EMC Test Report

Project Number: 3477563
Report Number: 3477563EMC01 **Revision Level:** 2
Client: PLUS Location Systems

Equipment Under Test: PLUS Transmit only UWB Tags
Model Name: Tag Module
Model Number 2110
Applicable Standards: FCC Part 15.519

Report issued on: 19 August 2014
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.

Table of Contents

1 Summary of Test Results

Basic Standards	Test Result
15.519(c) / 15.209, Radiated Emissions below 1 GHz	Compliant
15.519(d), Radiated Emissions in GPS Receive Bands	Compliant
15.519(b), UWB Bandwidth requirement	Compliant
15.519(c) Radiated power density(EIRP)	Compliant
15.519(e), Peak Power within a 50MHz bandwidth	Compliant

1.1 *Modifications Required to Compliance*

None

2 General Information

2.1 *Client Information*

Name: Kevin Trach
Address: 6767 Madison Pike NW Suite 310
City, State, Zip, Country: Huntsville AL 35806

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

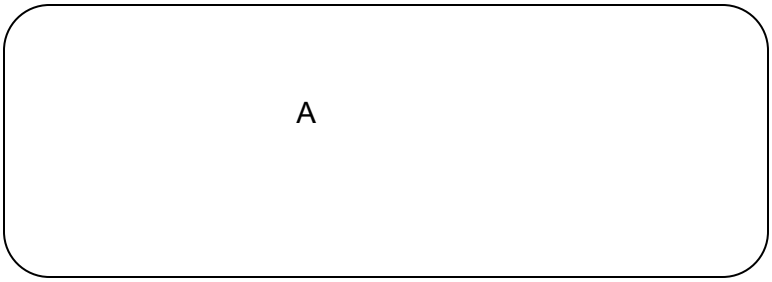
2.3 *General Information of EUT*

Product Name: Transmit only UWB Tags
Model Name: Tag Module
FCC ID: ZEH0414
Sample Received Date: 28APR2014
Dates of testing: 28-30APR2014

2.4 *Operating Modes and Conditions*

The EUT was programmed by the manufacturer to transmit continuously.

2.5 *EUT Block Diagram*



3 Radiated Emissions below 1 GHz

3.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC15.519(3) (c)	Compliant

3.2 *Test Method*

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	43.52	3m
216 – 960	46	3m

3.3 *Test Site*

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature:	24.5 °C
Relative Humidity:	60.1%
Atmospheric Pressure:	98.9 kPa

3.4 *Test Equipment*

Test Date: 30-Apr-2014

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	6-Aug-2014
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	6-Aug-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	7-Oct-2014

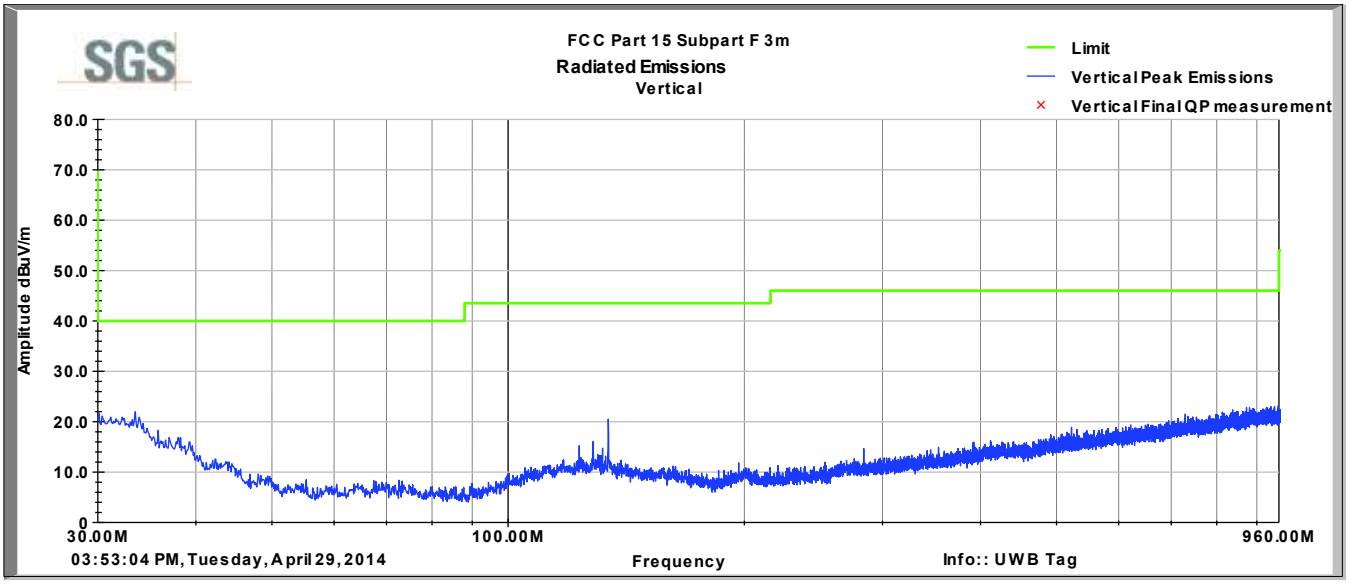
Note: The calibration period equipment is 1 year.

Software:
“Radiated Emissions” TILE! profile dated 15 Oct 2011

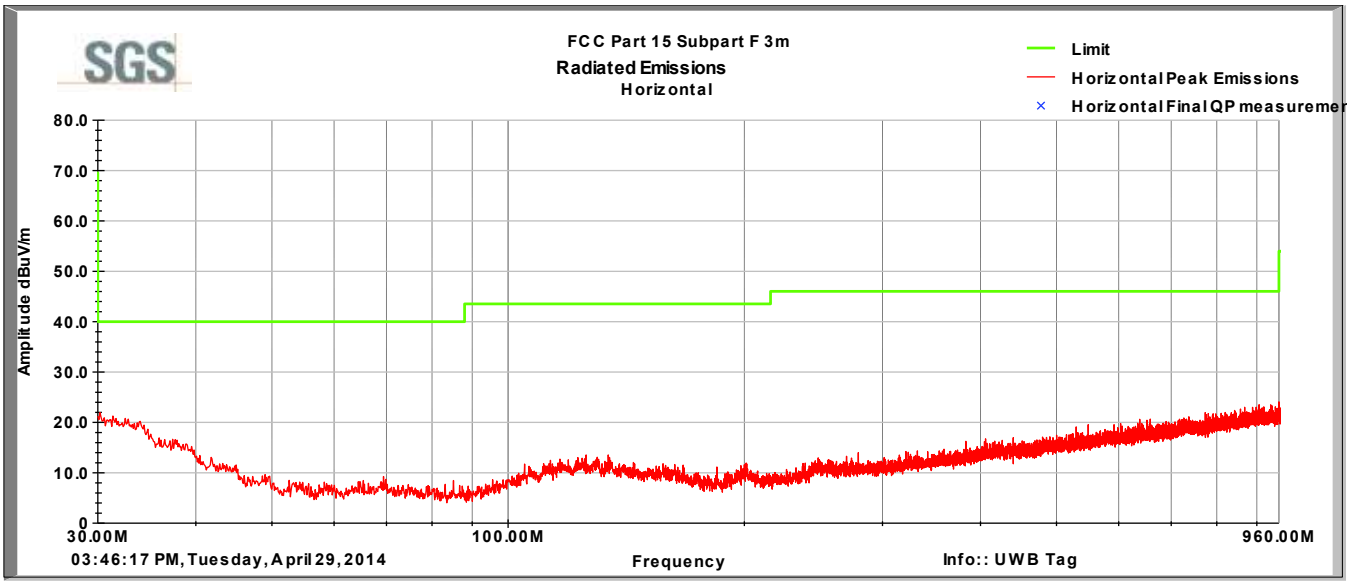
3.5 *Test Setup Photographs*

3.6 *Test Data*

Vertical Radiated Emissions Plot



Horizontal Radiated Emissions Plot



4 Bandwidth requirements

4.1 *Test Result*

Test Description	Basic Standards	Test Result
Bandwidth requirement (-10 dB requirements)	15.503 (d), 15.519 (3)(b)	Compliant

4.2 *Test Method*

1) The −10 dB bandwidth of the fundamental emission shall be at least 50 MHz. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the −10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of §15.31(m).
2) The −10 dB bandwidth is based on measurement using a peak detector, a 1 MHz resolution bandwidth, and a video bandwidth greater than or equal to the resolution bandwidth.

4.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	21.7 °C
Relative Humidity:	55.2%
Atmospheric Pressure:	97.4 kPa

4.4 *Test Equipment*

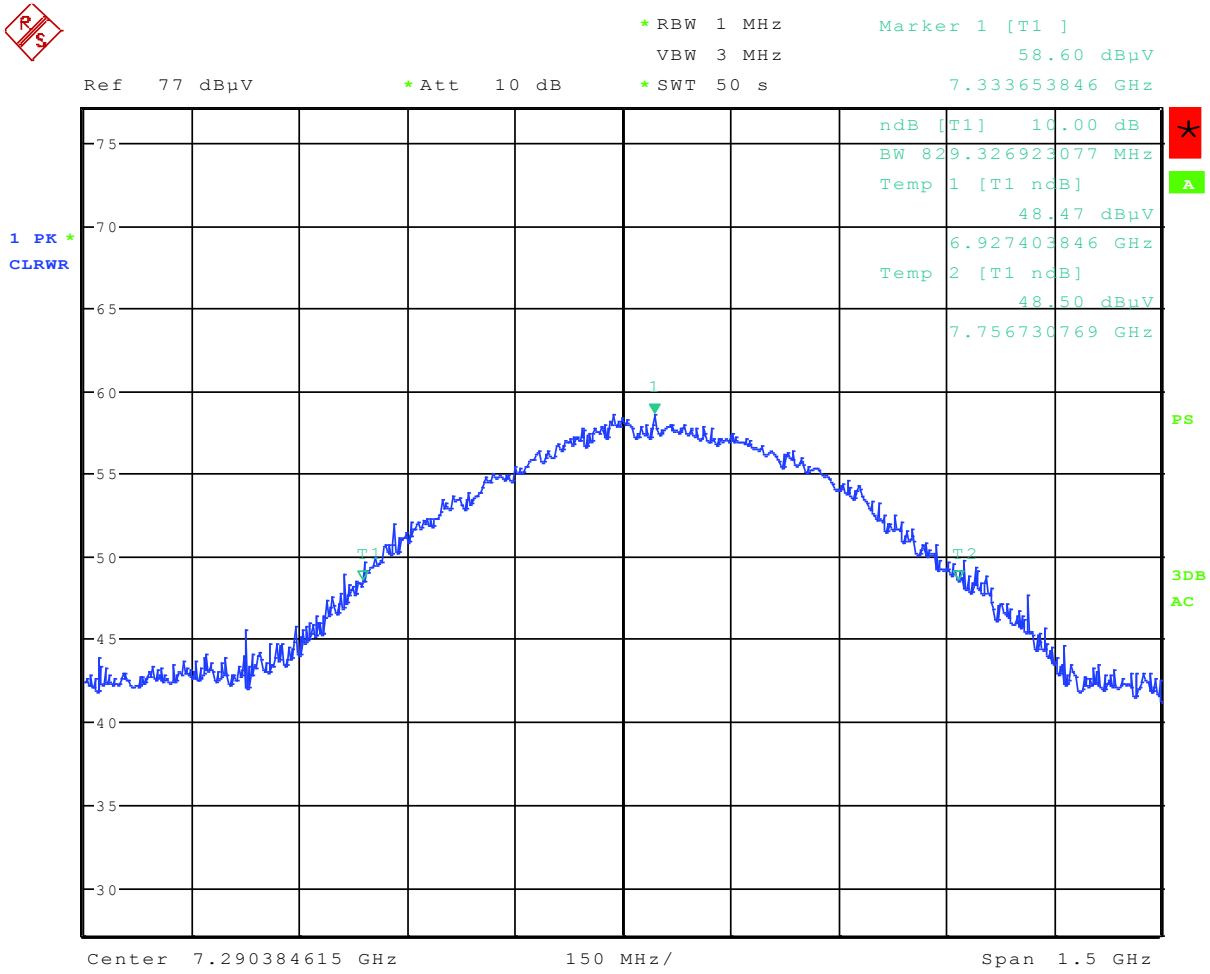
Test Date: 30-Apr-2014

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	6-Aug-2014
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	6-Aug-2014

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

4.5 *Test Setup Photographs*

4.6 *Test Data*



Date: 30.APR.2014 12:52:12

Bandwidth = 829.32 MHz

5 Peak Power within a 50 MHz bandwidth

5.1 *Test Result*

Test Description	Basic Standards	Test Result
Peak Power in a 50 MHz Bandwidth	15.519 (3)(e)	Compliant

5.2 *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, f_M. That limit is 0 dBm EIRP.
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.

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 Test Site.

Scans were performed with the EUT oriented in 3 orthogonal axes.

5.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	21.7 °C
Relative Humidity:	55.2%
Atmospheric Pressure:	97.4 kPa

5.4 *Test Equipment*

Test Date: 30-Apr-2014

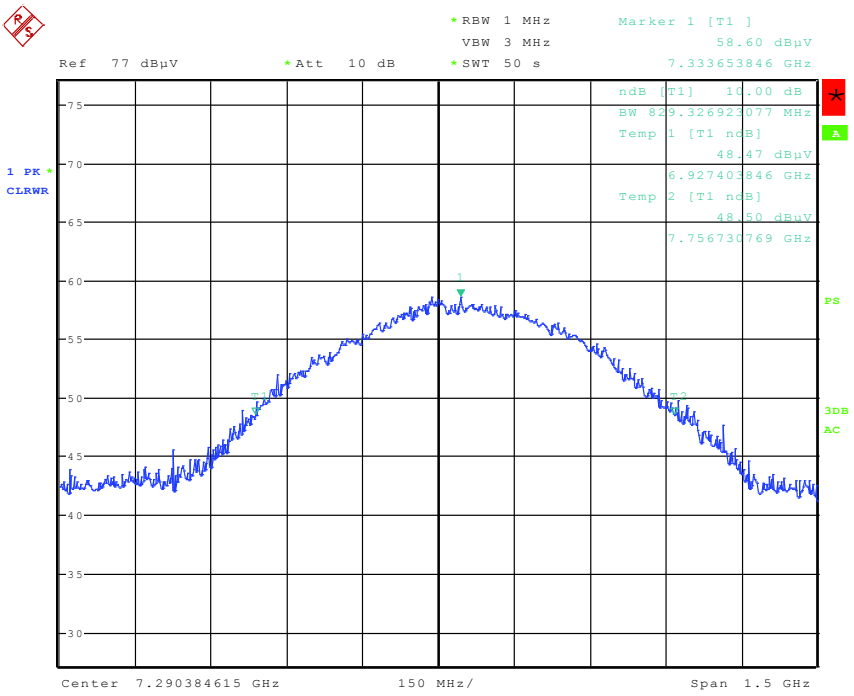
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	6-Aug-2014
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	6-Aug-2014

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

5.5 *Test Setup Photographs*

5.6 *Test Data*

Frequency MHz	Raw Peak (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Conversion 1 to 50MHz	Conversion F.S. to EIRP	Peak Value dBm	Limit (dBm)	Margin (dB)
7293.59	58.6	V	0.0	102.9	36.3	7.5	33.6	34.0	104.7	-1.9	0.0	-1.9
Peak Value = Raw Peak + AF + CL - Amp + 50MHz Conv + FStoEIRP Conv												
Margin = Peak Value - Limit												



Date: 30.APR.2014 12:52:12

6 Radiated Emissions (EIRP)

6.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated power density	15.519 (c)	Compliant

6.2 *Test Method*

An exploratory scan was performed on a test site that meets the requirements of ANSI C63.4 above 1 GHz. The scan was performed at a distance of 0.5 meter using the factor of 110.79 to convert a 0.5 meter field strength measurement to EIRP. If emissions were detected, the final emissions will be performed at a distance on 1 meter.

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 (dBm)
960–1610	-75.3
1610–1990	-63.3
1990–3100	-61.3
3100–10600	-41.3
Above 10600	-61.3

2) In addition to the radiated emission limits specified in the table in paragraph (d)(1) 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)
1164–1240	-85.3
1559–1610	-85.3

6.3 *Test Site*

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	21.8 °C
Relative Humidity:	53.7%
Atmospheric Pressure:	97.4 kPa

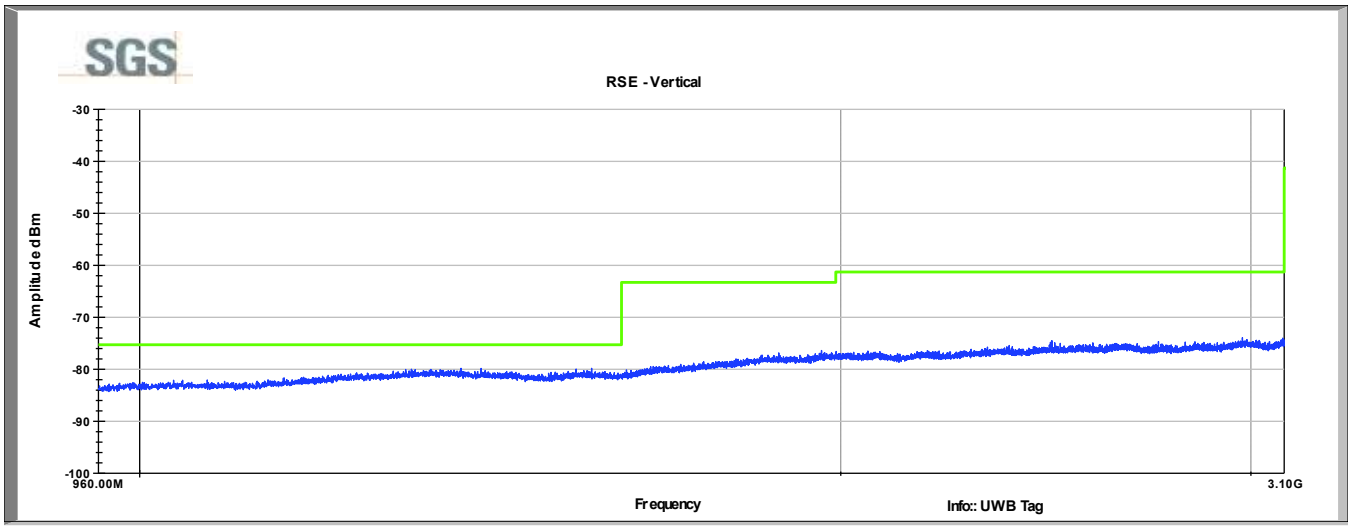
6.4 *Test Equipment*

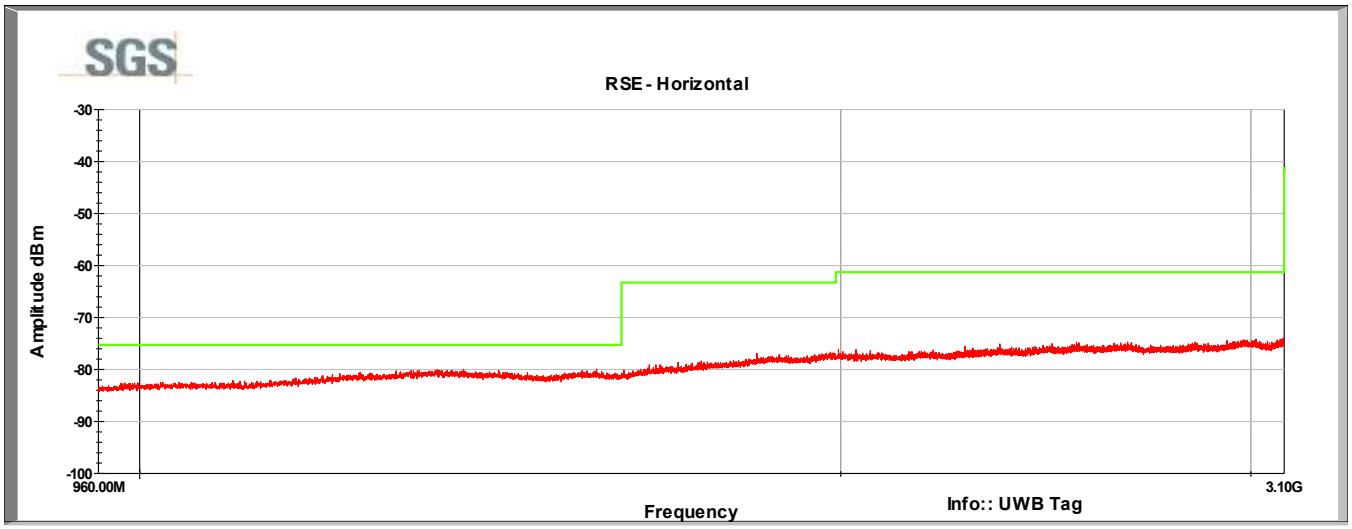
Test Date: 29-Apr-2014

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	31-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	6-Aug-2014
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	6-Aug-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079824	29-Oct-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	29-Oct-2014

Note: The calibration period equipment is 1 year.

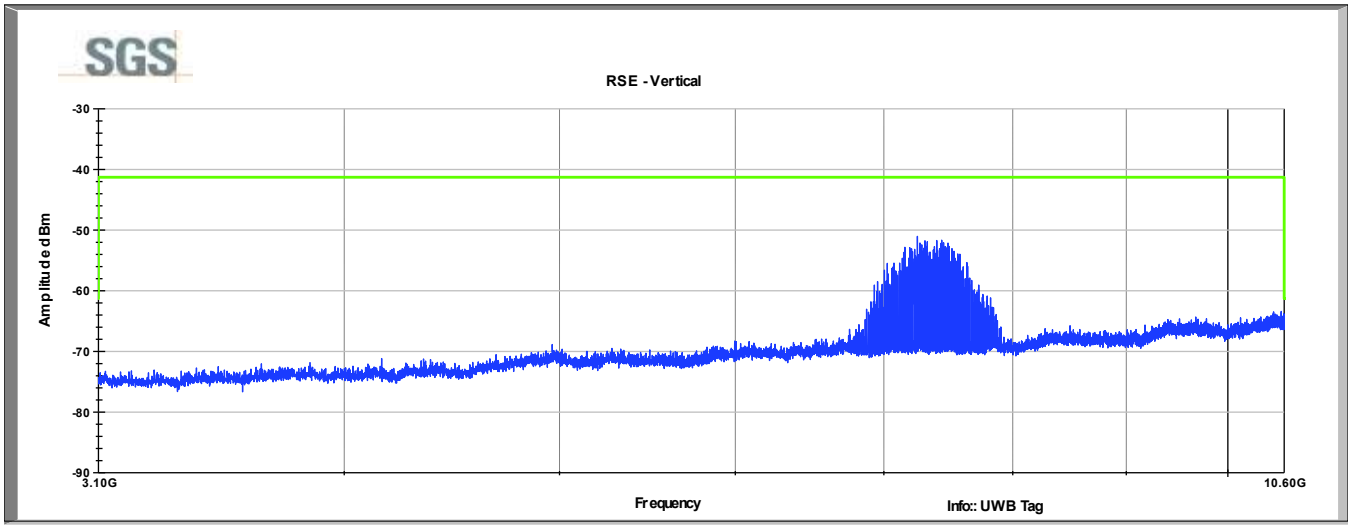
6.5 *Test Data*

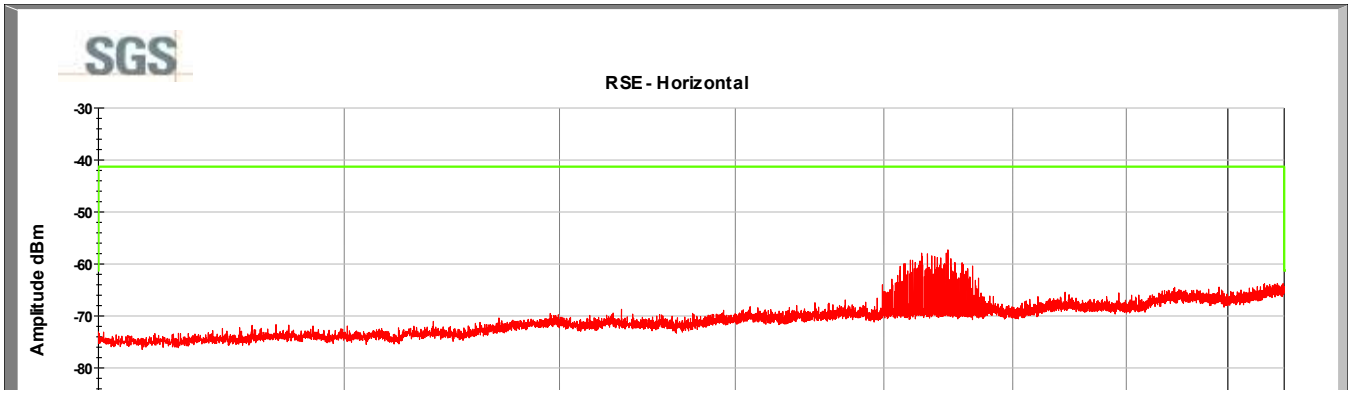

RSE - Vertical
Amplitude dBm
-30
-40
-50
-60
-70
-80
-90
-100
960.00M
3.10G
Frequency
Info:: UWB Tag

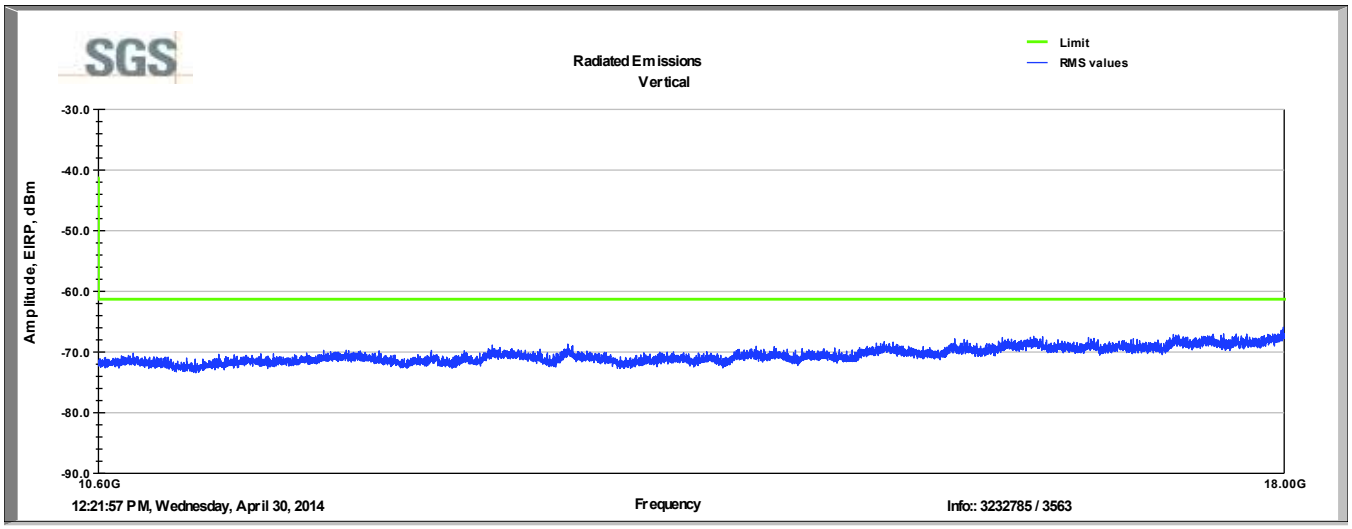

RSE - Horizontal
Amplitude dBm
-30
-40
-50
-60
-70
-80
-90
-100
960.00M
3.10G
Frequency
Info:: UWB Tag

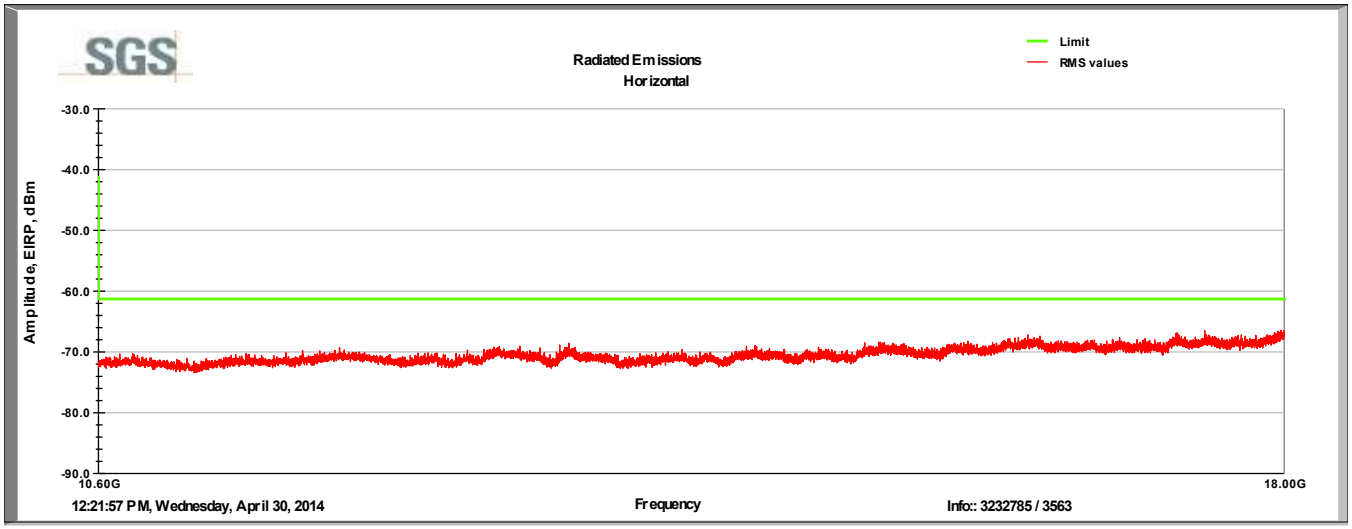
RMS – Maximum value of transmitter

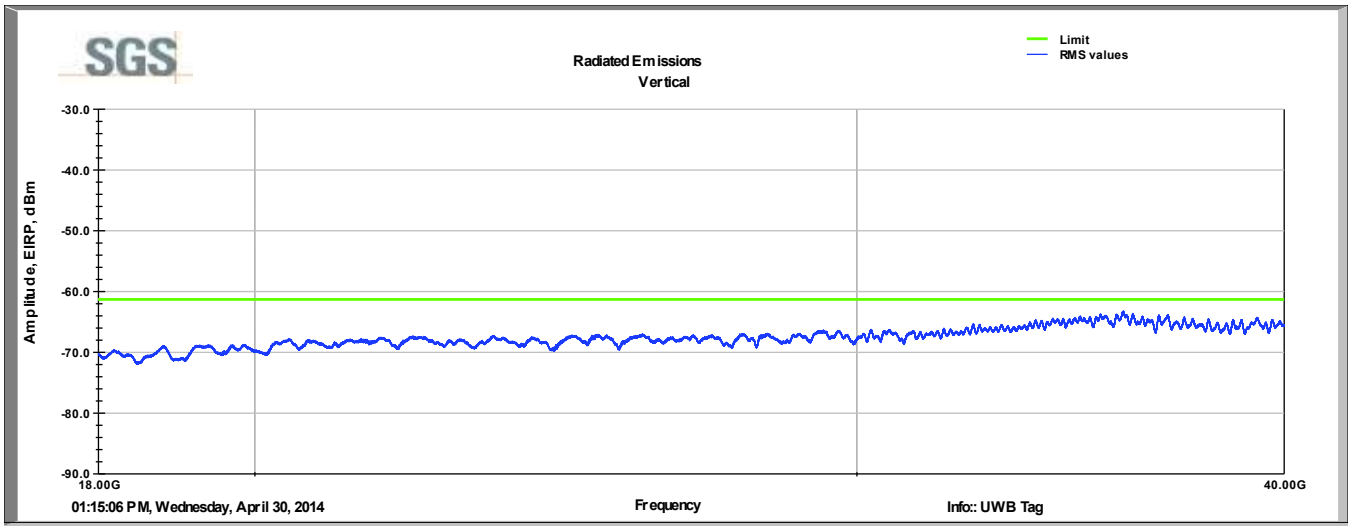
Frequency MHz	RMS (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Conversion F.S. to EIRP	RMSValue dBuV/m	Limit (dBuV/m)	Margin (dB)
7293.59	42.0	V	0.0	102.9	36.3	7.5	33.6	104.7	-52.5	-41.3	-11.2
RMS Value = Raw + AF + CL - Amp + FStoEIRP Conv											
Margin = Peak Value - Limit											

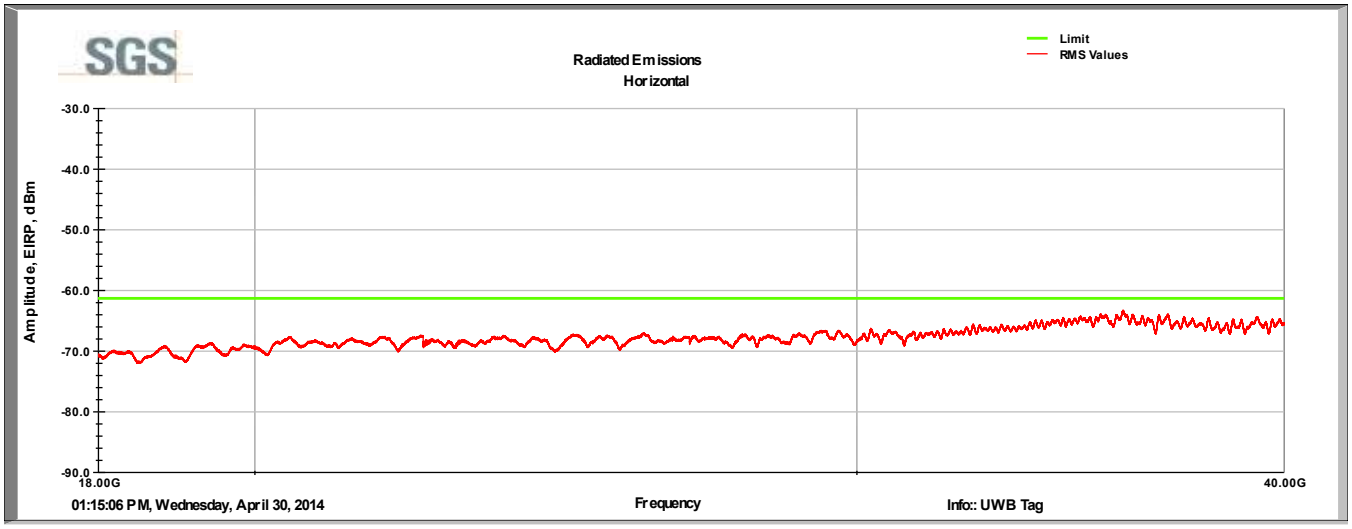





SGS
Radiated Emissions
Vertical
Limit
RMS values
Amplitude, EIRP, dBm
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
10.60G
18.00G
12:21:57 PM, Wednesday, April 30, 2014
Frequency
Info:: 3232785 / 3563

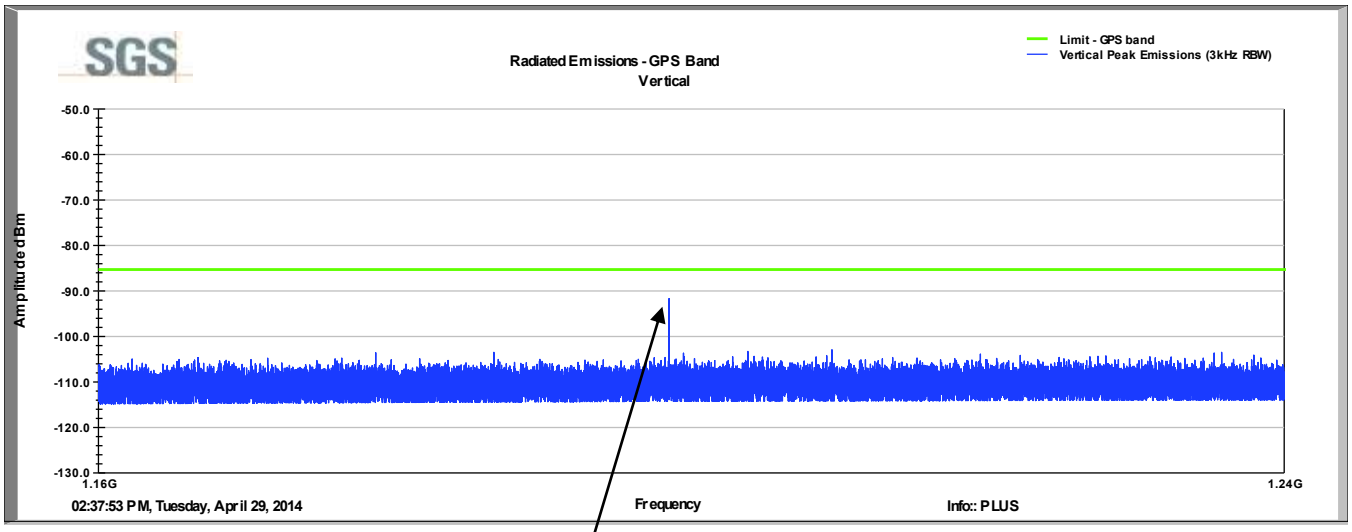

SGS
Radiated Emissions
Horizontal
Limit
RMS values
Amplitude, EIRP, dBm
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
10.60G
18.00G
12:21:57 PM, Wednesday, April 30, 2014
Frequency
Info:: 3232785 / 3563



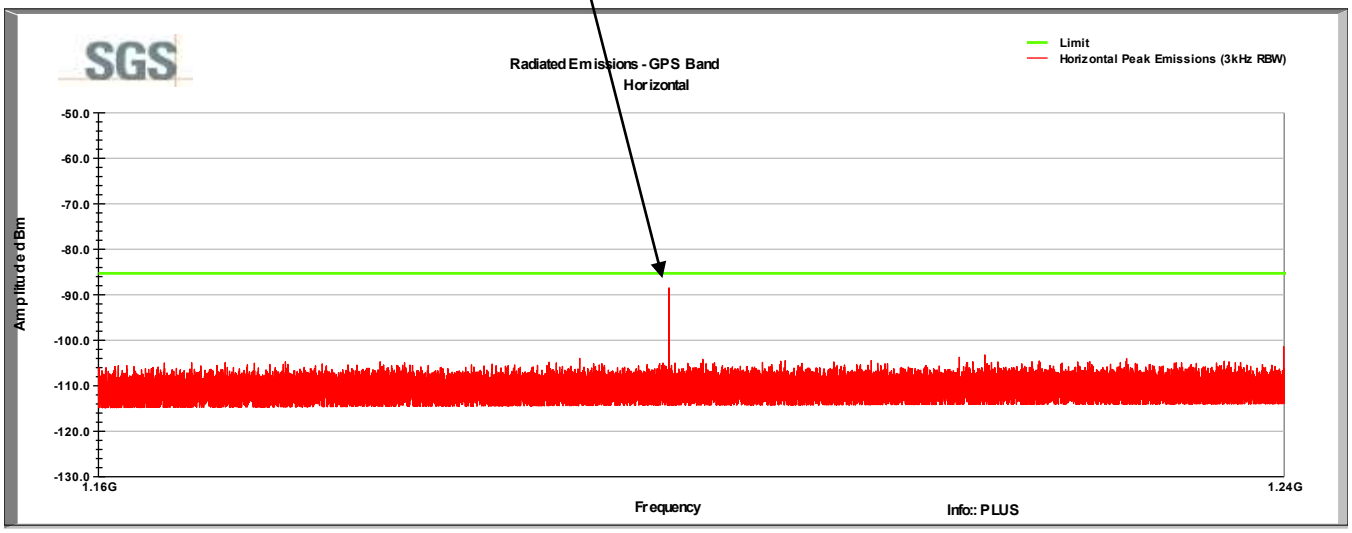


No emissions above equipment noise floor

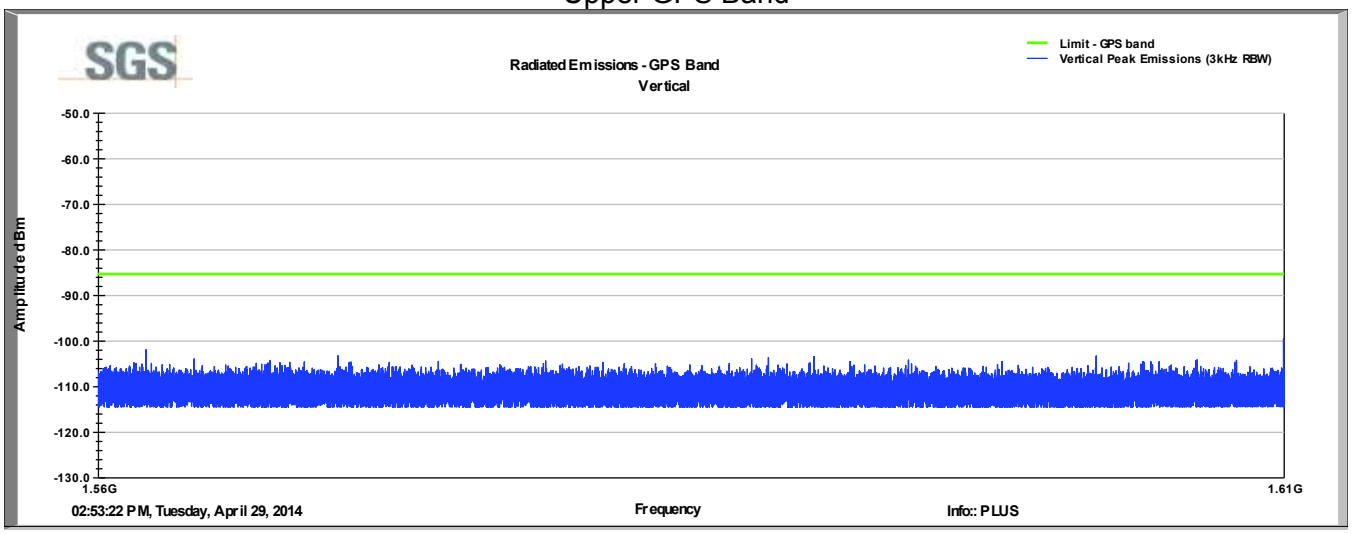
Lower GPS Band

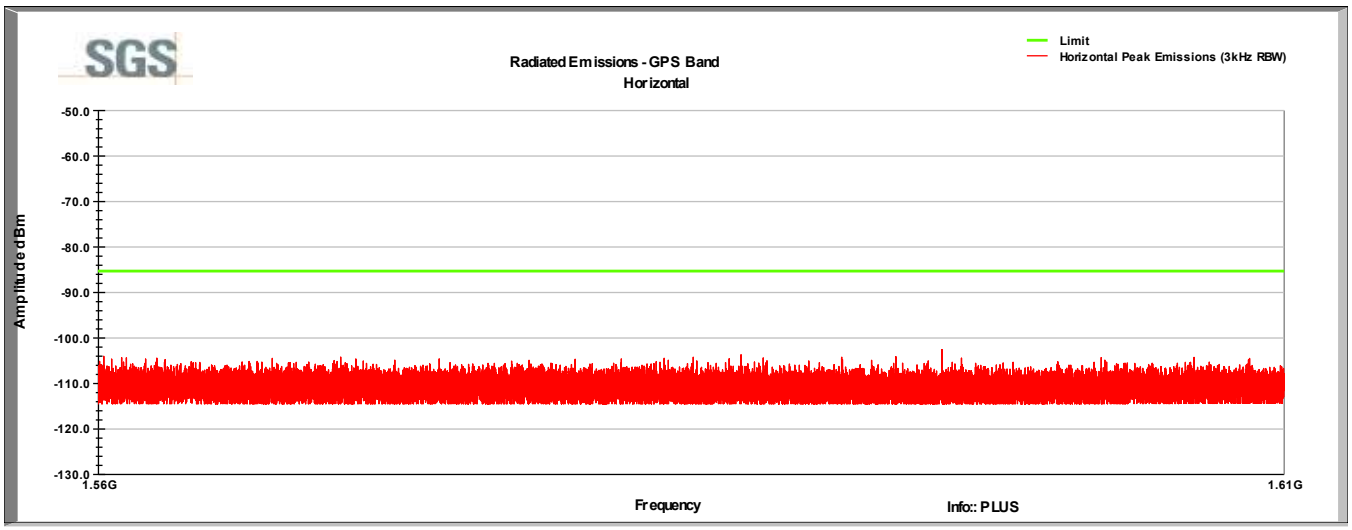


Noise unrelated to EUT.



Upper GPS Band





7 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	27May2014
1	Added peak plot to Section 5	12Jun2014
2	Updated radiated emissions plots to show only 30MHz to 960MHz. Corrected Part 15.519 references	19Aug2014