

April 26, 2019

Polycom Inc.
6001 America Center Drive
San Jose, CA 95002

Dear Tony Griffiths,

Enclosed is the EMC Wireless test report for compliance testing of the Polycom Inc., P011 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), FCC Part 15 Subpart C 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



Jennifer Warnell
Documentation Department

Reference: (\Polycom Inc.\EMCA102119A-FCC247 DSS)

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Electromagnetic Compatibility Criteria Test Report

for the

**Polycom Inc.
P011**

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart C
15.247 for Intentional Radiators

MET Report: EMCA102119A-FCC247 DSS

April 26, 2019

Prepared For:

**Polycom Inc.
6001 America Center Drive
San Jose, CA 95002**

Prepared By:
Eurofins MET Labs
914 W. Patapsco Ave.
Baltimore, MD 21230

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Title 47 of the CFR, Parts 15
15.247 Subpart C for Intentional Radiators



Giuliano Messina, Project Engineer
Electromagnetic Compatibility Lab



Jennifer Warnell
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, Austin Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	April 26, 2019	Initial Issue.

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List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μ H	microhenry
μ	microfarad
μ s	microseconds
NEBS	Network Equipment-Building System
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Polycom Inc. P011, 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 P011. Polycom Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the P011, 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 Polycom Inc., purchase order number 6090003000. All tests were conducted using measurement procedure ANSI C63.4-2014 and ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	20 dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	Average Time of Occupancy (Dwell Time)	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	Number of RF Channels	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RF Channel Separation	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	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	Spurious Conducted Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(g) & (h)	Declaration Statements for FHSS	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

II. Equipment Configuration

A. Overview

Eurofins MET Labs was contracted by Polycom Inc. to perform testing on the P011, under Polycom Inc.'s purchase order number 6090003000.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Polycom Inc., P011.

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

Model(s) Tested:	P011		
Model(s) Covered:	P011		
EUT Specifications:	Primary Power: 120VAC		
	FCC ID: M72-P011		
	Type of Modulations:	GFSK, QPSK, 8DPSK	
	Equipment Code:	DSS	
	Peak RF Output Power:	-1.27 dBm	
	EUT Frequency Ranges:	2402-2480	
Analysis:	The results obtained relate only to the item(s) tested.		
Environmental Test Conditions:	Temperature: 15-35° C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
Evaluated by:	Giuliano Messina		
Report Date(s):	April 26, 2019		

Table 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
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 447498 D01	General RF Exposure Guidance v06

Table 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.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.97 dB	2	95%
RF Power Radiated Emissions	±2.95 dB	2	95%

Table 4. Uncertainty Calculations Summary

E. Description of Test Sample

The Polycom Inc. P011, Equipment Under Test (EUT), is a video CODEC with Wi-Fi and Bluetooth functions. It is intended to be used in enterprise environments.



Photograph 1. Polycom Inc. P011

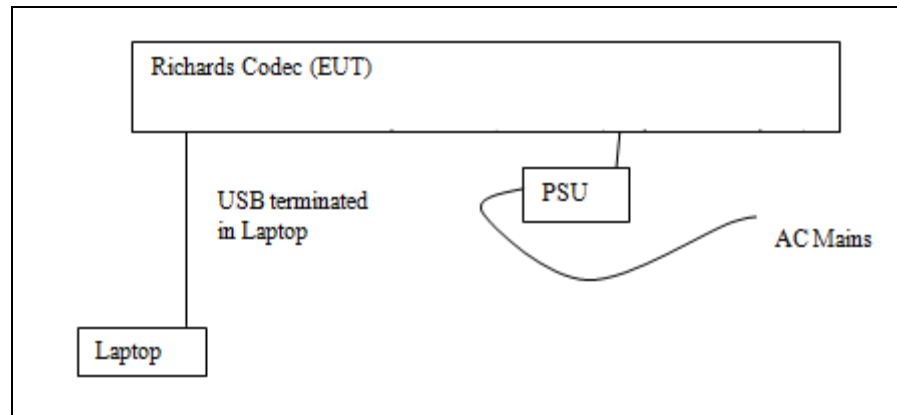


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	P011 CODEC	--	2201-85340-001	8219024D0080F2	--

Table 5. Equipment Configuration

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
1	PSU	Sparkle FSP180-AWAN3	9NA1804503	--
2	Laptop	ASUS	X200M	--

Table 6. 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
1	DC In	--	1	--	--	N	DC In
2	USB Type C	USB	1	--	--	--	Control system from laptop

Table 7. Ports and Cabling Information

I. Mode of Operation

The support laptop provided a direct means of controlling transmitter parameters.

Note: Unless otherwise stated or shown, all tests were performed at worst-case modulation and data rates.

J. Method of Monitoring EUT Operation

A spectrum analyzer was used to confirm proper transmitter operation.

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 Polycom 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):

Giuliano Messina

Test Date(s):

03/11/19

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 μ H/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 (dB μ V)	
	Quasi-Peak	Average
* 0.15 - 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Note: *Decreases with the logarithm of the frequency.

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 μ H 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 μ H 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): Giuliano Messina

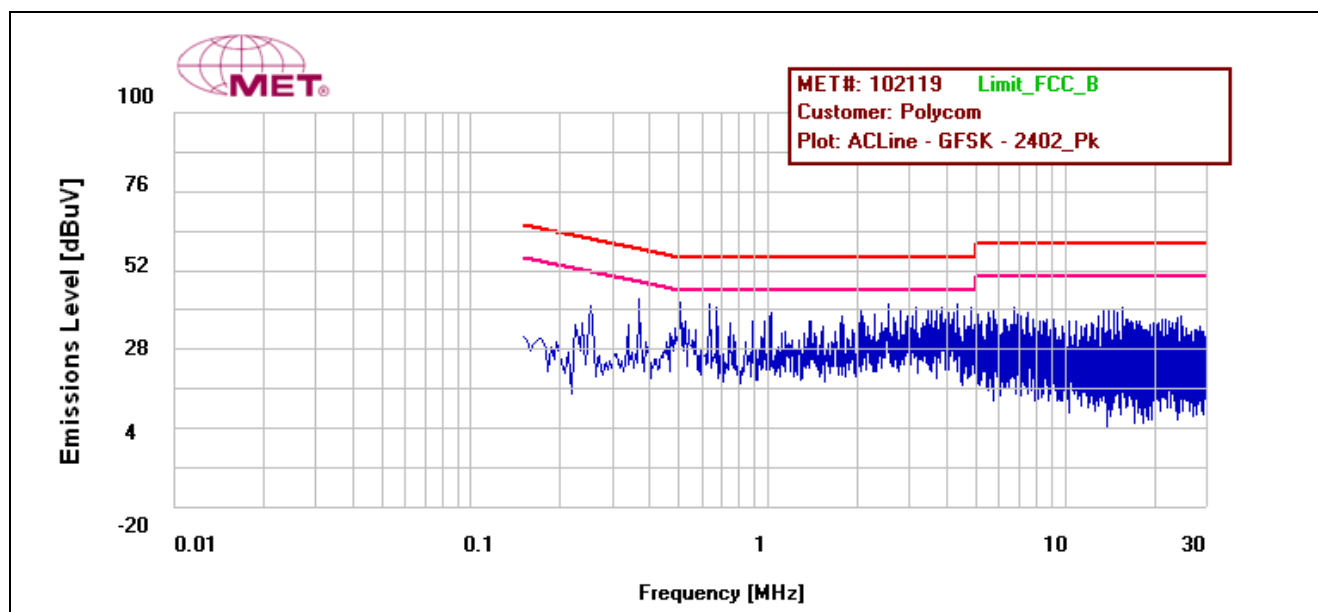
Test Date(s): 03/19/19

Meas. Location	Meas. m	Limit	Pass/Fail
Bonding measurement from LISN ground to ground plane	0.826	< 2.5 m Ω	Pass

15.207(a) Conducted Emissions Test Results, GFSK

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACLine - GFSK - 2402	0.254	42.6	61.637	-19.037	Pass	34.8	51.637	-16.837	Pass
ACLine - GFSK - 2402	0.370	42.1	58.521	-16.421	Pass	27	48.521	-21.521	Pass
ACLine - GFSK - 2402	0.510	42.1	56	-13.9	Pass	34.8	46	-11.2	Pass
ACLine - GFSK - 2402	0.638	40	56	-16	Pass	31.5	46	-14.5	Pass
ACLine - GFSK - 2402	2.562	38.5	56	-17.5	Pass	29.1	46	-16.9	Pass
ACLine - GFSK - 2402	4.350	40.8	56	-15.2	Pass	29.4	46	-16.6	Pass

Table 9. Conducted Emissions, 15.207(a), Phase Line, Test Results, GFSK

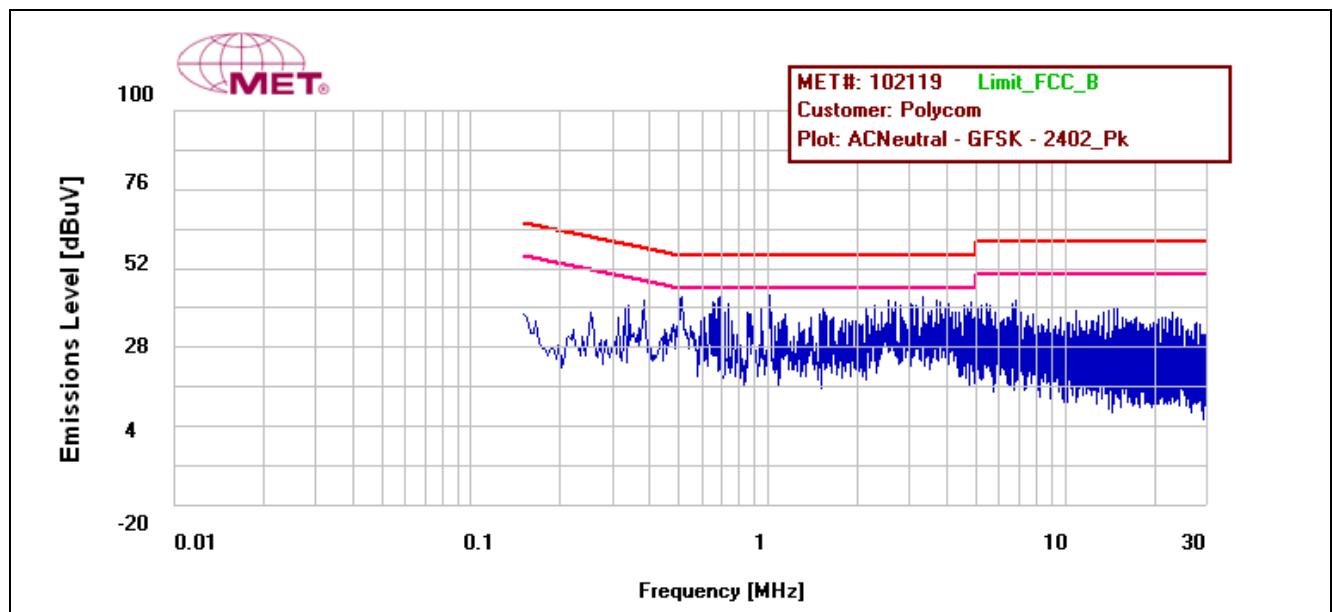


Plot 1. Conducted Emissions, 15.207(a), Phase Line, GFSK

15.207(a) Conducted Emissions Test Results, GFSK

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACNeutral - GFSK - 2402	0.514	40.4	56	-15.6	Pass	32.6	46	-13.4	Pass
ACNeutral - GFSK - 2402	0.682	40.4	56	-15.6	Pass	23.4	46	-22.6	Pass
ACNeutral - GFSK - 2402	0.690	40.4	56	-15.6	Pass	23	46	-23	Pass
ACNeutral - GFSK - 2402	1.014	41.1	56	-14.9	Pass	27.8	46	-18.2	Pass
ACNeutral - GFSK - 2402	2.558	41.6	56	-14.4	Pass	32.2	46	-13.8	Pass
ACNeutral - GFSK - 2402	3.322	40.1	56	-15.9	Pass	31	46	-15	Pass

Table 10. Conducted Emissions, 15.207(a), Neutral Line, Test Results, GFSK

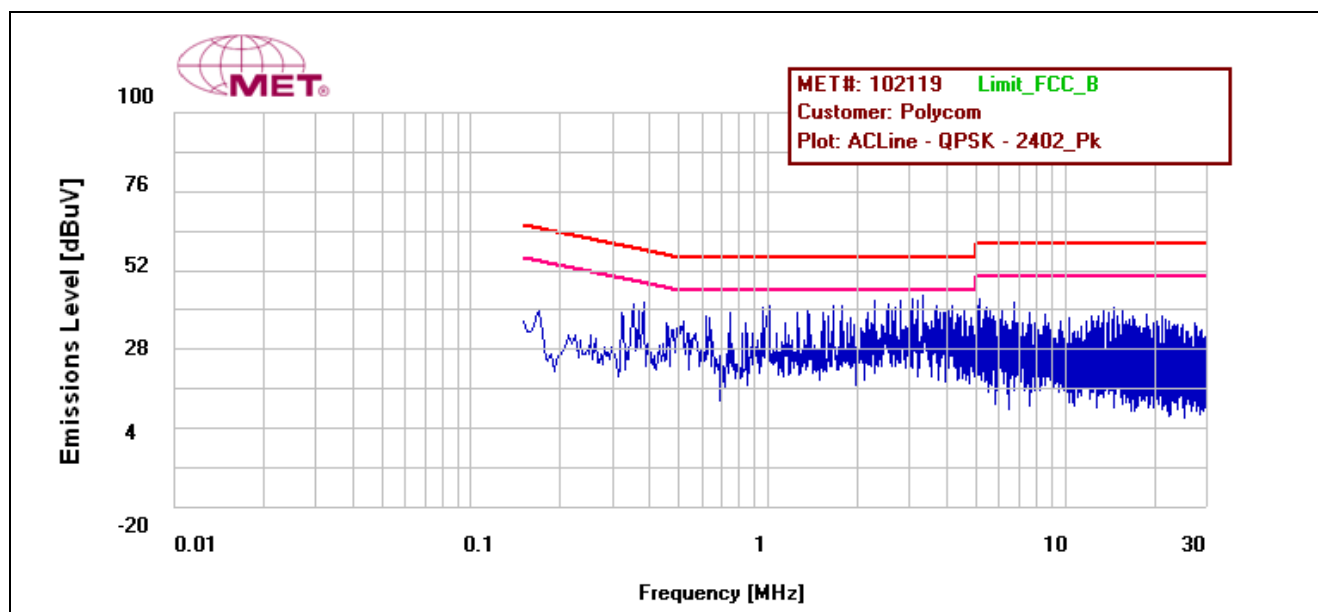


Plot 2. Conducted Emissions, 15.207(a), Neutral Line, GFSK

15.207(a) Conducted Emissions Test Results, QFSK

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACLIne - QPSK - 2402	0.382	42	58.257	-16.257	Pass	35.2	48.257	-13.057	Pass
ACLIne - QPSK - 2402	3.062	40.7	56	-15.3	Pass	30.6	46	-15.4	Pass
ACLIne - QPSK - 2402	3.194	41.7	56	-14.3	Pass	31.6	46	-14.4	Pass
ACLIne - QPSK - 2402	3.326	42.4	56	-13.6	Pass	32.5	46	-13.5	Pass
ACLIne - QPSK - 2402	5.206	37	60	-23	Pass	28.1	50	-21.9	Pass
ACLIne - QPSK - 2402	6.790	35.1	60	-24.9	Pass	26.3	50	-23.7	Pass

Table 11. Conducted Emissions, 15.207(a), Phase Line, Test Results, QFSK

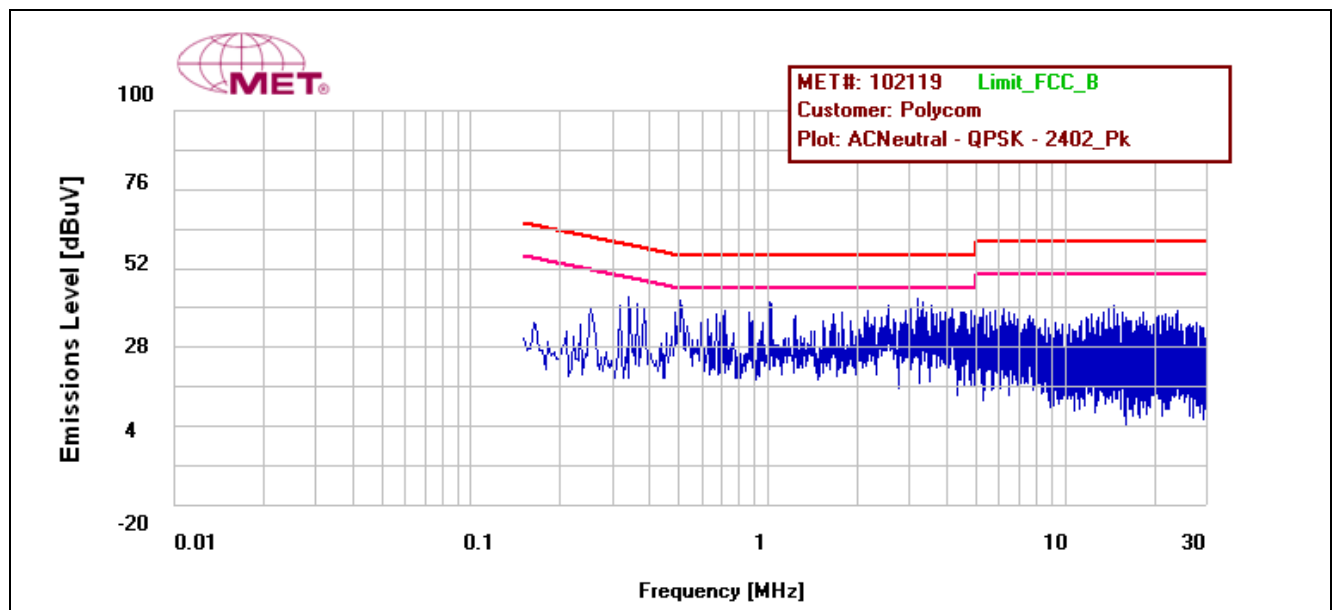


Plot 3. Conducted Emissions, 15.207(a), Phase Line, QFSK

15.207(a) Conducted Emissions Test Results, QPSK

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACNeutral - QPSK - 2402	0.342	40.5	59.173	-18.673	Pass	25.6	49.173	-23.573	Pass
ACNeutral - QPSK - 2402	0.362	41.4	58.702	-17.302	Pass	25.9	48.702	-22.802	Pass
ACNeutral - QPSK - 2402	0.510	42.2	56	-13.8	Pass	34.7	46	-11.3	Pass
ACNeutral - QPSK - 2402	1.018	40.3	56	-15.7	Pass	31.9	46	-14.1	Pass
ACNeutral - QPSK - 2402	3.186	39.3	56	-16.7	Pass	30.1	46	-15.9	Pass
ACNeutral - QPSK - 2402	3.322	40.3	56	-15.7	Pass	30	46	-16	Pass

Table 12. Conducted Emissions, 15.207(a), Neutral Line, Test Results, QPSK

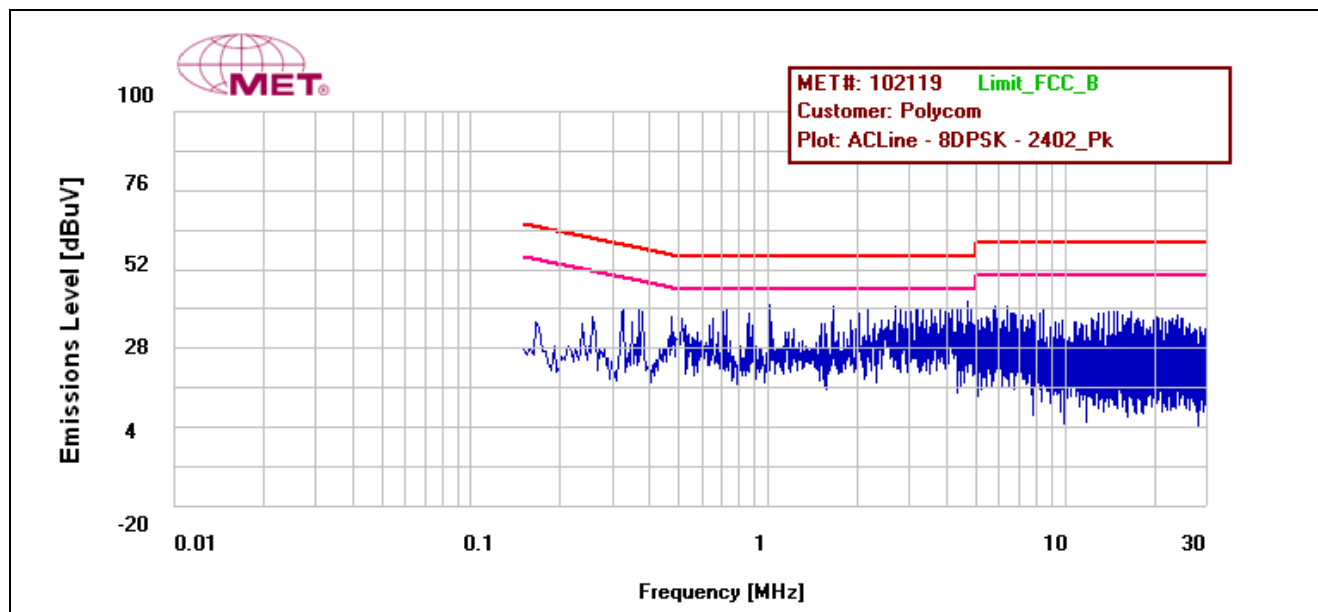


Plot 4. Conducted Emissions, 15.207(a), Neutral Line, QPSK

15.207(a) Conducted Emissions Test Results, 8DPSK

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACLLine - 8DPSK - 2402	0.166	32.8	65.16	-32.36	Pass	26.2	55.16	-28.96	Pass
ACLLine - 8DPSK - 2402	1.014	39.4	56	-16.6	Pass	28.7	46	-17.3	Pass
ACLLine - 8DPSK - 2402	2.678	38.9	56	-17.1	Pass	30.1	46	-15.9	Pass
ACLLine - 8DPSK - 2402	4.714	39.4	56	-16.6	Pass	28.8	46	-17.2	Pass
ACLLine - 8DPSK - 2402	5.866	38.7	60	-21.3	Pass	29.1	50	-20.9	Pass
ACLLine - 8DPSK - 2402	22.398	31.6	60	-28.4	Pass	29.1	50	-20.9	Pass

Table 13. Conducted Emissions, 15.207(a), Phase Line, Test Results, 8DPSK

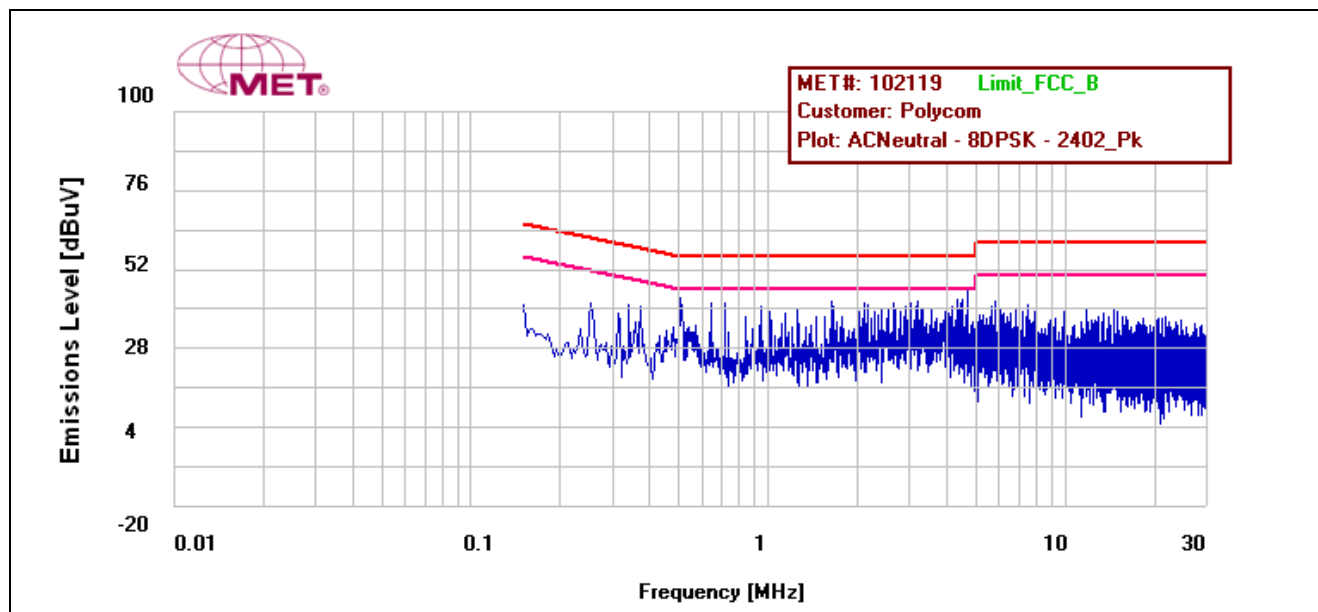


Plot 5. Conducted Emissions, 15.207(a), Phase Line, 8DPSK

15.207(a) Conducted Emissions Test Results, 8DPSK

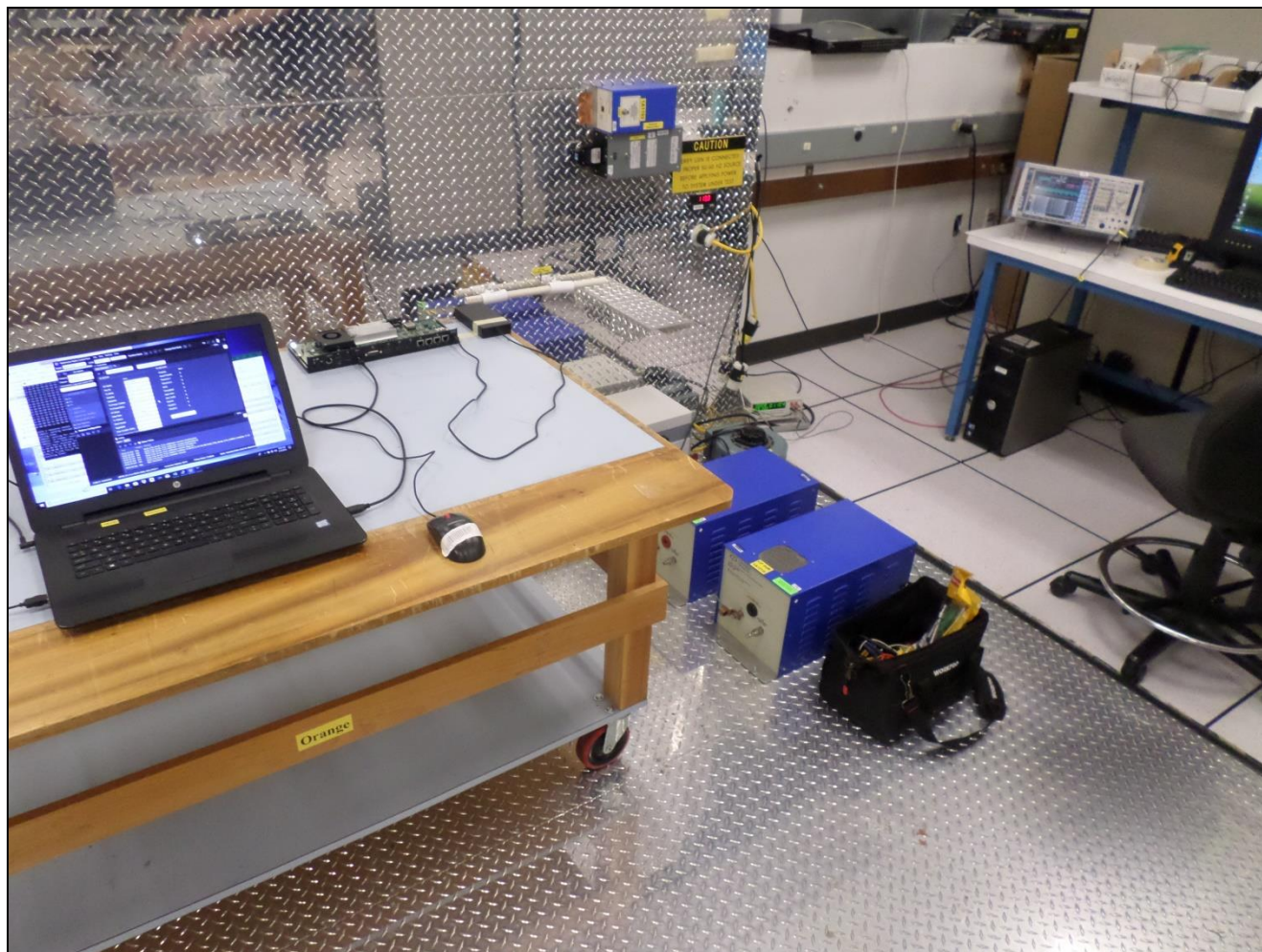
Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACNeutral - 8DPSK - 2402	0.510	41.3	56	-14.7	Pass	34.1	46	-11.9	Pass
ACNeutral - 8DPSK - 2402	1.654	38.4	56	-17.6	Pass	30.2	46	-15.8	Pass
ACNeutral - 8DPSK - 2402	3.186	41.4	56	-14.6	Pass	31.7	46	-14.3	Pass
ACNeutral - 8DPSK - 2402	4.330	38.6	56	-17.4	Pass	27	46	-19	Pass
ACNeutral - 8DPSK - 2402	4.550	33.8	56	-22.2	Pass	26.1	46	-19.9	Pass
ACNeutral - 8DPSK - 2402	4.710	40.2	56	-15.8	Pass	29.5	46	-16.5	Pass

Table 14. Conducted Emissions, 15.207(a), Neutral Line, Test Results, 8DPSK



Plot 6. Conducted Emissions, 15.207(a), Neutral Line, 8DPSK

15.207(a) Conducted Emissions Test Setup



Photograph 2. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) 20 dB Occupied Bandwidth

Test Requirements: § 15.247(a): 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. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Procedure: The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth. The 20 dB bandwidth was measured and recorded.

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

Test Engineer(s): Giuliano Messina

Test Date(s): 03/11/19

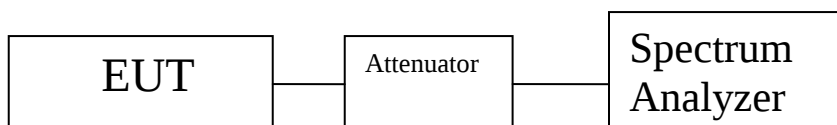


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

Modulation	Frequency (MHz)	20dB BW (MHz)
GFSK	2402	1.136
GFSK	2441	1.131
GFSK	2480	1.127
QPSK	2402	1.432
QPSK	2441	1.425
QPSK	2480	1.432
8DPSK	2402	1.437
8DPSK	2441	1.444
8DPSK	2480	1.442

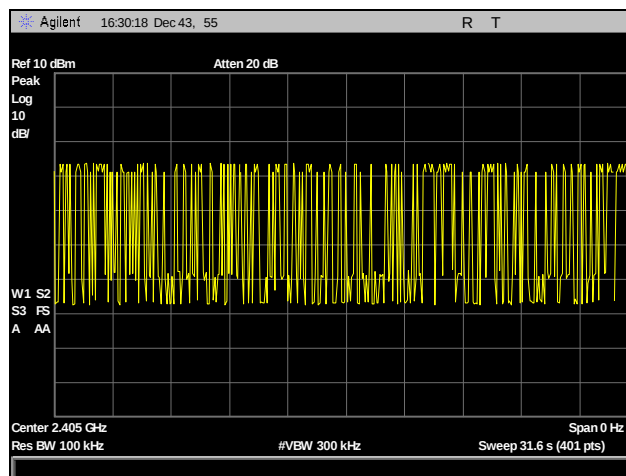
Table 15. Occupied Bandwidth, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators**§ 15.247(a)(1) Average Time of Occupancy (Dwell Time)**

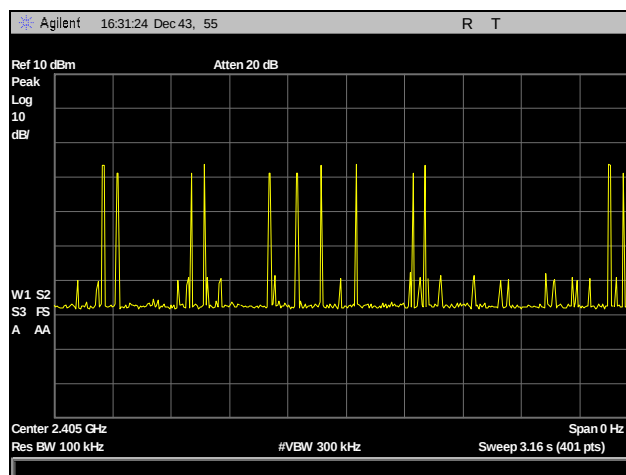
Test Requirements: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Results: The average time of occupancy is 0.377s in a 31.6s span.

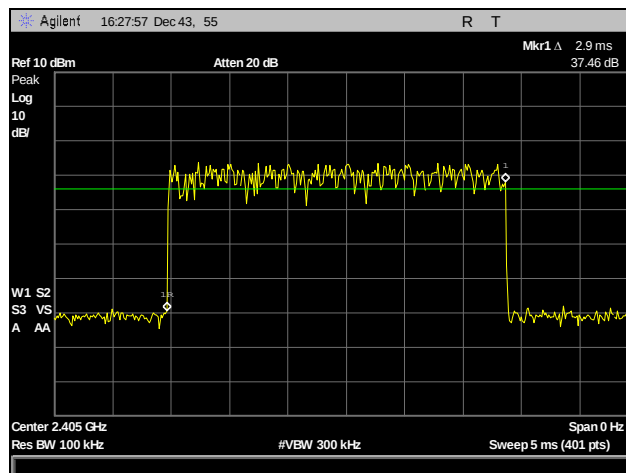
Dwell Time



Plot 7. Dwell Time, 31.6s Span



Plot 8. Dwell Time, 3.16s Span, 13 Pulses

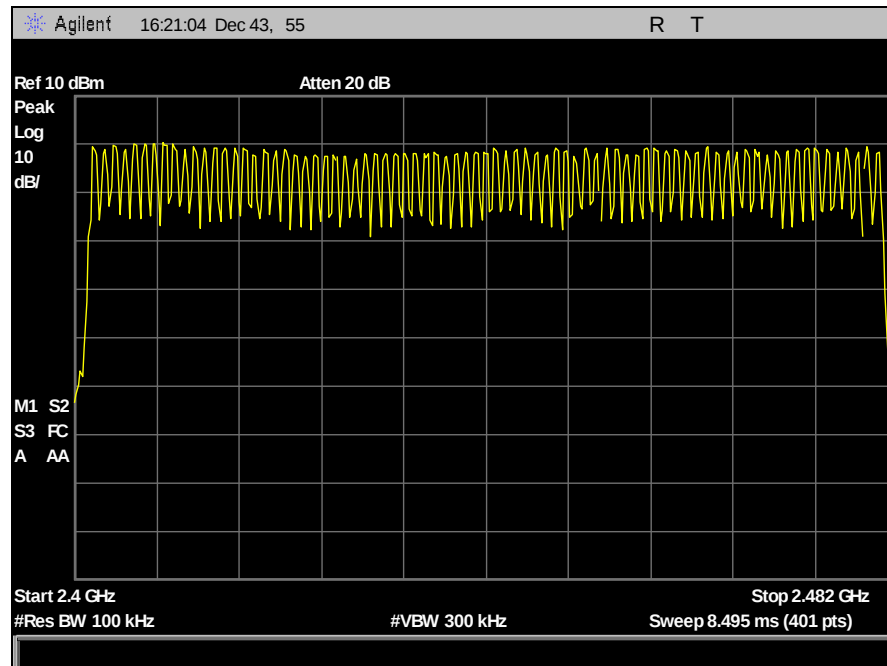


Plot 9. Dwell Time, Single Pulse, 2.9ms

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) Number of RF Channels

Total hopping channels is 79. The EUT meets the specifications of Section 15.247(a) (1) (iii) for Number of Hopping Channels.



Plot 10. Hopping Channels, 79

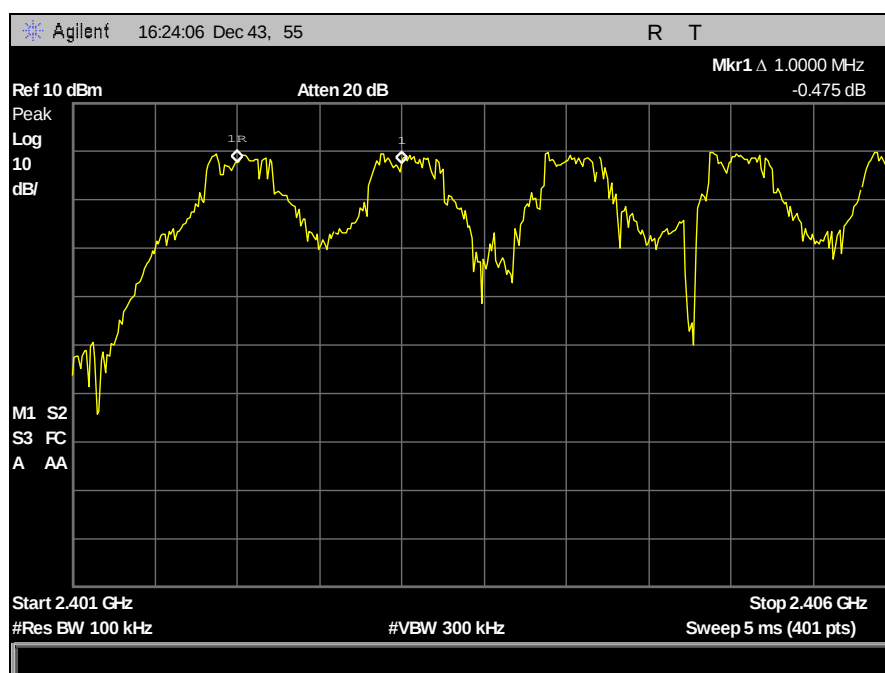
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) RF Channel Separation

Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Remarks: EUT operates below 125mW (20dBm). Channels are separated by more than two thirds of the -20dB Bandwidth.

EDR – $2/3 * 1.444 \text{ MHz (20dB Bandwidth)} = 963 \text{ kHz}$ Minimum Separation Distance



Plot 11. Channel Separation, 1 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: §15.247(b)(1): The maximum peak output power of the intentional radiator shall not exceed 0.125 Watts for frequency hopping systems operating in the 2400-2483.5 MHz band.

§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, 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, omnidirectional 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. RBW was set to 1MHz, VBW = 3*RBW. The EUT utilizes a 2.6dBi Antenna, so the maximum power allowed is 30dBm.

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

Test Engineer(s): Giuliano Messina

Test Date(s): 03/11/19



Figure 3. Peak Power Output Test Setup

Peak Power Output Test Results

Modulation	Frequency (MHz)	Peak Power (dBm)
GFSK	2402	-1.27
GFSK	2441	-2.39
GFSK	2480	-1.53
QPSK	2402	-2.74
QPSK	2441	-4.24
QPSK	2480	-3.12
8DPSK	2402	-2.61
8DPSK	2441	-4.54
8DPSK	2480	-3.03

Table 16. Peak Power Output, Test Results

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)

Table 17. 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 Table 18.

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

Table 18. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedure: The transmitter was set to the low, mid, and high channel at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

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.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

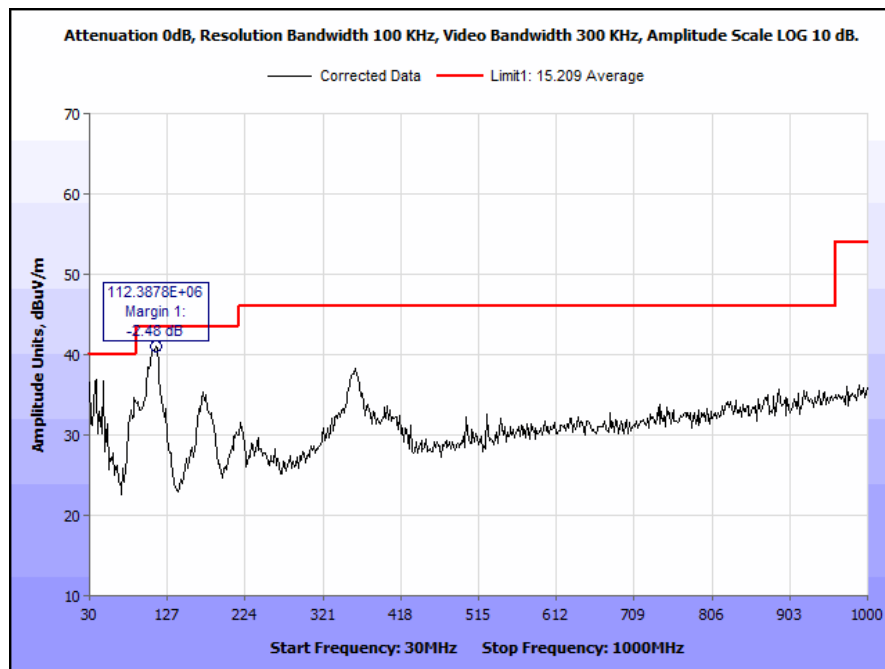
EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of §15.247(d). Only noise floor was measured above 18GHz.

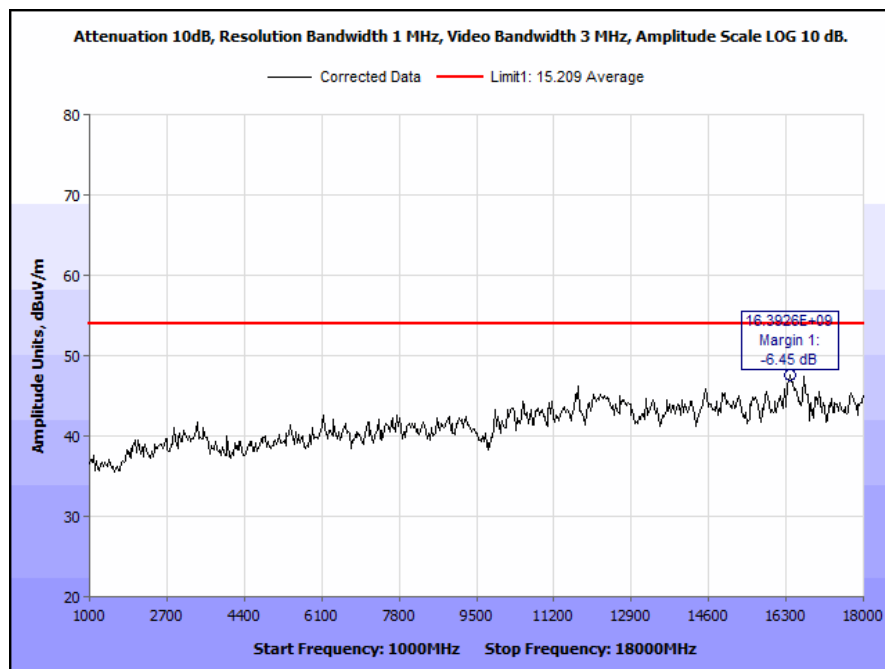
Test Engineer(s): Giuliano Messina

Test Date(s): 03/11/19

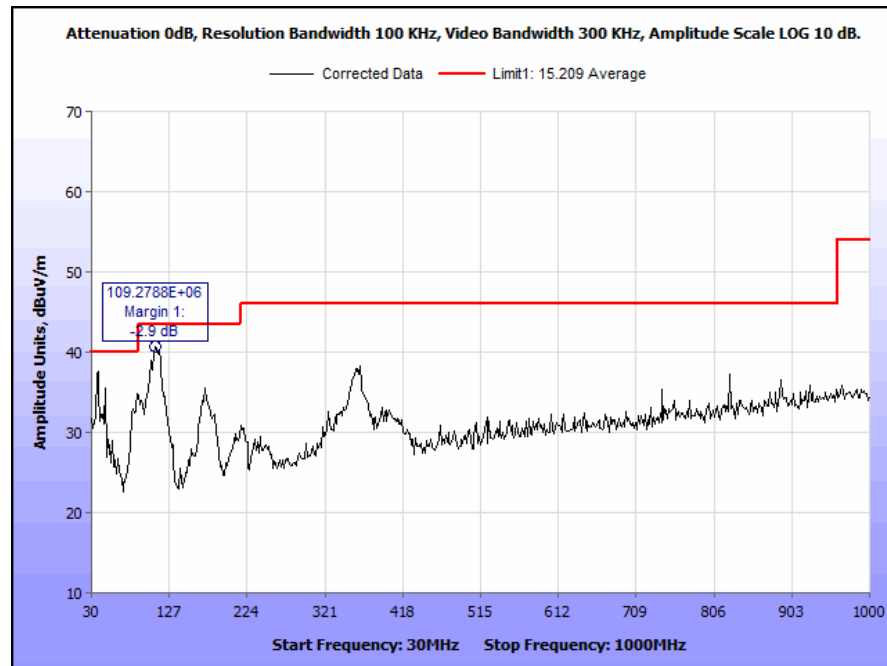
Radiated Spurious Emissions Test Results



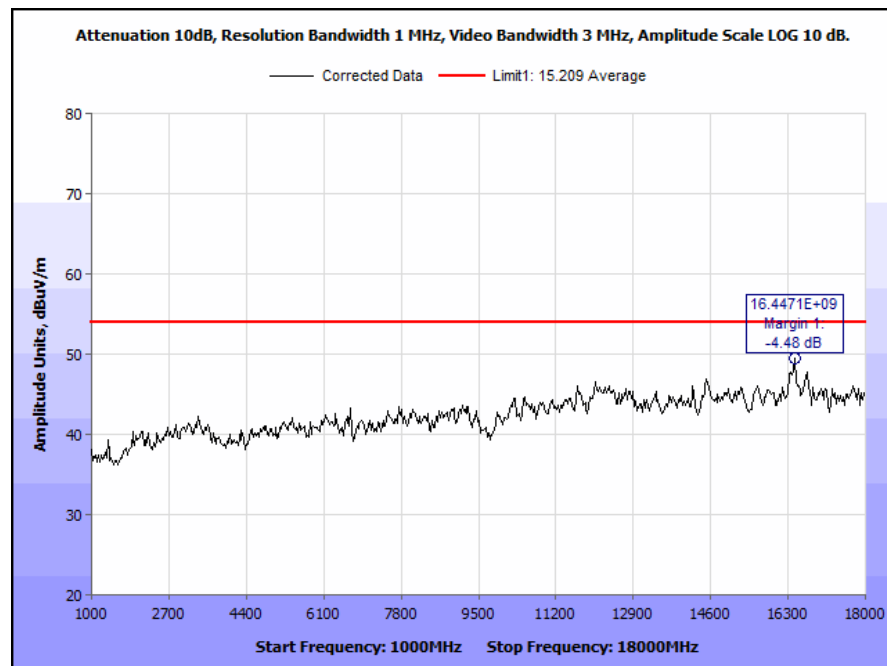
Plot 12. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz



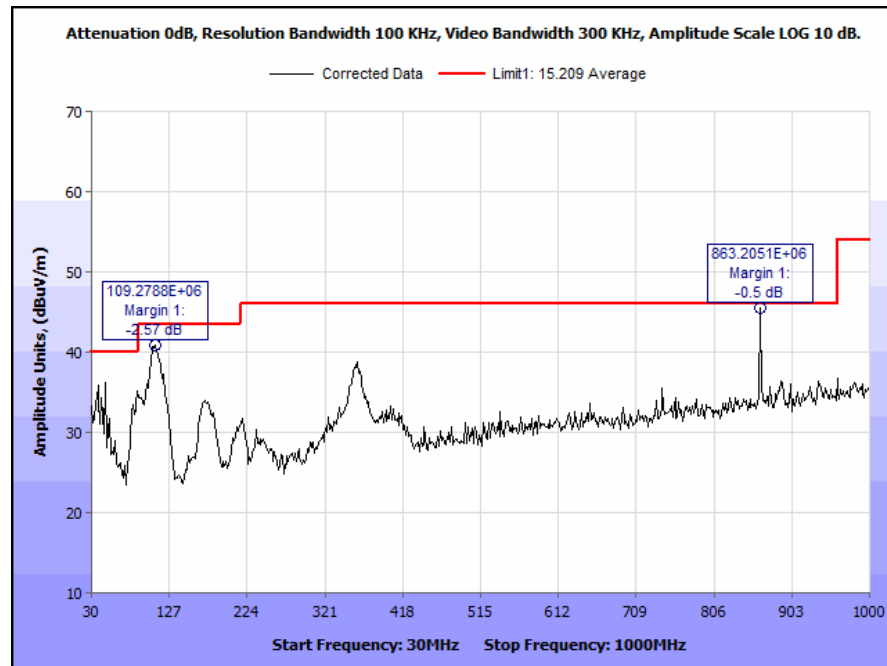
Plot 13. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz



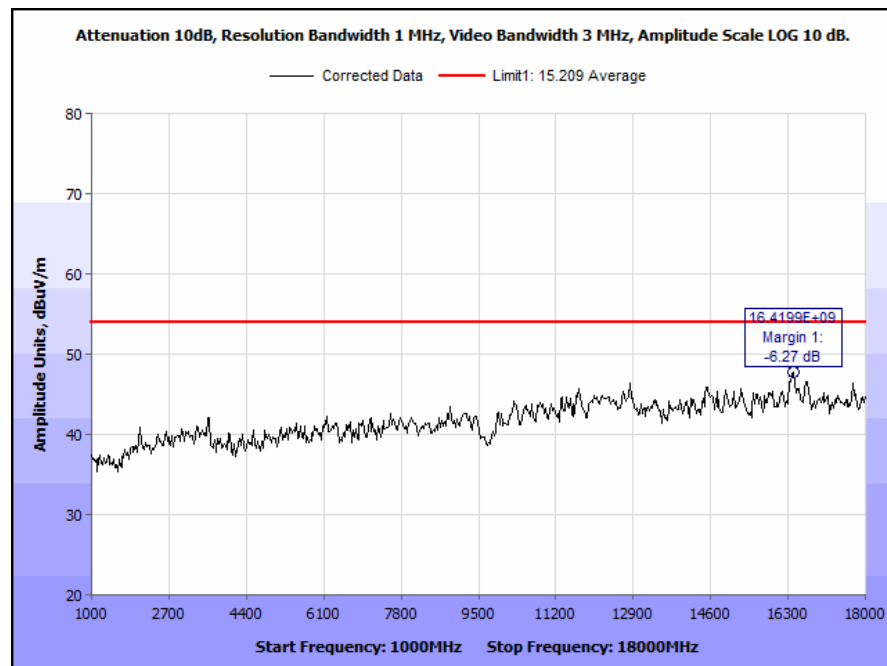
Plot 14. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz



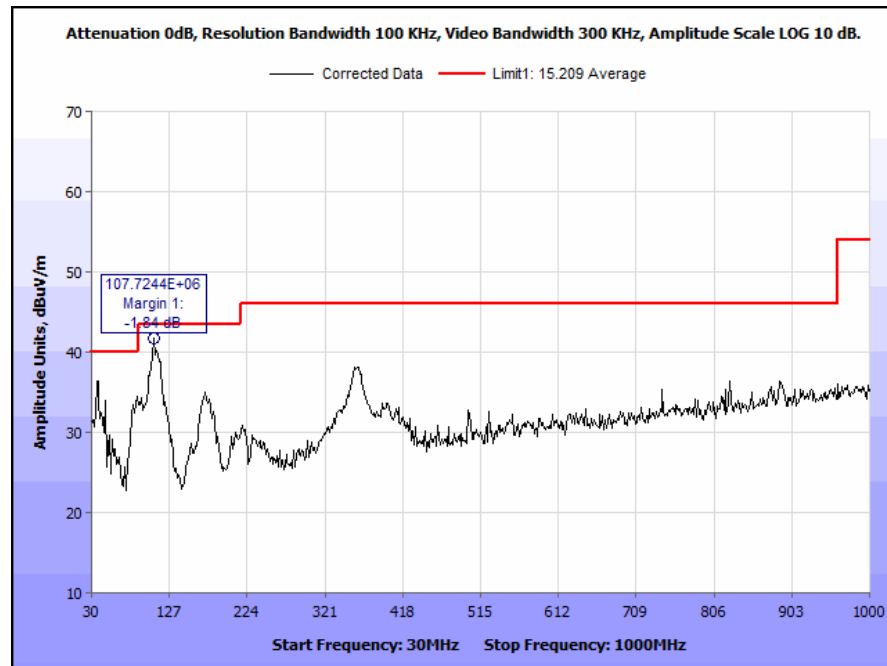
Plot 15. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz



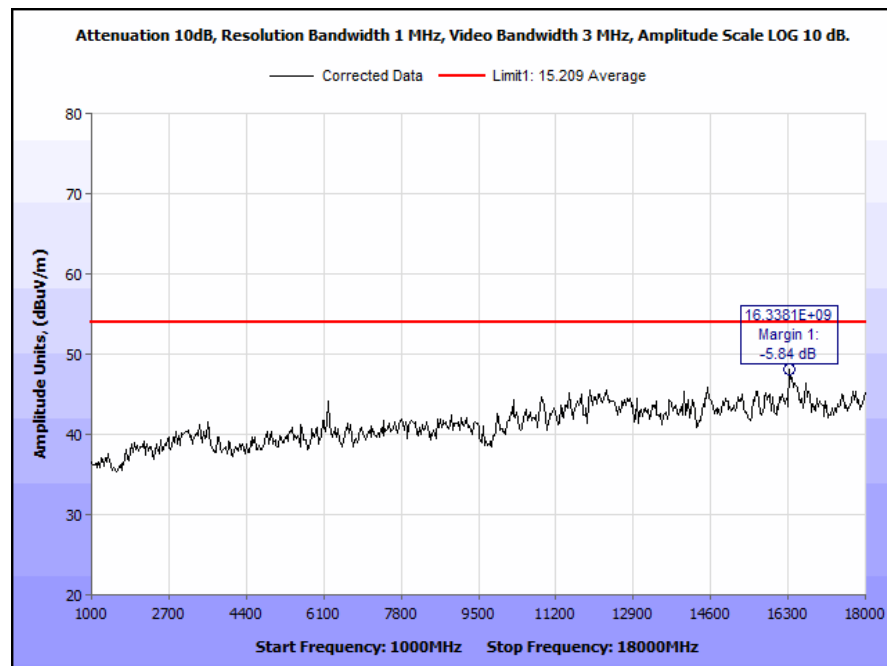
Plot 16. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz



Plot 17. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz



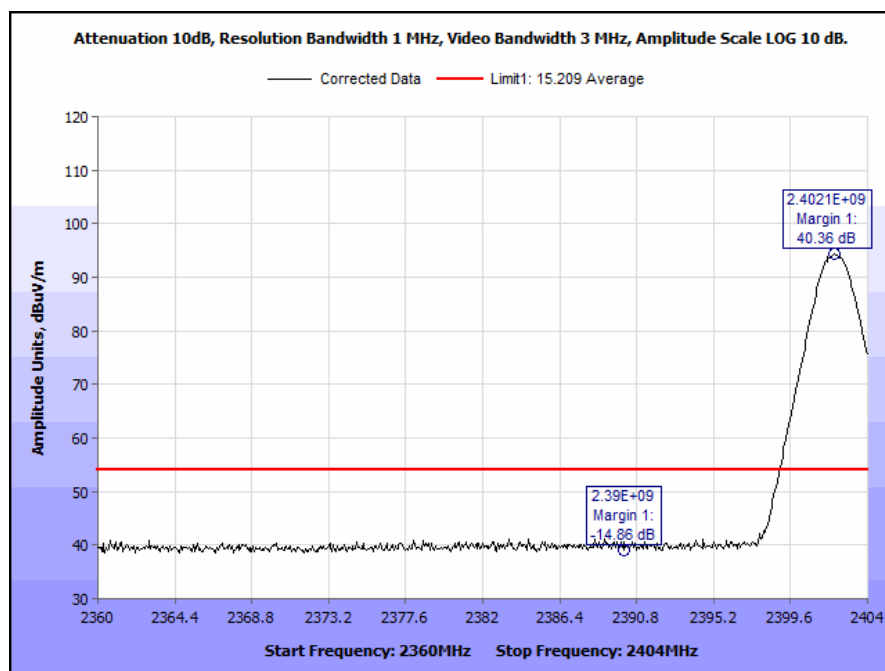
Plot 18. Radiated Spurious Emissions, Transmitter Off, 30 MHz – 1 GHz



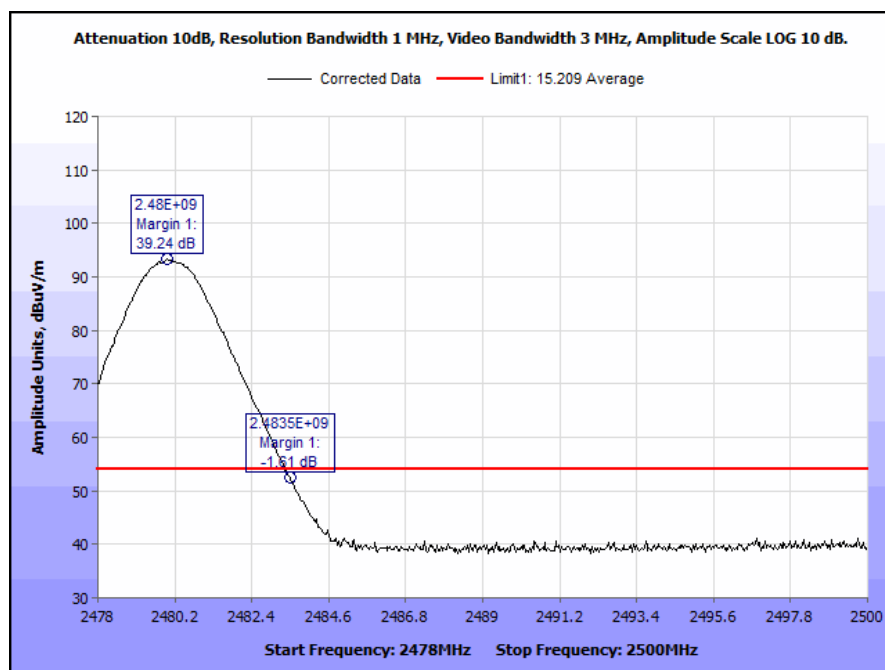
Plot 19. Radiated Spurious Emissions, Transmitter Off, 1 GHz – 18 GHz

Radiated Band Edge Measurements

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



Plot 20. Radiated Restricted Band Edge, Low Channel

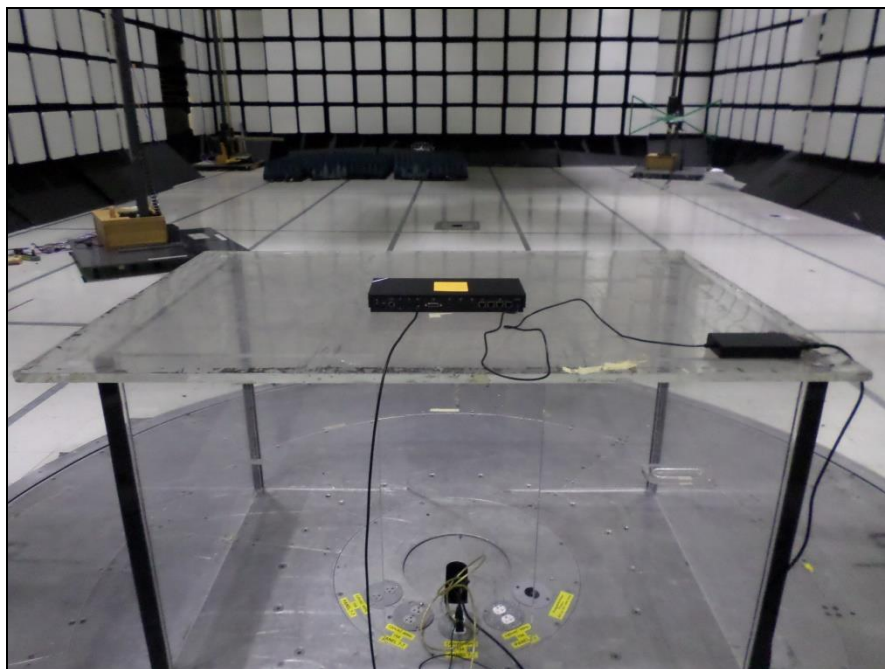


Plot 21. Radiated Restricted Band Edge, High Channel

Radiated Spurious Emissions Test Setup



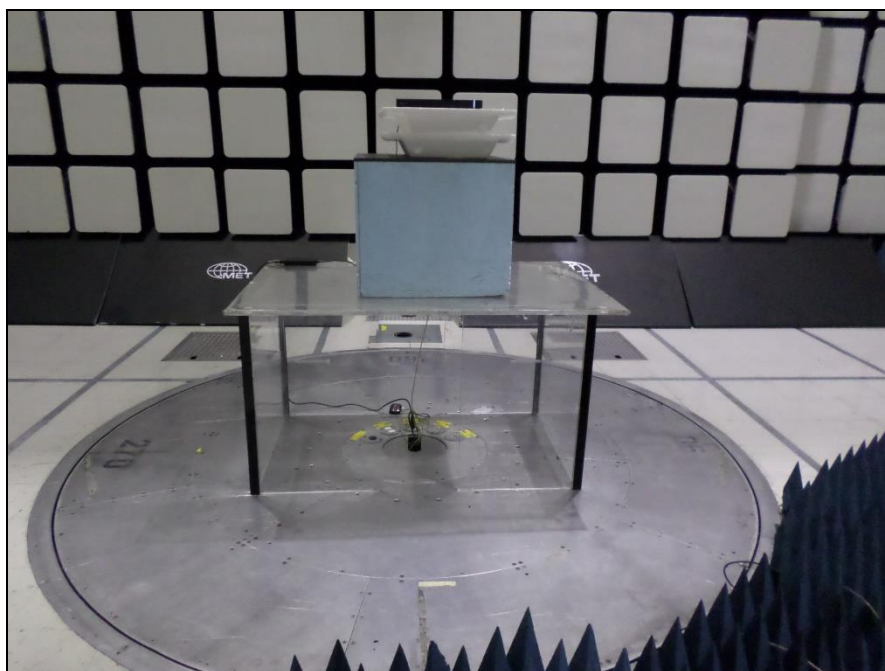
Photograph 3. Radiated Spurious Emissions, Test Setup, Below 1 GHz, Front View



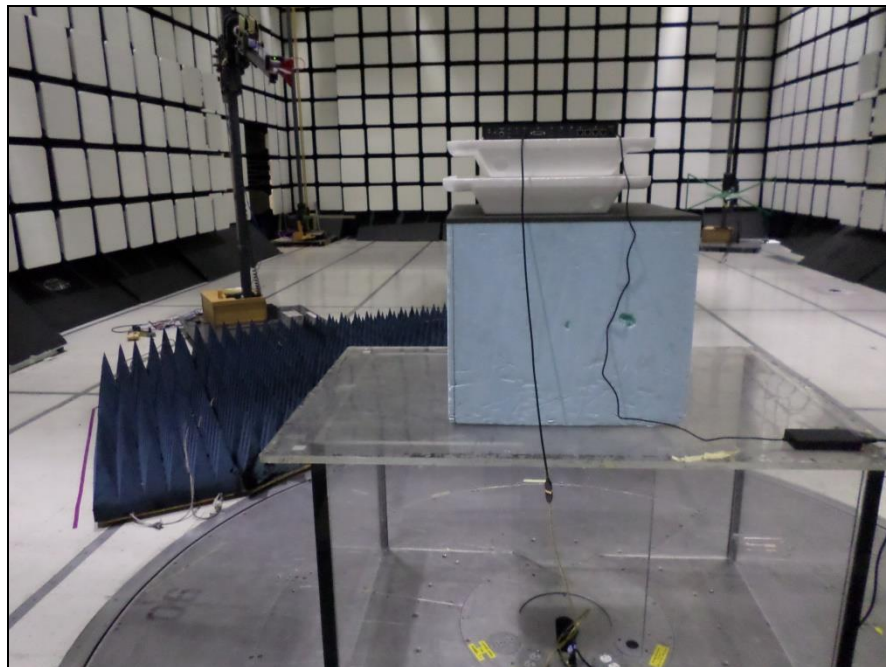
Photograph 4. Radiated Spurious Emissions, Test Setup, Below 1 GHz, Rear View



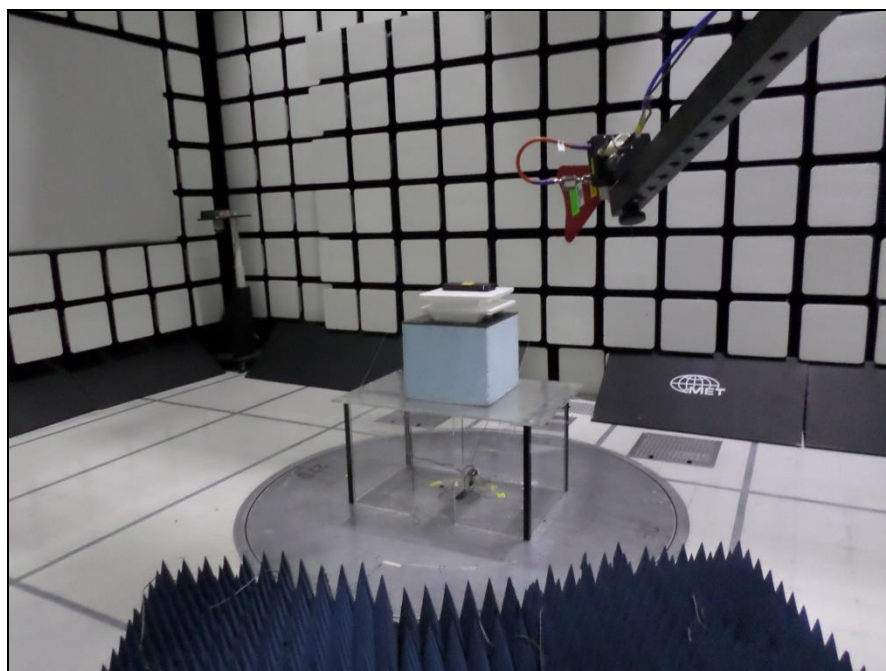
Photograph 5. Radiated Spurious Emissions, Test Setup, Below 1 GHz, Antenna View



Photograph 6. Radiated Spurious Emissions, Test Setup, Above 1 GHz, Front View



Photograph 7. Radiated Spurious Emissions, Test Setup, Above 1GHz, Rear View



Photograph 8. Radiated Spurious Emissions, Test Setup, Above 1GHz, Antenna View

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.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor and cable loss.

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)**.

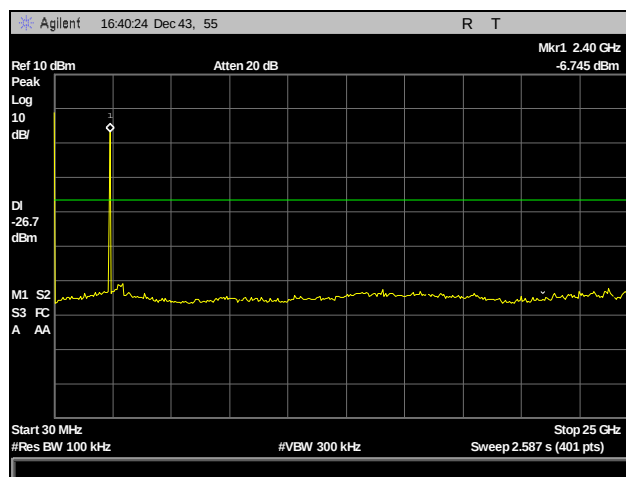
Test Engineer(s): Giuliano Messina

Test Date(s): 03/11/19

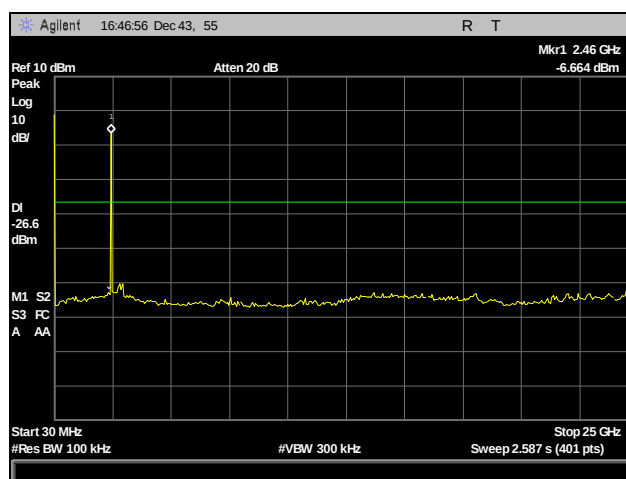


Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

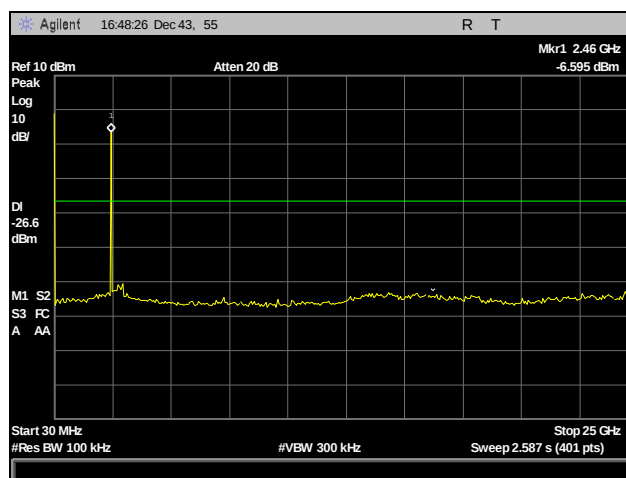
Conducted Spurious Emissions Test Results



Plot 22. Conducted Spurious Emissions, Low Channel, 30 MHz – 25 GHz

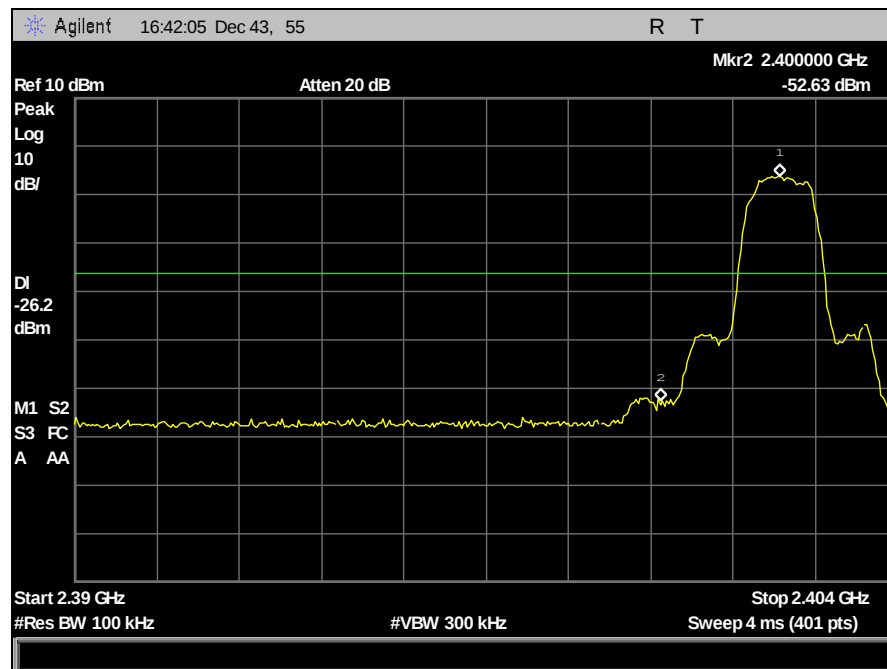


Plot 23. Conducted Spurious Emissions, Mid Channel, 30 MHz – 25 GHz

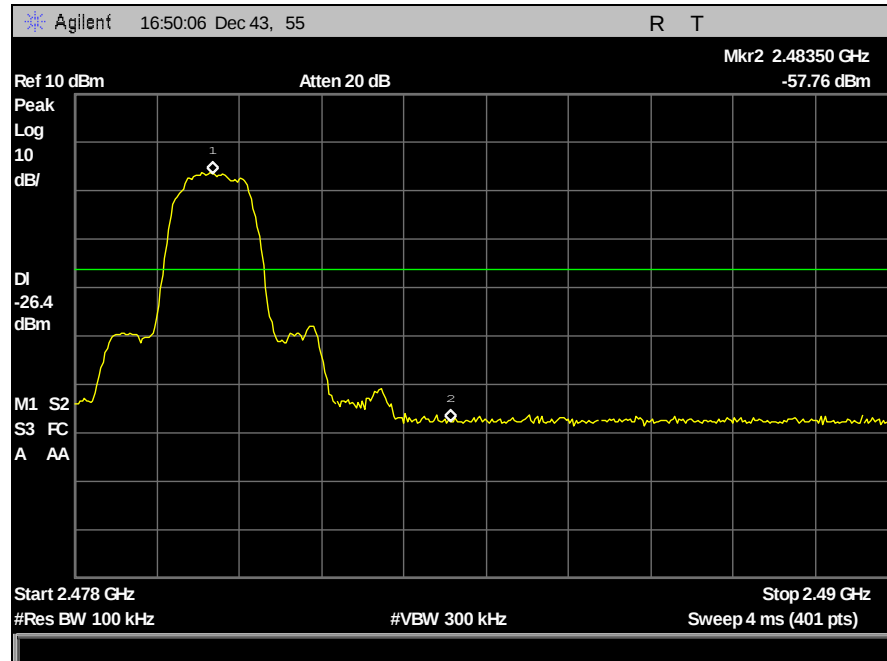


Plot 24. Conducted Spurious Emissions, High Channel, 30 MHz – 25 GHz

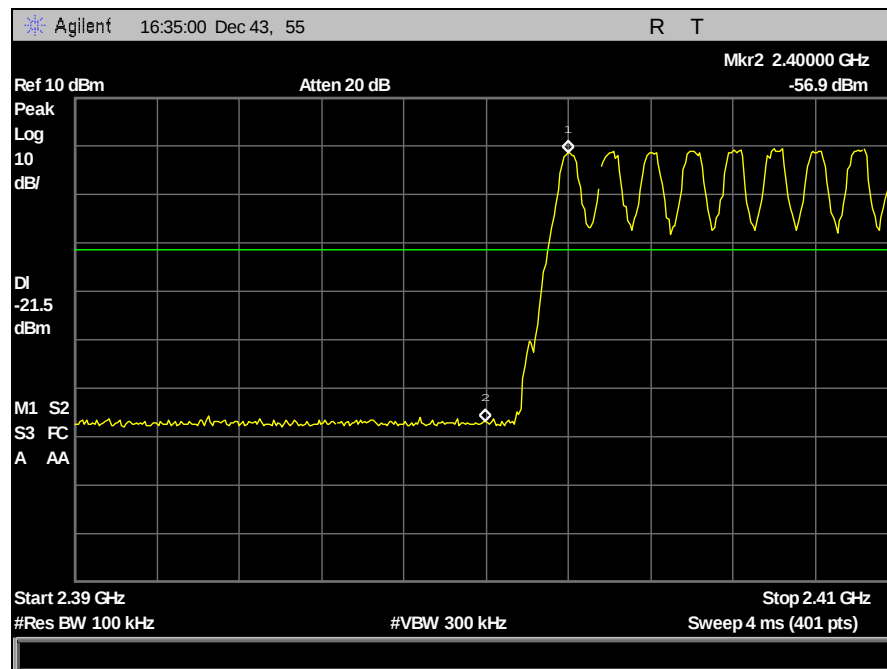
Conducted Band Edge Test Results



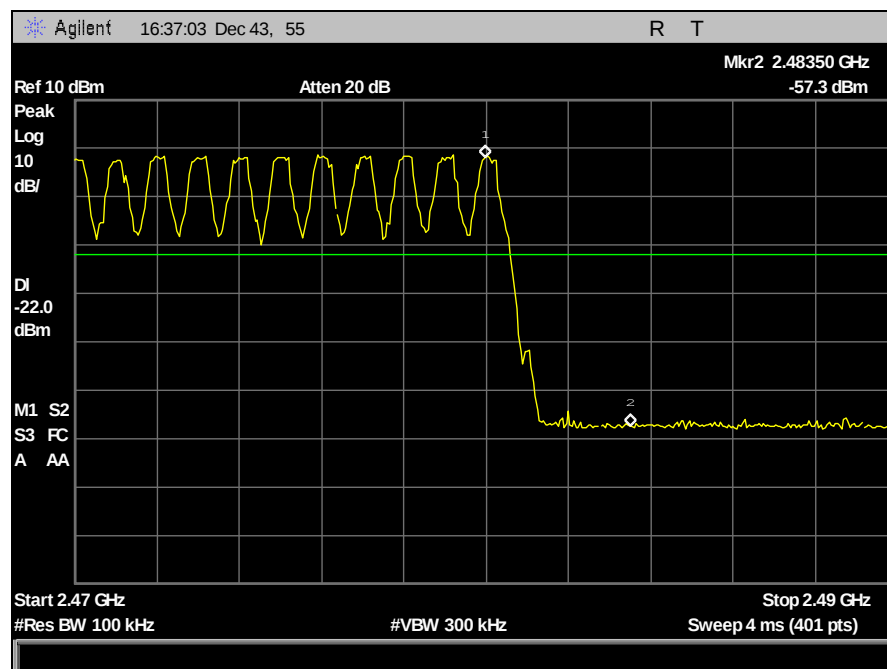
Plot 25. Conducted Band Edge, Low Channel



Plot 26. Conducted Band Edge, High Channel



Plot 27. Conducted Hopping Band Edge, Low Channel



Plot 28. Conducted Hopping Band Edge, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators § 15.247(g)(h) Declaration Statements for FHSS

The P011 device complies with all of the regulations in part 15.247 should the transmitter be presented with a continuous data (or information) stream. If/when the system employs short transmission bursts, it complies with the definition of a frequency hopping system and distributes its transmissions over the minimum number of hopping channels specified in this section.

This device incorporates intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels. This device does not coordinate frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters

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/cm² or 10 W/m²**

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/cm²)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm ²)	Limit (mW/cm ²)	Margin	Distance (cm)	Result
2402	-1.27	0.746	2.6	1.82	0.00027	1	0.99973	20	Pass

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

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 #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1184	SPECTRUM ANALYZER	AGILENT	E4407B	4/20/2018	4/20/2019
1A1083	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	10/17/2018	10/17/2019
1A1106	10M CHAMBER (FCC)	ETS	SEMI-ANECHOIC	12/2/2016	12/2/2019
1A1050	BILOG ANTENNA (30MHZ TO 1GHZ)	SCHAFFNER	CBL 6112D	8/29/2018	2/29/2020
1A1050-A	ATTENUATOR	FAIRVIEW MICROWAVE	SA6N5WA-04	8/29/2018	2/29/2020
1A1047	HORN ANTENNA	ETS	3117	10/30/2018	4/30/2020
1A1161	DRG HORN ANTENNA	ETS	3116C-PA	10/9/2018	4/9/2020
1A1099	GENERATOR	COM-POWER CORP	CGO-51000	SEE NOTE	
1A1088	PRE-AMP	ROHDE & SCHWARZ	TS-PR1	SEE NOTE	
1A1044	GENERATOR	COM-POWER CORP	CG-520	SEE NOTE	
1A1073	MULTI DEVICE CONTROLLER	ETS EMCO	2090	SEE NOTE	
1A1074	SYSTEM CONTROLLER	PANASONIC	WV-CU101	SEE NOTE	
1A1080	MULTI DEVICE CONTROLLER	ETS EMCO	2090	SEE NOTE	
1A1180	PRE-AMP	MITEQ	AMF-7D-01001800-22-10P	SEE NOTE	

Table 19. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. 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 users 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