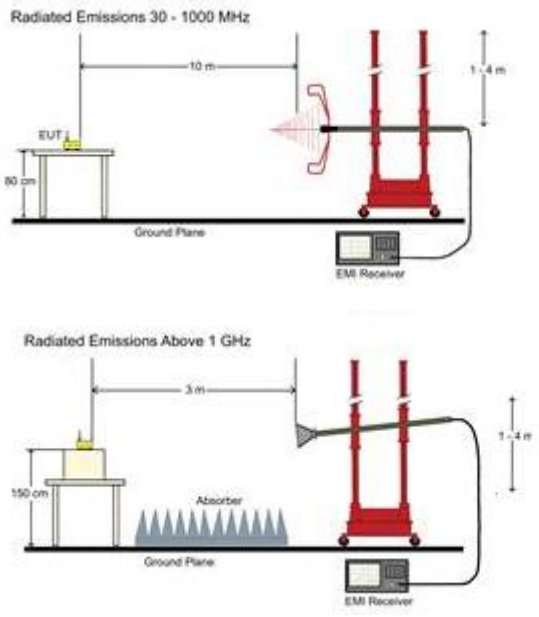

Figure 32: Radiated Emissions Test Setup

Radiated Spurious Emissions

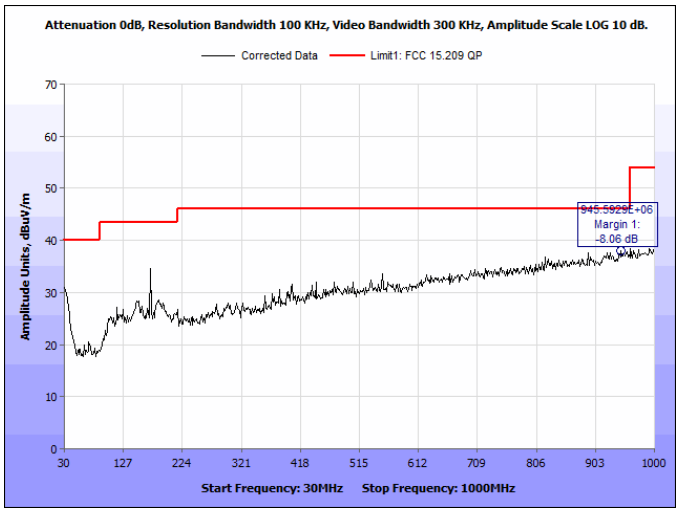

Figure 33: Radiated Spurious Emissions, 2405 MHz - 30-1000 MHz - Horizontal.

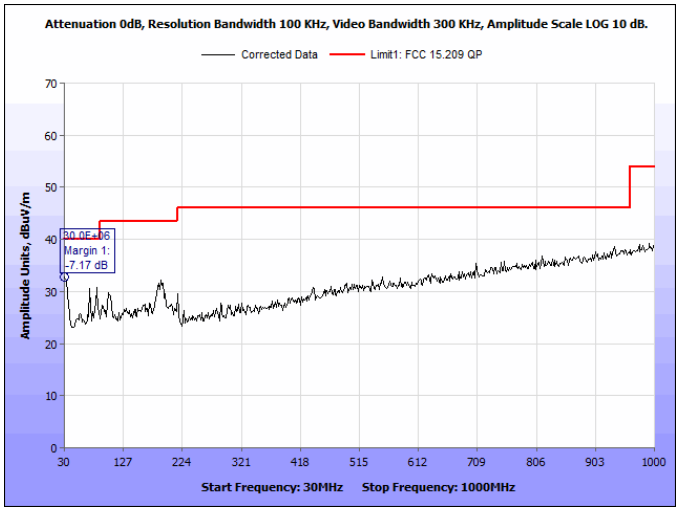

Figure 34: Radiated Spurious Emissions, 2405 MHz - 30-1000 MHz – Vertical

Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Detector	RBW (KHz)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit, 15.209 QP (dBuV/m)	Margin (dB)
945.5929	20.03	H	QP	100	10.46	26.7	-19.25	37.94	46	-8.06
954.9199	19.68	H	QP	100	10.46	26.8	-19.19	37.76	46	-8.24
950.2564	19.64	H	QP	100	10.46	26.8	-19.23	37.67	46	-8.33
30.0000	22.19	V	QP	100	10.46	25	-24.82	32.83	40	-7.17
934.7115	20.37	V	QP	100	10.46	27.1	-19.34	38.59	46	-7.41
31.5545	22.24	V	QP	100	10.46	24.43	-24.72	32.42	40	-7.58

Figure 35: Radiated Spurious Emissions, 2405 MHz - 30-1000 MHz

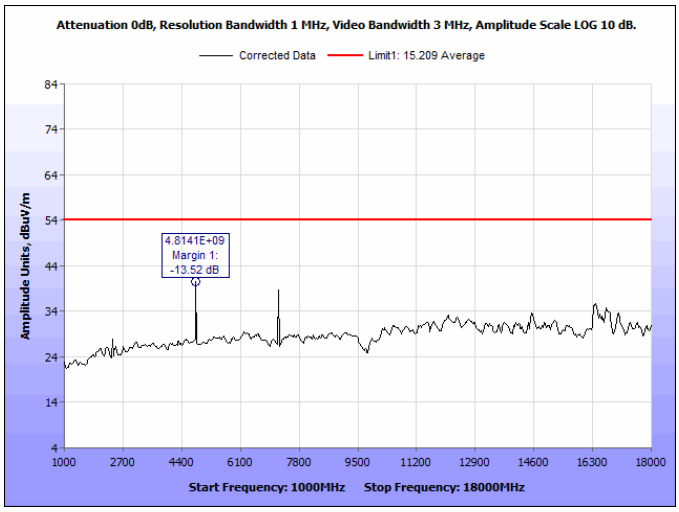

Figure 36: Radiated Spurious Emissions, 2405 MHz - 1-18 GHz - Average - Horizontal.

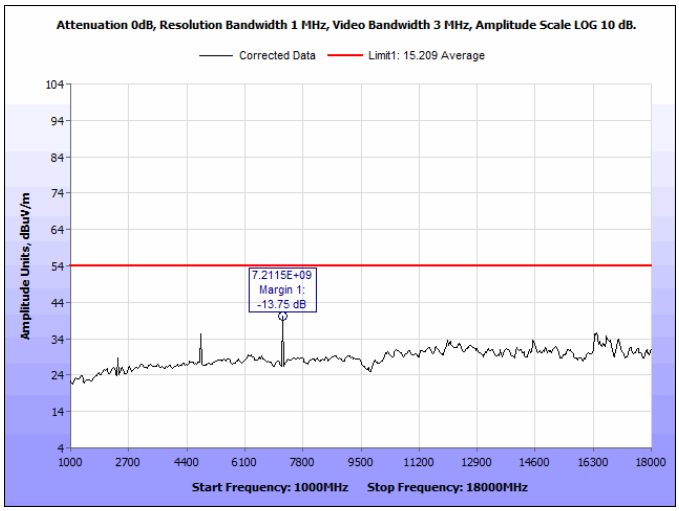

Figure 37: Radiated Spurious Emissions, 2405 MHz - 1-18 GHz - Average - Vertical

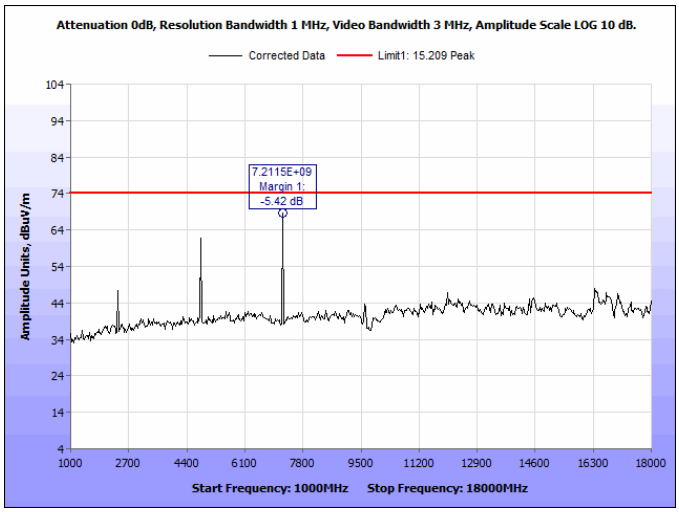

Figure 38: Radiated Spurious Emissions, 2405 MHz - 1-18 GHz - Peak – Horizontal

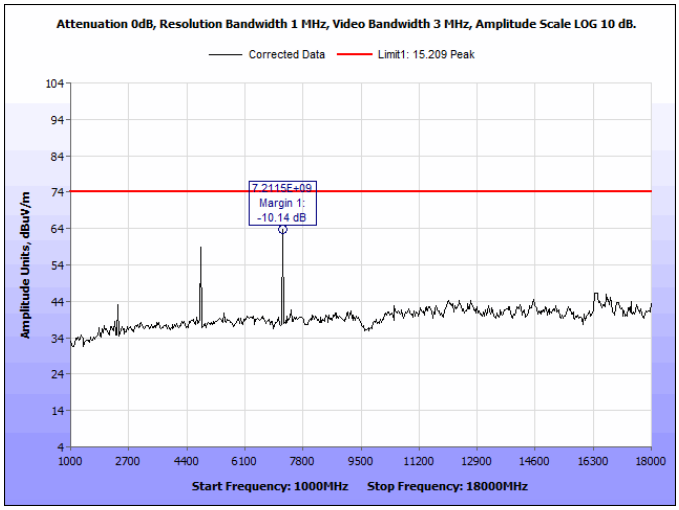

Figure 39: Radiated Spurious Emissions, 2405 MHz - 1-18 GHz - Peak - Vertical

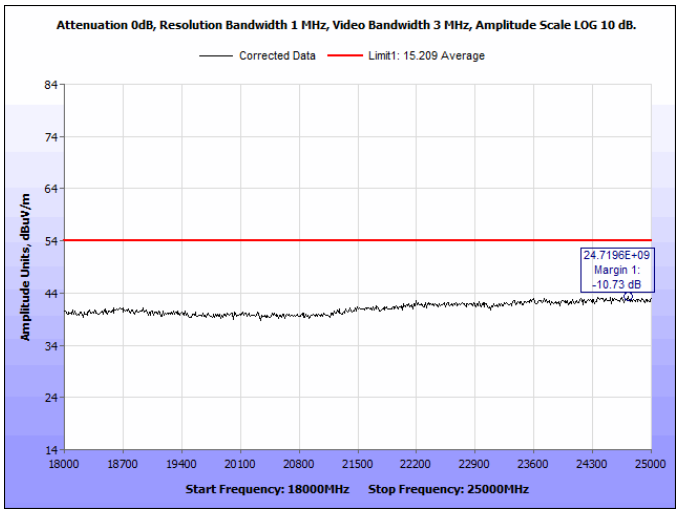

Figure 40: Radiated Spurious Emissions, 2405 MHz - 18-25 GHz - Average - Horizontal.

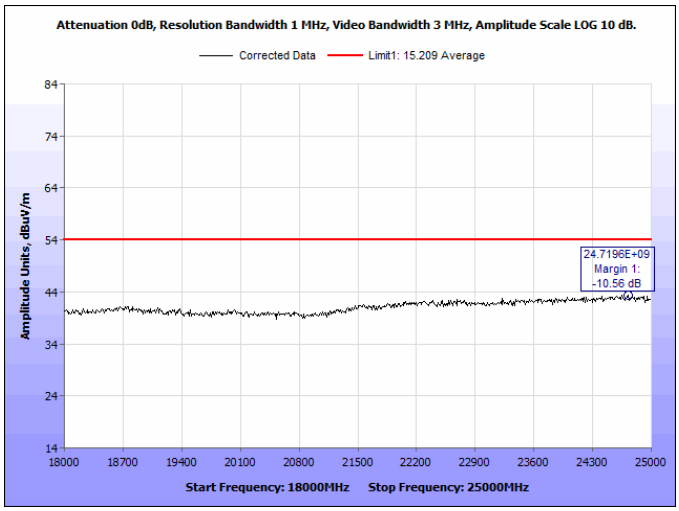

Figure 41: Radiated Spurious Emissions, 2405 MHz - 18-25 GHz - Average - Vertical

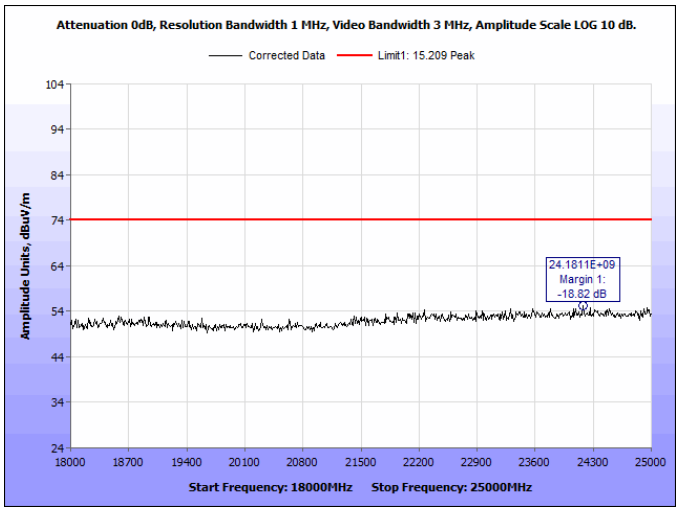

Figure 42: Radiated Spurious Emissions, 2405 MHz - 18-25 GHz - Peak - Horizontal.

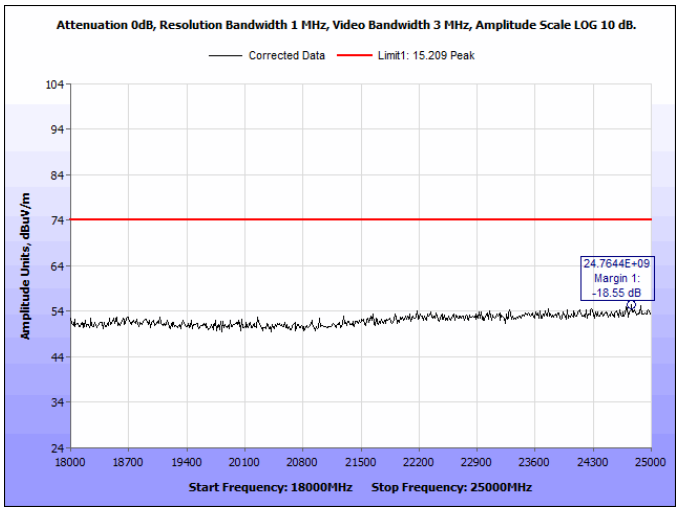

Figure 43: Radiated Spurious Emissions, 2405 MHz - 18-25 GHz - Peak – Vertical

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Detector	RBW (MHz)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit 1, 15.209 Average (dBuV/m)	Limit 2, 15.209 Peak (dBuV/m)	Margin 1, (dB)	Margin 2, (dB)
4.8141	45.15	H	Average	1	33.82	-38.49	40.48	54	--	-13.52	--
7.2115	44.9	V	Average	1	35.35	-40	40.25	54	--	-13.75	--
7.2115	73.19	H	Peak	1	35.38	-40	68.58	--	74	--	-5.42
7.2115	68.5	V	Peak	1	35.35	-40	63.86	--	74	--	-10.14
24.7196	29.85	H	Average	1	45.37	-31.95	43.27	54	--	-10.73	--
24.7196	30.01	V	Average	1	45.38	31.95	43.44	54	--	-10.56	--
24.1811	41.83	H	Peak	1	45.35	32.01	55.18	--	74	--	-18.82
24.7644	42.02	V	Peak	1	45.38	31.94	55.45	--	74	--	-18.55

Figure 44: Radiated Emissions, 2405 MHz - 1-25 GHz.

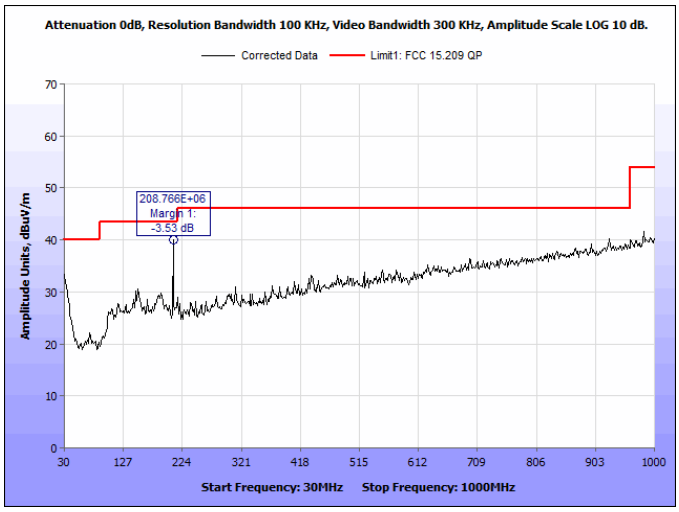

Figure 45: Radiated Spurious Emissions, 2440 MHz - 30-1000 MHz - Horizontal.

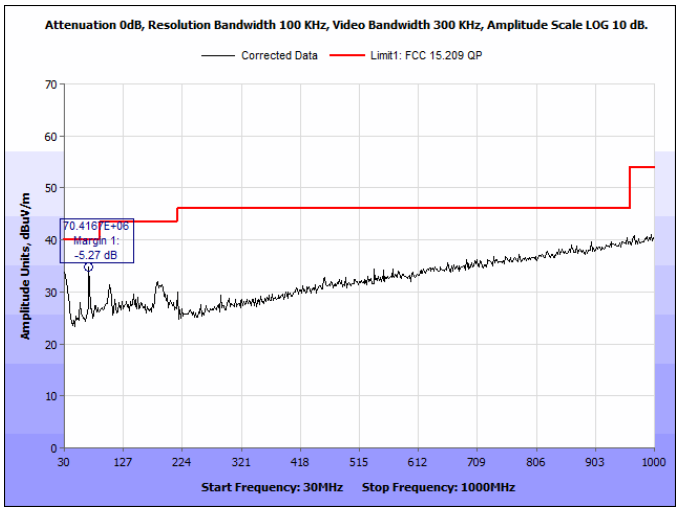

Figure 46: Radiated Spurious Emissions, 2440 MHz - 30-1000 MHz – Vertical

Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Detector	RBW (KHz)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit, 15.209 QP (dBuV/m)	Margin (dB)
208.7660	38.04	H	QP	100	10.46	14.3	-22.83	39.97	43.5	-3.53
925.3846	22.57	H	QP	100	10.46	26.64	-19.42	40.25	46	-5.75
30.0000	22.87	H	QP	100	10.46	24.9	-24.82	33.41	40	-6.59
70.4167	36.76	V	QP	100	10.46	11.64	-24.13	34.73	40	-5.27
954.9199	21.93	V	QP	100	10.46	27.2	-19.19	40.41	46	-5.59
30.0000	23.15	V	QP	100	10.46	25	-24.82	33.79	40	-6.21

Figure 47: Radiated Spurious Emissions, 2440 MHz - 30-1000 MHz

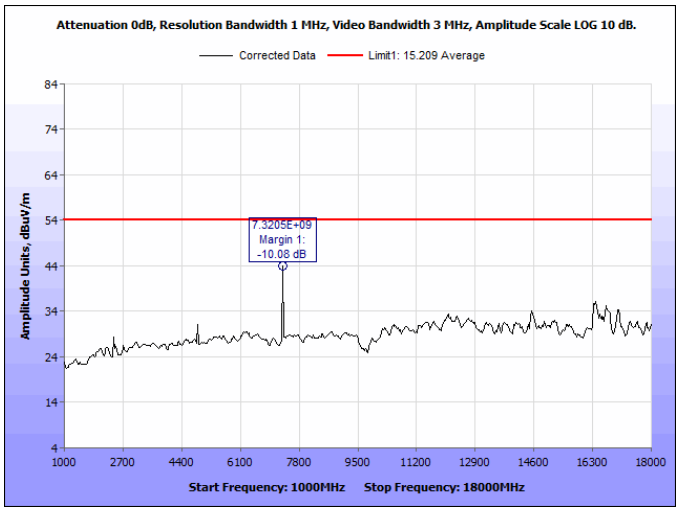

Figure 48: Radiated Spurious Emissions, 2440 MHz - 1-18 GHz - Average - Horizontal

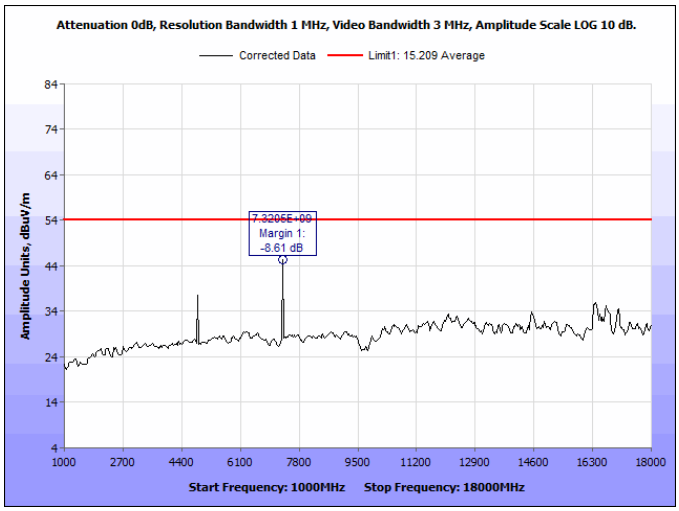

Figure 49: Radiated Spurious Emissions, 2440 MHz - 1-18 GHz - Average - Vertical

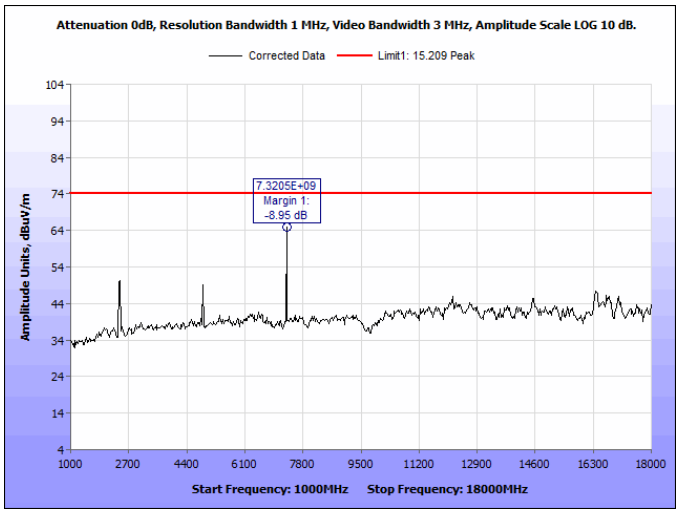

Figure 50: Radiated Spurious Emissions, 2440 MHz - 1-18 GHz - Peak - Horizontal

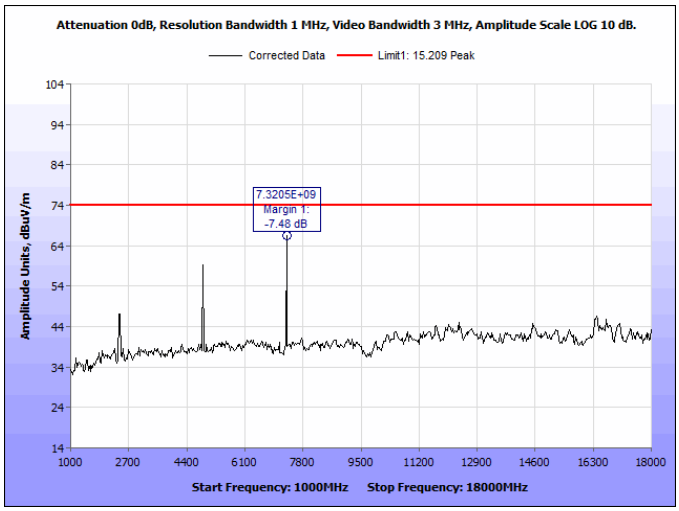

Figure 51: Radiated Spurious Emissions, 2440 MHz - 1-18 GHz - Peak - Vertical

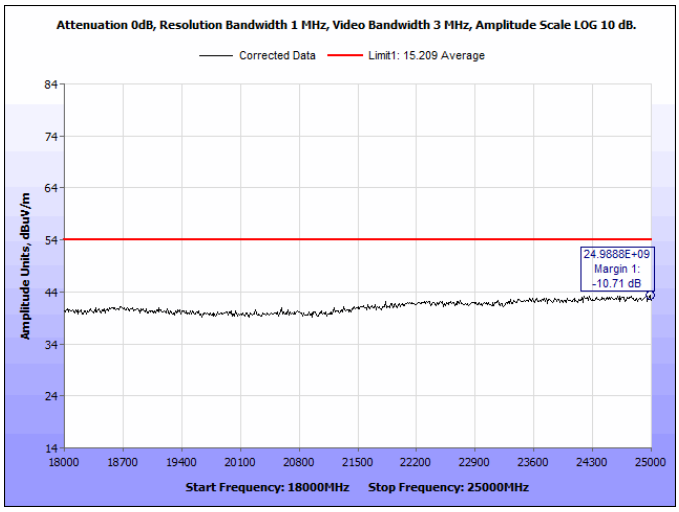

Figure 52: Radiated Spurious Emissions, 2440 MHz - 18-25 GHz - Average - Horizontal.

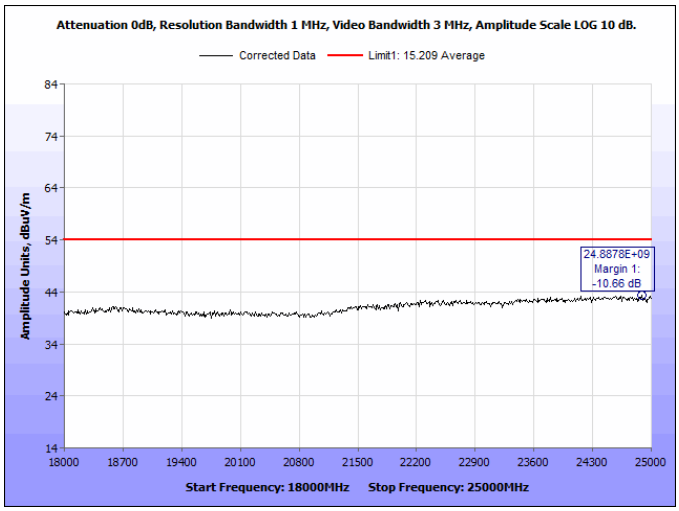

Figure 53: Radiated Spurious Emissions, 2440 MHz - 18-25 GHz - Average - Vertical

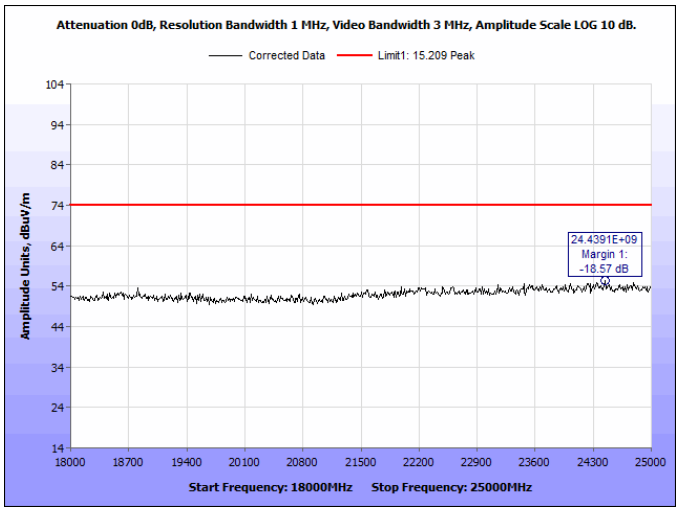

Figure 54: Radiated Spurious Emissions, 2440 MHz - 18-25 GHz - Peak - Horizontal.

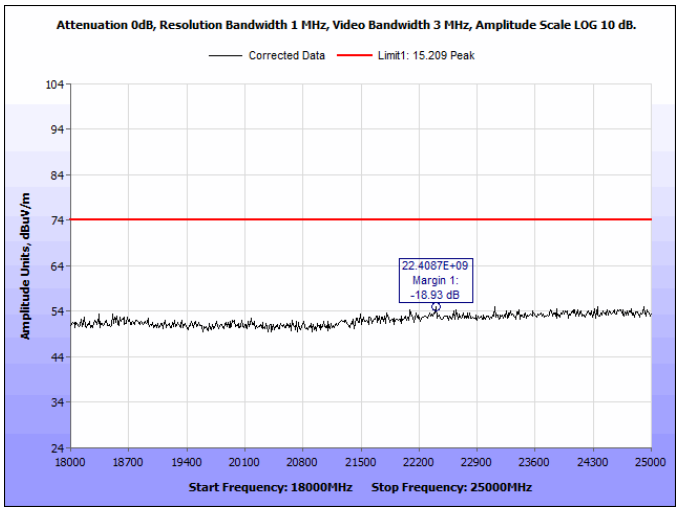

Figure 55: Radiated Spurious Emissions, 2440 MHz - 18-25 GHz - Peak – Vertical

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Detector	RBW (MHz)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit 1, 15.209 Average (dBuV/m)	Limit 2, 15.209 Peak (dBuV/m)	Margin 1, (dB)	Margin 2, (dB)
7.3205	48.46	H	Average	1	35.38	-39.93	43.92	54	--	-10.08	--
7.3205	49.93	V	Average	1	35.39	-39.93	45.39	54	--	-8.61	--
7.3205	69.59	H	Peak	1	35.38	-39.93	65.05	--	74	--	-8.95
7.3205	71.06	V	Peak	1	35.39	-39.93	66.52	--	74	--	-7.48
24.9888	29.74	H	Average	1	45.48	-39.93	43.29	54	--	-10.71	--
24.8878	29.89	V	Average	1	45.39	-39.93	43.34	54	--	-10.66	--
24.4391	42	H	Peak	1	45.33	31.90	55.43	--	74	--	-18.57
22.4087	42.61	V	Peak	1	45.09	-32.63	55.07	--	74	--	-18.93

Figure 56: Radiated Emissions, 2440 MHz - 1-25 GHz.

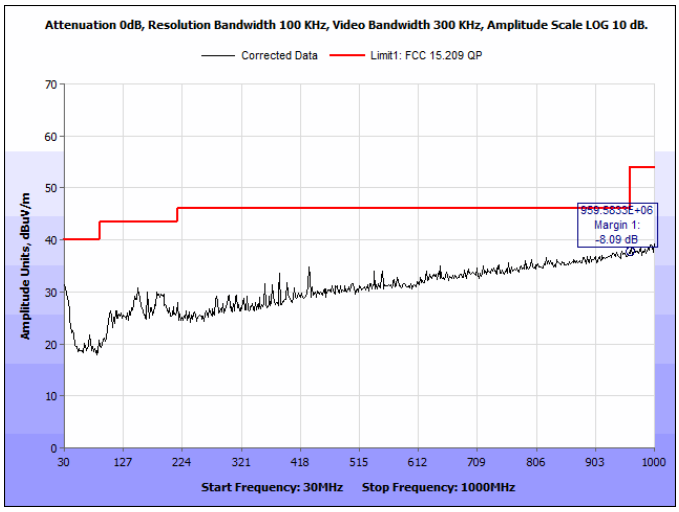

Figure 57: Radiated Spurious Emissions, 2475 MHz - 30-1000 MHz - Horizontal (plevel -8).

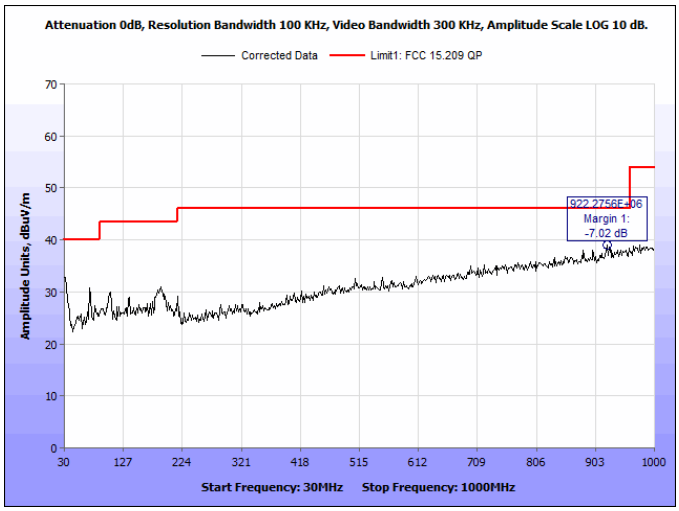

Figure 58: Radiated Spurious Emissions, 2475 MHz - 30-1000 MHz - Vertical (plevel -8).

Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Detector	RBW (KHz)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit, 15.209 QP (dBuV/m)	Margin (dB)
928.4936	19.25	H	QP	100	10.46	26.7	-19.4	37.01	46	-8.99
948.7019	19.22	H	QP	100	10.46	26.73	-19.24	37.17	46	-8.83
934.7115	19.38	H	QP	100	10.46	26.7	-19.34	37.2	46	-8.8
883.4135	20.76	V	QP	100	10.46	26.5	-19.68	38.04	46	-7.96
945.5929	19.67	V	QP	100	10.46	27.16	-19.25	38.04	46	-7.96
930.0481	19.88	V	QP	100	10.46	27.1	-19.39	38.05	46	-7.95

Figure 59: Radiated Spurious Emissions, 2475 MHz - 30-1000 MHz

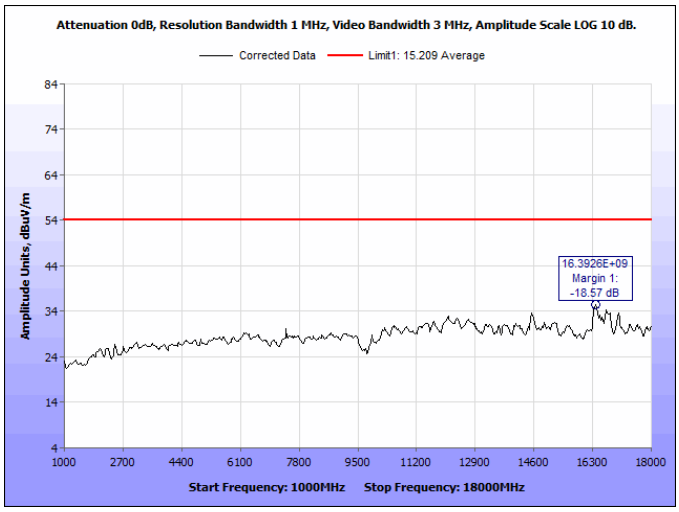

Figure 60: Radiated Spurious Emissions, 2475 MHz - 1-18 GHz - Average - Horizontal (plevel -8).

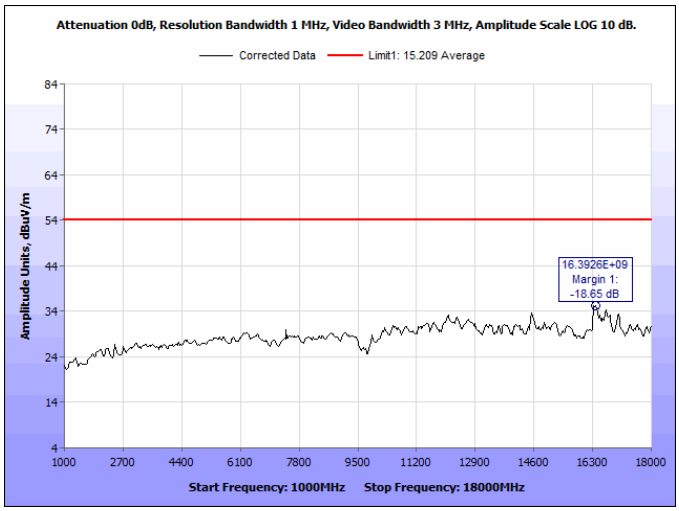

Figure 61: Radiated Spurious Emissions, 2475 MHz - 1-18 GHz - Average - Vertical (plevel -8).

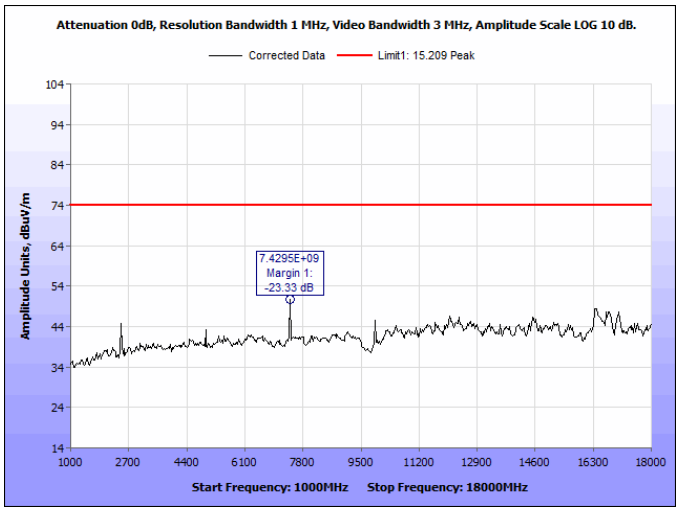

Figure 62: Radiated Spurious Emissions, 2475 MHz - 1-18 GHz - Peak - Horizontal (plevel -8).

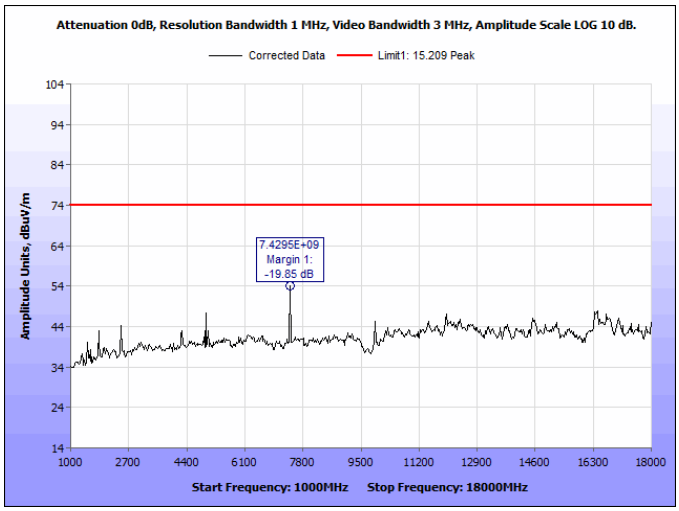

Figure 63: Radiated Spurious Emissions, 2475 MHz - 1-18 GHz - Peak - Vertical (plevel -8).

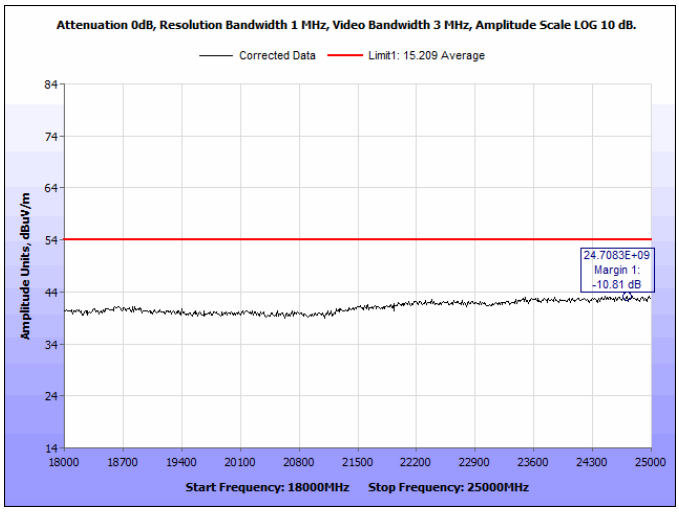

Figure 64: Radiated Spurious Emissions, 2475 MHz - 18-25 GHz - Average - Horizontal.

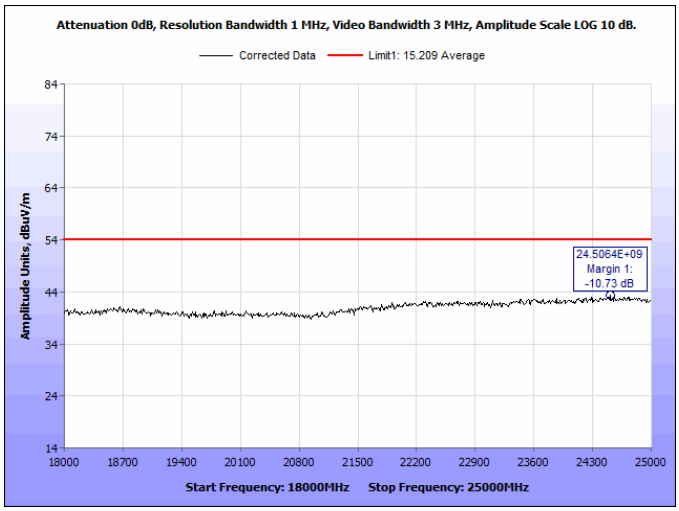

Figure 65: Radiated Spurious Emissions, 2475 MHz - 18-25 GHz - Average - Vertical

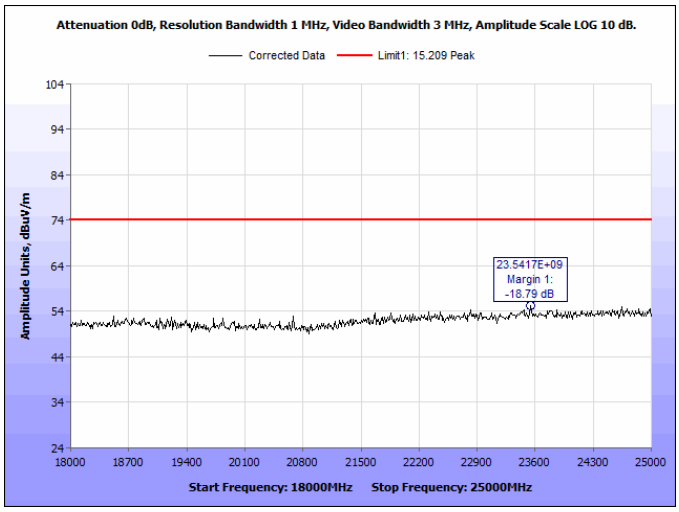

Figure 66: Radiated Spurious Emissions, 2475 MHz - 18-25 GHz - Peak – Horizontal

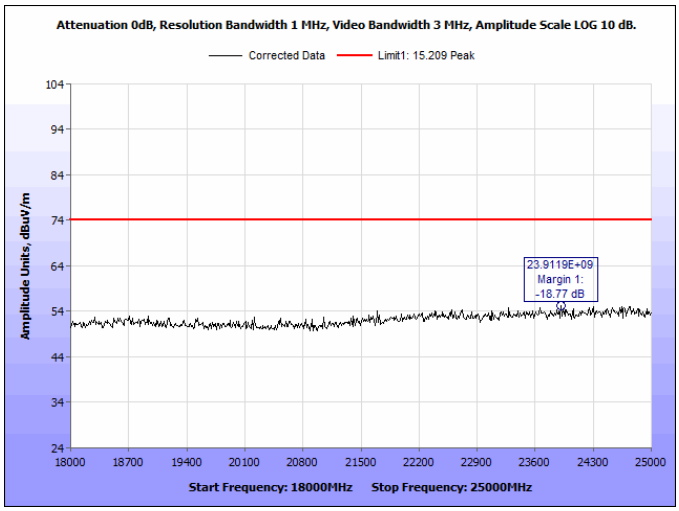

Figure 67: Radiated Spurious Emissions, 2475 MHz - 18-25 GHz - Peak – Vertical

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Detector	RBW (MHz)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit 1, 15.209 Average (dBuV/m)	Limit 2, 15.209 Peak (dBuV/m)	Margin 1, (dB)	Margin 2, (dB)
16.3926	35.89	H	Average	1	40.57	-41.03	35.43	54	--	-18.57	--
16.3926	35.83	V	Average	1	40.55	-41.03	35.35	54	--	-18.65	--
7.4295	54.84	H	Peak	1	35.38	-39.55	50.67	--	74	--	-23.33
7.4295	58.32	V	Peak	1	35.38	-39.55	54.15	--	74	--	-19.85
24.7083	29.76	H	Average	1	45.37	-39.95	43.19	54	--	-10.81	--
24.5064	29.75	V	Average	1	45.43	-31.91	43.27	54	--	-10.73	--
23.5417	42.00	H	Peak	1	45.19	-31.99	55.21	--	74	--	-18.79
23.9119	42.14	V	Peak	1	45.34	-32.25	55.23	--	74	--	-18.77

Figure 68: Radiated Emissions, 2475 MHz - 1-25 GHz.

Figure 69: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Antenna View

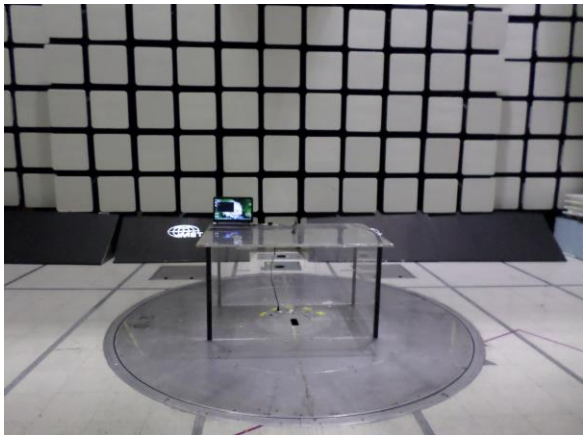

Figure 70: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Front View

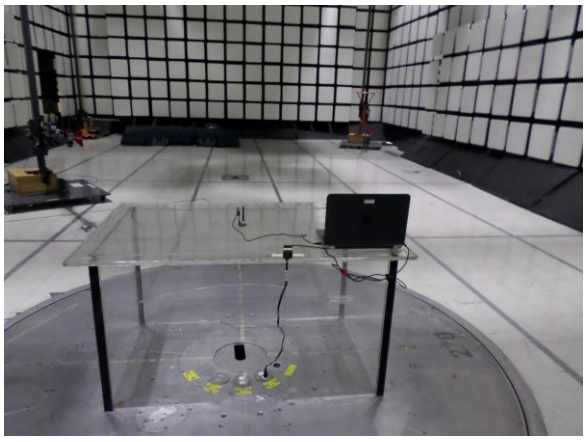

Figure 71: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Rear View

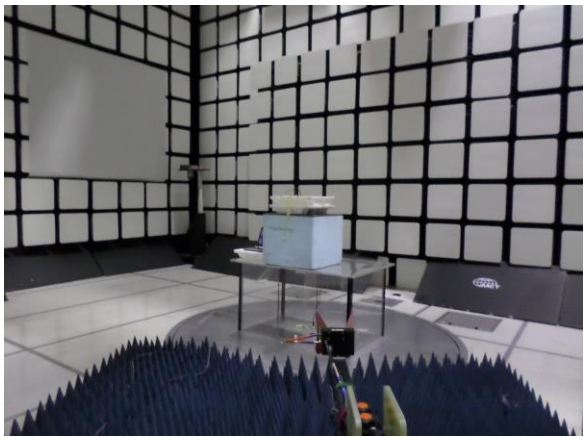

Figure 72: Radiated Spurious Emissions, 1GHz-18GHz - Setup Antenna View

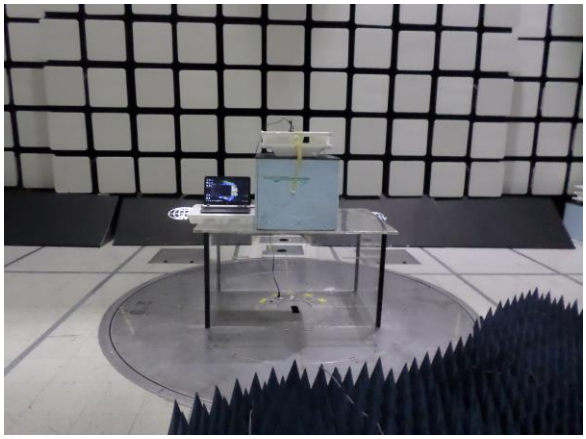

Figure 73: Radiated Spurious Emissions, 1GHz-18GHz - Setup Front View

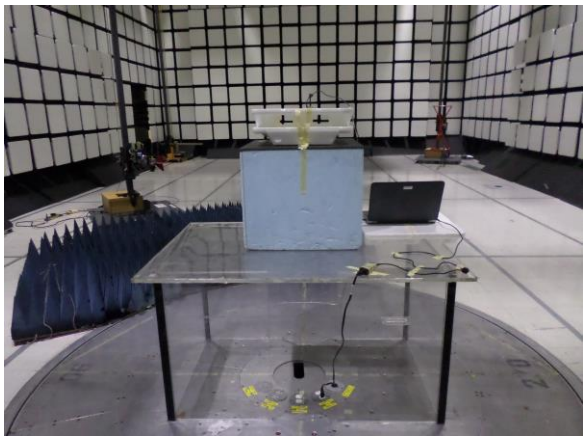

Figure 74: Radiated Spurious Emissions, 1GHz-18GHz - Setup Rear View

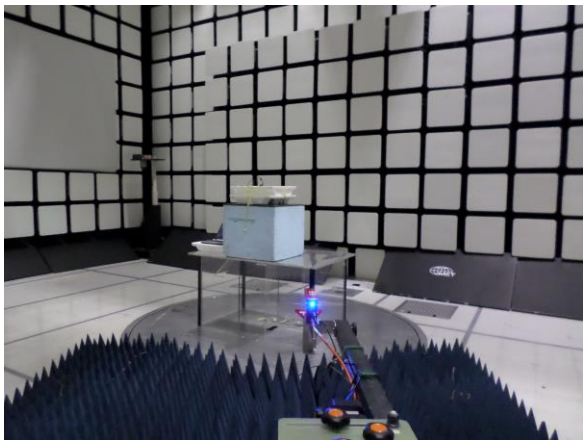

Figure 75: Radiated Spurious Emissions, 18GHz-25GHz - Setup Antenna View

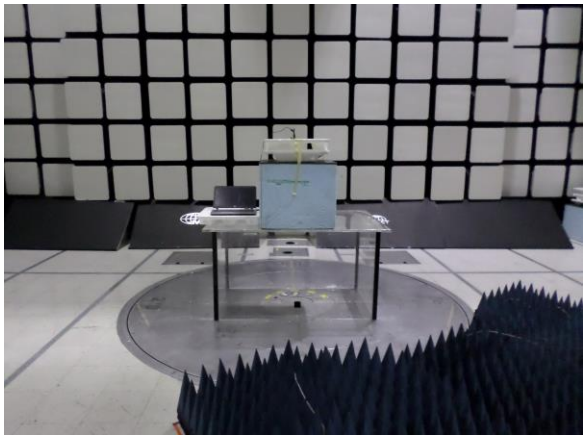

Figure 76: Radiated Spurious Emissions, 18GHz-25GHz - Setup Front View

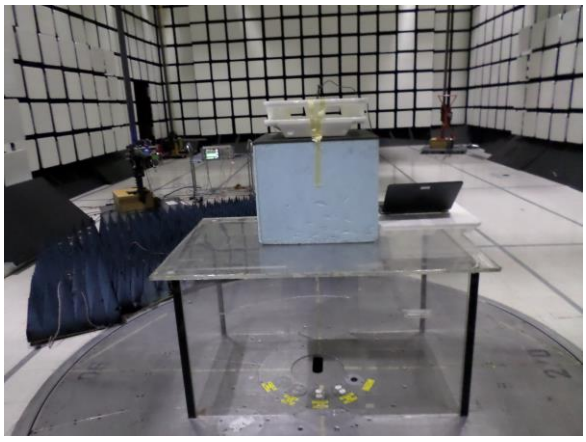

Figure 77: Radiated Spurious Emissions, 18GHz-25GHz - Setup Rear View

Radiated Band Edge Measurements

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.

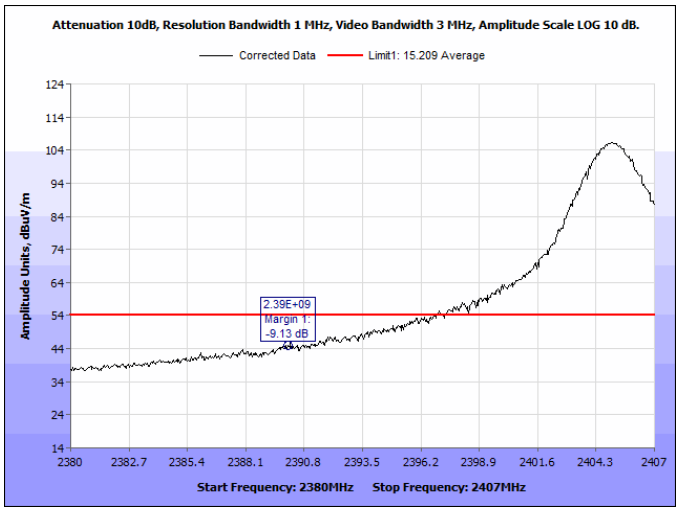

Figure 78: Radiated Band Edge, 2405 MHz - Average - Horizontal.

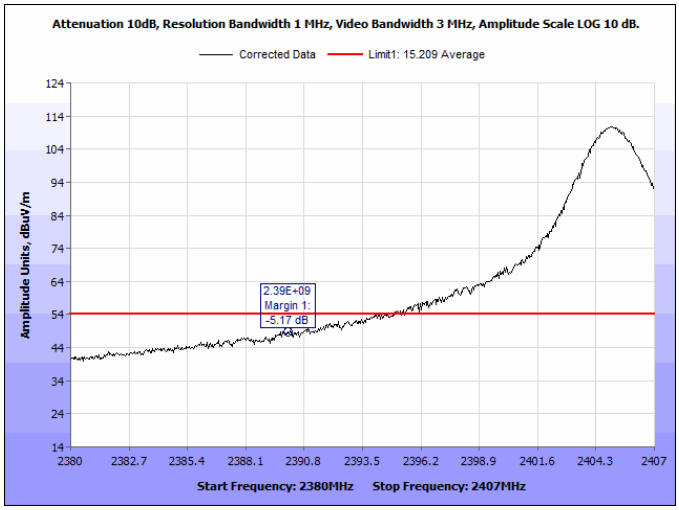

Figure 79: Radiated Band Edge, 2405 MHz - Average - Vertical

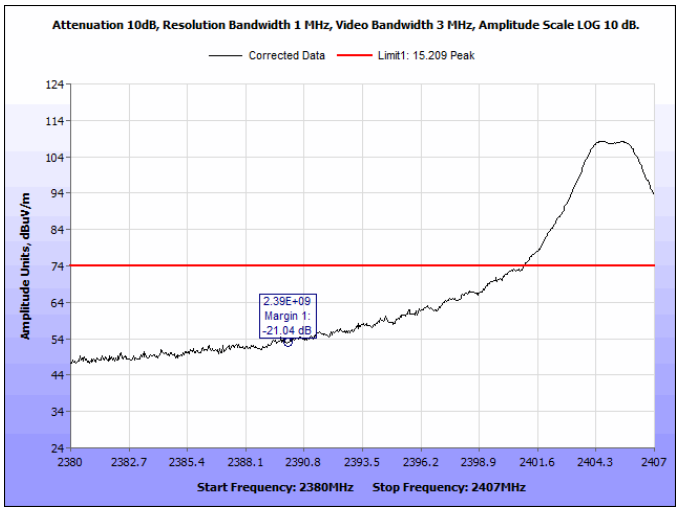

Figure 80: Radiated Band Edge, 2405 MHz - Peak - Horizontal.

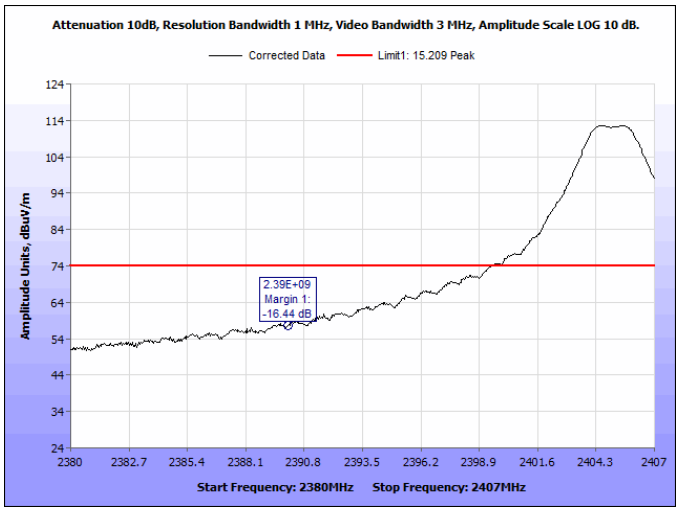

Figure 81: Radiated Band Edge, 2405 MHz - Peak - Vertical

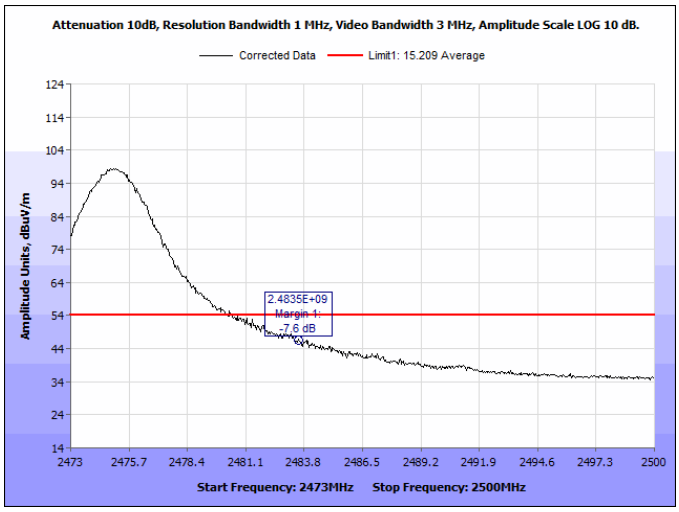

Figure 82: Radiated Band Edge, 2475 MHz - Average - Horizontal (plevel -8).

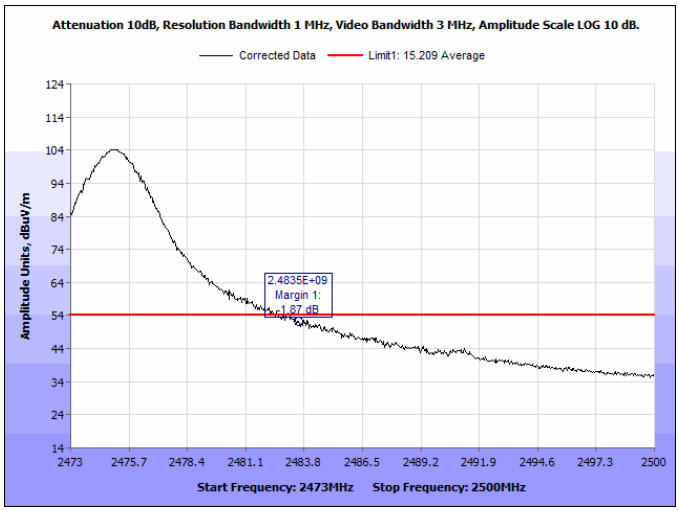

Figure 83: Radiated Band Edge, 2475 MHz - Average - Vertical (plevel -8).

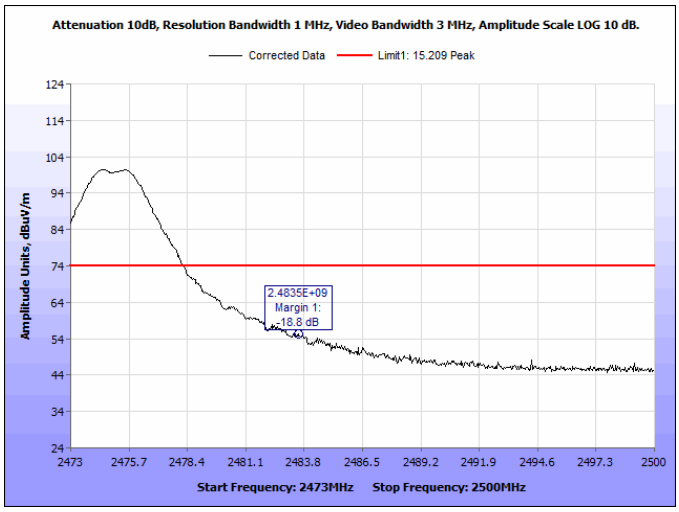

Figure 84: Radiated Band Edge, 2475 MHz - Peak - Horizontal (plevel -8).

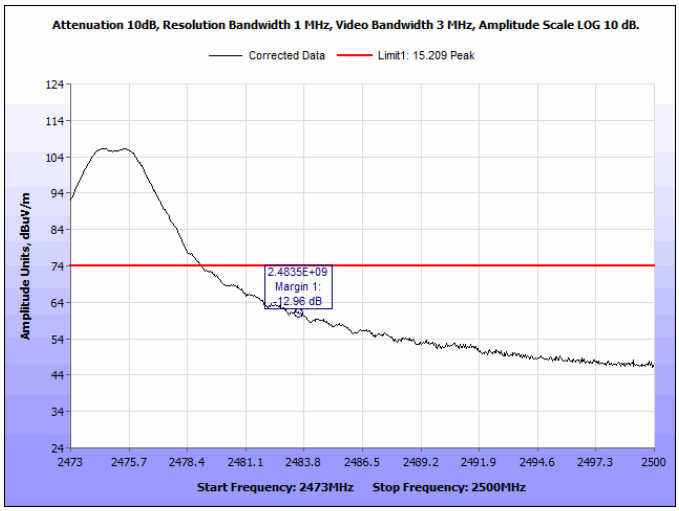

Figure 85: Radiated Band Edge, 2475 MHz - Peak - Vertical (plevel -8).

Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

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

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.

Conducted measurements were performed and since the EUT demonstrates compliance with the peak conducted output power a 20 dB attenuation is used. The test result and plots are shown below.

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

Test Engineer(s): Adan Arab

Test Date(s): September 16, 2020

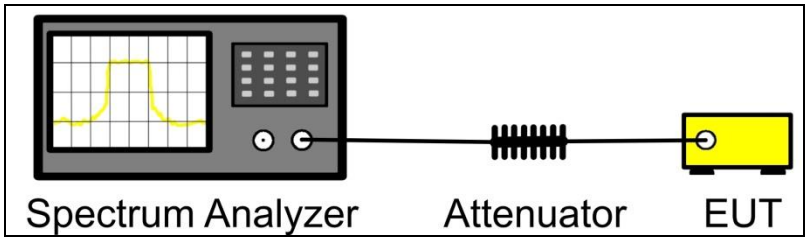

Figure 86: Block Diagram, Conducted Spurious Emissions Test Setup

Conducted Spurious Emissions Test Results

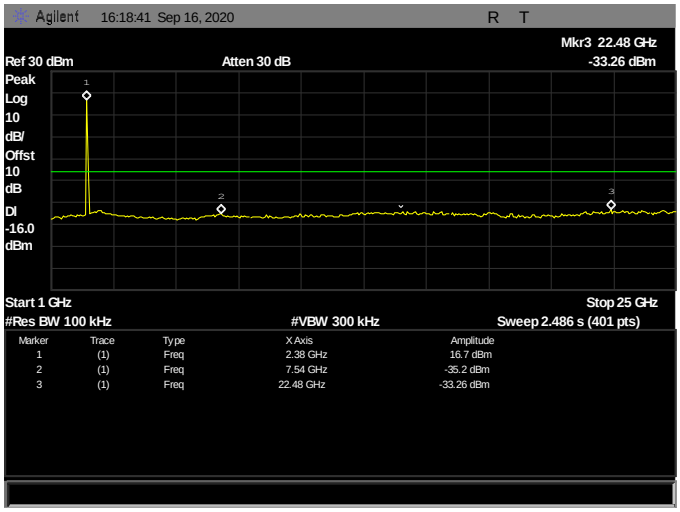

Figure 87: Conducted Spurious Emissions, Ch. 11 (2405 MHz) - 1GHz-25GHz

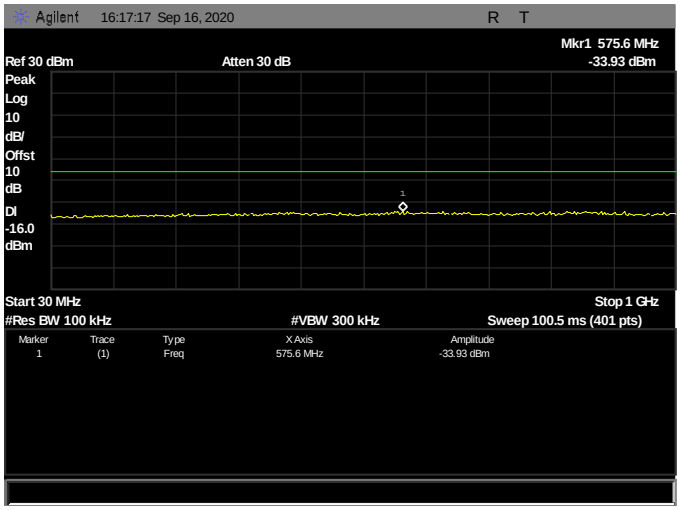

Figure 88: Conducted Spurious Emissions, Ch. 11 (2405 MHz) - 30MHz-1000 MHz

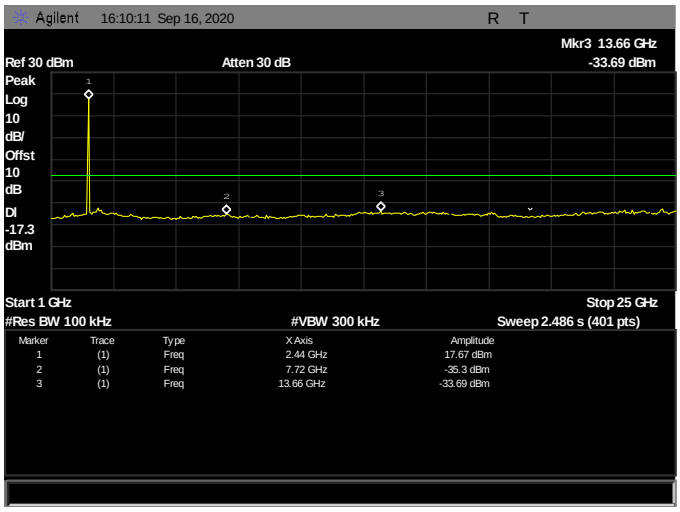

Figure 89: Conducted Spurious Emissions, Ch. 18 (2440 MHz) - 1GHz-25GHz

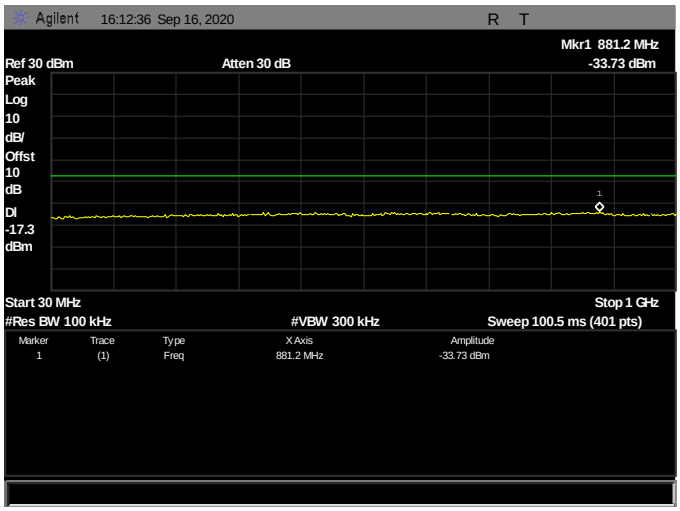

Figure 90: Conducted Spurious Emissions, Ch. 18 (2440 MHz) - 30MHz-1000 MHz

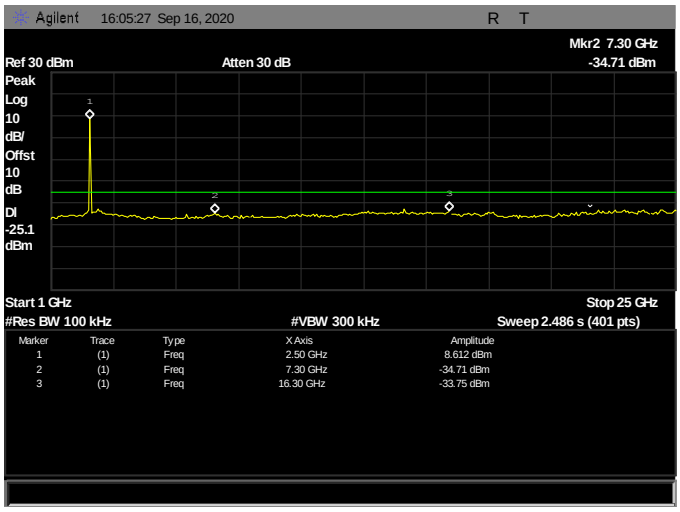

Figure 91: Conducted Spurious Emissions, Ch. 25 (2475 MHz) - 1GHz-25GHz

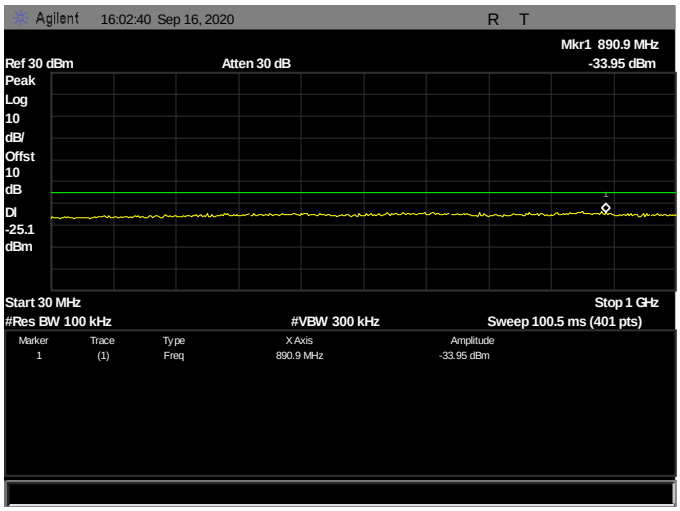

Figure 92: Conducted Spurious Emissions, Ch. 25 (2475 MHz) - 30MHz-1000 MHz

Conducted Band Edge

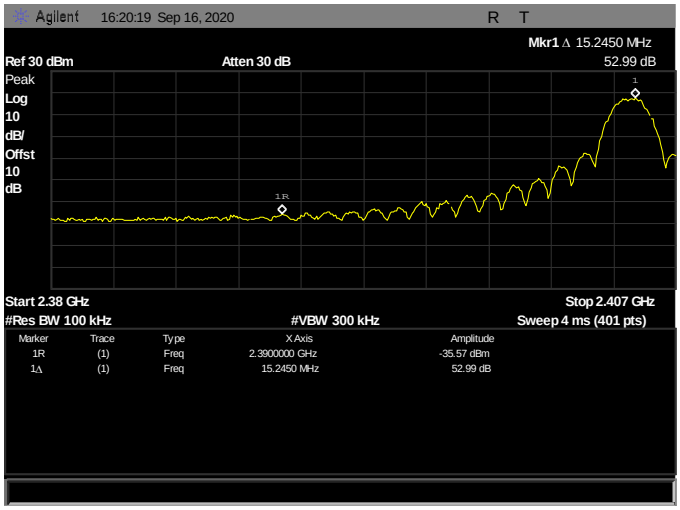

Figure 93: Conducted Band Edge, Ch. 21 (2405 MHz)

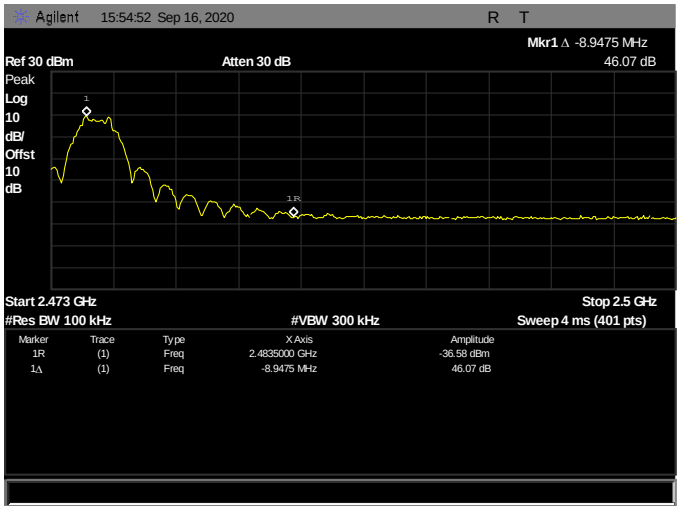

Figure 94: Conducted Band Edge, Ch. 25 (2475 MHz)

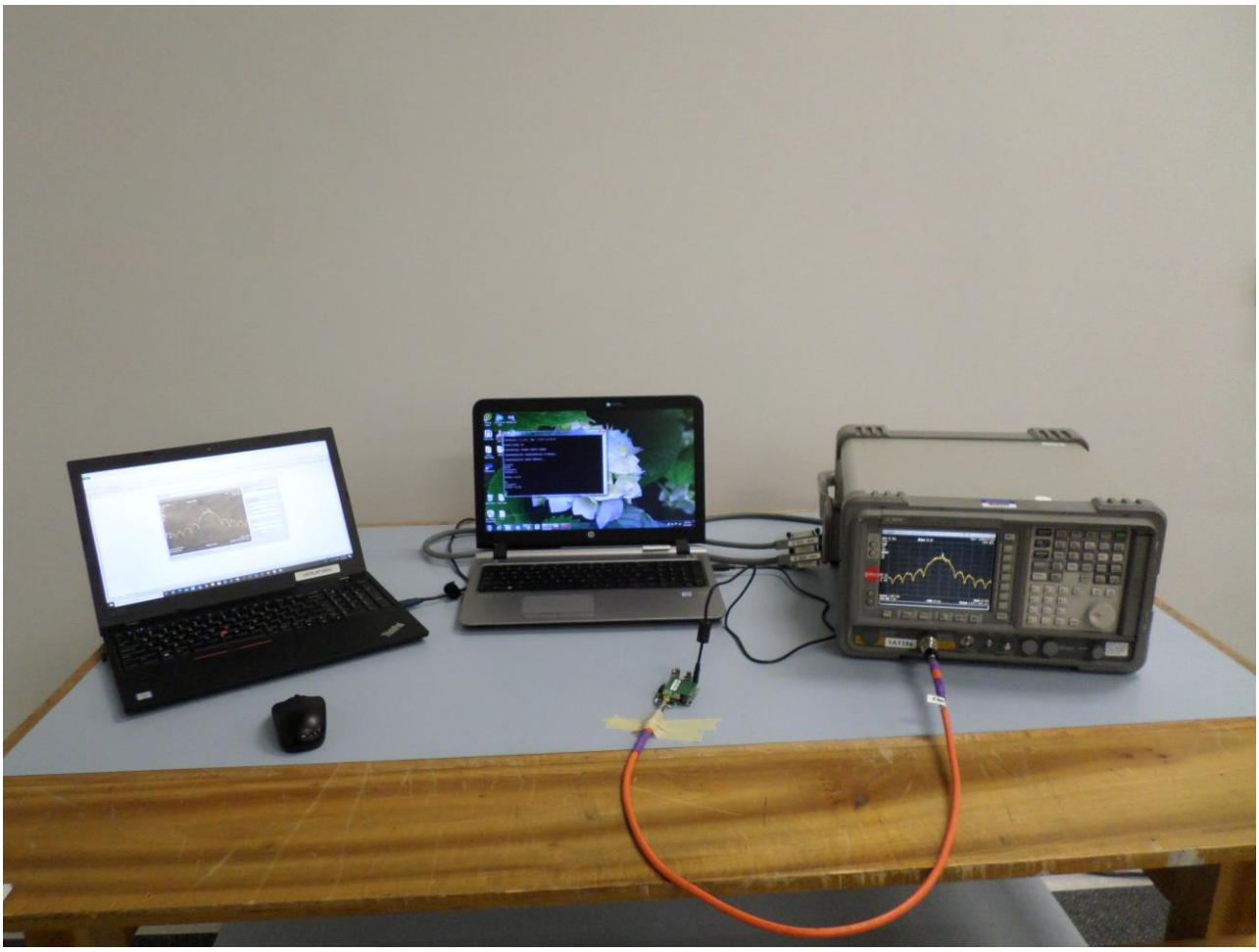

Figure 95: Conducted Tests, Setup Photo

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 throughout each of the 100 sweeps of power averaging. The RBW was set to 3 kHz and a VBW set to 9 kHz or greater. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels.

Test Results: The EUT was **compliant** with the peak power spectral density limits of **§ 15.247 (e)**. The Peak Power Spectral Density was measured and recorded. Test result data and Plots are on the following page(s).

Test Engineer(s): Adan Arab

Test Date(s): September 16, 2020

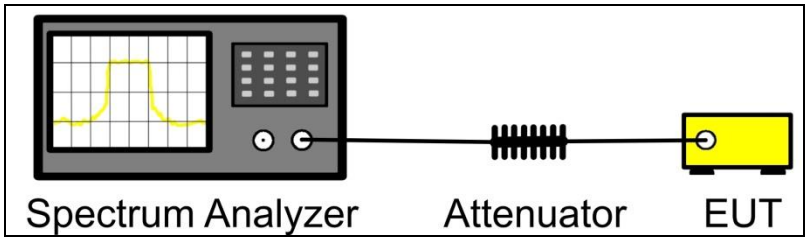

Figure 96: Block Diagram, Peak Power Spectral Density Test Setup

Channel (MHz)	Power Density (dBm)	Limit (dBm/3KHz)
2405	3.974	8
2440	2.701	8
2475	-5.097	8

Figure 97: Peak Power Spectral Density, Test Results

Peak Power Spectral Density

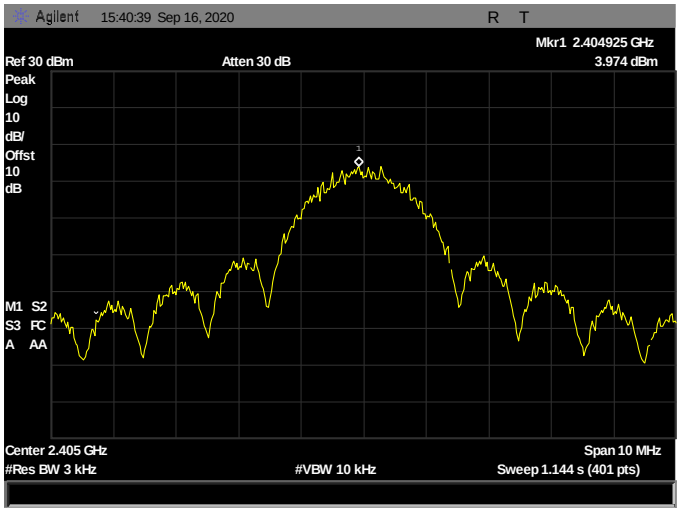

Figure 98: Power Spectral Density, Ch.11 (2405 MHz) - 3.974 dBm

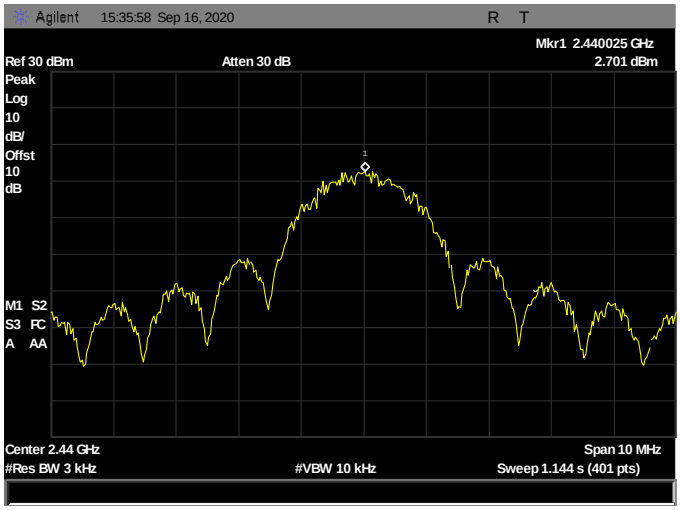

Figure 99: Power Spectral Density, Ch.18 (2440 MHz) - 2.701 dBm4

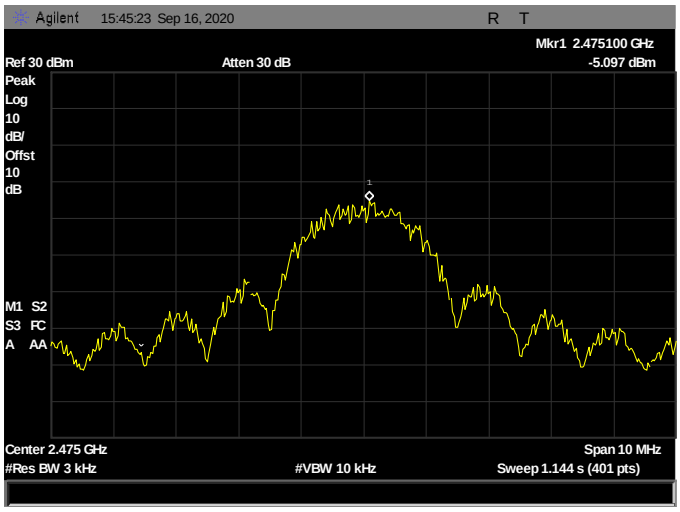

Figure 100: Power Spectral Density, Ch.25 (2475 MHz) - (-5.097 dBm)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 2400-2483.5 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{(PG / 4\pi S)}$$

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

FCC											
Frequency (MHz)	**Measured Conducted Power (dBm)**	**Tune-up Tolerance (± dB)**	**Conducted Power + Tune-up (dBm)**	**Conducted Power + Tune-up (mW)**	**Antenna Gain (dBi)**	**Antenna Gain Numeric**	**Power Density (mW/cm2)**	**Limit (mW/cm2)**	**Margin**	**Distance (cm)**	**Result**
2405	20.10	2	22.10	162.181	2.54	1.795	0.05791	1	0.94209	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

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	CAL DUE
1A1065	EMI RECEIVER	ROHDE & SCHWARZ	ESCI	06/22/2020	06/22/2021
1A1087	ATTENUATOR	ROHDE & SCHWARZ	ESH3Z2	06/10/2020	06/10/2021
1A1122	LISN	TESEQ	NNB 51	08/04/2020	08/04/2021
1A1191	TEMPERATURE HUMIDITY PRESSURE SENSOR/RECORDER	OMEGA	PRHTEMP2000	02/04/2020	02/04/2021
1A1116	MULTIMETER	FLUKE	179	01/28/2020	01/28/2021
1A1119	TEST AREA	CUSTOM MADE	N/A	SEE NOTE	SEE NOTE
1A1141	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	08/24/2020	08/24/2021
1A1083	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	10/10/2019	10/10/2020
1A1176	ACTIVE LOOP ANTENNA	ETS-LINDGREN	6502	1/31/2018	7/31/2019
1A1147	BILOG ANTENNA (30-1000 MHZ)	SUNOL SCIENCES CORP	JB3	06/05/2019	12/05/2020
1A1183	DOUBLE RIDGED WAVEGUIDE ANTENNA (1-18 GHZ)	ETS LINDGREN	3117	06/01/2020	06/01/2022
1A1161	DRG HORN ANTENNA	ETS LINDGREN	3116C-PA	06/03/2020	06/03/2022
1A1099	1A1099	GENERATOR	COM-POWER CORP	SEE NOTE	SEE NOTE
1A1044	1A1044	GENERATOR	COM-POWER CORP	SEE NOTE	SEE NOTE
1A1088	PRE-AMP	ROHDE & SCHWARZ	TS-PR1	SEE NOTE	SEE NOTE
1A1080	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	SEE NOTE
1A1073	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	SEE NOTE
1A1180	PRE-AMP	MITEQ	AMF-7D-01001800-22-10P	SEE NOTE	SEE NOTE
1A1106	10M SEMI-ANECHOIC CHAMBER	LINDGREN	N/A	SEE NOTE	SEE NOTE

Figure 101: Test Equipment List

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

Certification & User's Manual Information

Certification & User's Manual Information

M. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

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

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

End of Report