3D Robotics, Inc.

ADDENDUM TO EMC TEST REPORT 96782-9A

Solo
Model: S111A

Tested To The Following Standards:

FCC Part 15 Subpart C Section 15.247

Report No.: 96782-9B

Date of issue: May 14, 2015

ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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San Diego, CA 92154

Representative: Jeff Wurzbach

REPORT PREPARED BY:

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Mariposa, CA 95338

Project Number: 96782

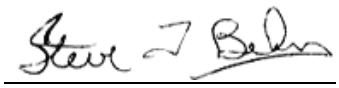
DATE OF EQUIPMENT RECEIPT: March 4, 2015
DATE(S) OF TESTING: March 4 & April 10, 2015

Revision History

Original: Testing of Solo, Model: S111A to FCC Part 15 Subpart C Section 15.247.
Addendum A: To correct the antenna description statement and by adding the beam forming and directional gain value in the test conditions in sections 15.247(a)(2), (b)(3), CE(d), and (e), and removed an incorrect reference to the cross-polarized antenna procedure in CE section (d).
Addendum B: To add a manufacturer statement for equivalent models in the Equipment Under Test section.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.00.14
Immunity	5.00.07

Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A	US0060	SL2-IN-E-1146R	3082D-1	90473	A-0147

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C

Test Procedure	Description	Modifications*	Results
15.31(e)	Voltage Variation	NA	Pass
15.247(a)(2)	Bandwidth	NA	Pass
15.247(b)(3)	RF Power Output	NA	Pass
15.247(d)	Conducted Spurious Emissions	NA	Pass
15.247(d)	Radiated Spurious Emissions and Band Edge	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass

Modifications* During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

***Modifications listed above must be incorporated into all production units.**

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

The following model has been tested by CKC Laboratories: Solo, Model: S111A

The manufacturer states that the following additional models are identical electrically to the one which was tested, or any differences between them do not affect their EMC characteristics, and therefore they meet the level of testing equivalent to the tested models. S110A and S114A

EQUIPMENT UNDER TEST

Solo
Manuf: 3D Robotics, Inc.
Model: S111A
Serial: NA

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

Laptop
Manuf: Dell
Model: Latitude E6530
Serial: 6QN6JX1

Video Camera
Manuf: GoPro
Model: Hero4
Serial: NA

FCC PART 15 SUBPART C

15.31(e) Voltage Variations

Test Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Pl • Brea, CA 92823 • 714-993-6112

Customer: **3D Robotics, Inc.**
Specification: **15.31e**
Work Order #: **96782** Date: 4/7/2015
Test Type: **Maximized Emissions** Time: 15:56:13
Equipment: **Solo** Sequence#: 2
Manufacturer: 3D Robotics, Inc. Tested By: Don Nguyen
Model: S111A
S/N:

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
T1	AN00309	Preamp	8447D	3/12/2014	3/12/2016
T2	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
T3	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
T4	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	AN02672	Spectrum Analyzer	E4446A	8/14/2013	8/14/2015
T5	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
T7	AN02946	Cable	32022-2-2909K-36TC	7/31/2013	7/31/2015
T8	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T9	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/5/2013	6/5/2015
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo*	3D Robotics, Inc.	S111A	

Support Devices:

Function	Manufacturer	Model #	S/N
Video Camera	GoPro	Hero4	NA

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the Styrofoam table top.
The EUT is powered on and is continuously transmitting at its maximum rated output power.

Channel 4 (2427MHz), Channel 6 (2437MHz) and Channel 11 (2462MHz) +25dBm both antennas, MCS15.
The EUT is tested running off a fully charged battery.
HDMI cable from the EUT is connected to support video camera. F
frequency range scanned and maximized for this data sheet is 0.009MHz to 25000MHz.

0.009MHz to 0.15MHz RBW=VBW=0.2kHz.
0.15MHz to 30MHz RBW=VBW=9kHz.
30MHz to 1000MHz RBW=VBW=120kHz.
1000MHz to 25000MHz RBW=VBW=1MHz.

Temperature: 17°C, Relative Humidity 30%, Atmospheric Pressure: 100kPa.

The EUT is tested in each of three axis systems.

Site A. Test method used, ANSI C63.4 2003.

15.31e The EUT is tested with fully charged battery.

Test Setup Photo(s)

15.247(a)(2) Bandwidth

Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714-993-6112

Customer: **3D Robotics, Inc.**
Specification: **15.247(a)(2) 6dB Bandwidth**
Work Order #: **96782** Date: 3/4/2015
Test Type: **Conducted Emissions** Time: 08:27:06
Equipment: **Solo** Sequence#: 1
Manufacturer: 3D Robotics, Inc. Tested By: E. Wong
Model: S111A 8.3V
S/N: NA

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
	AN02946	Cable	32022-2-2909K-36TC	7/31/2013	7/31/2015

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo	3D Robotics, Inc.	S111A	NA

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6530	6QN6JX1

Test Conditions / Notes:

The EUT is placed on the test bench. The EUT is set in test mode via support laptop.

Protocol:
802.11n20 (program code :TX99)
Freq 2400-2483.5MHz
2427MHz, 2437MHz, 2462MHz (channel 4,6,11)
Power Command: 25,25,25
MIMO, Correlated, vertically polarized dipole antenna, gain=2.3dBi, beam forming, directional gain =3dB

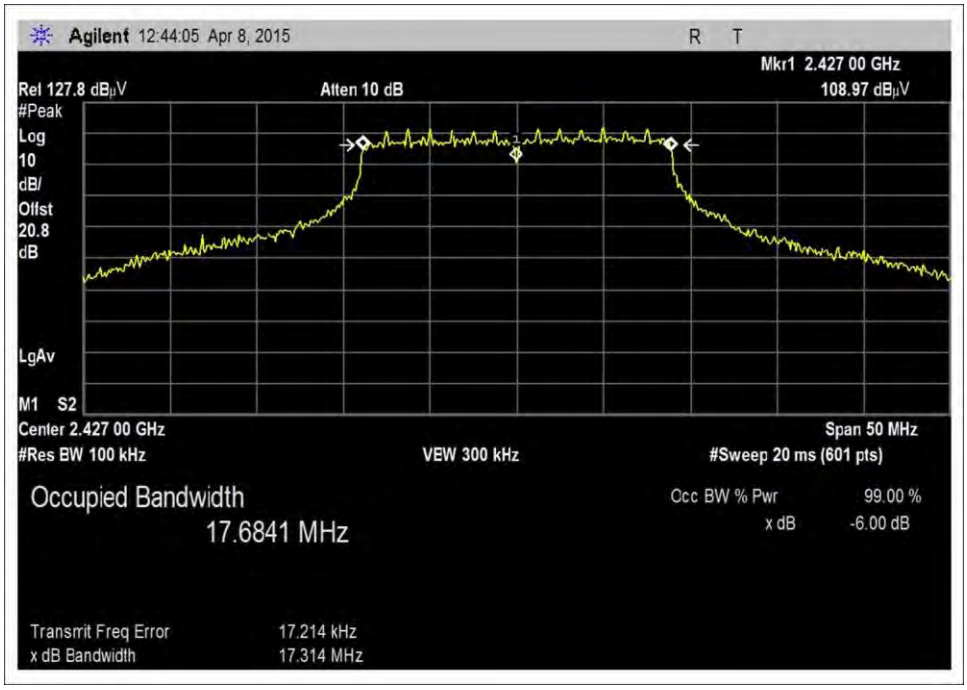
Test environment conditions: Temperature: 21.1°C, Relative Humidity: 40 %, Atmospheric Pressure: 100kPa

RF parameter is measured at the antenna ports of WiFi card PN: PCE3202AH

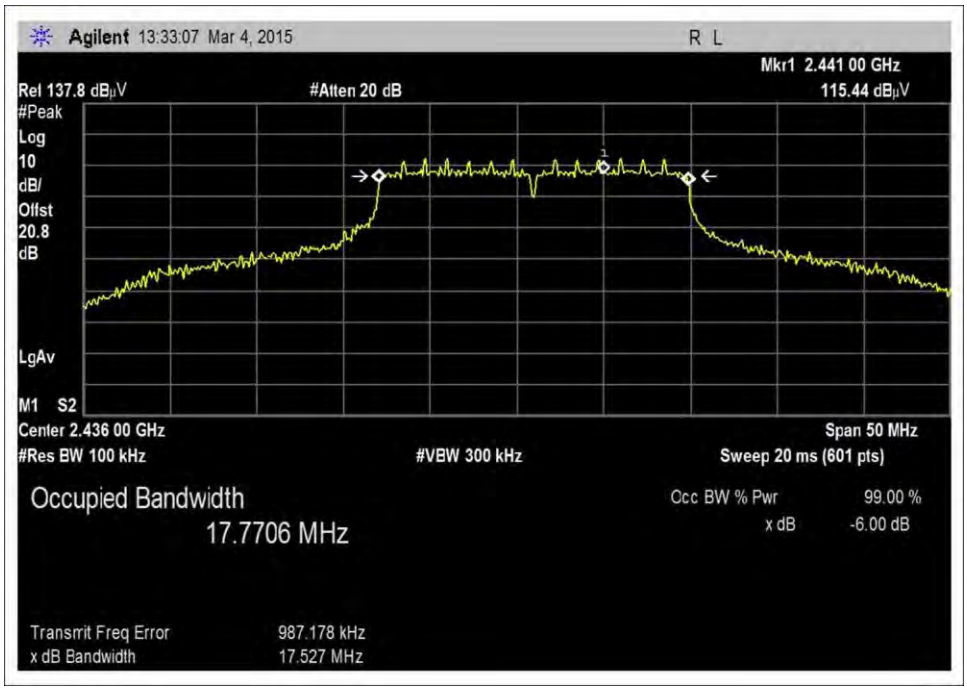
Test performed IAW 8.2 DTS Bandwidth 8.2 Option2 of
Test Procedure: 558074 D01 DTS Meas Guidance V03r02, June 5, 2014
Reported Bandwidth measured at antenna port 1, same measurement at antenna port 2 was verified. No deviation in emission signature.

Note: All conducted emission test results are done on unit Solo Controller, model: AT11A which has the same wireless module as the EUT.

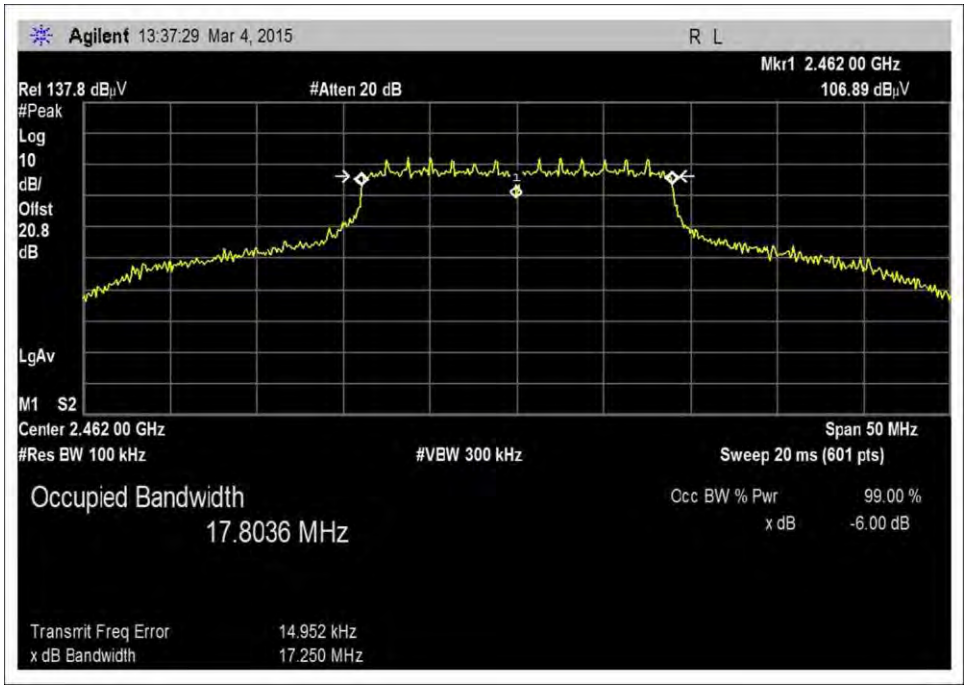
Test Data



2427MHz



2437MHz



2462MHz

Test Setup Photo

15.247(b)(3) RF Power Output

Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714-993-6112

Customer: **3D Robotics, Inc.**
Specification: **15.247(b)(3) RF Output Power**
Work Order #: **96782** Date: 3/4/2015
Test Type: **Conducted Emissions** Time: 08:27:06
Equipment: **Solo** Sequence#: 1
Manufacturer: 3D Robotics, Inc. Tested By: E. Wong
Model: S111A 8.3V
S/N: NA

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	03494	RF Powerhead	ETS Lindgren	11/20/2014	11/20/2016
	03495	RF Powerhead	ETS Lindgren	11/20/2014	11/20/2016

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo	3D Robotics, Inc.	S111A	NA
Battery Charger	3E	CG15-088150-AU	NA

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6530	6QN6JX1

Test Conditions / Notes:

The EUT is placed on the test bench. The EUT is set in test mode via support laptop.

Protocol:
802.11n20 (program code :TX99)
Freq 2400-2483.5MHz

2427MHz, 2437MHz, 2462MHz (channel 4,6,11)
Power Command: 25,25,25
MIMO, Correlated, vertically polarized dipole antenna, gain=2.3dBi, beam forming, directional gain =3dB

Test environment conditions: Temperature: 21.1°C, Relative Humidity: 40 %, Atmospheric Pressure: 100kPa

RF parameter is measured at the antenna ports of WiFi card PN: PCE3202AH

The controller capable of battery power or charger powered is powered by a dedicated battery charger during the test.

Test performed in accordance with, Power meas:9.2.3.1 Method AVGPM-G (measurement using a gated RF average power meter)
And MIMO summation in accordance with, E(1) and 2(C)(i)

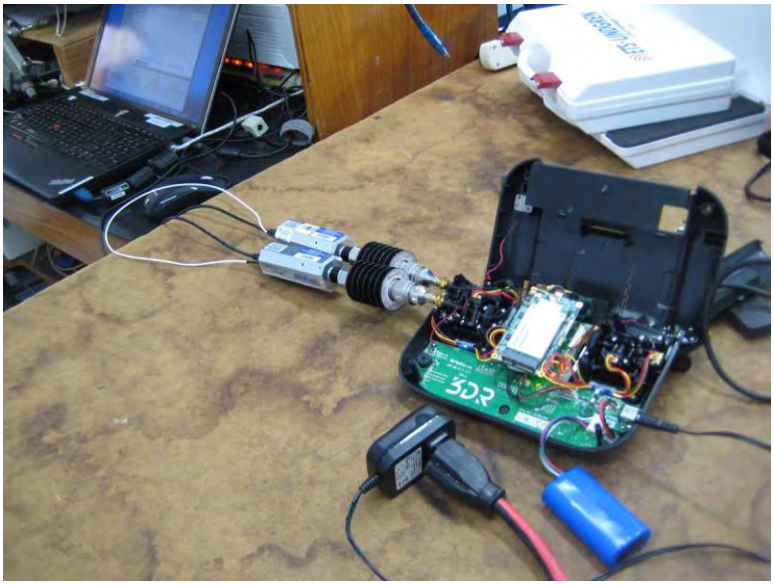
Test Procedure: 558074 D01 DTS Meas Guidance V03r02, June 5, 2014
Test Procedure: 662911 D01 Multiple Transmitter Output v02r01, October 31, 2013

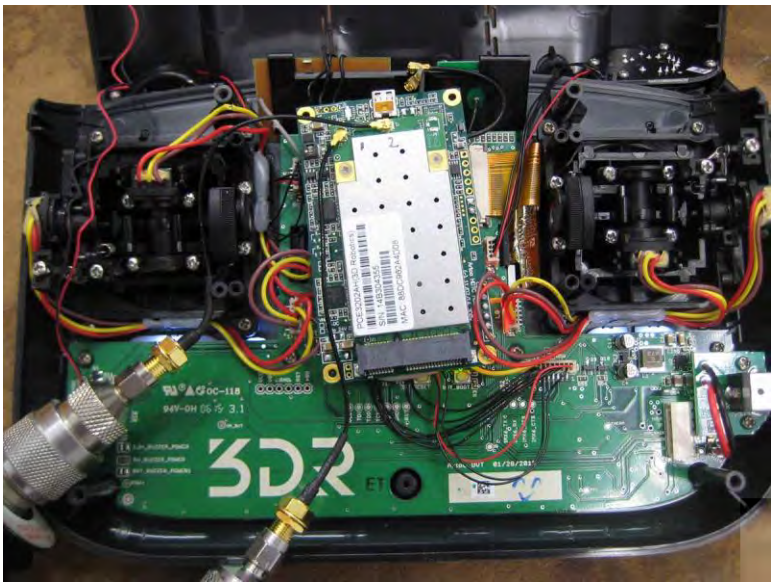
Test software: EMPower ETSI Burst Measurement System. V1.0.2.11

Note: All conducted emission test results are done on unit Solo Controller, model: AT11A which has the same wireless module as the EUT.

802.11n 20	Peak Power1	Peak Power 2	Peak Power 1	Peak Power2	Total Peak Power
	dBm	dBm	w	w	W
2427	23.73	23.83	0.236048	0.241546	0.4776
2437	24.58	24.62	0.287078058	0.289734359	0.5768
2462	24.79	24.59	0.301300602	0.287739841	**0.5890**

Test Setup Photo(s)





15.247(d) Conducted Spurious Emissions

Test Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112

Customer: **3D Robotics, Inc.**
Specification: **15.247(d) Conducted Spurious Emissions**
Work Order #: **96782** Date: 3/4/2015
Test Type: **Conducted Emissions** Time: 16:21:59
Equipment: **Solo** Sequence#: 1
Manufacturer: 3D Robotics, Inc. Tested By: E. Wong
Model: S111A 8.3V
S/N: NA

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
T2	AN02946	Cable	32022-2-2909K-36TC	7/31/2013	7/31/2015

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo*	3D Robotics, Inc.	S111A	NA

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6530	6QN6JX1

Test Conditions / Notes:

The EUT is placed on the test bench. The EUT is set in test mode via support laptop.

Protocol:
802.11n20 (program code :TX99)
Freq 2400-2483.5MHz

2427MHz, 2437MHz, 2462MHz (channel 4,6,11)
Power Command: 25,25,25
MIMO, Correlated, vertically polarized dipole antenna, gain=2.3dBi, beam forming, directional gain =3dB

Frequency range of measurement = 9 kHz- 25GHz. RBW=VBW=100kHz.

Test environment conditions: Temperature: 21.1°C, 40 % Relative Humidity, Pressure: 100kPa

RF parameter is measured at the antenna ports of WiFi card PN: PCE3202AH
The battery powered controller is powered by dedicated battery Charger during the test.

15.31(e) To simulate a fully charge battery, a support power supply is used for providing DC power to the Drone. The drone is designed not to transmit in charging mode.

Conducted spurious emissions limit = 113dBuV/100kHz (max measured) - 30= 83dBuV/100kHz.
No emission found, recorded emission represents noise floor level.

Test Procedure: 558074 D01 DTS Meas Guidance V03r02, June 5, 2014
Test Procedure: 662911 D01 Multiple Transmitter Output v02r01, October 31, 2013
3) Out-of-Band and Spurious Emission Measurements b) Relative Limits: Without 10Log N applied. relative limit reference to conducted power at individual antenna port.
Where conducted measurements are used for compliance with conducted limits, the measured conducted output power or PSD must be summed across the outputs, as described in Attachment 662911 D01 of this publication.

Note: All conducted emission test results are done on unit Solo Controller, model: AT11A which has the same wireless module as the EUT.

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Lead: Ant Port

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	4821.000M	47.8	+0.0	+1.2			+0.0	49.0	83.0 ant1	-34.0	Ant P
2	4915.700M	47.1	+0.0	+1.2			+0.0	48.3	83.0 ant2	-34.7	Ant P
3	4819.000M	46.3	+0.0	+1.2			+0.0	47.5	83.0 ant2	-35.5	Ant P
4	4874.000M	44.2	+0.0	+1.2			+0.0	45.4	83.0 ant2	-37.6	Ant P
5	4917.000M	43.2	+0.0	+1.2			+0.0	44.4	83.0 ant1	-38.6	Ant P
6	4891.000M	42.7	+0.0	+1.2			+0.0	43.9	83.0 ant1	-39.1	Ant P

Test Setup Photo

15.247(d) Radiated Spurious Emissions and Band Edge

Test Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Pl • Brea, CA 92823 • 714-993-6112

Customer: **3D Robotics, Inc.**
Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**
Work Order #: **96782** Date: 4/10/2015
Test Type: **Maximized Emissions** Time: 14:25:18
Equipment: **Solo** Sequence#: 2
Manufacturer: 3D Robotics, Inc. Tested By: Don Nguyen
Model: S111A
S/N:

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
T1	AN00309	Preamp	8447D	3/12/2014	3/12/2016
T2	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
T3	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
T4	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	AN02672	Spectrum Analyzer	E4446A	8/14/2013	8/14/2015
T5	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
T7	AN02946	Cable	32022-2-2909K-36TC	7/31/2013	7/31/2015
T8	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T9	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/5/2013	6/5/2015
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo*	3D Robotics, Inc.	S111A	NA

Support Devices:

Function	Manufacturer	Model #	S/N
Video Camera	GoPro	Hero4	NA

Test Conditions / Notes:

The equipment under test (EUT) is stand alone on the Styrofoam table top.
The EUT is powered on and is continuously transmitting at its maximum rated output power.
Channel 4 (2427MHz), Channel 6 (2437MHz) and Channel 11 (2462MHz) +25dBm both antennas, MCS15.
The EUT is tested running off a fully charged battery.
HDMI cable from the EUT is connected to support video camera.

The EUT is tested in each of three axis systems.

Frequency range scanned and maximized for this data sheet is 0.009MHz to 25000MHz.

0.009MHz to 0.15MHz RBW=VBW=0.2kHz.
0.15MHz to 30MHz RBW=VBW=9kHz.
30MHz to 1000MHz RBW=VBW=120kHz.
1000MHz to 25000MHz RBW=VBW=1MHz.
Temperature: 17°C, Humidity 30%, Pressure: 100kPa.

Site A. Test method used, ANSI C63.4 2003.

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	965.005M QP	50.9	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	53.9	54.0	-0.1	Vert
^	965.005M	51.2	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	54.2	54.0	+0.2	Vert
^	964.982M	37.3	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	40.3	54.0	-13.7	Vert
4	965.000M QP	49.5	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	52.5	54.0	-1.5	Horiz
^	965.000M	49.8	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	52.8	54.0	-1.2	Horiz
6	355.260M QP	53.2	-27.9 +0.0 +0.0	+15.2 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	44.0	46.0	-2.0	Horiz
^	355.260M	54.1	-27.9 +0.0 +0.0	+15.2 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	44.9	46.0	-1.1	Horiz
8	419.960M	49.3	-27.9 +0.0 +0.0	+16.8 +0.0	+0.3 +0.0	+3.6 +0.0	+0.0	42.1	46.0	-3.9	Horiz
9	1854.500M	59.2	+0.0 -38.3 +0.0	+0.0 +24.5	+0.0 +0.4	+0.0 +3.6	+0.0	49.4	54.0	-4.6	Vert

10	345.460M	50.4	-27.9 +0.0 +0.0	+14.9 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	40.9	46.0	-5.1	Horiz
11	158.925M	53.5	-28.0 +0.0 +0.0	+10.5 +0.0	+0.1 +0.0	+2.1 +0.0	+0.0	38.2	43.5	-5.3	Horiz
12	1113.000M	63.4	+0.0 -39.8 +0.0	+0.0 +21.9	+0.0 +0.5	+0.0 +2.7	+0.0	48.7	54.0	-5.3	Vert
13	211.960M	52.4	-28.0 +0.0 +0.0	+10.0 +0.0	+0.1 +0.0	+2.4 +0.0	+0.0	36.9	43.5	-6.6	Horiz
14	869.635M	37.2	-27.2 +0.0 +0.0	+23.3 +0.0	+0.4 +0.0	+5.4 +0.0	+0.0	39.1	46.0	-6.9	Horiz
15	1483.500M Ave	59.2	+0.0 -38.6 +0.0	+0.0 +22.8	+0.0 +0.5	+0.0 +3.2	+0.0	47.1	54.0	-6.9	Vert
^	1483.500M	64.1	+0.0 -38.6 +0.0	+0.0 +22.8	+0.0 +0.5	+0.0 +3.2	+0.0	52.0	54.0	-2.0	Vert
17	1038.750M	62.4	+0.0 -40.3 +0.0	+0.0 +21.7	+0.0 +0.5	+0.0 +2.6	+0.0	46.9	54.0	-7.1	Horiz
18	296.950M	50.1	-27.9 +0.0 +0.0	+13.4 +0.0	+0.2 +0.0	+3.0 +0.0	+0.0	38.8	46.0	-7.2	Vert
19	2225.100M	54.9	+0.0 -38.1 +0.0	+0.0 +25.2	+0.0 +0.8	+0.0 +3.9	+0.0	46.7	54.0	-7.3	Horiz
20	170.680M	52.4	-28.0 +0.0 +0.0	+9.5 +0.0	+0.1 +0.0	+2.2 +0.0	+0.0	36.2	43.5	-7.3	Horiz
21	2002.850M	55.5	+0.0 -38.2 +0.0	+0.0 +25.1	+0.0 +0.5	+0.0 +3.7	+0.0	46.6	54.0	-7.4	Vert
22	1187.000M	60.1	+0.0 -39.5 +0.0	+0.0 +22.1	+0.0 +0.5	+0.0 +2.8	+0.0	46.0	54.0	-8.0	Vert
23	178.580M	51.9	-28.0 +0.0 +0.0	+9.1 +0.0	+0.1 +0.0	+2.2 +0.0	+0.0	35.3	43.5	-8.2	Horiz
24	351.330M	47.2	-27.9 +0.0 +0.0	+15.0 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	37.8	46.0	-8.2	Vert
25	1483.600M	57.9	+0.0 -38.6 +0.0	+0.0 +22.8	+0.0 +0.5	+0.0 +3.2	+0.0	45.8	54.0	-8.2	Horiz
26	2225.347M	53.9	+0.0 -38.1 +0.0	+0.0 +25.2	+0.0 +0.8	+0.0 +3.9	+0.0	45.7	54.0	-8.3	Vert

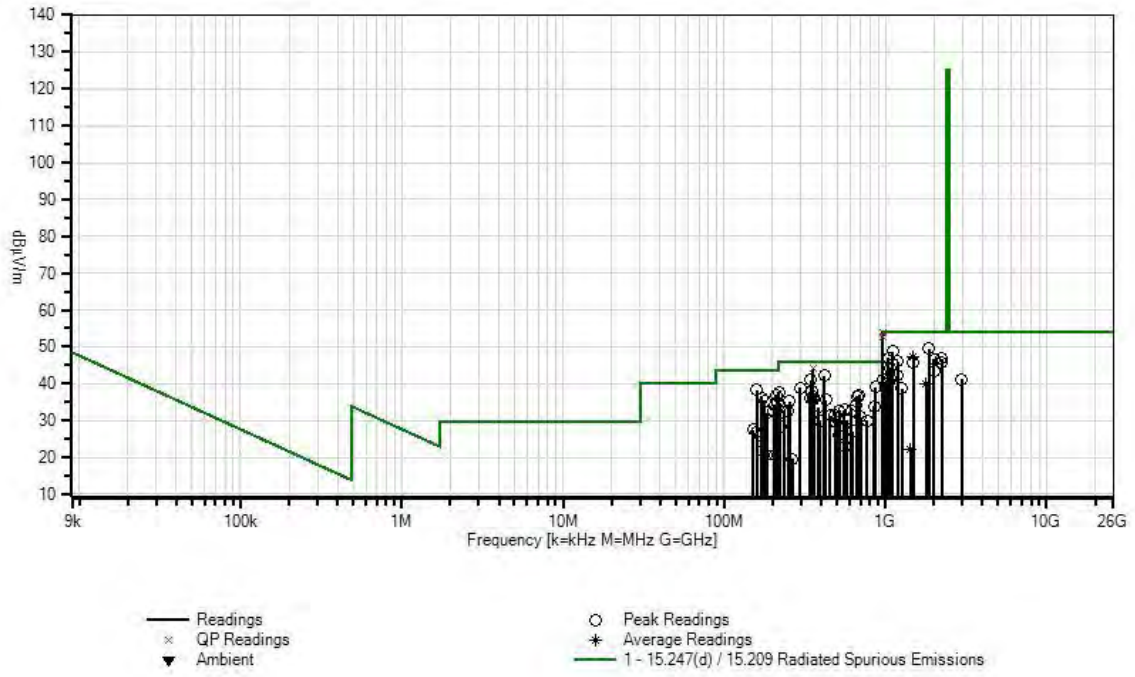
27	217.860M	52.4	-28.0 +0.0 +0.0	+10.5 +0.0	+0.2 +0.0	+2.5 +0.0	+0.0	37.6	46.0	-8.4	Horiz
28	1112.800M	60.2	+0.0 -39.8 +0.0	+0.0 +21.9	+0.0 +0.5	+0.0 +2.7	+0.0	45.5	54.0	-8.5	Horiz
29	215.880M	49.9	-28.0 +0.0 +0.0	+10.3 +0.0	+0.2 +0.0	+2.5 +0.0	+0.0	34.9	43.5	-8.6	Horiz
30	687.780M	38.0	-27.3 +0.0 +0.0	+21.0 +0.0	+0.4 +0.0	+4.8 +0.0	+0.0	36.9	46.0	-9.1	Horiz
31	206.060M	50.2	-28.0 +0.0 +0.0	+9.6 +0.0	+0.1 +0.0	+2.4 +0.0	+0.0	34.3	43.5	-9.2	Horiz
32	668.083M	38.3	-27.4 +0.0 +0.0	+20.7 +0.0	+0.3 +0.0	+4.7 +0.0	+0.0	36.6	46.0	-9.4	Vert
33	357.230M	45.7	-27.9 +0.0 +0.0	+15.2 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	36.5	46.0	-9.5	Vert
34	341.380M	45.9	-27.9 +0.0 +0.0	+14.7 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	36.2	46.0	-9.8	Horiz
35	1076.000M	59.0	+0.0 -40.0 +0.0	+0.0 +21.8	+0.0 +0.5	+0.0 +2.7	+0.0	44.0	54.0	-10.0	Vert
36	359.080M	44.9	-27.9 +0.0 +0.0	+15.3 +0.0	+0.2 +0.0	+3.3 +0.0	+0.0	35.8	46.0	-10.2	Horiz
37	427.880M	42.6	-27.9 +0.0 +0.0	+16.9 +0.0	+0.3 +0.0	+3.6 +0.0	+0.0	35.5	46.0	-10.5	Vert
38	2002.850M	52.3	+0.0 -38.2 +0.0	+0.0 +25.1	+0.0 +0.5	+0.0 +3.7	+0.0	43.4	54.0	-10.6	Vert
39	255.080M	47.4	-28.0 +0.0 +0.0	+12.8 +0.0	+0.2 +0.0	+2.7 +0.0	+0.0	35.1	46.0	-10.9	Horiz
40	204.080M	48.5	-28.0 +0.0 +0.0	+9.4 +0.0	+0.1 +0.0	+2.4 +0.0	+0.0	32.4	43.5	-11.1	Horiz
41	184.480M	48.6	-28.0 +0.0 +0.0	+9.0 +0.0	+0.1 +0.0	+2.3 +0.0	+0.0	32.0	43.5	-11.5	Horiz
42	1186.800M	56.2	+0.0 -39.5 +0.0	+0.0 +22.1	+0.0 +0.5	+0.0 +2.8	+0.0	42.1	54.0	-11.9	Horiz
43	660.000M	35.9	-27.4 +0.0 +0.0	+20.6 +0.0	+0.3 +0.0	+4.6 +0.0	+0.0	34.0	46.0	-12.0	Vert

44	848.060M	32.3	-27.2 +0.0 +0.0	+23.1 +0.0	+0.4 +0.0	+5.3 +0.0	+0.0	33.9	46.0	-12.1	Horiz
45	221.780M	48.3	-28.0 +0.0 +0.0	+10.8 +0.0	+0.2 +0.0	+2.5 +0.0	+0.0	33.8	46.0	-12.2	Horiz
46	386.330M	41.9	-27.9 +0.0 +0.0	+16.0 +0.0	+0.3 +0.0	+3.4 +0.0	+0.0	33.7	46.0	-12.3	Vert
47	1075.650M	56.3	+0.0 -40.0 +0.0	+0.0 +21.8	+0.0 +0.5	+0.0 +2.7	+0.0	41.3	54.0	-12.7	Horiz
48	2967.500M	46.6	+0.0 -38.8 +0.6	+0.0 +27.3	+0.0 +0.8	+0.0 +4.7	+0.0	41.2	54.0	-12.8	Vert
49	964.305M	38.1	-27.3 +0.0 +0.0	+24.2 +0.0	+0.4 +0.0	+5.7 +0.0	+0.0	41.1	54.0	-12.9	Horiz
50	553.506M	36.9	-27.7 +0.0 +0.0	+19.1 +0.0	+0.3 +0.0	+4.2 +0.0	+0.0	32.8	46.0	-13.2	Vert
51	516.210M	37.7	-27.8 +0.0 +0.0	+18.4 +0.0	+0.3 +0.0	+4.1 +0.0	+0.0	32.7	46.0	-13.3	Vert
52	249.180M	45.2	-28.0 +0.0 +0.0	+12.6 +0.0	+0.2 +0.0	+2.7 +0.0	+0.0	32.7	46.0	-13.3	Horiz
53	612.310M	35.3	-27.5 +0.0 +0.0	+20.1 +0.0	+0.3 +0.0	+4.5 +0.0	+0.0	32.7	46.0	-13.3	Vert
54	233.480M	45.9	-28.0 +0.0 +0.0	+11.6 +0.0	+0.2 +0.0	+2.6 +0.0	+0.0	32.3	46.0	-13.7	Horiz
55	999.995M	36.8	-27.5 +0.0 +0.0	+24.5 +0.0	+0.4 +0.0	+5.9 +0.0	+0.0	40.1	54.0	-13.9	Horiz
56	1780.250M Ave	50.1	+0.0 -38.3 +0.0	+0.0 +24.2	+0.0 +0.6	+0.0 +3.5	+0.0	40.1	54.0	-13.9	Vert
^	1780.250M	61.3	+0.0 -38.3 +0.0	+0.0 +24.2	+0.0 +0.6	+0.0 +3.5	+0.0	51.3	54.0	-2.7	Vert
58	1038.500M Ave	55.5	+0.0 -40.3 +0.0	+0.0 +21.7	+0.0 +0.5	+0.0 +2.6	+0.0	40.0	54.0	-14.0	Vert
^	1038.500M	67.3	+0.0 -40.3 +0.0	+0.0 +21.7	+0.0 +0.5	+0.0 +2.6	+0.0	51.8	54.0	-2.2	Vert
60	488.730M	37.3	-27.8 +0.0 +0.0	+17.9 +0.0	+0.3 +0.0	+3.9 +0.0	+0.0	31.6	46.0	-14.4	Vert

61	455.180M	37.9	-27.9 +0.0 +0.0	+17.4 +0.0	+0.3 +0.0	+3.7 +0.0	+0.0	31.4	46.0	-14.6	Horiz
62	999.995M	35.6	-27.5 +0.0 +0.0	+24.5 +0.0	+0.4 +0.0	+5.9 +0.0	+0.0	38.9	54.0	-15.1	Vert
63	705.182M	31.8	-27.3 +0.0 +0.0	+21.2 +0.0	+0.4 +0.0	+4.8 +0.0	+0.0	30.9	46.0	-15.1	Vert
64	1261.000M	52.1	+0.0 -39.2 +0.0	+0.0 +22.3	+0.0 +0.5	+0.0 +2.9	+0.0	38.6	54.0	-15.4	Vert
65	504.006M	35.8	-27.8 +0.0 +0.0	+18.2 +0.0	+0.3 +0.0	+4.0 +0.0	+0.0	30.5	46.0	-15.5	Vert
66	571.111M	33.7	-27.6 +0.0 +0.0	+19.4 +0.0	+0.3 +0.0	+4.3 +0.0	+0.0	30.1	46.0	-15.9	Vert
67	772.782M	29.4	-27.2 +0.0 +0.0	+22.3 +0.0	+0.4 +0.0	+5.1 +0.0	+0.0	30.0	46.0	-16.0	Vert
68	392.380M	37.9	-27.9 +0.0 +0.0	+16.2 +0.0	+0.3 +0.0	+3.5 +0.0	+0.0	30.0	46.0	-16.0	Horiz
69	151.110M	42.4	-28.0 +0.0 +0.0	+10.9 +0.0	+0.1 +0.0	+2.0 +0.0	+0.0	27.4	43.5	-16.1	Vert
70	492.480M	35.1	-27.8 +0.0 +0.0	+18.0 +0.0	+0.3 +0.0	+4.0 +0.0	+0.0	29.6	46.0	-16.4	Horiz
71	158.910M	41.9	-28.0 +0.0 +0.0	+10.5 +0.0	+0.1 +0.0	+2.1 +0.0	+0.0	26.6	43.5	-16.9	Vert
72	168.755M	42.1	-28.0 +0.0 +0.0	+9.7 +0.0	+0.1 +0.0	+2.2 +0.0	+0.0	26.1	43.5	-17.4	Vert
73	222.730M	42.9	-28.0 +0.0 +0.0	+10.8 +0.0	+0.2 +0.0	+2.5 +0.0	+0.0	28.4	46.0	-17.6	Vert
74	630.025M	29.4	-27.4 +0.0 +0.0	+20.3 +0.0	+0.3 +0.0	+4.5 +0.0	+0.0	27.1	46.0	-18.9	Horiz
75	515.980M	31.1	-27.8 +0.0 +0.0	+18.4 +0.0	+0.3 +0.0	+4.1 +0.0	+0.0	26.1	46.0	-19.9	Horiz
76	170.760M	38.0	-28.0 +0.0 +0.0	+9.5 +0.0	+0.1 +0.0	+2.2 +0.0	+0.0	21.8	43.5	-21.7	Vert
77	208.060M	36.5	-28.0 +0.0 +0.0	+9.7 +0.0	+0.1 +0.0	+2.4 +0.0	+0.0	20.7	43.5	-22.8	Vert

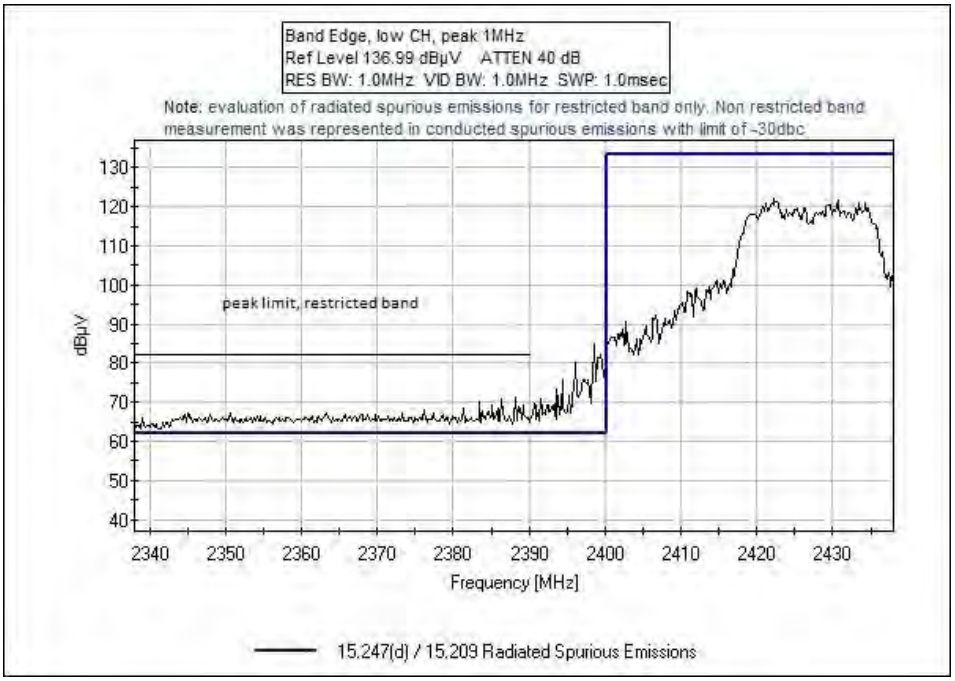
78	182.545M	37.1	-28.0 +0.0 +0.0 +0.0	+9.0 +0.0	+0.1 +0.0	+2.3 +0.0	+0.0	20.5	43.5	-23.0	Vert
79	553.220M	27.0	-27.7 +0.0 +0.0 +0.0	+19.1 +0.0	+0.3 +0.0	+4.2 +0.0	+0.0	22.9	46.0	-23.1	Horiz
80	265.030M	31.6	-28.0 +0.0 +0.0 +0.0	+12.9 +0.0	+0.2 +0.0	+2.8 +0.0	+0.0	19.5	46.0	-26.5	Vert
81	1431.750M Ave	34.6	+0.0 -38.7 +0.0	+0.0 +22.7	+0.0 +0.5	+0.0 +3.1	+0.0	22.2	54.0	-31.8	Vert
^	1431.750M	63.5	+0.0 -38.7 +0.0	+0.0 +22.7	+0.0 +0.5	+0.0 +3.1	+0.0	51.1	54.0	-2.9	Vert

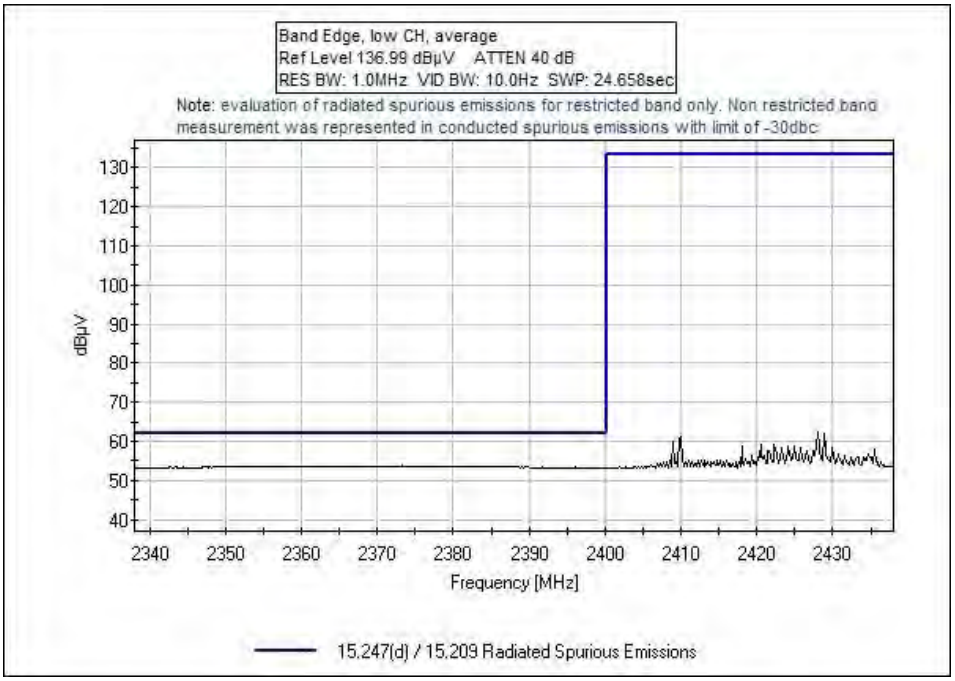
CKC Laboratories, Inc. 15.247(d) / 15.209 Radiated Spurious Emissions 4/10/2015 14:25:18 Test Distance: 3 Meters Site: A
3D Robotics, Inc., WO#: 96782
Sequence #2

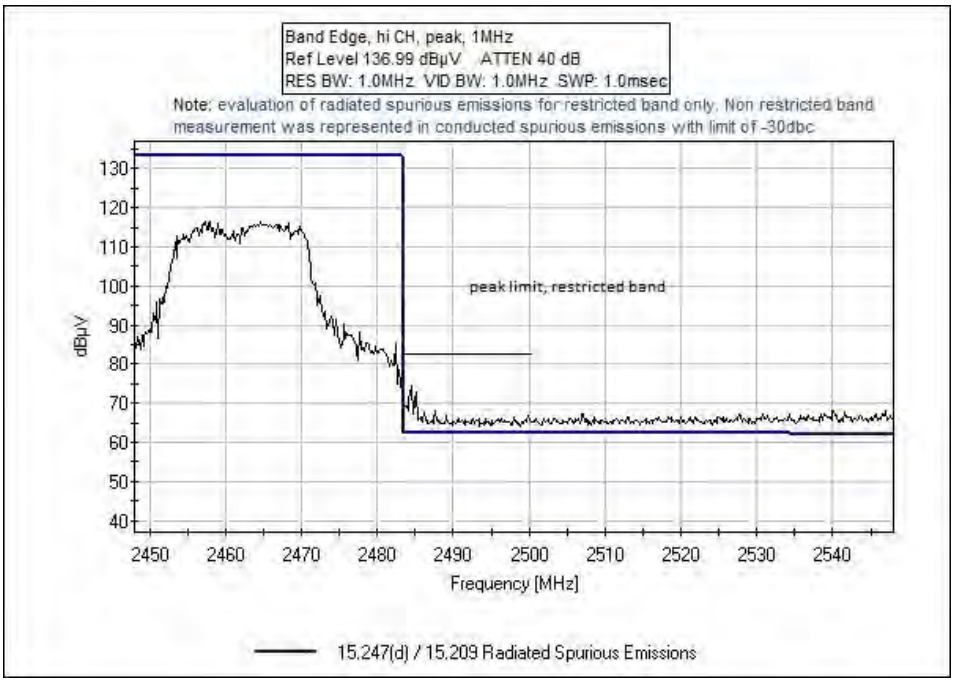


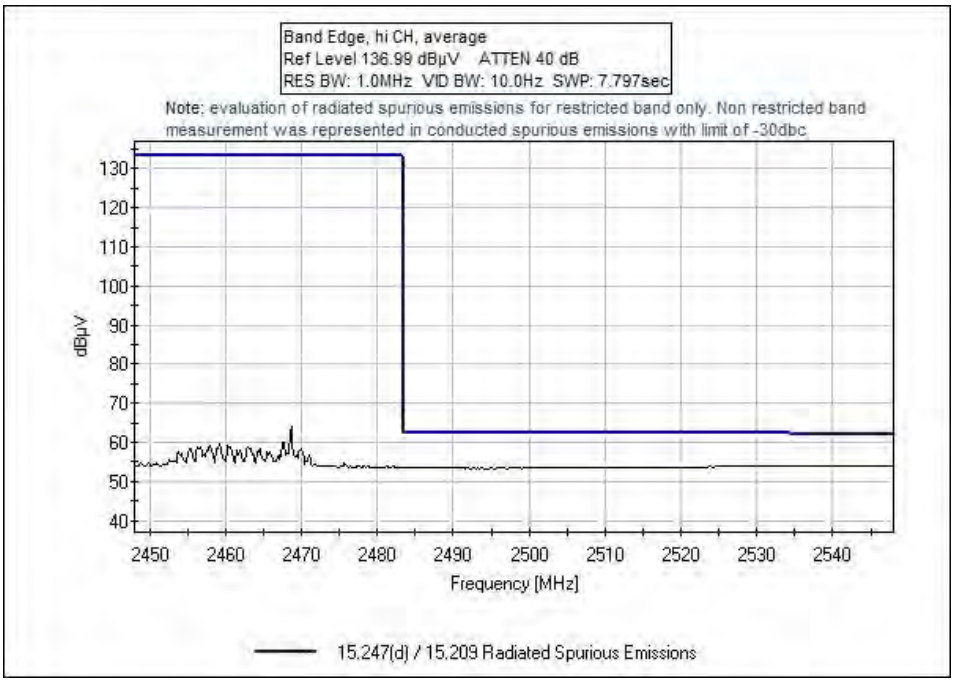
Band Edge

Test Data






Band Edge, hi CH, peak, 1MHz
Ref Level 136.99 dBµV ATTEN 40 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 1.0msec
Note: evaluation of radiated spurious emissions for restricted band only. Non restricted band measurement was represented in conducted spurious emissions with limit of -30dbc
peak limit, restricted band
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


Band Edge, hi CH, average
Ref Level 136.99 dBµV ATTEN 40 dB
RES BW: 1.0MHz VID BW: 10.0Hz SWP: 7.797sec
Note: evaluation of radiated spurious emissions for restricted band only. Non restricted band measurement was represented in conducted spurious emissions with limit of -30dbc
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup Photo(s)

15.247(e) Power Spectral Density

Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714-993-6112

Customer:	**3D Robotics, Inc.**		
Specification:	**15.247(e) Power Spectral Density**		
Work Order #:	**96782**	Date:	3/4/2015
Test Type:	**Conducted Emissions**	Time:	08:27:06
Equipment:	Solo	Sequence#:	1
Manufacturer:	3D Robotics, Inc.	Tested By:	E. Wong
Model:	S111A		8.3V
S/N:	NA		

***Test Equipment*:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
	AN02946	Cable	32022-2-2909K-36TC	7/31/2013	7/31/2015

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Solo Controller	3D Robotics, Inc.	S111A	NA

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Dell	Latitude E6530	6QN6JX1

Test Conditions / Notes:

The EUT is placed on the test bench. The EUT is set in test mode via support laptop.

Protocol:
802.11n20 (program code :TX99)
Freq 2400-2483.5MHz
2427MHz, 2437MHz, 2462MHz (channel 4,6,11)
Power Command: 25,25,25
MIMO, Correlated, vertically polarized dipole antenna, gain=2.3dBi, beam forming, directional gain =3dB

Test environment conditions: Temperature: 21.1°C, Relative Humidity: 40 %, Atmospheric Pressure: 100kPa
RF parameter is measured at the antenna ports of WiFi card PN: PCE3202AH

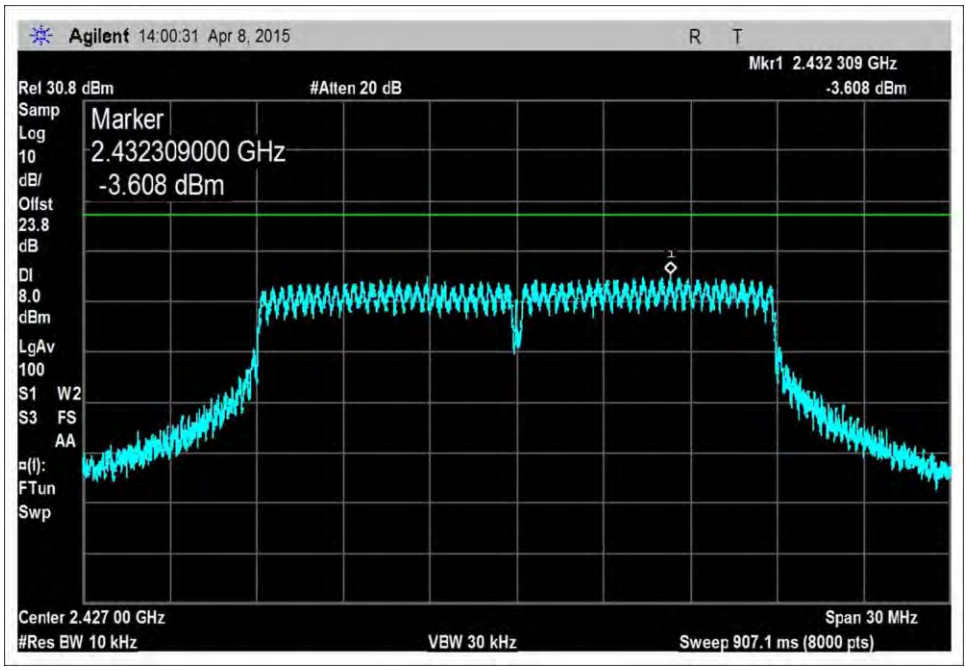
Test performed in accordance with, PSD measurement 10.3 Method AVGPSD-1 (Trace Averaging with EUT transmitting at full power thought out each sweep) and MIMO summation in accordance with , E(1) and 2(c)(i)
Test Procedure: 558074 D01 DTS Meas Guidance V03r02, June 5, 2014
Test Procedure: 662911 D01 Multiple Transmitter Output v02r01, October 31, 2013

3dB amplitude offset added to the measurement. (10 Log 2=3dB)

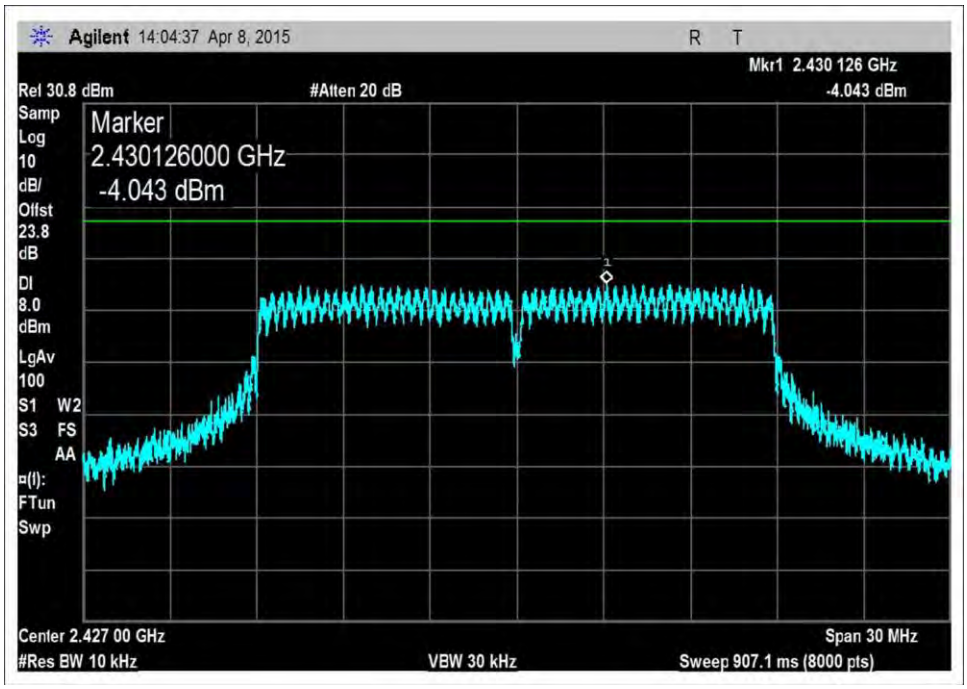
Note To expedite test time, the RBW is set at 10kHz, which the result is under the limit of 8dBm/3kHz.

Note: All conducted emission test results are done on unit Solo Controller, Model: AT11A which has the same wireless module as the EUT.

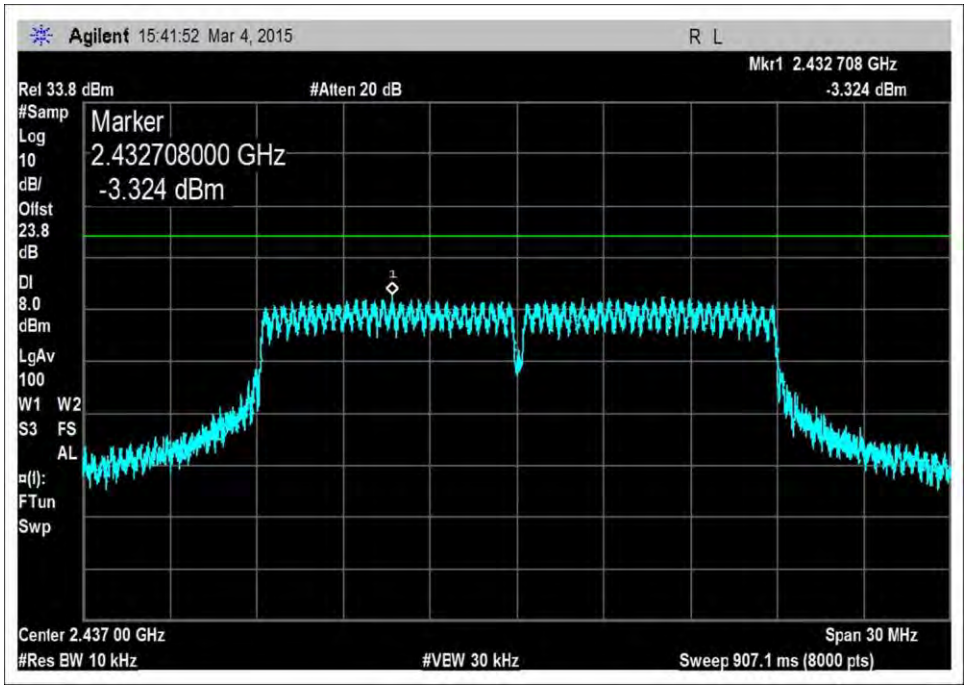
Test Data



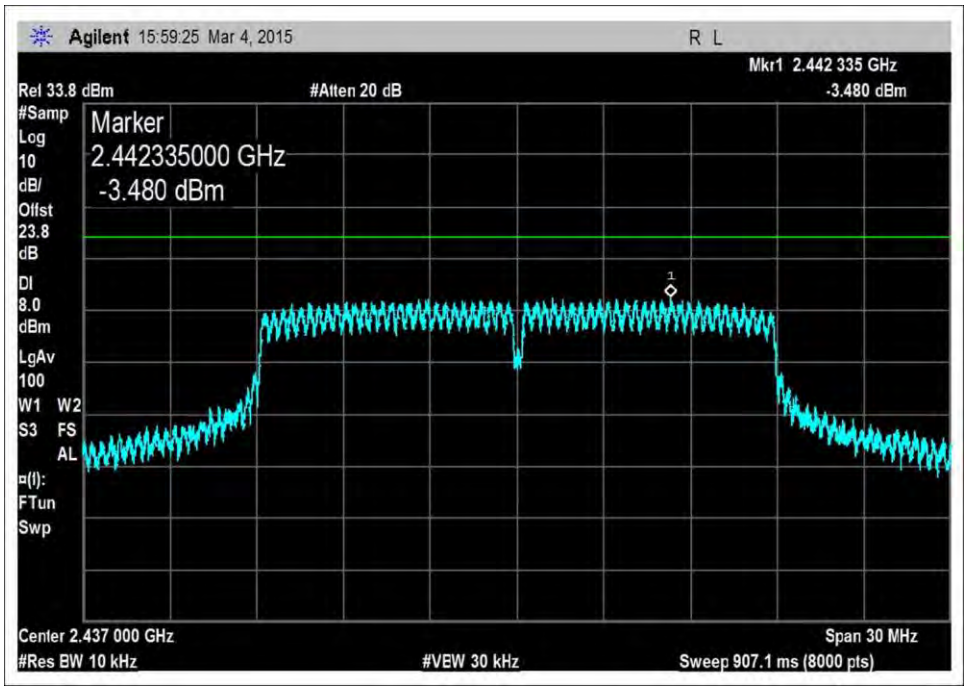
2427MHz



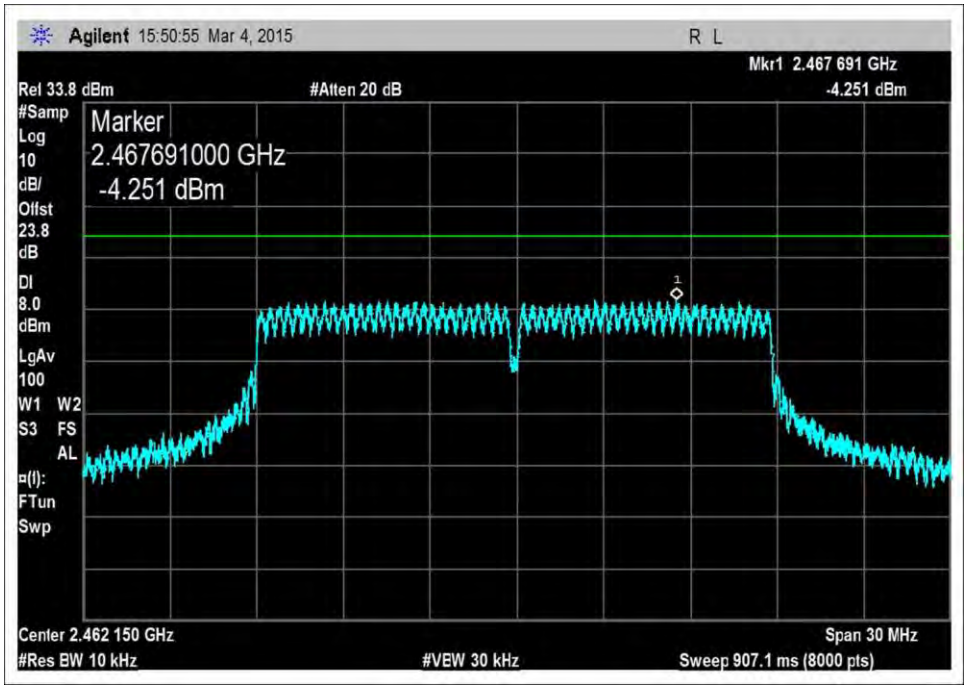
2427MHz



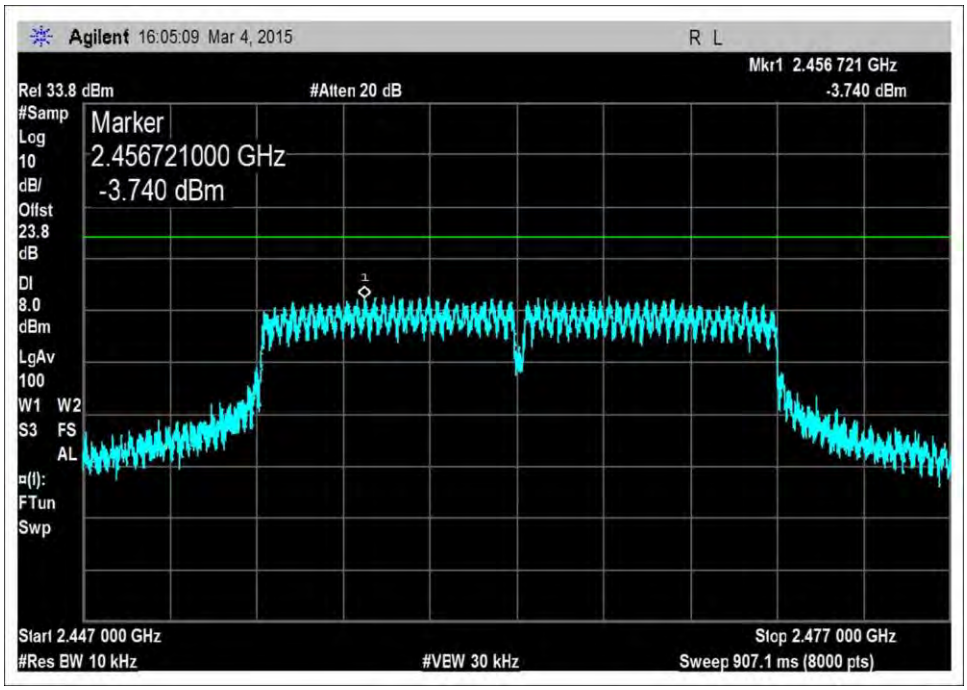
2437MHz



2437MHz



2462MHz



2462MHz

Test Setup Photo

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or carrot ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.