



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372

3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372

13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

March 6, 2019

HID Global Corporation
6533 Flying Cloud Drive
Eden Prairie, MN 55344

Dear Robert Cresswell,

Enclosed is the EMC Wireless test report for compliance testing of the HID Global Corporation, R10F as tested to the requirements of LP0002 Low-power Radio-frequency Devices Technical Regulations for Certification as an Intentional Radiator.

Thank you for using the services of MET Laboratories, Inc. 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,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\\HID Global Corporation\\EMCA99585-LP0002BLE Rev.1)

Certificates and reports shall not be reproduced except in full, without the written permission of MET Laboratories, Inc. While use of the A2LA logo in this report reflects MET accreditation under these programs, the report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any agency of the Federal Government. This letter of transmittal is not a part of the attached report.



The Nation's First Licensed Nationally Recognized Testing Laboratory

Electromagnetic Compatibility Criteria Test Report

for the

**HID Global Corporation
R10F**

Tested under

LP0002 Low-power Radio-frequency Devices Technical Regulations
for Intentional Radiators

MET Report: EMCA99585-LP0002BLE Rev. 1

March 6, 2019

Prepared For:

**HID Global Corporation
6533 Flying Cloud Drive
Eden Prairie, MN 55344**

Prepared By:
MET Laboratories, Inc.
13501 McCallen Pass
Austin, TX 78753

Electromagnetic Compatibility Criteria Test Report

for the

**HID Global Corporation
R10F**

Tested under

LP0002 Low-power Radio-frequency Devices Technical Regulations
for Intentional Radiators

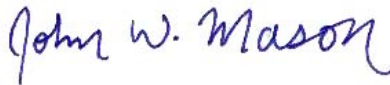


Giuliano Messina, Project Engineer
Electromagnetic Compatibility Lab



Joel Huna
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 LP0002 under normal use and maintenance.



John Mason,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	December 13, 2018	Initial Issue.
1	March 6, 2019	Korean Submission Updates.

Table of Contents

I.	Executive Summary	1
	A. Purpose of Test	2
	B. Executive Summary	2
II.	Equipment Configuration	3
	A. Overview.....	4
	B. References.....	5
	C. Test Site	5
	D. Description of Test Sample.....	5
	E. Equipment Configuration.....	6
	F. Support Equipment	6
	G. Mode of Operation.....	6
	H. Method of Monitoring EUT Operation	6
	I. Modifications	6
	a) Modifications to EUT.....	6
	b) Modifications to Test Standard.....	6
	J. Disposition of EUT.....	6
III.	Electromagnetic Compatibility Criteria for Intentional Radiators.....	7
	§2.2 Antenna Requirement	8
	§2.3 Conducted Emissions Limits	9
	§3.10.1.2 Peak Power Output	13
	§3.10.1.5 Spurious Radiated Emissions	15
	§3.10.1.5 Spurious RF Conducted Emissions	24
	§3.10.1.6 Occupied Bandwidth	28
	§3.10.1.6 Peak Power Spectral Density.....	30
	§5.20 Maximum Permissible Exposure.....	33
IV.	Test Equipment	34

List of Tables

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing	2
Table 2. EUT Summary Table.....	4
Table 3. References	5
Table 4. Equipment Configuration	6
Table 5. Support Equipment.....	6
Table 6. Conducted Limits for Intentional Radiators from § 2.3	9
Table 7. Conducted Emissions, 2.3, Test Results.....	10
Table 8. Output Power Requirements from §3.10.1.2	13
Table 9. Restricted Bands of Operation.....	15
Table 10. General Radiated Emissions Limits of §2.8	16
Table 11. Test Equipment List	35

List of Plots

Plot 1. Conducted Emissions, DC+	11
Plot 2. Conducted Emissions, DC-	11
Plot 3. Peak Power Output, 2402.....	14
Plot 4. Peak Power Output, 2442.....	14
Plot 5. Peak Power Output, 2480.....	14
Plot 6. Radiated Emissions, 30 MHz – 1 GHz, Horizontal	17
Plot 7. Radiated Emissions, 30 MHz – 1 GHz, Vertical.....	17
Plot 8. Radiated Emissions, 1 GHz – 7 GHz, Horizontal, Average.....	17
Plot 9. Radiated Emissions, 1 GHz – 7 GHz, Horizontal, Peak	18
Plot 10. Radiated Emissions, 1 GHz – 7 GHz, Vertical, Average.....	18
Plot 11. Radiated Emissions, 1 GHz – 7 GHz, Vertical, Peak.....	18
Plot 12. Radiated Emissions, 7 GHz – 18 GHz, Horizontal, Average.....	19
Plot 13. Radiated Emissions, 7 GHz – 18 GHz, Horizontal, Peak	19
Plot 14. Radiated Emissions, 7 GHz – 18 GHz, Vertical, Average.....	19
Plot 15. Radiated Emissions, 7 GHz – 18 GHz, Vertical, Peak.....	20
Plot 16. Conducted Spurious Emissions, 2402, 1 – 26.5 GHz	25
Plot 17. Conducted Spurious Emissions, 2402, 30 MHz – 1 GHz	25
Plot 18. Conducted Spurious Emissions, 2442, 1 – 26.5 GHz	25
Plot 19. Conducted Spurious Emissions, 2442, 30 MHz – 1 GHz	26
Plot 20. Conducted Spurious Emissions, 2480, 1 – 26.5 GHz	26
Plot 21. Conducted Spurious Emissions, 2480, 30 MHz – 1 GHz	26
Plot 22. Conducted Spurious Emissions, 2402, Bandedge	27
Plot 23. Conducted Spurious Emissions, 2480, Bandedge	27
Plot 24. 6 dB Occupied Bandwidth, 2402	29
Plot 25. 6 dB Occupied Bandwidth, 2442	29
Plot 26. 6 dB Occupied Bandwidth, 2480	29
Plot 27. Power Density, 2402	31
Plot 28. Power Density, 2442	31
Plot 29. Power Density, 2480	31

List of Figures

Figure 1. Block Diagram of Test Configuration.....	5
Figure 2. Peak Power Output Test Setup.....	13
Figure 3. Block Diagram, Conducted Spurious Emissions Test Setup.....	24
Figure 4. Block Diagram, Occupied Bandwidth Test Setup.....	28
Figure 5. Block Diagram, Peak Power Spectral Density Test Setup	30

List of Photographs

Photograph 1. Conducted Emissions, Test Setup	12
Photograph 2. Conducted Emissions, LISN Setup	12
Photograph 3. Radiated Emissions, Below 1 GHz, Antenna.....	21
Photograph 4. Radiated Emissions, Below 1 GHz, Front.....	21
Photograph 5. Radiated Emissions, Below 1 GHz, Rear.....	22
Photograph 6. Radiated Emissions, Above 1 GHz, Antenna.....	22
Photograph 7. Radiated Emissions, Above 1 GHz, Front	23
Photograph 8. Radiated Emissions, Above 1 GHz, Rear.....	23
Photograph 9. Conducted Testing Setup	32

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB_μA	Decibels above one microamp
dB_μV	Decibels above one microvolt
dB_μA/m	Decibels above one microamp per meter
dB_μV/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
μH	microhenry
μ	microfarad
μs	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 HID Global Corporation R10F, with the requirements of LP0002 Low-power Radio-frequency Devices Technical Regulations. In accordance with LP0002, the following data is presented in support of the Certification of the R10F. HID Global Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the R10F, 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 LP0002, in accordance with HID Global Corporation, purchase order number 1110960546. All tests were conducted using measurement procedure ANSI C63.4-2014 and LP0002 Appendix.

LP0002 Reference	Description	Compliance
2.2	Antenna Requirement	Compliant
2.3	Conducted Emission Limits	Compliant
3.10.1.2	Peak Power Output	Compliant
3.10.1.5	Radiated Spurious Emissions Requirements	Compliant
3.10.1.5	RF Conducted Spurious Emissions Requirements	Compliant
3.10.1.6	Occupied Bandwidth	Compliant
3.10.1.6	Peak Power Spectral Density	Compliant
5.20	RF Exposure/Calculation	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by HID Global Corporation to perform testing on the R10F, under HID Global Corporation's purchase order number 1110960546.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the HID Global Corporation, R10F.

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

Model(s) Tested:	R10F	
Model(s) Covered:	R10F	
EUT Specifications:	Equipment Type: RFID Rader	
	Brand: HID	
	Primary Power: 12 VDC	
	Type of Modulations:	GFSK
	Equipment Code:	DTS
	Peak RF Output Power:	4.47 dBm
	EUT Frequency Ranges:	2402 – 2480 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Giuliano Messina	
Report Date(s):	March 6, 2019	

Table 2. EUT Summary Table

B. References

LP0002: 2018	Low-power Radio-frequency Devices Technical Regulations.
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 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Table 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.

MET Laboratories' NCC accreditation number is US0004.

MET Laboratories' Taiwan Lab number is SL2-IN-E-1142R.

D. Description of Test Sample

The HID Global Corporation R10F, Equipment Under Test (EUT), is a wall-mountable HF card reader that can connect via Bluetooth.

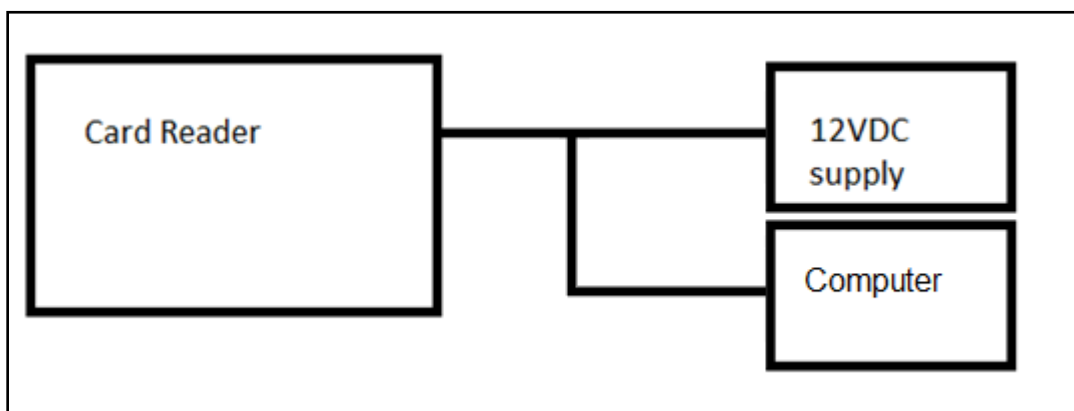


Figure 1. Block Diagram of Test Configuration

E. 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	Slot #	Name / Description	Model Number	Part Number (White / Light Almond)	Serial Number	Rev. #
NA	NA	RFID Reader	R10F	NA	NA	NA

Table 4. Equipment Configuration

F. 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
NA	12VDC Source	Duracell	DURA12-7F2	NA
NA	Contact Card	HID	NA	NA

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.

Table 5. Support Equipment

G. Mode of Operation

The EUT was turned on and configured to transmit consistently, with a computer interface used to control Bluetooth parameters.

H. Method of Monitoring EUT Operation

The transmitter was monitored through a spectrum analyzer throughout testing.

I. 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.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§2.2 Antenna Requirement

Test Requirement: Antenna requirement: Low-power radio frequency transmitter or transceiver(receiver) shall utilize a permanently, semi-permanently attached antenna or uses a unique coupling of the antenna and at any cable connector between the transmitter and the antenna. The antenna shall be an omni-directional type. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector or other than authorized is prohibited. Such standard connectors are for example: BNC, F type, N type, M type, UG type, RCA, SMA, SMB, and other standard type antenna connectors.

Results: The EUT as tested is compliant to the criteria of §2.2. The EUT contains an integrated antenna.

Test Engineer(s): Giuliano Messina

Test Date(s): June 21, 2018

Electromagnetic Compatibility Criteria for Intentional Radiators

§2.3 Conducted Emissions Limits

Test Requirement(s): § 2.3: 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 6. Conducted Limits for Intentional Radiators from § 2.3

Note: (*) Decreases with the logarithm of the frequency.

Test Procedure: The EUT was placed on a 0.8 m-high wooden table above a ground plane. 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 and LP0002 Appendix I*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMI receiver. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were within applicable limits.

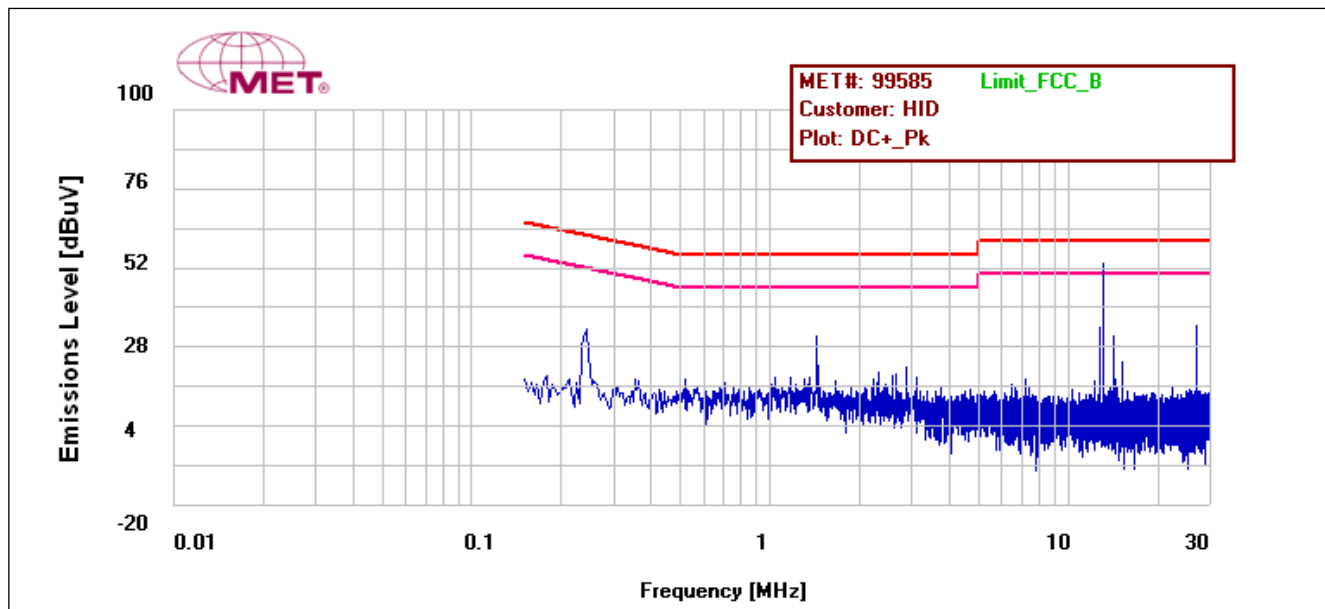
Test Engineer(s): Giuliano Messina

Test Date(s): June 21, 2018

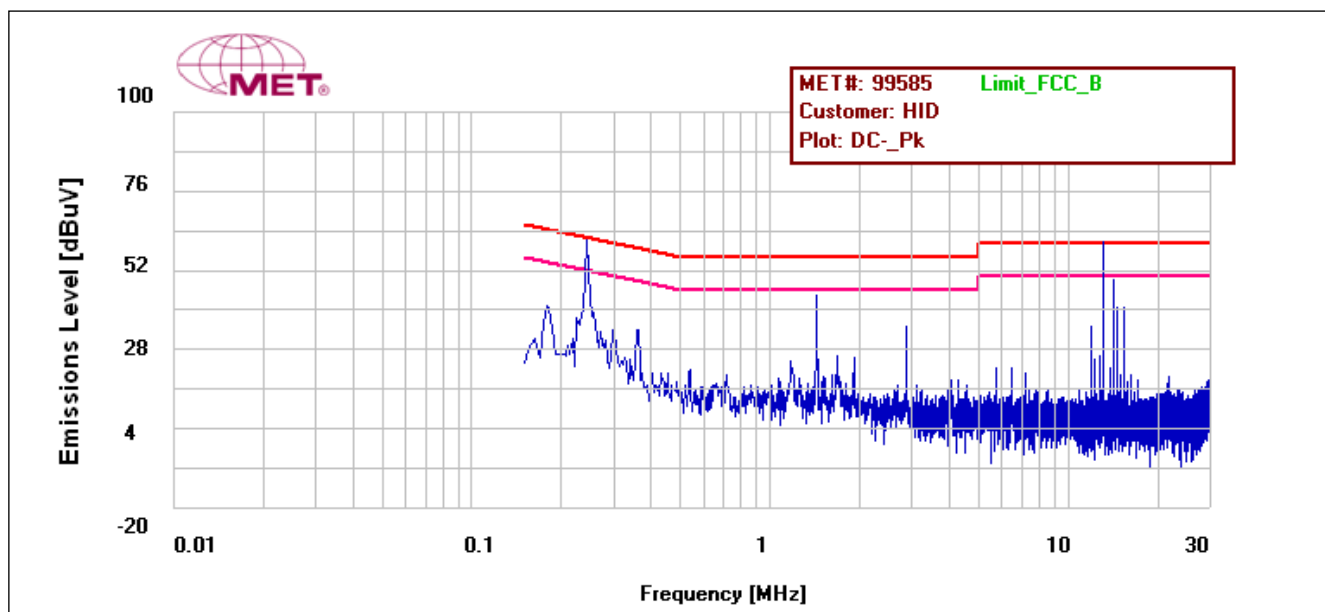
Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
DC+	0.242	31	62.038	-31.038	Pass	19.4	52.038	-32.638	Pass
DC+	1.442	29.3	56	-26.7	Pass	26.2	46	-19.8	Pass
DC+	12.81	22.9	60	-37.1	Pass	5.4	50	-44.6	Pass
DC+	13.214	38.9	60	-21.1	Pass	8.6	50	-41.4	Pass
DC+	14.346	20.8	60	-39.2	Pass	5.6	50	-44.4	Pass
DC+	27.122	32.4	60	-27.6	Pass	18.5	50	-31.5	Pass
DC-	0.178	40.5	64.582	-24.082	Pass	39.1	54.582	-15.482	Pass
DC-	0.242	58.9	62.038	-3.138	Pass	46.4	52.038	-5.638	Pass
*DC-	1.438	44.1	56	-11.9	Pass	44.1	46	-1.9	Pass
DC-	2.878	34.6	56	-21.4	Pass	33.9	46	-12.1	Pass
DC-	13.23	49.4	60	-10.6	Pass	15.5	50	-34.5	Pass
DC-	14.33	34	60	-26	Pass	8.9	50	-41.1	Pass

Table 7. Conducted Emissions, 2.3, Test Results

Note 1: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

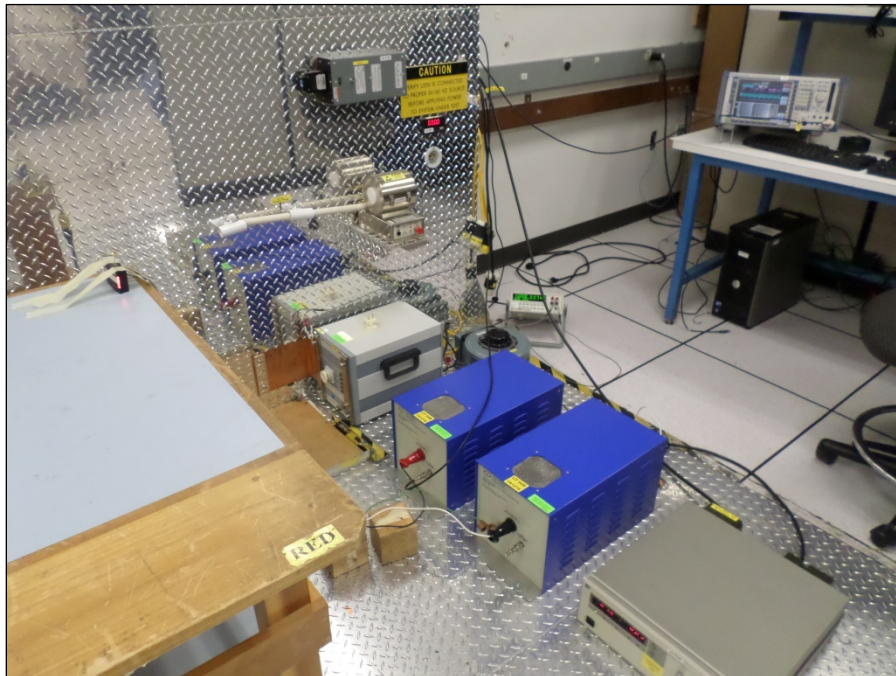


Plot 1. Conducted Emissions, DC+

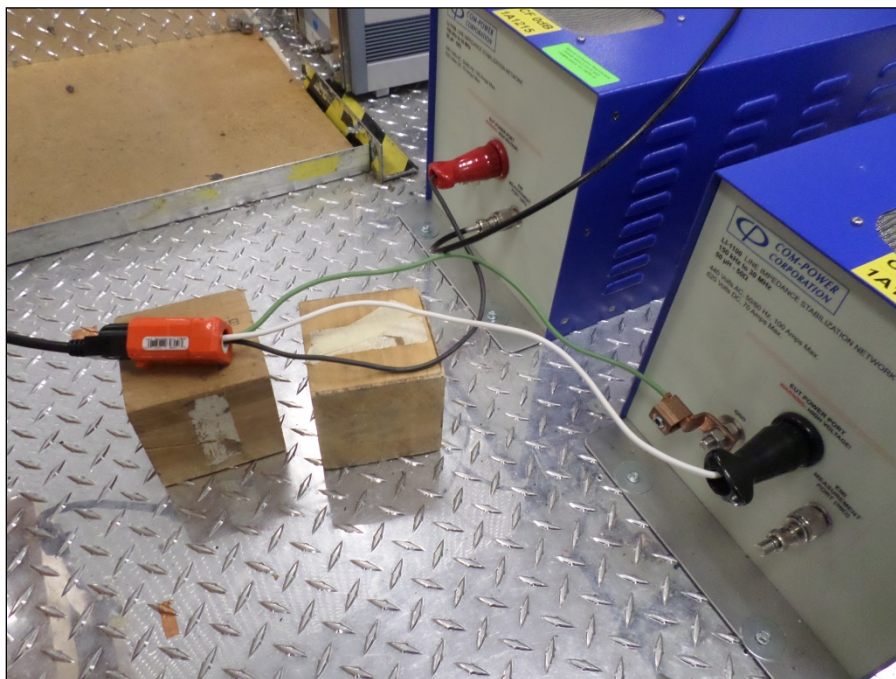


Plot 2. Conducted Emissions, DC-

Conducted Emissions Test Setup Photo



Photograph 1. Conducted Emissions, Test Setup



Photograph 2. Conducted Emissions, LISN Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§3.10.1.2 Peak Power Output

Test Requirements: §3.10.1.2: The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
2400–2483.5	1.000

Table 8. Output Power Requirements from §3.10.1.2

§3.10.1.3: 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 Table 8, 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.

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 §3.10.1.2.

Test Engineer(s): Giuliano Messina

Test Date(s): June 22, 2018

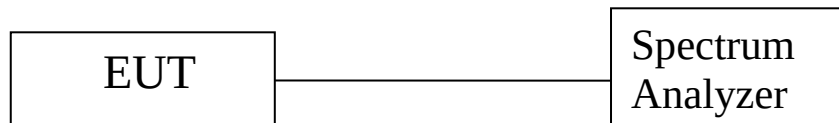
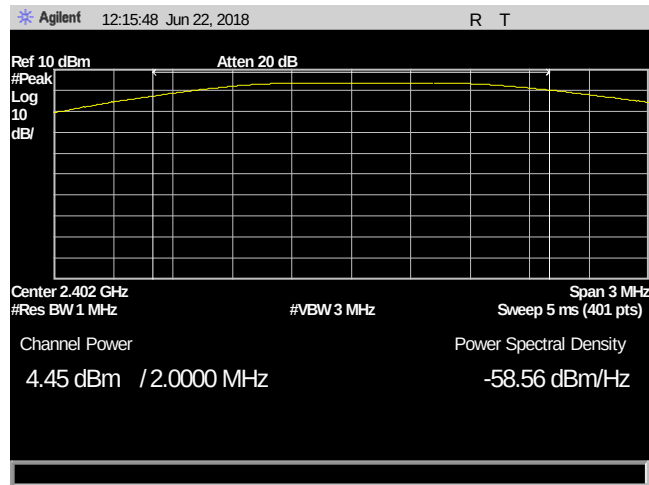
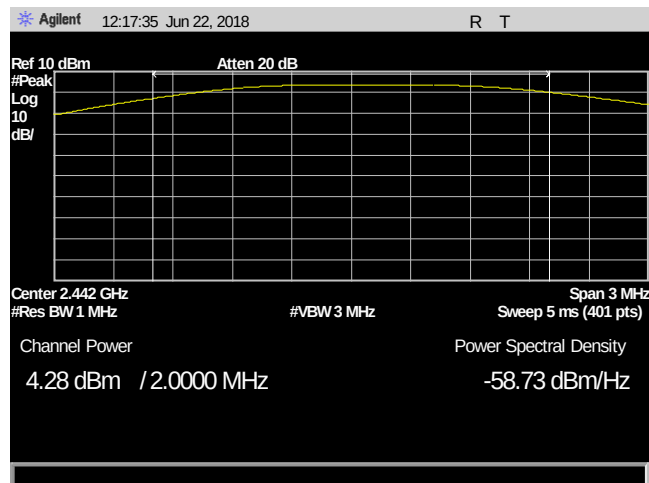


Figure 2. Peak Power Output Test Setup

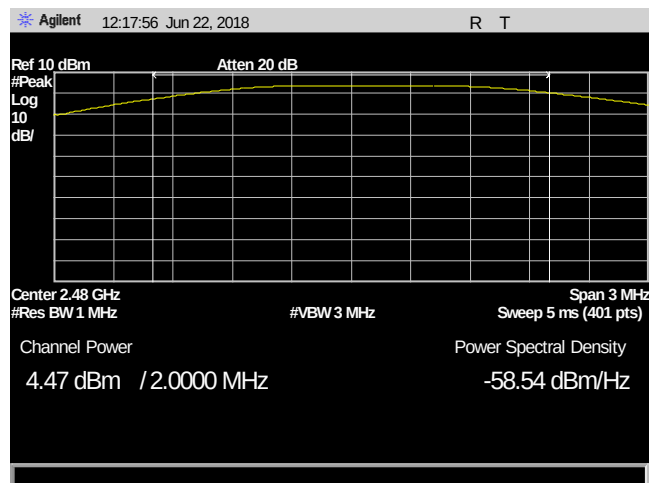
Peak Power Output Test Results



Plot 3. Peak Power Output, 2402



Plot 4. Peak Power Output, 2442



Plot 5. Peak Power Output, 2480

Electromagnetic Compatibility Criteria for Intentional Radiators

§3.10.1.5 Spurious Radiated Emissions

Test Requirements: §3.10.1.5; §2.7: Emissions outside the frequency band.

§3.10.1.5: 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 below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, the attenuation shall be as below:

- (1) The attenuation shall be at least 20dB when the conducted power is measured according to Appendix II of this section, based on either an RF conducted or a radiated measurement.
- (2) The attenuation shall be at least 30dB when the conducted power is measured according to the paragraph (1) (C) of this section 3.10.1.2.

In addition, for radiated emissions that fall under Section 2.7 the restricted bands must also comply with the radiated emission limit specified in Section 2.8.

§2.7: Except as shown in 3.10.1.5 of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110	149.9–150.05	1805–1865	9.0–9.2
0.490–0.510	156.7–156.9	1885–1900	9.3–9.5
2.172–2.198	162.01–167.17	1905–1985	10.6–12.7
4.115–4.198	167.72–173.2	2015–2025	13.25–13.4
5.670–5.690	240–285	2125–2165	14.47–14.5
6.2–6.3	322–335.4	2200–2300	15.35–16.2
8.230–8.4	399.9–410	2310–2390	17.7–21.4
12.265–12.600	485–510	2483.5–2900	22.01–23.12
13.340–13.430	608–614	3260–3267	23.6–24.0
14.965–15.020	703–748	3332–3339	31.2–31.8
16.700–16.755	758–803	3345.8–3358	36.43–36.5
19.965–20.020	825–915	3500–4400	Above 38.6
25.5–25.70	930–1240	4500–5250	
37.475–38.275	1300–1427	5350–5460	
73.5–75.4	1435–1626.5	7250–7750	
108–138	1660–1770	8025–8500	

Table 9. Restricted Bands of Operation

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (m)
30 (included) – 88 (included)	100	3
88 (excluded) – 216 (included)	150	3
216 (excluded) – 960 (included)	200	3
Above 960 (excluded)	500	3

Table 10. General Radiated Emissions Limits of §2.8

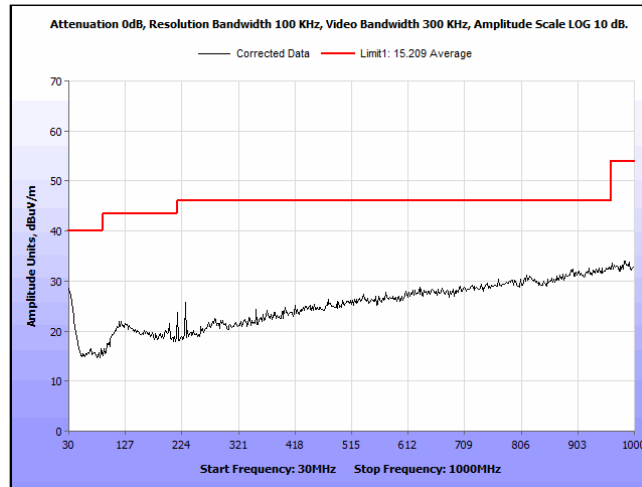
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EMI receiver was set for a max hold and maximum emissions for all three channels were compiled into a single plot. The EUT was rotated orthogonally through all three axes. Plots shown are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

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of §3.10.1.5. Measured emissions were within applicable limits.

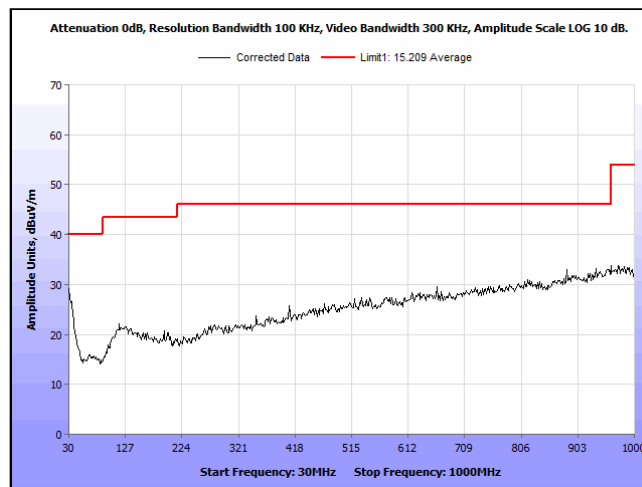
Test Engineer(s): Giuliano Messina

Test Date(s): June 21, 2018

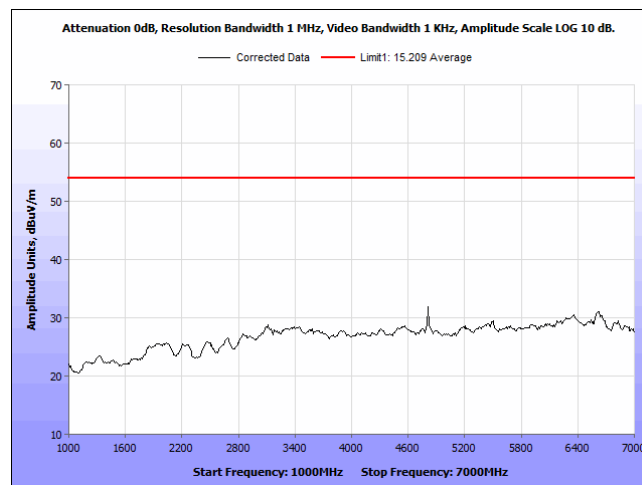
Radiated Spurious Emissions, Test Results



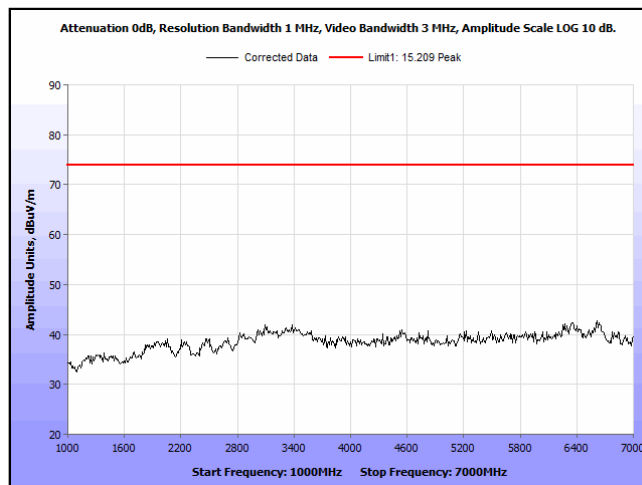
Plot 6. Radiated Emissions, 30 MHz – 1 GHz, Horizontal



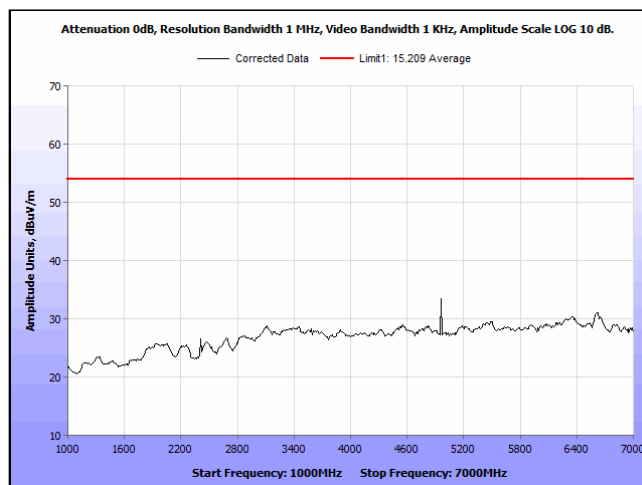
Plot 7. Radiated Emissions, 30 MHz – 1 GHz, Vertical



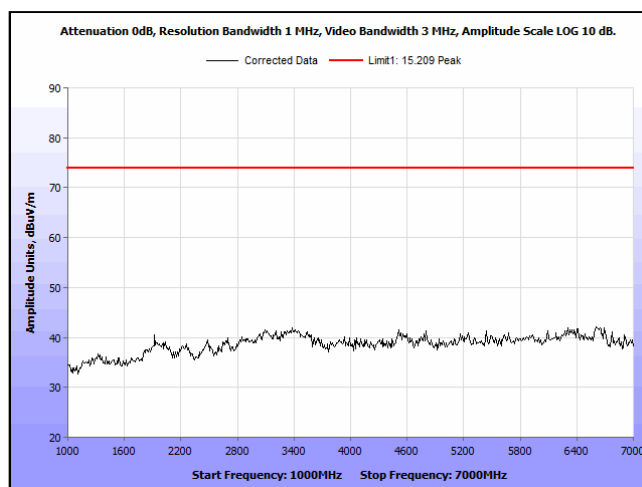
Plot 8. Radiated Emissions, 1 GHz – 7 GHz, Horizontal, Average



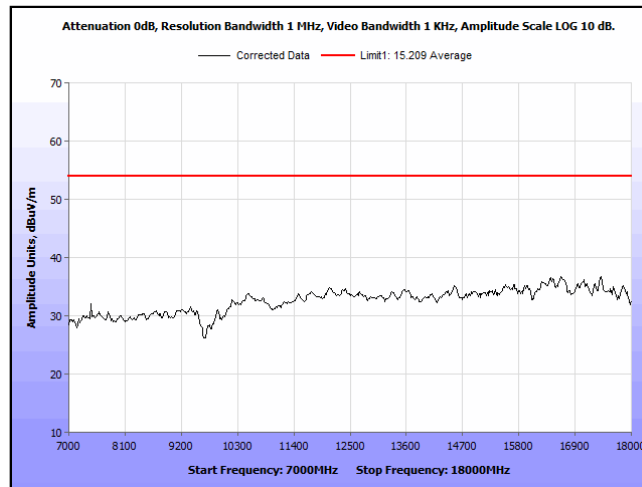
Plot 9. Radiated Emissions, 1 GHz – 7 GHz, Horizontal, Peak



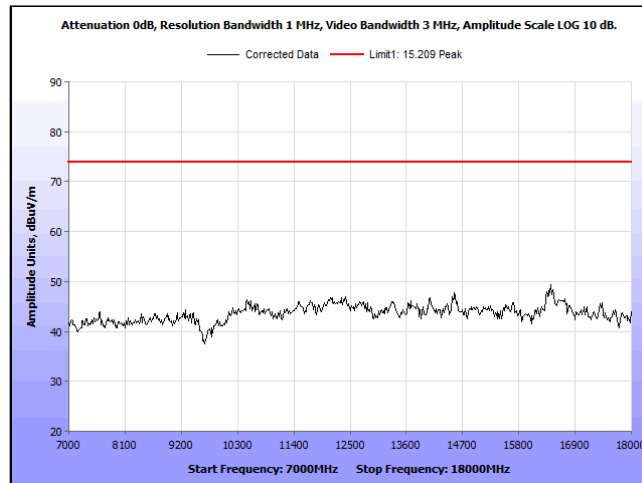
Plot 10. Radiated Emissions, 1 GHz – 7 GHz, Vertical, Average



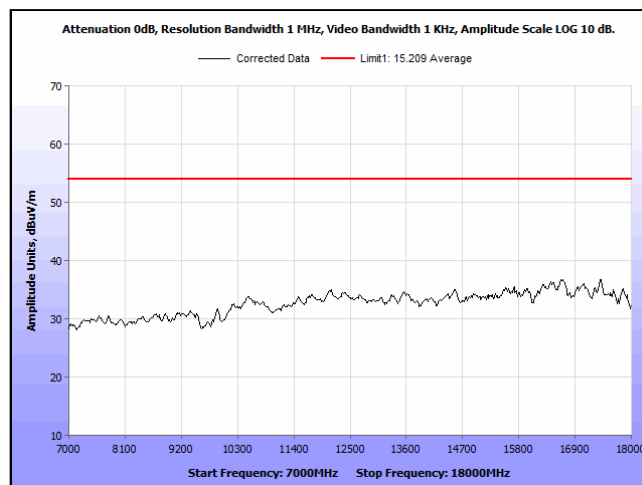
Plot 11. Radiated Emissions, 1 GHz – 7 GHz, Vertical, Peak



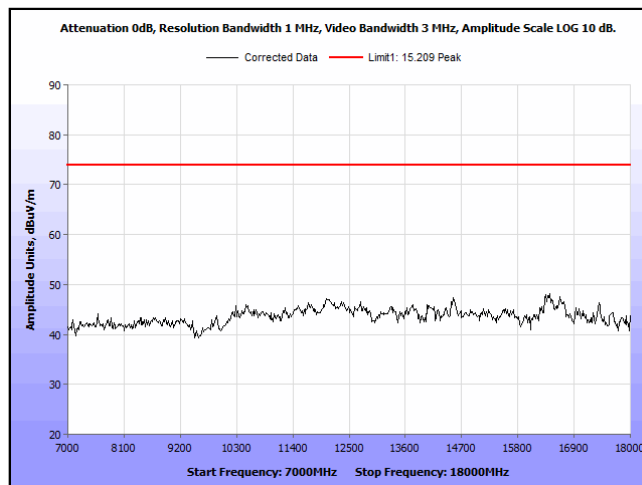
Plot 12. Radiated Emissions, 7 GHz – 18 GHz, Horizontal, Average



Plot 13. Radiated Emissions, 7 GHz – 18 GHz, Horizontal, Peak



Plot 14. Radiated Emissions, 7 GHz – 18 GHz, Vertical, Average

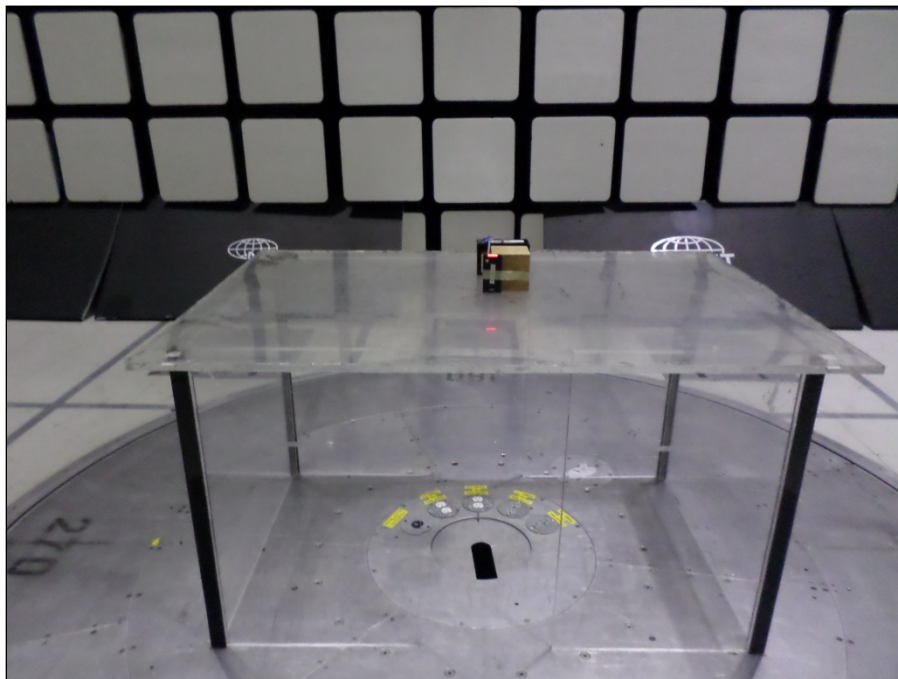


Plot 15. Radiated Emissions, 7 GHz – 18 GHz, Vertical, Peak

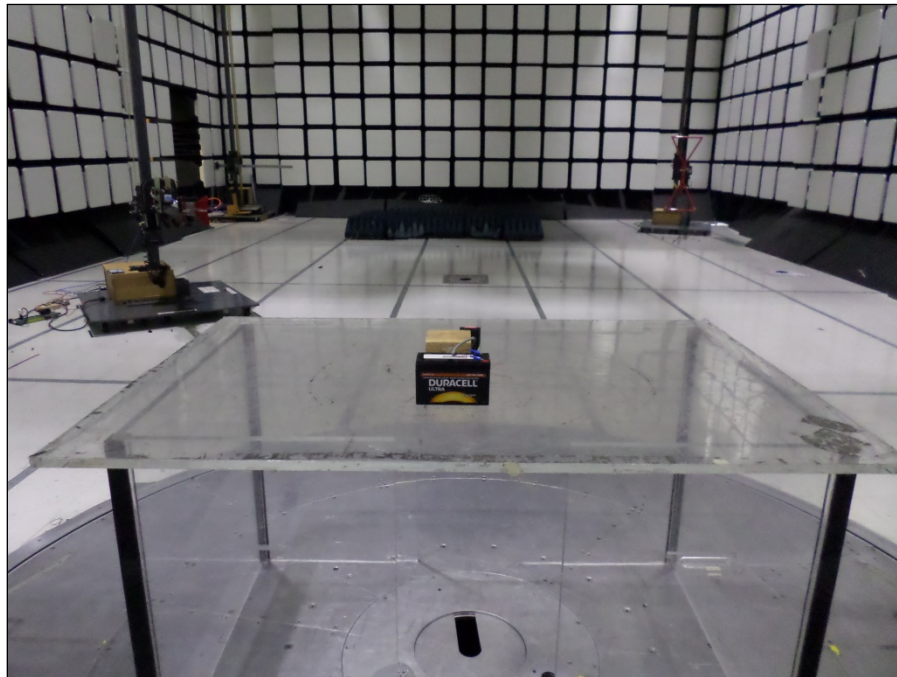
Radiated Spurious Emissions Test Setup



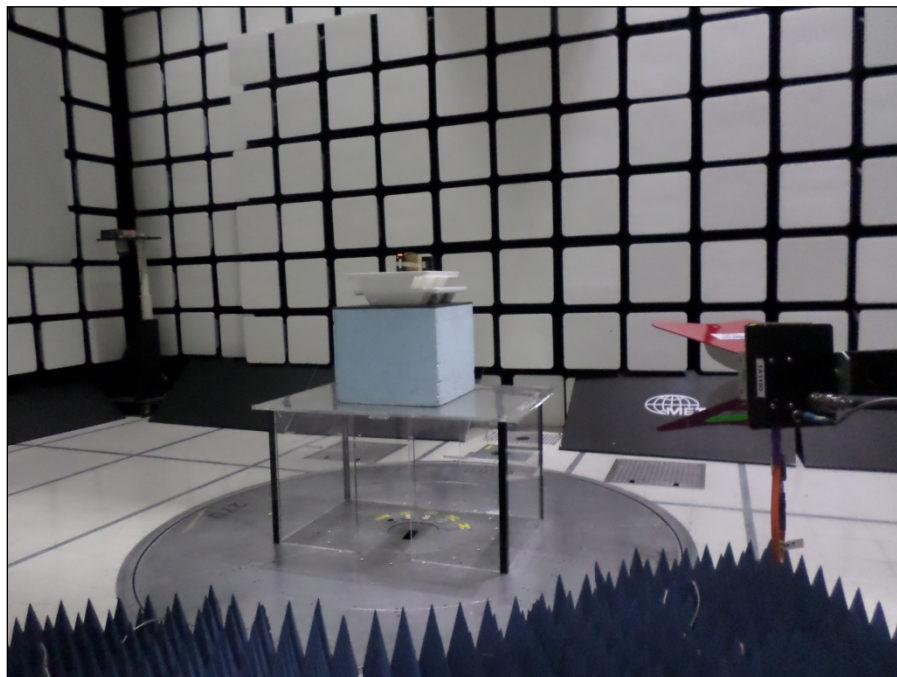
Photograph 3. Radiated Emissions, Below 1 GHz, Antenna



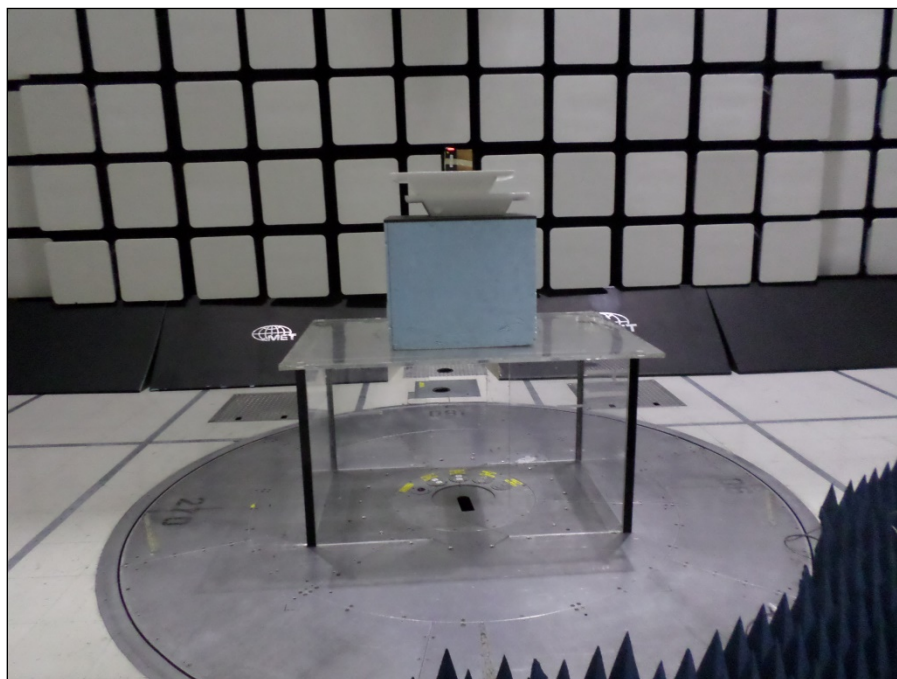
Photograph 4. Radiated Emissions, Below 1 GHz, Front



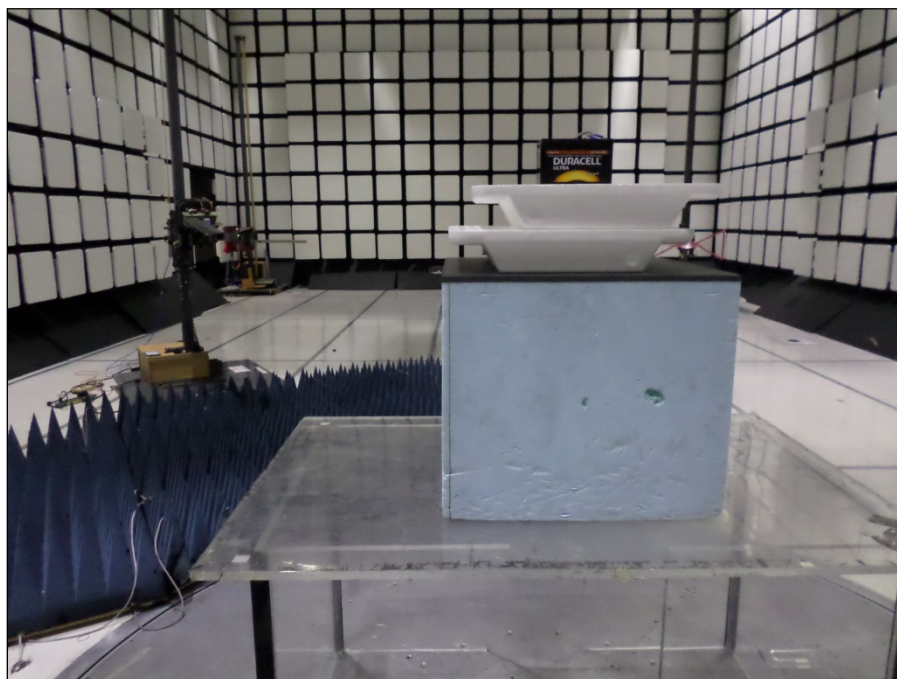
Photograph 5. Radiated Emissions, Below 1 GHz, Rear



Photograph 6. Radiated Emissions, Above 1 GHz, Antenna



Photograph 7. Radiated Emissions, Above 1 GHz, Front



Photograph 8. Radiated Emissions, Above 1 GHz, Rear

Electromagnetic Compatibility Criteria for Intentional Radiators

§3.10.1.5 Spurious RF Conducted Emissions

Test Requirement:	<p>§3.10.1.5: 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 below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, the attenuation shall be as below:</p> <ol style="list-style-type: none"> (1) The attenuation shall be at least 20dB when the conducted power is measured according to Appendix II of this section, based on either an RF conducted or a radiated measurement. (2) The attenuation shall be at least 30dB when the conducted power is measured according to the paragraph (1) (C) of this section 3.10.1.2.
Test Procedure:	<p>For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated with 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.</p> <p>See following pages for detailed test results with RF Conducted Spurious Emissions.</p>
Test Results:	<p>The EUT was compliant with the Conducted Spurious Emission limits of §3.10.1.5. Measured emissions were within applicable limits.</p>
Test Engineer(s):	<p>Giuliano Messina</p>
Test Date(s):	<p>June 22, 2018</p>

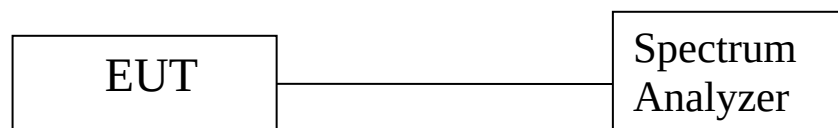
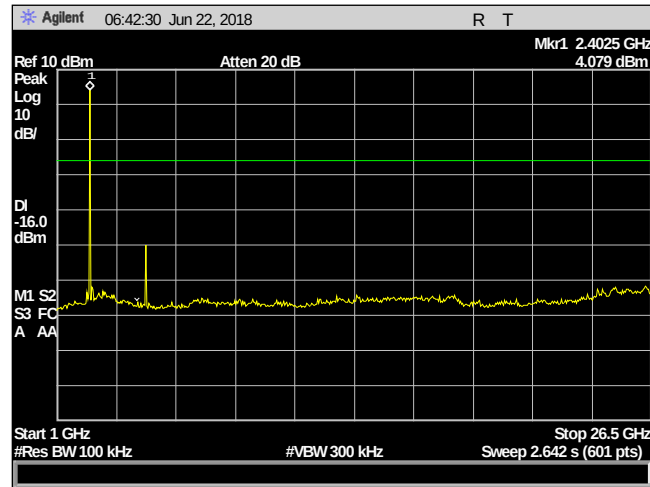
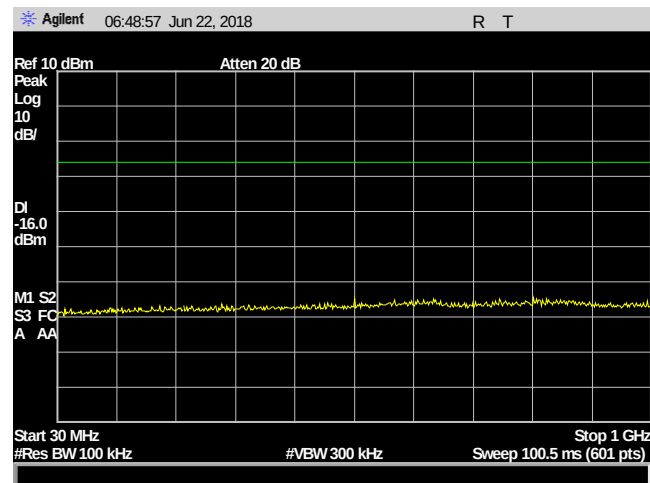


Figure 3. Block Diagram, Conducted Spurious Emissions Test Setup

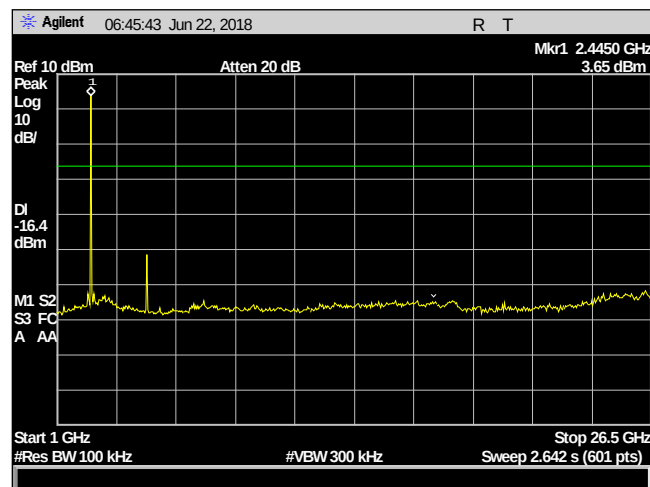
Spurious Emissions in Non-restricted Bands, Test Results



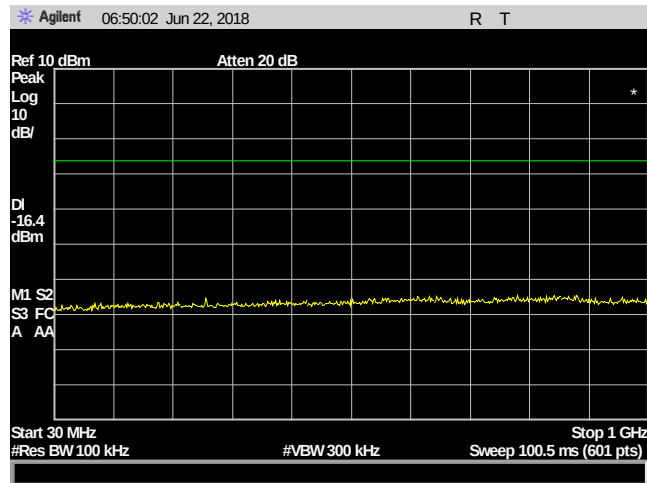
Plot 16. Conducted Spurious Emissions, 2402, 1 – 26.5 GHz



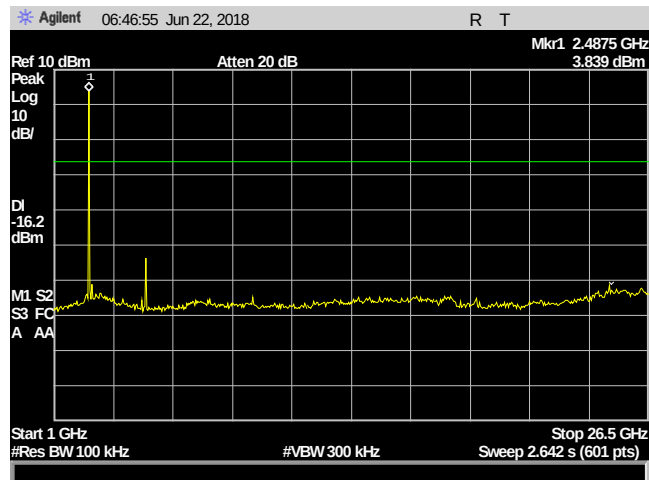
Plot 17. Conducted Spurious Emissions, 2402, 30 MHz – 1 GHz



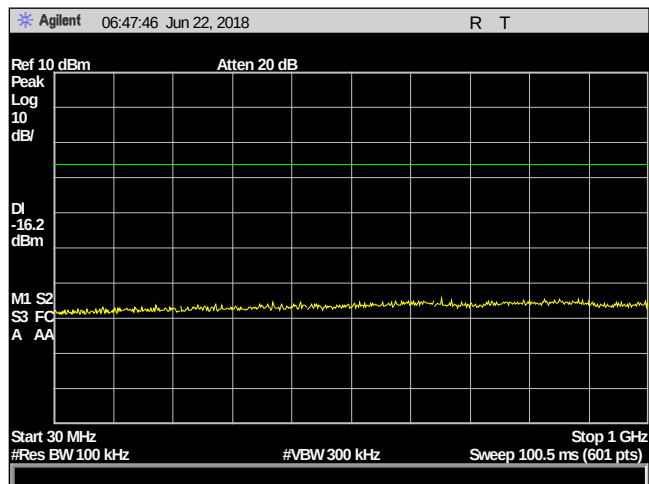
Plot 18. Conducted Spurious Emissions, 2442, 1 – 26.5 GHz



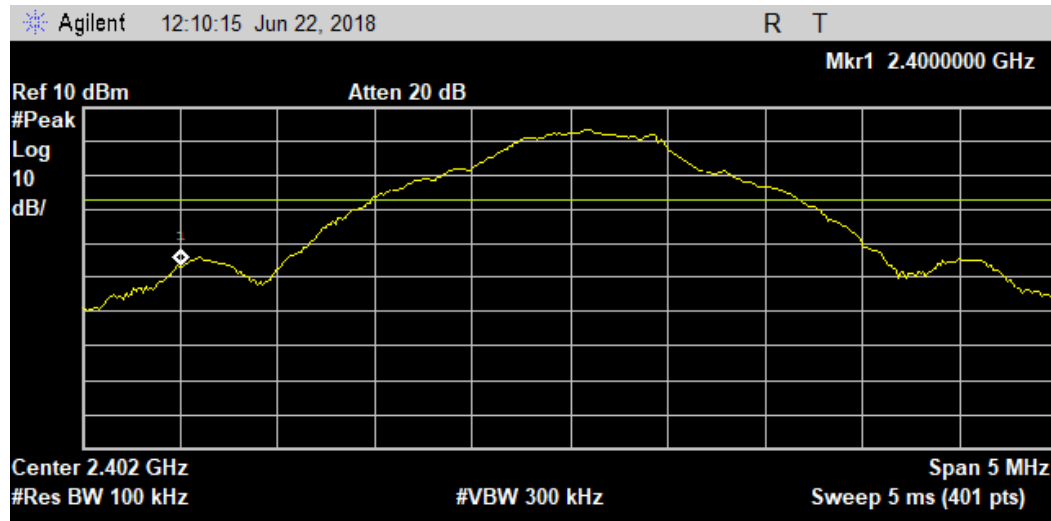
Plot 19. Conducted Spurious Emissions, 2442, 30 MHz – 1 GHz



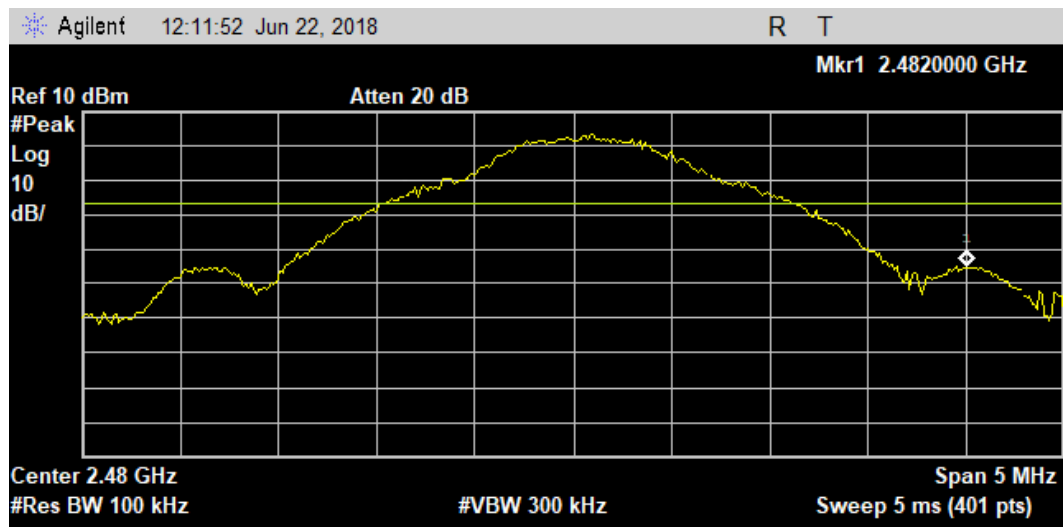
Plot 20. Conducted Spurious Emissions, 2480, 1 – 26.5 GHz



Plot 21. Conducted Spurious Emissions, 2480, 30 MHz – 1 GHz



Plot 22. Conducted Spurious Emissions, 2402, Bandedge



Plot 23. Conducted Spurious Emissions, 2480, Bandedge

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 3.10.1.6 Occupied Bandwidth

Test Requirements: §3.10.1.6: 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 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 1-5% 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 §3.10.1.6.

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

Test Engineer(s): Giuliano Messina

Test Date(s): June 22, 2018

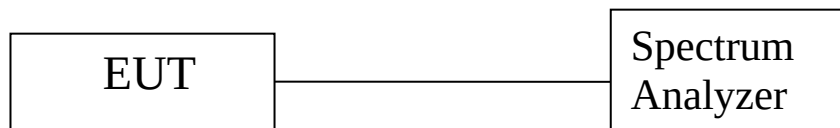
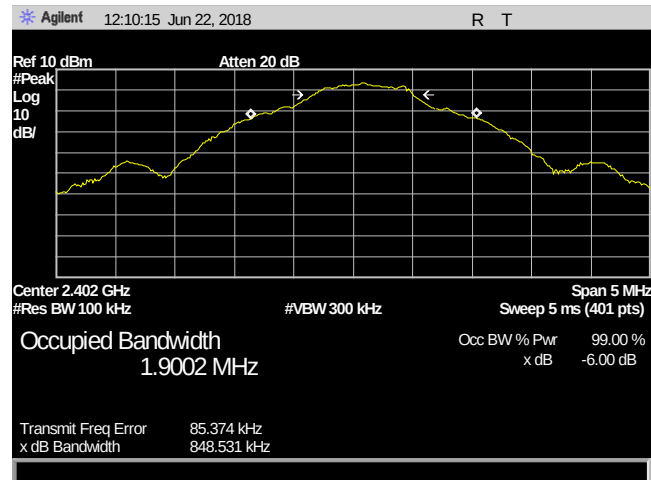
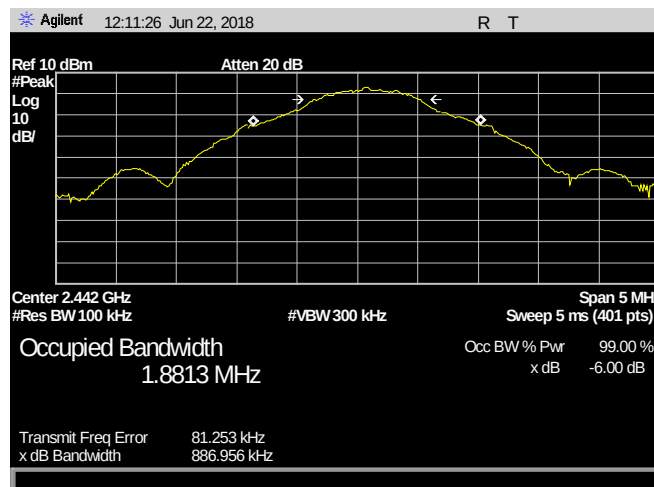


Figure 4. Block Diagram, Occupied Bandwidth Test Setup

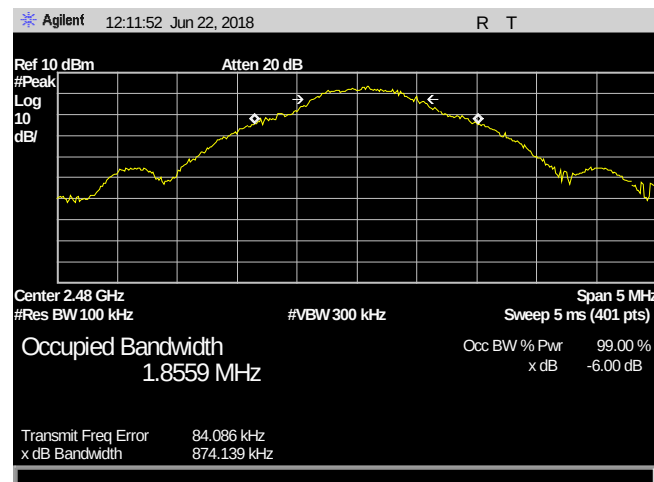
Occupied Bandwidth Test Results



Plot 24. 6 dB Occupied Bandwidth, 2402



Plot 25. 6 dB Occupied Bandwidth, 2442



Plot 26. 6 dB Occupied Bandwidth, 2480

Electromagnetic Compatibility Criteria for Intentional Radiators

§3.10.1.6 Peak Power Spectral Density

Test Requirements: §3.10.1.6: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer. The power level was set to the maximum level. The RBW was set to 30 kHz and a VBW set to 100 kHz. 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 §3.10.1.6.

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

Test Engineer: Giuliano Messina

Test Date: June 22, 2018

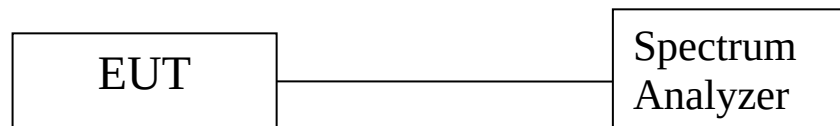
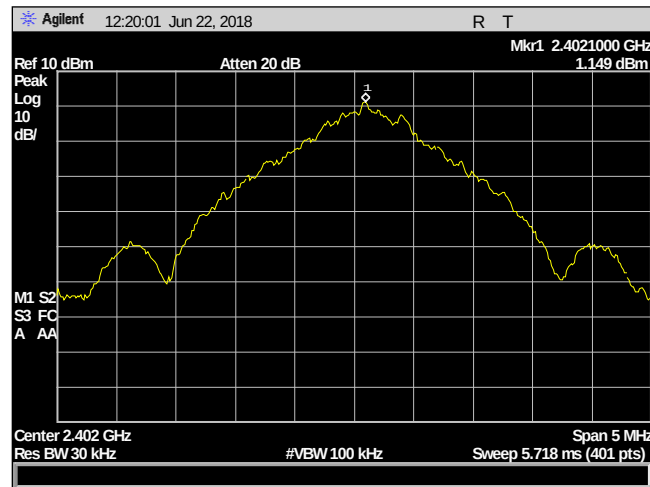
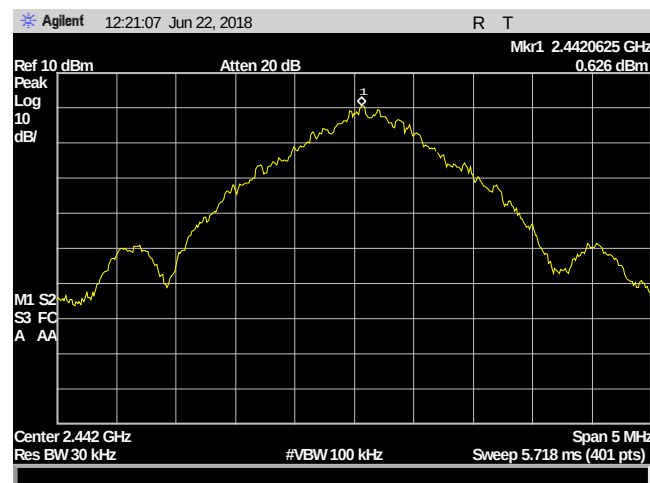


Figure 5. Block Diagram, Peak Power Spectral Density Test Setup

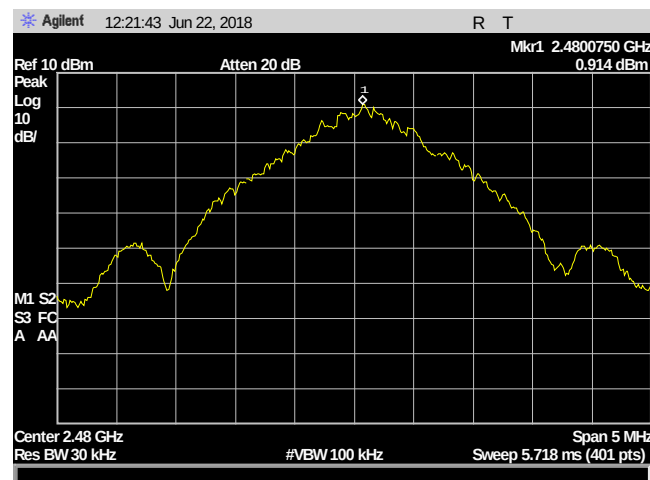
Peak Power Spectral Density



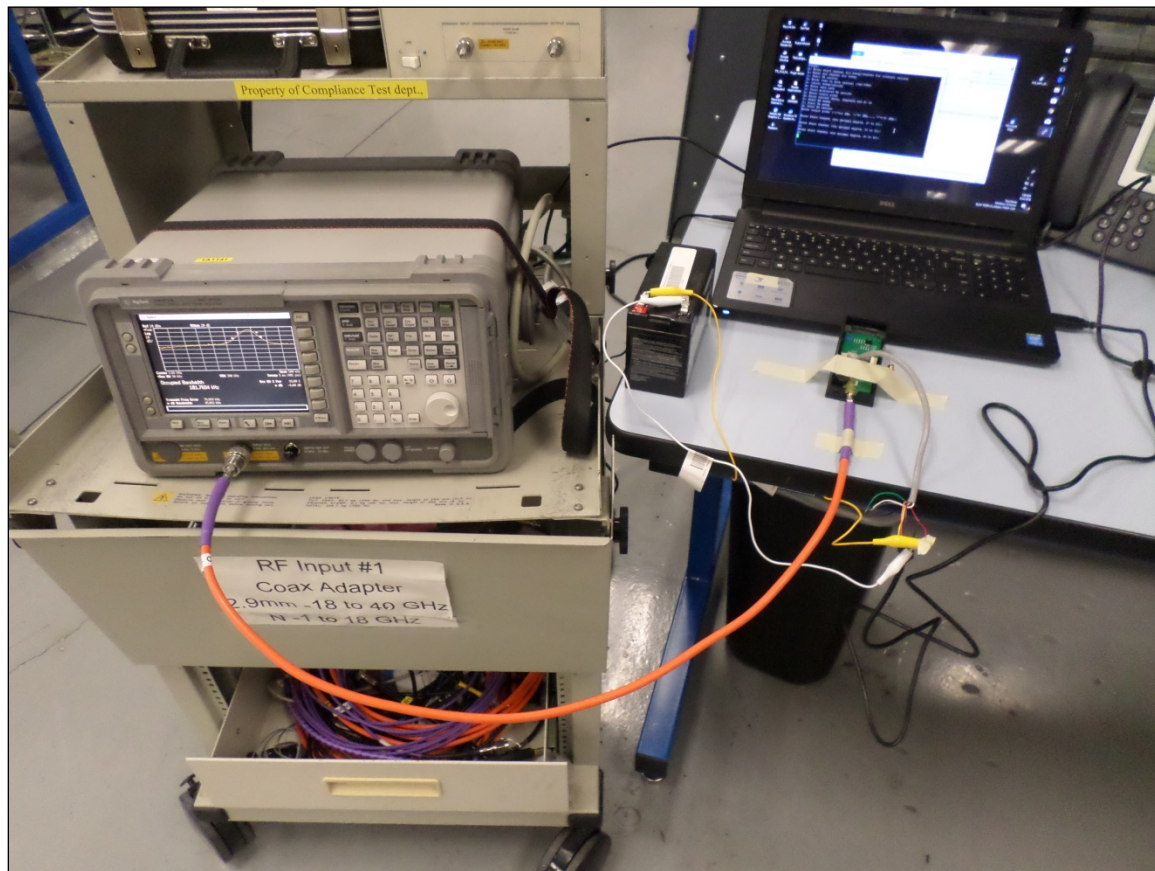
Plot 27. Power Density, 2402



Plot 28. Power Density, 2442



Plot 29. Power Density, 2480



Photograph 9. Conducted Testing Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§5.20 Maximum Permissible Exposure

BLE SAR Exclusion Calculation

Per KDB 447498, Section 4.3.1 (a), applicable for frequencies from 100 MHz to 6 GHz and test separation distances ≤ 50 mm:

Using the formula from 4.3.1 (a), and using the LP0002 whole-body uncontrolled exposure SAR limit of 0.08 W/kg:

$$\text{Power allowed at numeric threshold for 50 mm and 2.4 GHz in step 4.3.1 (a)} = \left(\frac{0.08}{\sqrt{2.4}} \right) * 50 \text{ mm} = 2.582 \text{ mW}$$

Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Total Pwr. (mW)	Calculated SAR Threshold	1.0-g SAR Limit	Margin	Separation Distance Declared (mm)	Result
2480	4.47	2.799	-10	0.1	2.899	0.913	3.0	2.08693	5	Pass

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 17025:2005.

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	9/12/2017	10/12/2018
1A1106	10m Chamber (FCC)	ETS	Semi-Anechoic	See Note	
1A1147	Bilog Antenna (30MHz to 1GHz)	Sunol Sciences Corp	JB3	3/9/2017	10/9/2018
1A1047	Horn Antenna	ETS	3117	2/23/2017	8/23/2018
1A1099	Generator	COM-Power Corp	CGO-51000	See Note	
1A1088	Pre-Amp	Rohde & Schwarz	TS-PR1	See Note	
1A1180	Pre-Amp	Miteq	AMF-7D-01001800-22-10P	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	

Table 11. Test Equipment List

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

End of Report