EMC Test Report

Project Number: 2931451

Report Number: 2931451EMC01 **Revision Level:** 1

Client: Time Domain Corporation

Equipment Under Test: UWB transmitter

Model Name: PulsON 412

Model Number: P412

Applicable Standards: FCC Part 15, Subpart F

Report issued on: 20 December 2012

Test Result: Compliant

Tested by: Brian Forster, EMC Engineer

Reviewed by: David Schramm, EMC Manager

Remarks:
This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Reference	Description	Test Result
15.519(b)	10dB bandwidth contained within 3100 to 10600 MHz	Compliant
15.503(d)	10dB bandwidth greater than 500 MHz	Compliant
15.519(c)	Radiated emissions above 960 MHz	Compliant
15.519(d)	Radiated emissions in GPS receive band	Compliant
15.519(e)	Peak emission in a 50 MHz bandwidth	Compliant
15.521(c)	Radiated emissions below 960 MHz per 15.209 (Emissions from digital circuitry used to enable the operation of the UWB transmitter)	Compliant
15.109(b)	Radiated emissions below 960 MHz (Emissions from digital circuitry NOT used to enable the operation of the UWB transmitter)	Compliant

1.1 *Modifications Required to Compliance*

None

2 General Information

2.1 *Client Information*

Name:	TDC ACQUISITION HOLDINGS INC
Address:	4955 CORPORATE DR NW SUITE 101
City, State, Zip, Country:	HUNTSVILLE AL 35805 United States

2.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA

2.3 *General Information of EUT*

Product Name:	PulsON 412
Model Number:	P412
Serial Number:	0236A0F40C0005
Voltage:	120 Vac, 60 Hz
Sample Received Date:	22 October 2012
Dates of testing:	22 – 23 October 2012

2.4 *Operating Modes and Conditions*

The EUT was programmed by the manufacturer to run continuously exercising all modes of operation.

3 UWB Bandwidth requirements

3.1 *Test Result*

Test Description	Reference	Test Result
10dB bandwidth contained within 3100 MHz and 10,600 MHz	15.519(b)	Compliant
10dB bandwidth greater than 500 MHz	15.503(d)	Compliant

3.2 *Test Method*

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3,100 MHz and 10,600 MHz.

Ultra-wideband (UWB) transmitter: An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

3.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 23.4 to 24.7℃
Relative Humidity: 37 to 47 %

3.4 *Test Equipment*

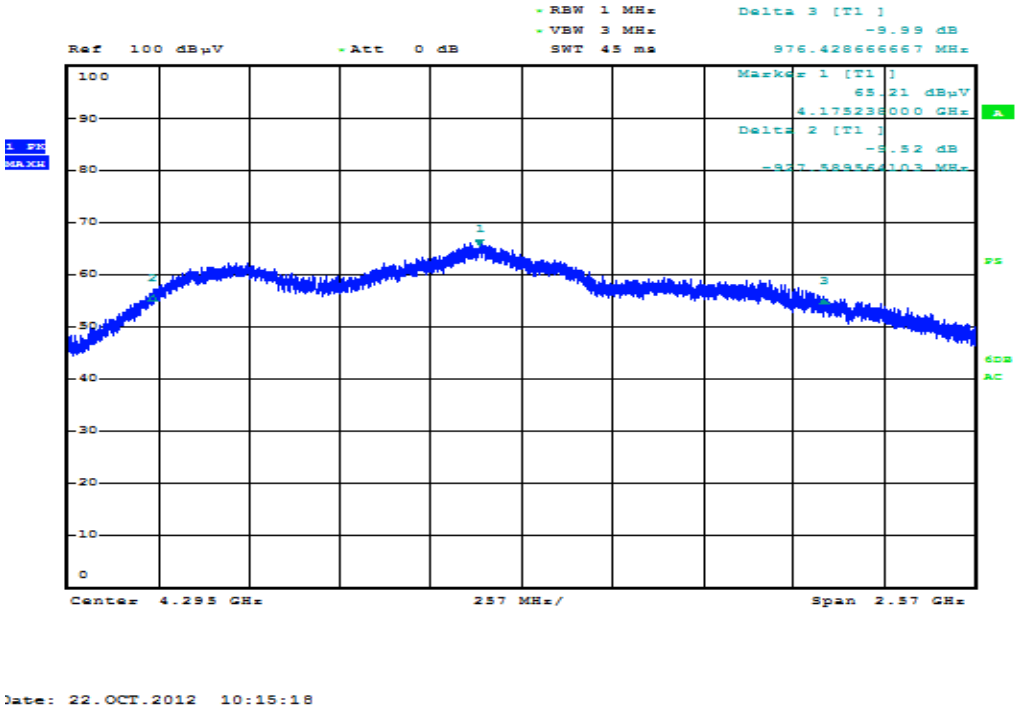
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
BiLog Antenna	JB6	Sunol	B079690	12-Sep-13
DRWG Antenna	3117	ETS	B079691	31-May-13
Receiver	ESU40	R & S	B079629	24-Sep-13
RF Preamplifier	NSP1800-25-HG	Miteq	B085930	29-Oct-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079714	13-Aug-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079661	13-Aug-13

Note: The calibration period for this equipment is 1 year.

3.5 *Test Data*

Test Date:
Operator: Brian Forster

Bandwidth Plot



Test Date: 22oct2012
Operator: Brian Forster

Bandwidth Results					
Antenna Polarity	Frequency 10dB below peak MHz	Frequency 10dB above peak MHz	10 dB bandwidth MHz	Bandwidth requirement >500 MHz	Detectors / RBW / VBW
V	3247.64	5151.67	1904.01823	Compliant	RMS 1MHz / 3MHz

4 Radiated emissions above 960 MHz

4.1 *Test Result*

Test Description	Reference	Test Result
Radiated emissions above 960 MHz	15.519(c)	Compliant

4.2 *Test Method*

Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth:

Frequency (MHz)	EIRP in dBm	EIRP (dBµV/m) at 3m	EIRP (dBµV/m) at 1m
960–1610	-75.3	19.9	29.4
1610–1990	-63.3	31.9	41.4
1990–3100	-61.3	33.9	43.4
3100–10600	-41.3	53.9	63.4
Above 10600	-61.3	33.9	43.4

Because the limits are so low, some bands may have been scanned at a distance closer than 1 meter. If any emissions were detected in these bands, final measurements were made at distance of 1 meter or greater. The actual distance for final measurement was indicated in the measurement data.

4.3 *Test Site*

10m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 23.4 to 24.7℃
Relative Humidity: 37 to 47 %

4.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
BiLog Antenna	JB6	Sunol	B079690	12-Sep-13
DRWG Antenna	3117	ETS	B079691	31-May-13
Receiver	ESU40	R & S	B079629	24-Sep-13
RF Preamplifier	NSP1800-25-HG	Miteq	B085930	29-Oct-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079714	13-Aug-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079661	13-Aug-13

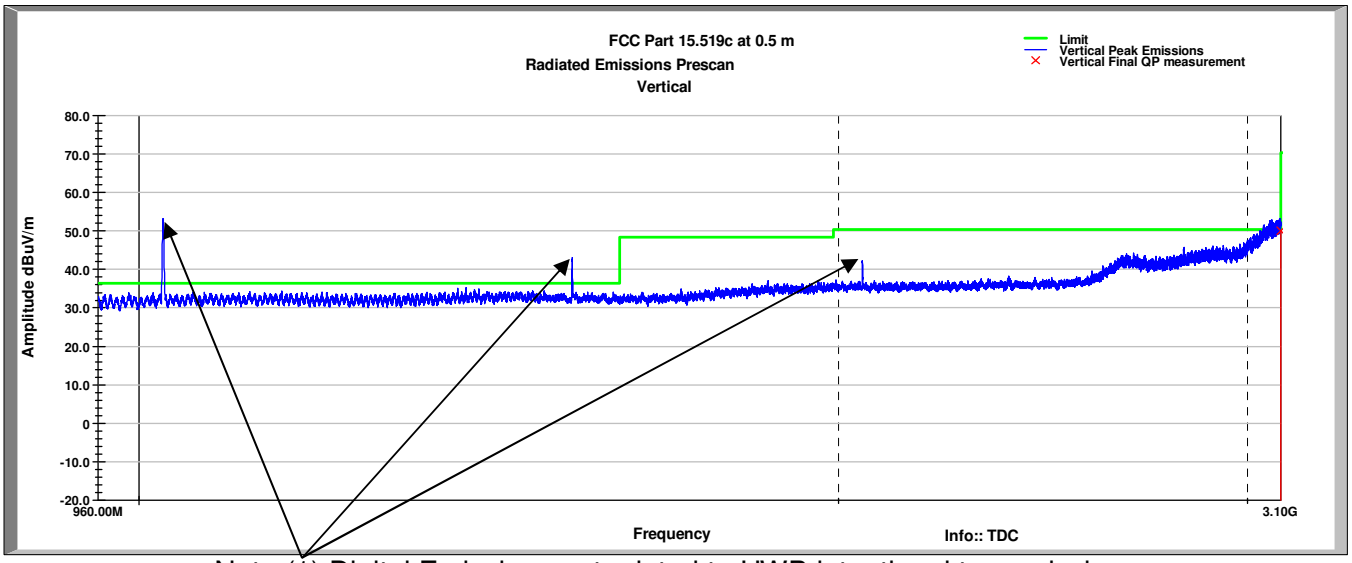
Note: The calibration period equipment is 1 year.

Software:
“Direct_Final_Radiated Emissions 1-18GHz.TIL” TILE! profile dated 03 MAY 2012
“Direct_Final_Radiated Emissions 18-40GHz.TIL” TILE! profile dated 03 MAY 2012

4.5 *Test Data*

Test Date:
Operator: Brian Forster

Plot: Vertical Emissions Pre-scan from 960 MHz to 3100 MHz
at 0.5m test distance

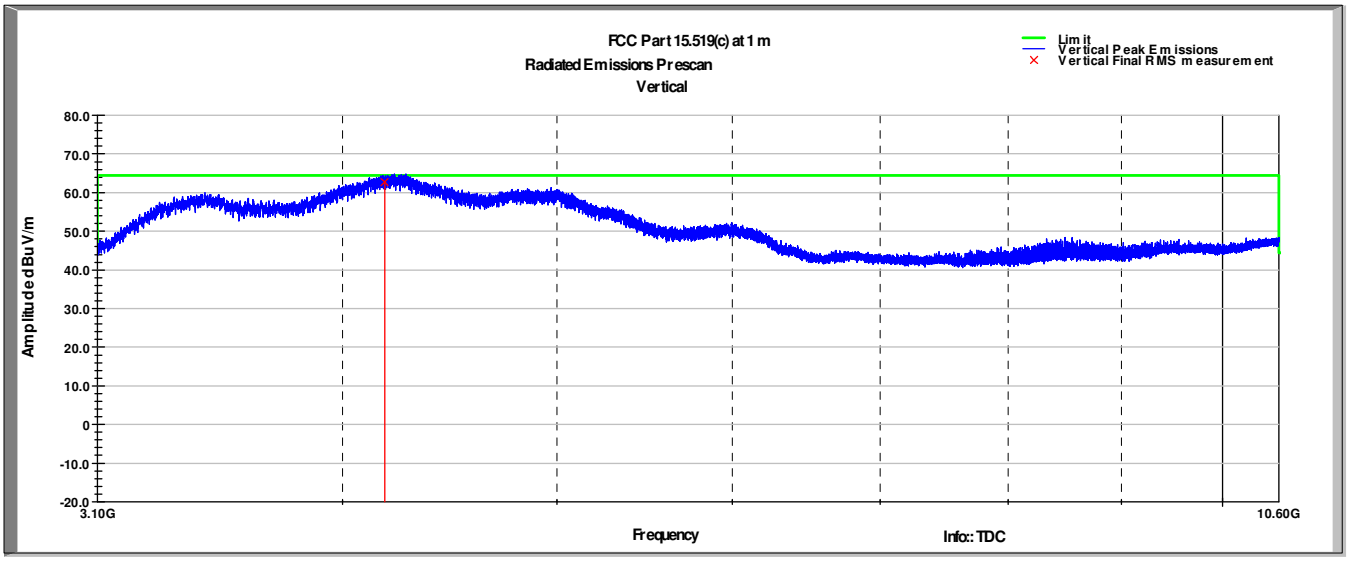


Note:(1) Digital Emissions not related to UWB intentional transmissions

Frequency MHz	Raw RMS dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
3100.00	50.3	V	12.0	105.1	33.3	6.5	41.4	48.7	49.5	-0.8
RMS Value = Level + AF + CL - Amp										
Margin = RMS Value - Limit										

Frequency MHz	RMS Value (dBm)	Limit (dBm)	Margin (dB)
3100.00	-62.1	-61.3	-0.8

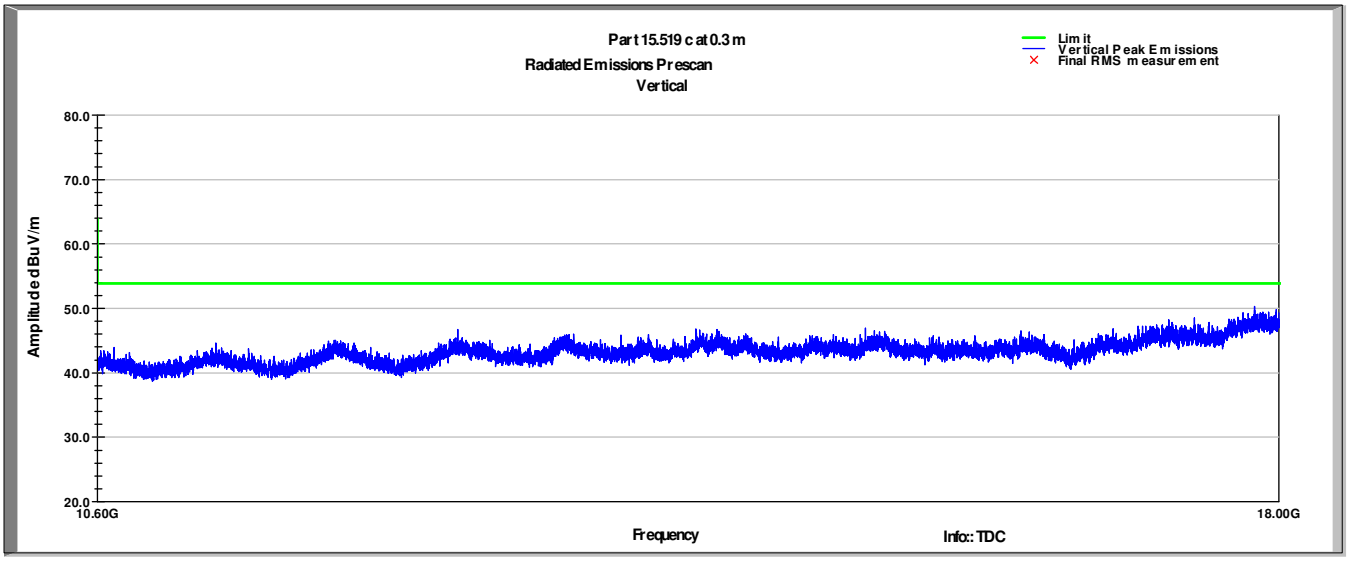
Plot: Vertical Emissions Pre-scan from 3.1 to 10.6 GHz at 1m test distance



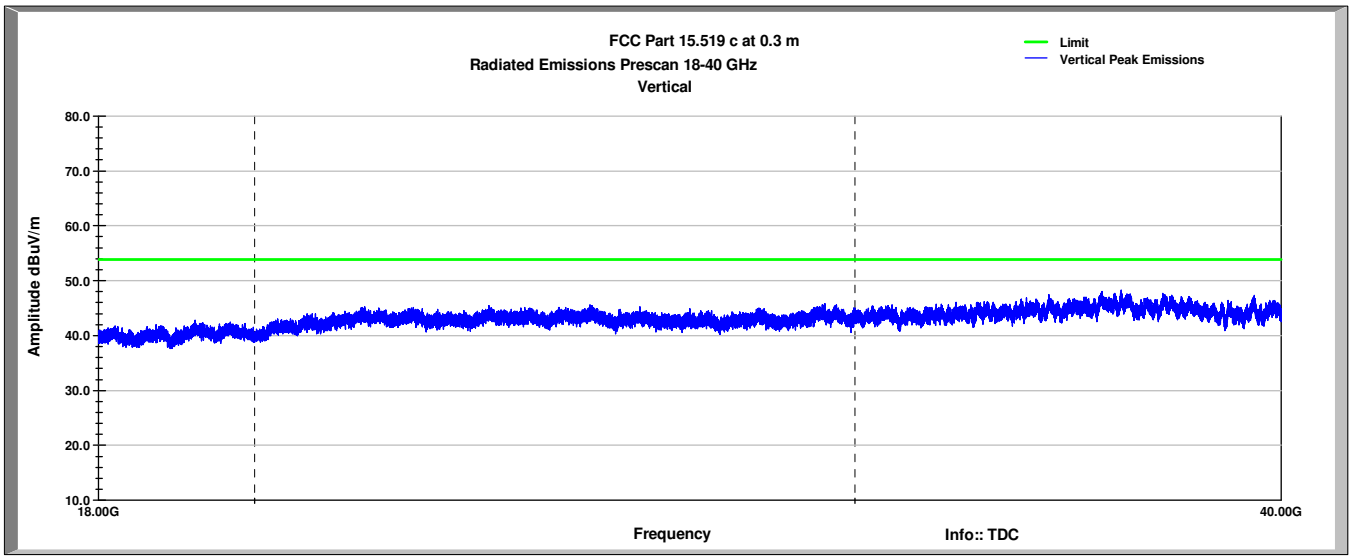
Frequency MHz	Raw RMS dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4179.49	62.9	V	13.3	104.7	33.6	7.7	41.5	62.7	63.4	-0.7
RMS Value = Level + AF + CL - Amp										
Margin = RMS Value - Limit										

Antenna Polarity	Measured RMS value	RMS Limit dBm	Margin dB
V	-42.0	-41.3	-0.7

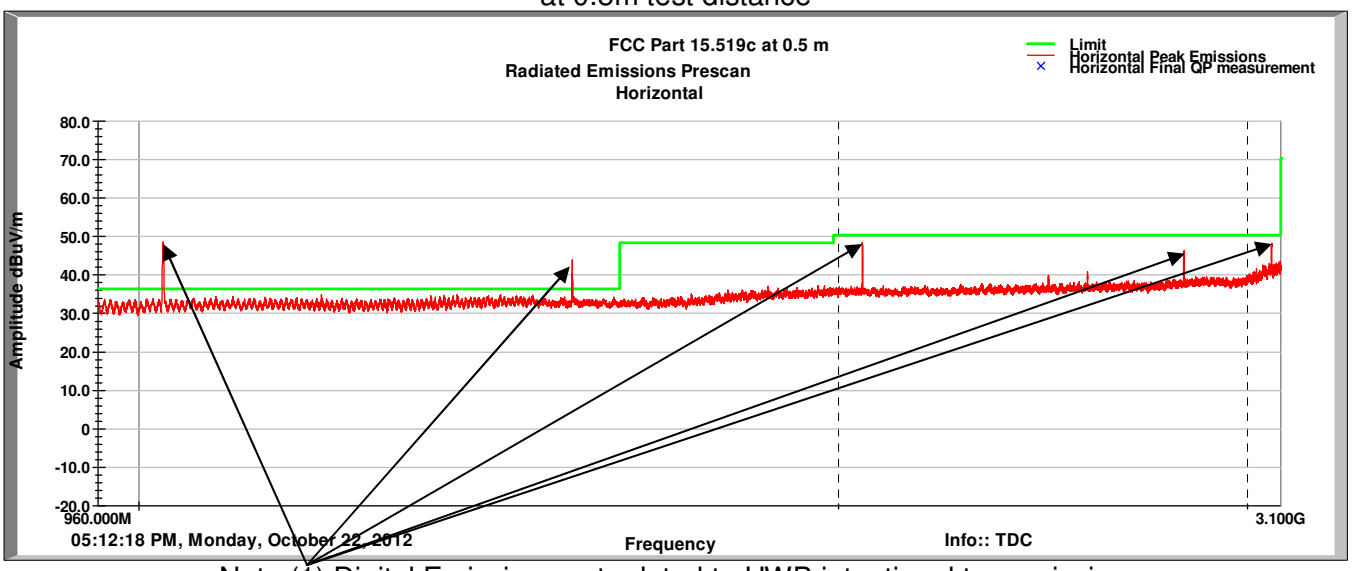
Plot: Vertical Emissions Pre-scan from 10.6 to 18 GHz
at 0.3m test distance



Plot: Vertical Emissions Pre-scan from 18 to 40 GHz
at 0.3m test distance

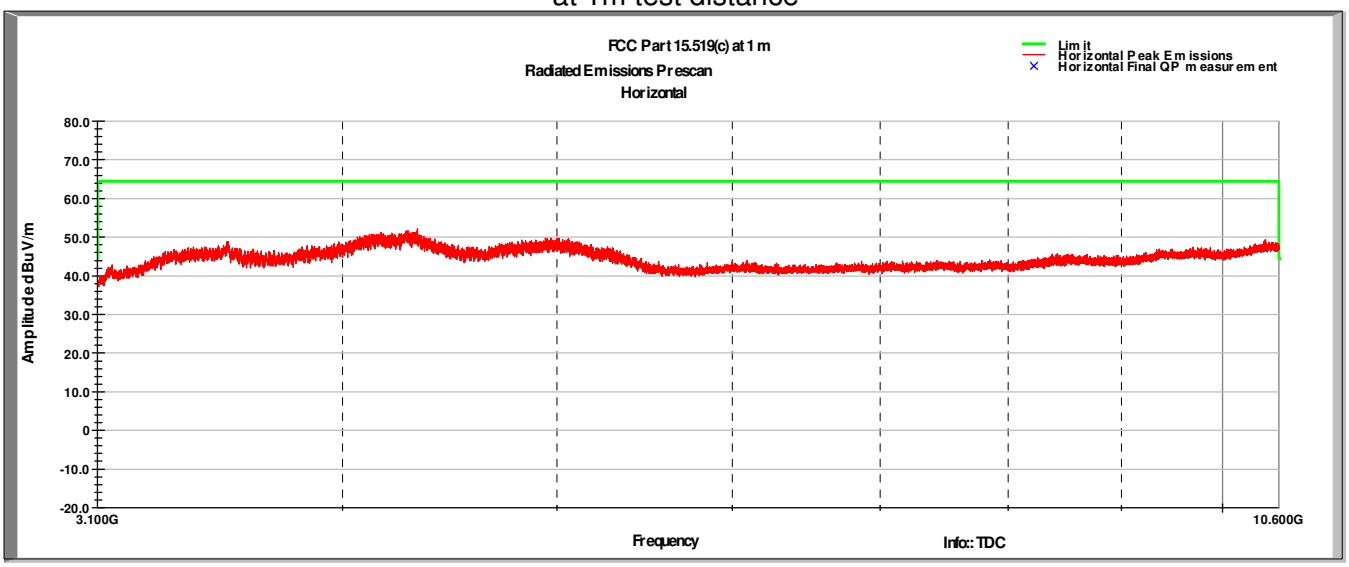


Plot: Horizontal Emissions Pre-scan from 960 to 3100 MHz
at 0.5m test distance

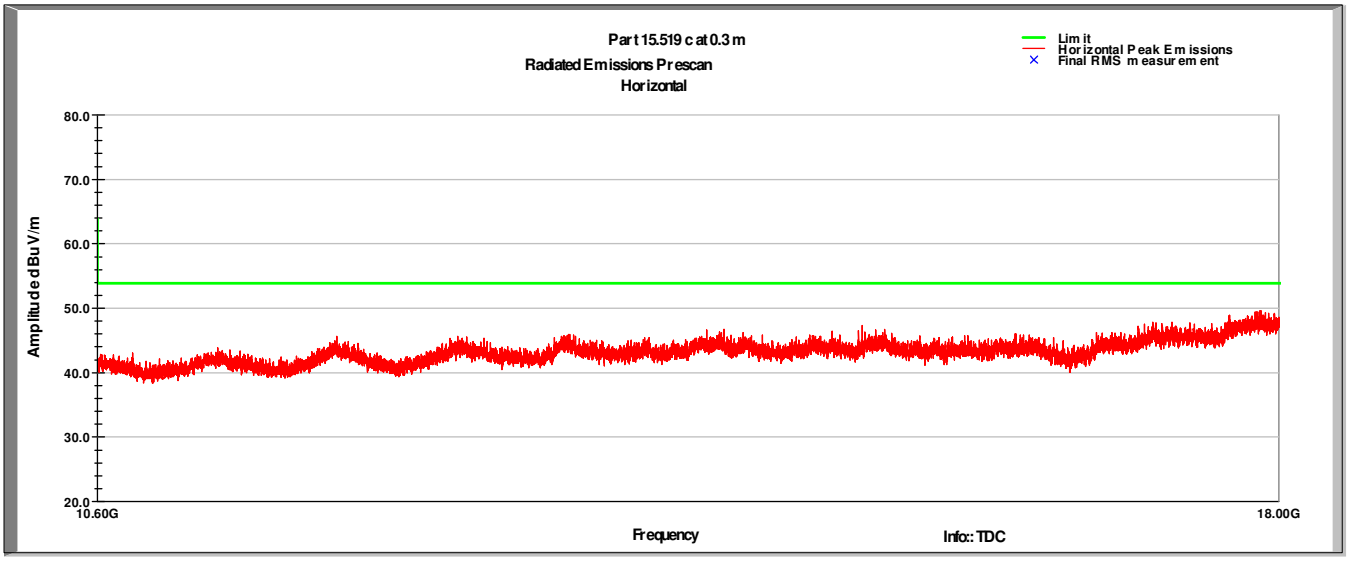


Note:(1) Digital Emissions not related to UWB intentional transmissions

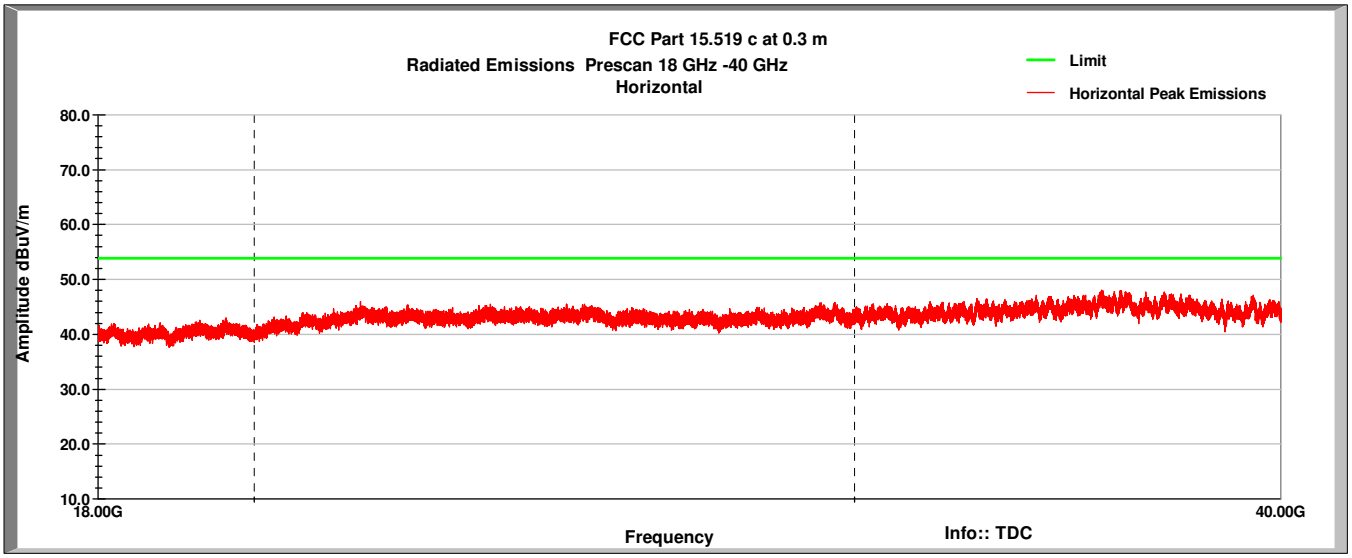
Plot: Horizontal Emissions Pre-scan from 3.1 to 10.6 GHz
at 1m test distance



Horizontal Emissions Pre-scan from 10.6 to 18 GHz
at 0.3m test distance



Plot: Horizontal Emissions Pre-scan from 18 to 40 GHz
at 0.3m test distance



5 Radiated emissions in GPS receive band

5.1 *Test Result*

Test Description	Reference	Test Result
Radiated emissions in GPS receive band	15.519(d)	Compliant

5.2 *Test Method*

In addition to the radiated emission limits specified in the table in paragraph (c) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP dBm	EIRP (dBµV/m) at 3m	EIRP (dBµV/m) at 1m
1164–1240	-85.3	9.9	19.4
1559–1610	-85.3	9.9	19.4

5.3 *Test Site*

10m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 23.4 to 24.7℃
Relative Humidity: 37 to 47 %

5.4 *Test Equipment*

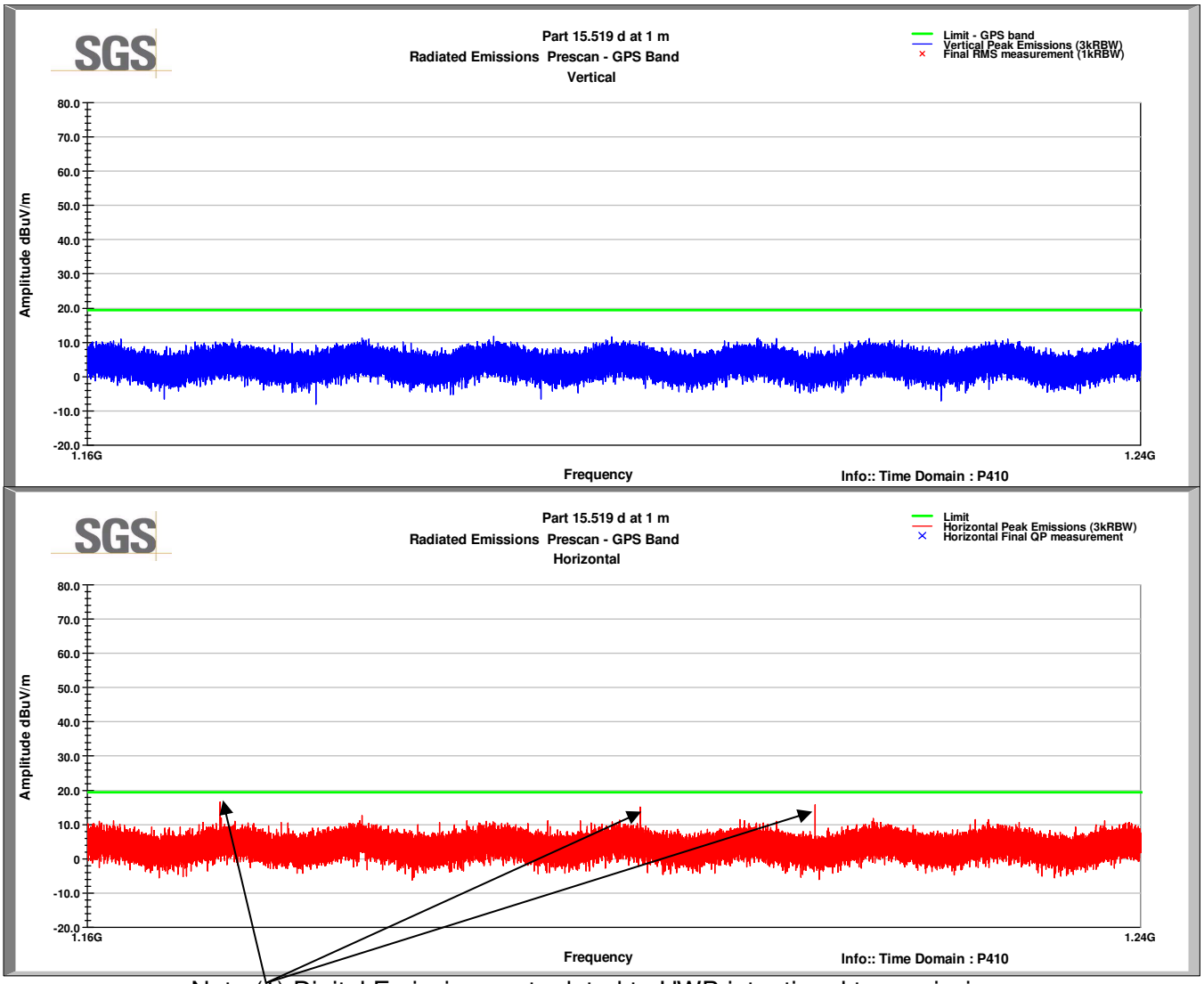
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DRWG Antenna	3117	ETS	B079691	31-May-13
Receiver	ESU40	R & S	B079629	24-Sep-13
RF Preamplifier	NSP1800-25-HG	Miteq	B085930	29-Oct-13
Low Pass Filter	LPM17270	Micro-Tronics	B093646	18-Oct-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079714	13-Aug-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079661	13-Aug-13

Note: The calibration period equipment is 1 year.

5.5 *Test Data*

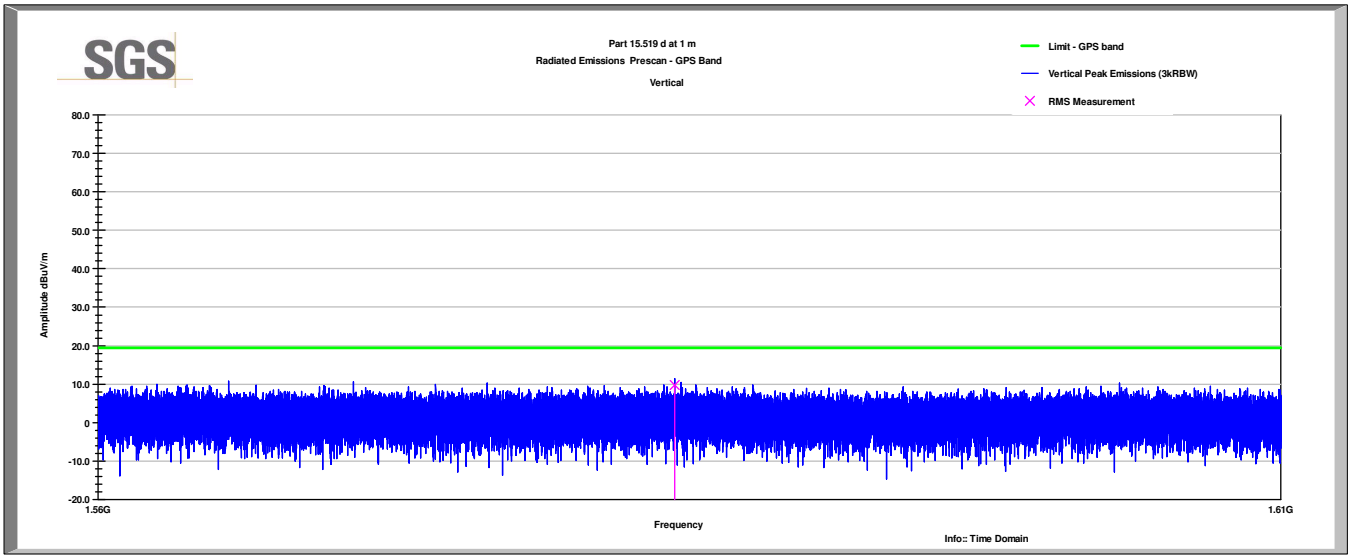
Test Date:
Operator: Brian Forster

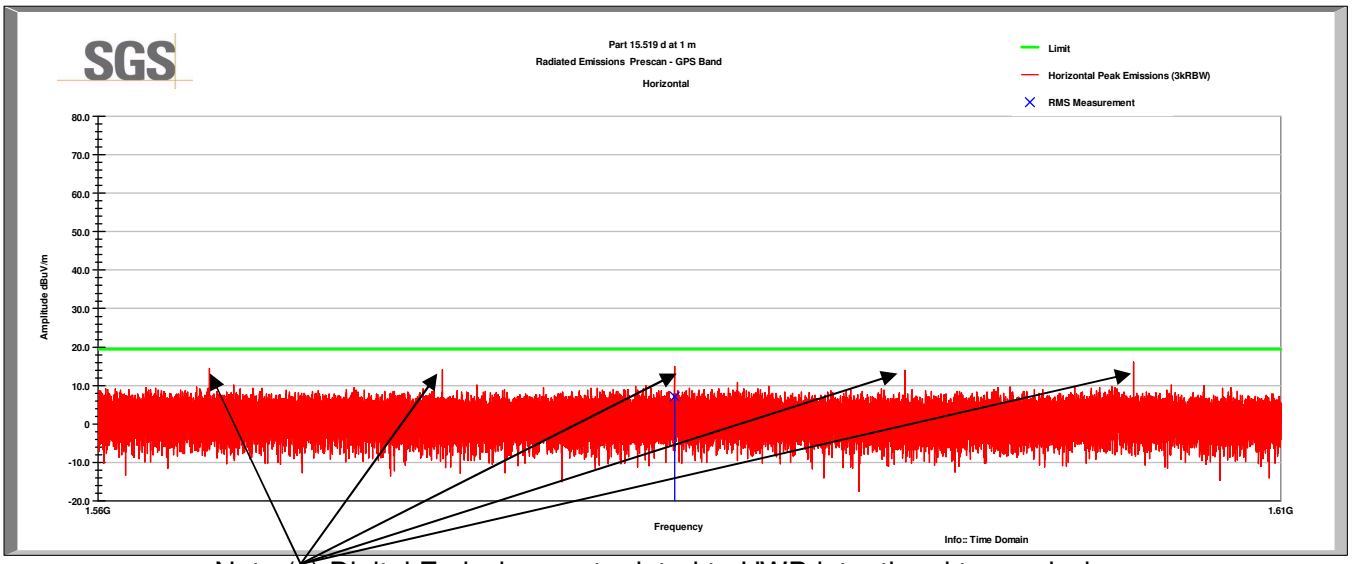
Plot: Radiated Emissions in lower GPS Receive Band



Note:(1) Digital Emissions not related to UWB intentional transmissions
(2) Maximum peak UWB signal detected was 12.5dBuV/m; 6.9 dB below the RMS Limit

Plot: Radiated Emissions in upper GPS Receive Band





Note:(1) Digital Emissions not related to UWB intentional transmissions

Data: Radiated Emissions in GPS Receive Bands
Upper

Frequency MHz	Level dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value dBuV/m	Limit (dBuV/m)	Margin dB
1583.65	15.6	V	107.0	100.0	29.2	2.5	40.4	6.9	19.4	-12.6

Frequency MHz	RMS Value dBm	Limit (dBm)	Margin dB
1583.65	-97.9	-85.3	-12.6

Frequency MHz	Raw RMS dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1583.65	18.2	H	283.0	125.0	29.2	2.5	40.4	9.5	19.4	-9.9

Frequency MHz	RMS Value dBm	Limit (dBm)	Margin dB
1583.65	-95.2	-85.3	-9.9

6 Peak Power within a 50 MHz bandwidth

6.1 *Test Result*

Test Description	Basic Standards	Test Result
Peak Power in a 50 MHz Bandwidth	15.519(e)	Compliant

6.2 *Test Method*

1) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the 3100–10600 MHz band.
2) The peak EIRP limit is 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than RBW.
3) If RBW is greater than 3 MHz, the application for certification filed with the Commission shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

Limits

Frequency (MHz)	EIRP in 50 MHz BW dBm	EIRP in 50 MHz BW (dBµV/m) at 3m	EIRP in 50 MHz BW (dBµV/m) at .5m
3100 - 10600	0	95.2	104.7

Limits converted to 1 MHz RBW

Frequency (MHz)	EIRP in 1 MHz BW dBm	EIRP in 1 MHz BW (dBµV/m) at 3m	EIRP in 50 MHz BW (dBµV/m) at .5m
3100 - 10600	-34	61.2	80.3

6.3 *Test Site*

10m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.4 to 24.7℃
Relative Humidity: 37 to 47 %

6.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DRWG Antenna	3117	ETS	B079691	31-May-13
Receiver	ESU40	R & S	B079629	24-Sep-13
RF Preamplifier	NSP1800-25-HG	Miteq	B085930	29-Oct-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079714	13-Aug-13
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079661	13-Aug-13

Note: The calibration period for this equipment is 1 year.

6.5 *Test Data*

Operator: Brian Forster

Peak Power Results						
Antenna Polarity	Frequency MHz	Field Strength at 1m dBµV/m	EIRP RBW: 1 MHz dBm	EIRP 1 MHz Limit dBm	Margin (dB)	Detectors / RBW / VBW
V	4142.579	100.70	-38.01	-34.0	-4.0	Peak 1MHz / 3MHz

EIRP = Field Strength (at 1m) – 104.74
Margin = EIRP - Limit

7 Radiated emissions below 960 MHz

7.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15.521(c) / 15.209 and 15.109	Compliant

7.2 *Test Method*

The initial preliminary exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receivers resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHZ and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limit below 1 GHz		
Frequency Range(MHz)	Limit(QP dBµV/m)	Distance
30 – 88	40	3m
88 – 216	43.5	3m
216 – 960	46	3m

7.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions
Temperature: 23.4 to 24.7℃
Relative Humidity: 37 to 47 %

7.4 *Test Equipment*

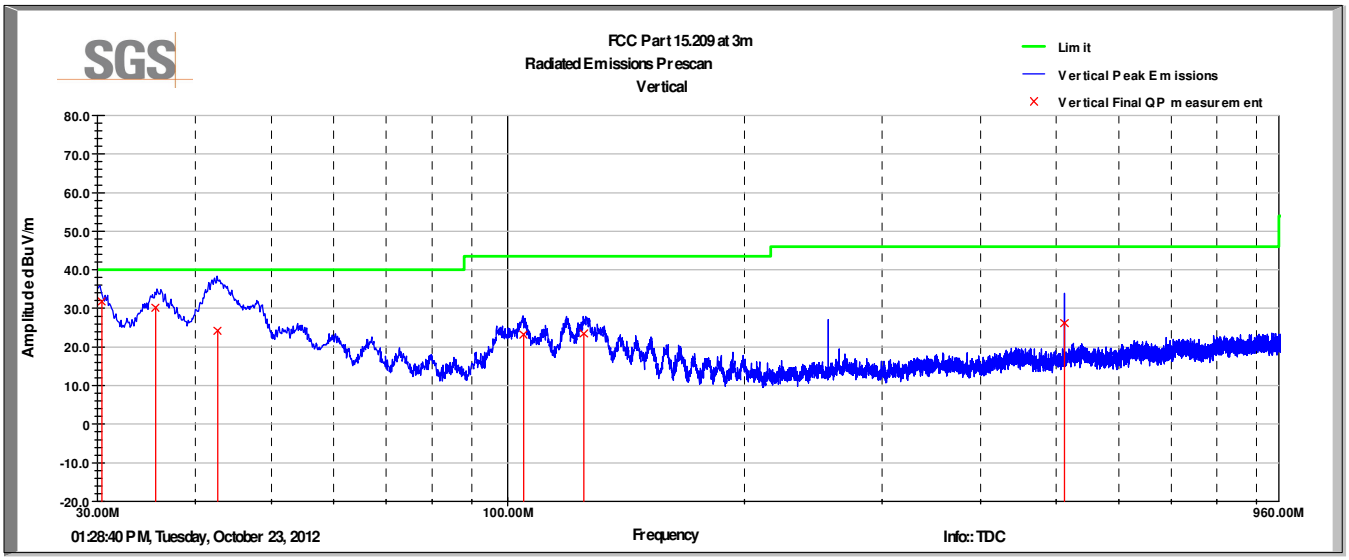
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Bilog Antenna	JB6	Sunol	B079689	9/4/2013
Receiver	ESU8	Rohde & Schwarz	B085759	6/12/2013
Pre-Amplifier	NSP1800-25-HG	Mini-Circuits	B079817	10/30/2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079712	9/20/2013
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079711	9/20/2013
Coaxial Cable	Sucoflex 106	Huber+Suhner	B085888	10/22/2013

Note: The calibration period equipment is 1 year.
Software: “Radiated Emissions” TILE! profile dated 15 Oct 2011

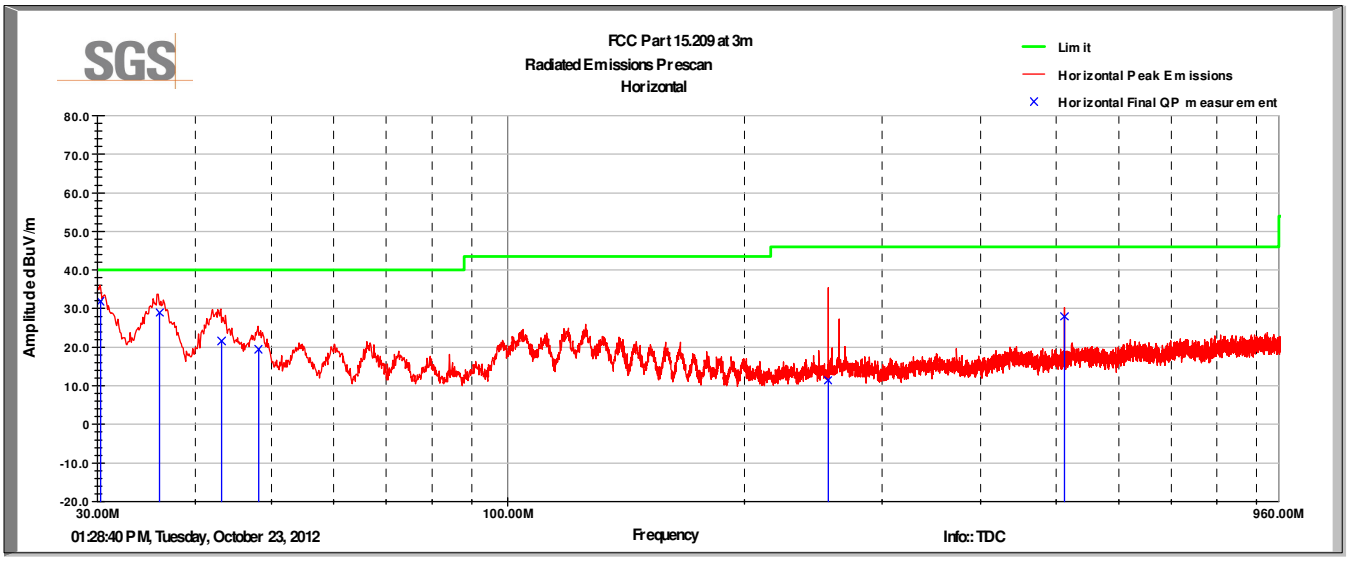
7.5 *Test Data*

Operator: Brian Forster

Vertical Radiated Emissions Plot



Horizontal Radiated Emissions Plot



Vertical Radiated Emissions Data

Frequency MHz	Raw QP dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.37	50.6	V	70.0	100.0	20.8	0.4	40.0	31.8	40.0	-8.2
35.54	52.9	V	92.0	100.0	16.9	0.5	40.1	30.2	40.0	-9.8
42.67	52.6	V	25.0	100.0	11.6	0.5	40.5	24.2	40.0	-15.8
104.65	51.6	V	0.0	100.0	11.5	0.8	40.7	23.2	43.5	-20.3
124.95	49.8	V	266.0	100.0	13.8	0.9	40.9	23.5	43.5	-20.0
511.93	47.4	V	197.0	100.0	17.9	1.8	41.0	26.2	46.0	-19.8

Horizontal Radiated Emissions Data

Frequency MHz	Raw QP dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.25	50.6	H	121.0	161.0	20.9	0.4	40.0	31.9	40.0	-8.1
36.00	52.0	H	79.0	161.0	16.6	0.5	40.1	28.9	40.0	-11.1
43.16	50.3	H	205.0	161.0	11.3	0.5	40.5	21.6	40.0	-18.4
48.10	51.3	H	108.0	161.0	8.6	0.5	40.9	19.5	40.0	-20.5
255.83	39.6	H	192.0	161.0	11.7	1.3	41.1	11.4	46.0	-34.6
511.93	49.2	H	174.0	161.0	17.9	1.8	41.0	28.0	46.0	-18.0

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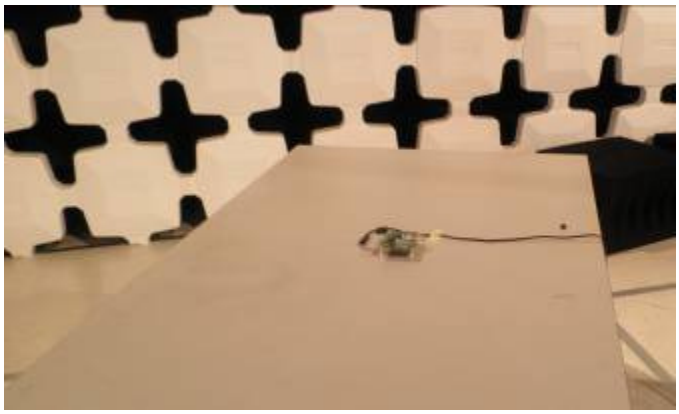
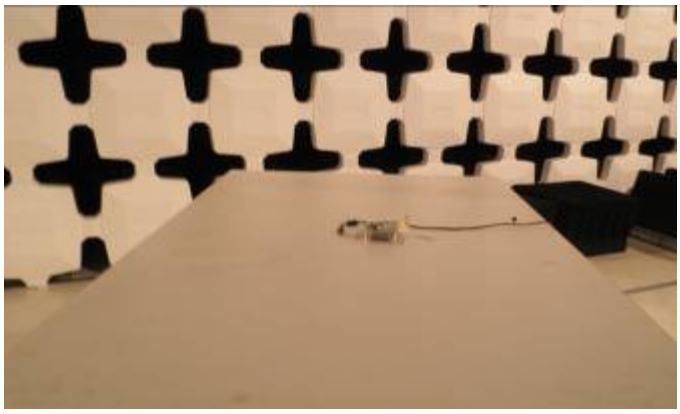
8 Test Setup Photographs





9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	28 November 2012
1	Corrected references to proper sections of the FCC rules. Corrected typographical errors in some of the plots (frequency range notes)	20 December 2012