EMC Test Report

Project Number: 3925452

Report Number: 3925452EMC01 **Revision Level:** 1

Client: PLUS Location Systems

Equipment Under Test: PLUS Transmit only UWB Tag

Model Name: Tag Module

Model Number 2112

FCC ID: ZEH0116

Applicable Standards: FCC Part 15.519

ANSI C63.10:2013

Report issued on: 17 March 2016

Test Result: Compliant

Tested by: David Schramm, EMC/RF/SAR/HAC Manager

Reviewed by: Jeremy O. Pickens, Senior EMC Engineer

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

Basic Standards	Test Result
15.519(c) / 15.209, Radiated Emissions below 960 MHz	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:	Keven 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

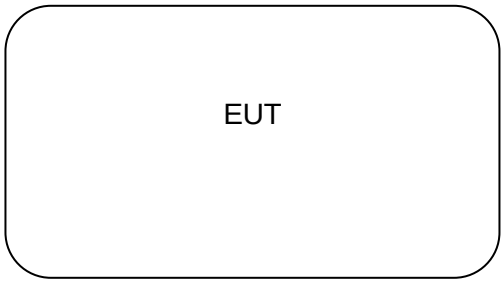
2.3 *General Information of EUT*

Product Name:	Transmit only UWB Tag
Model Name:	Tag Module
FCC ID:	ZEH0116
Sample Received Date:	11 January 2016
Dates of testing:	11-13 January 2016

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 960 MHz

3.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC15.519(3)(c) ANSI C63.10: 2013, Clause 10	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. The receiver's resolution bandwidth was set to 120 kHz. 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 EUT was manipulated through 3 orthogonal axes. 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*

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

Environmental Conditions

Temperature:	24.8 °C
Relative Humidity:	16.3%
Atmospheric Pressure:	98.4 kPa

3.4 *Test Equipment*

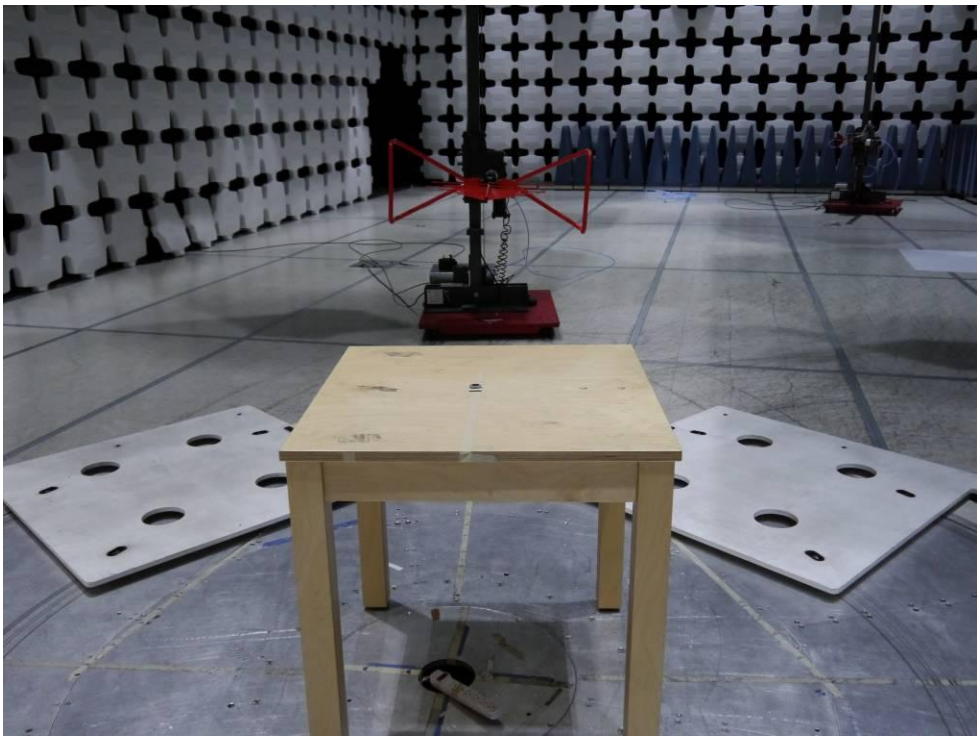
Test Date: 11-Jan-2016 Tester: FRN

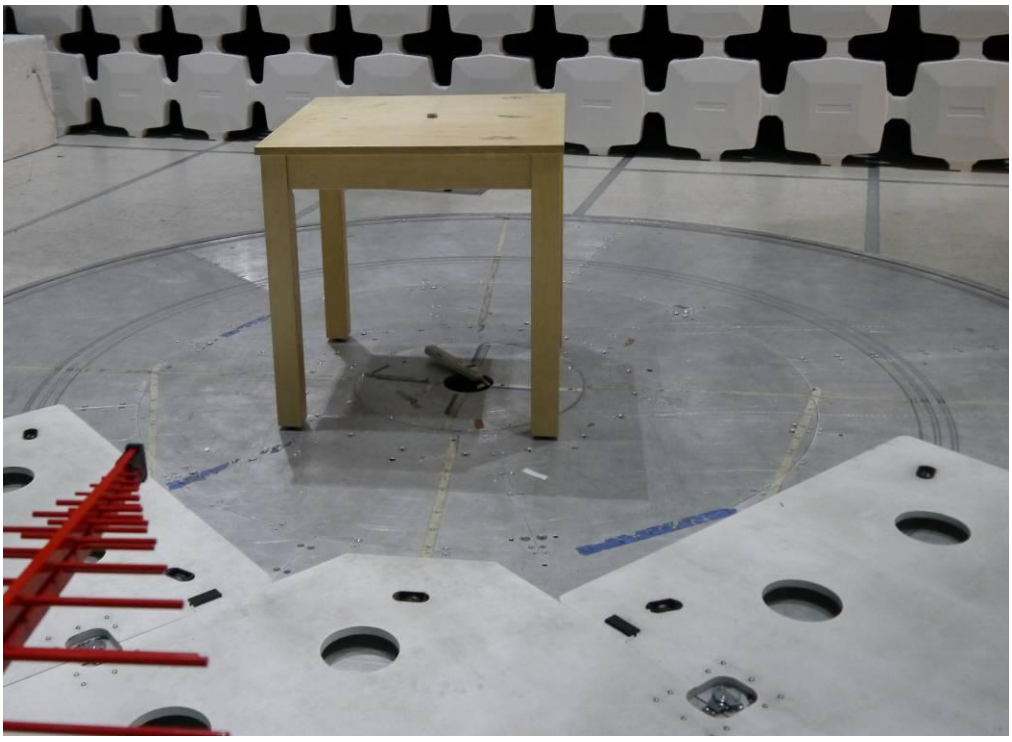
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	21-Oct-2016
6DB ATTENUATOR 50 Ohm	15542	Mini Circuit	15017	3-Aug-2016
RF CABLE	SF106	HUBER&SUHNER	B085887	3-Aug-2016
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	3-Aug-2016
RF CABLE	SF106	HUBER&SUHNER	B085892	3-Aug-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	15003	24-Aug-2016

Note: The calibration period equipment is 1 year.

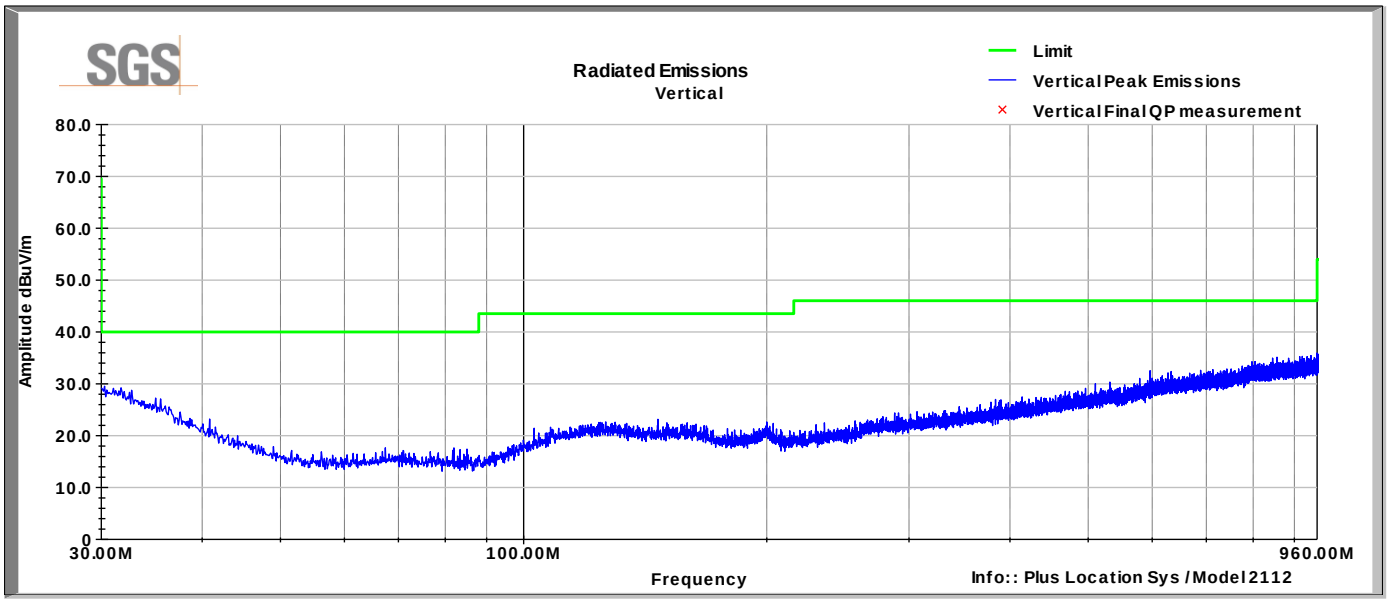
Software:
“RE 30-1000 MHz (12-2015)” TILE! profile dated 15 Oct 2011

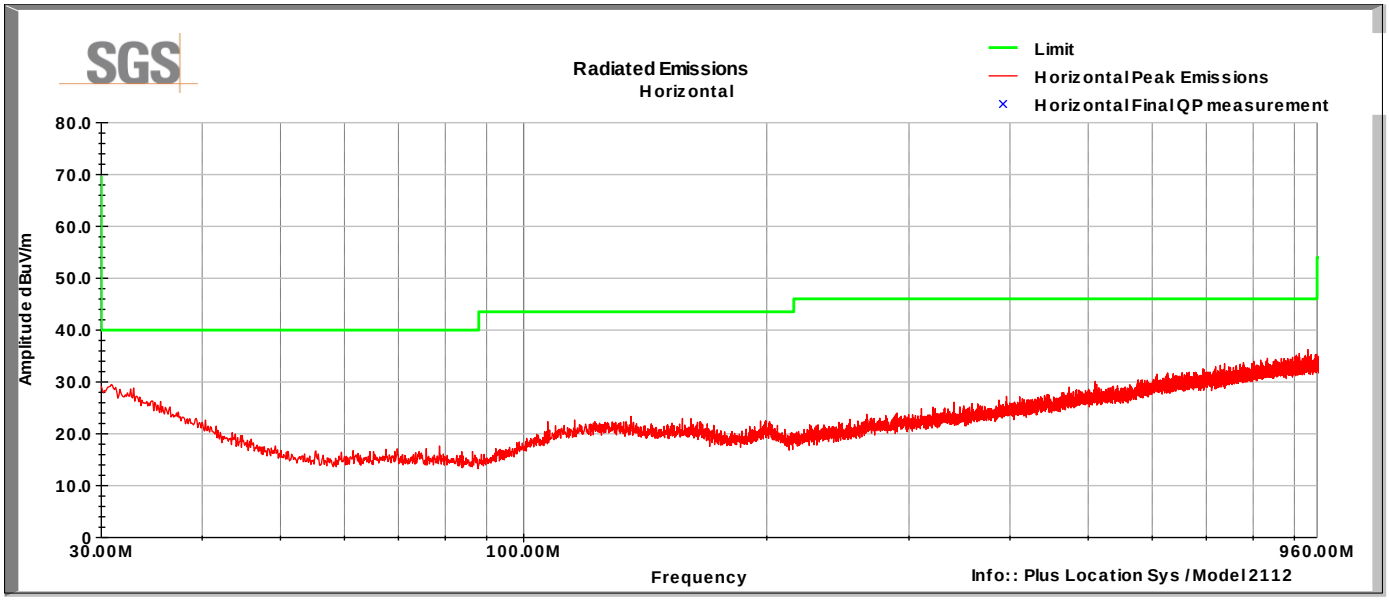
3.5 *Test Setup Photographs*





3.6 *Test Data*


Radiated Emissions
Vertical
Limit
Vertical Peak Emissions
Vertical Final QP measurement
Amplitude dBuV/m
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
30.00M
100.00M
960.00M
Frequency
Info:: Plus Location Sys / Model 2112


Radiated Emissions
Horizontal
Limit
Horizontal Peak Emissions
Horizontal Final QP measurement
Amplitude dBuV/m
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
30.00M
100.00M
960.00M
Frequency
Info:: Plus Location Sys / Model 2112

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) ANSI C63.10: 2013, Clause 10	Compliant

4.2 *Test Method*

1) The −10 dB bandwidth of the fundamental emission shall be at least 500 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:	22.8 °C
Relative Humidity:	18.4%
Atmospheric Pressure:	98.5 kPa

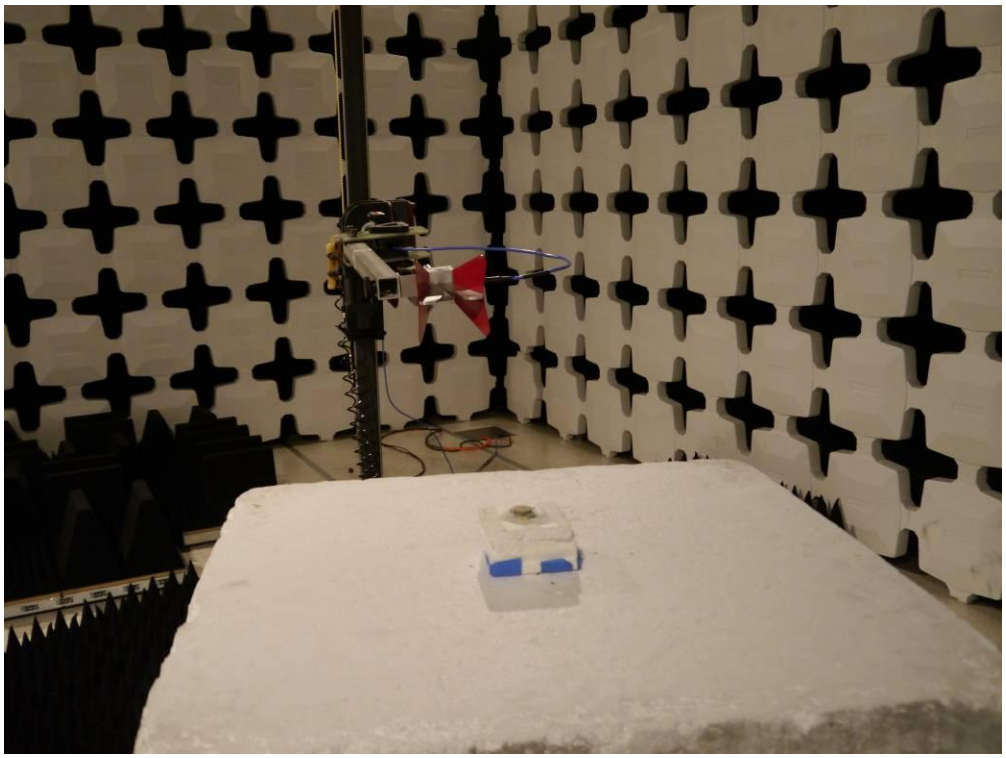
4.4 *Test Equipment*

Test Date: 11-Jan-2016 Tester: DJS

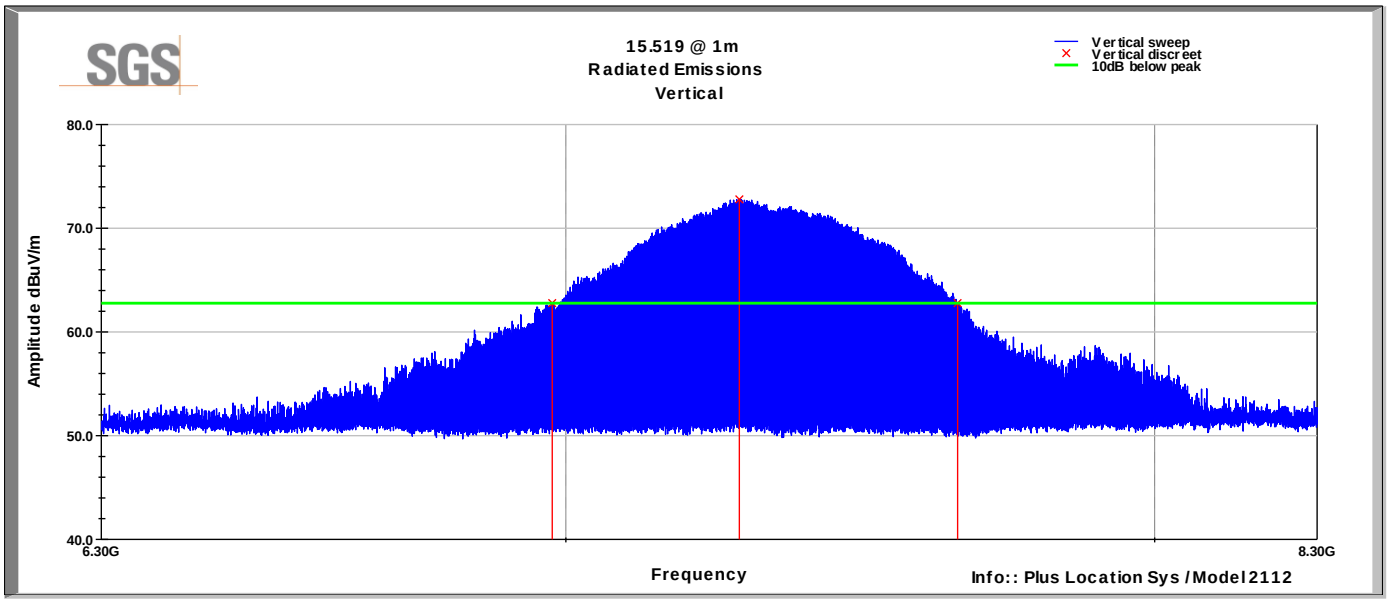
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	4-Aug-2016
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	4-Aug-2016
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	3-Aug-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016

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

4.5 *Test Setup Photographs*



4.6 *Test Data*



Peak: 7.281 GHz, 72.8 dBuV/m
Lower: 6.9784 GHz, 62.8 dBuV/m
Upper: 7.6502 GHz, 62.8 dBuV/m

Bandwitdth = 671.8 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) ANSI C63.10: 2013, Clause 10	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:	22.8 °C
Relative Humidity:	18.4%
Atmospheric Pressure:	98.5 kPa

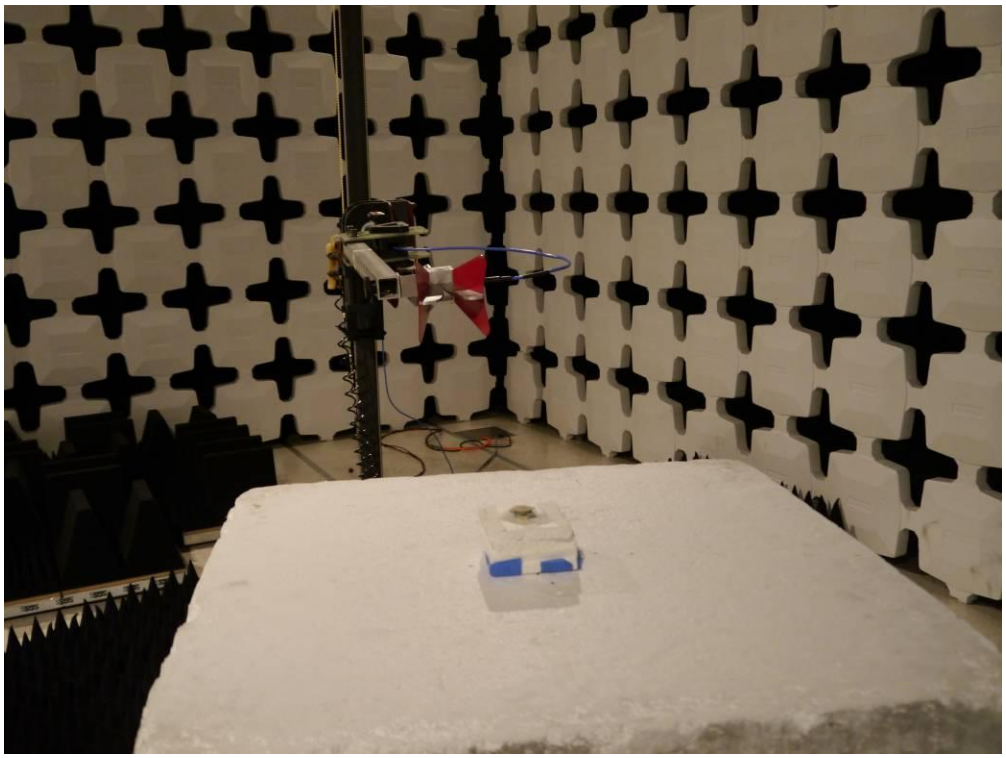
5.4 *Test Equipment*

Test Date: 11-Jan-2016 Tester: DJS

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	4-Aug-2016
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	4-Aug-2016
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	3-Aug-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016

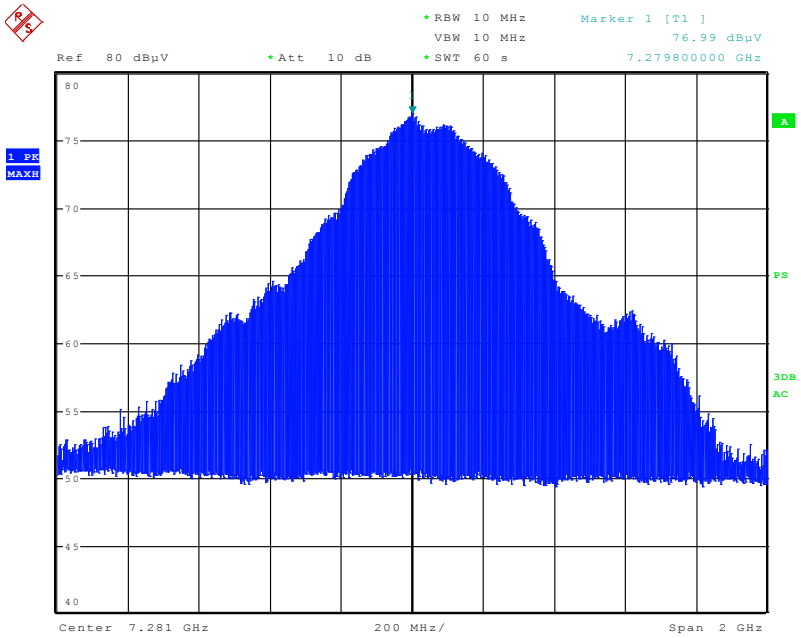
Note: The calibration period for this equipment is 1 year.

5.5 *Test Setup Photographs*



5.6 *Test Data*

Frequency MHz	Raw Peak (dBuV)	Polarity (V/H)	Axis (x,y,z)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Conversion 10 to 50MHz	Conversion F.S. to EIRP	Peak Value dBm	Limit (dBm)	Margin (dB)
7281.00	77.0	V	Z	45.0	171.6	35.6	6.3	33.1	14.0	104.7	-5.0	0.0	-5.0
7287.00	75.8	H	Y	335.6	171.3	35.6	6.3	33.1	14.0	104.7	-6.2	0.0	-6.2
Peak Value = Raw Peak + AF + CL - Amp + 50MHz Conv + FStoEIRP Conv													
Margin = Peak Value - Limit													



Date: 11.JAN.2016 11:30:06

6 Radiated Emissions (EIRP)

6.1 *Test Result*

Test Description	Basic Standards	Test Result
Radiated power density	15.519 (c) ANSI C63.10: 2013, Clause 10	Compliant

6.2 *Test Method*

Exploratory scan was performed on a test site that meets the requirements of ANSI C63.4:2014 above 960 MHz. The scan was performed at a distance of 1 meter. Field strength measurements were converted to EIRP. The distance of the scan is indicated on each scan.

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

The conversion factor was calculated using 95.2 + 20*log(3/D) where D is the measurement distance.

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*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.8 °C
Relative Humidity:	18.4%
Atmospheric Pressure:	98.5 kPa

6.4 *Test Equipment*

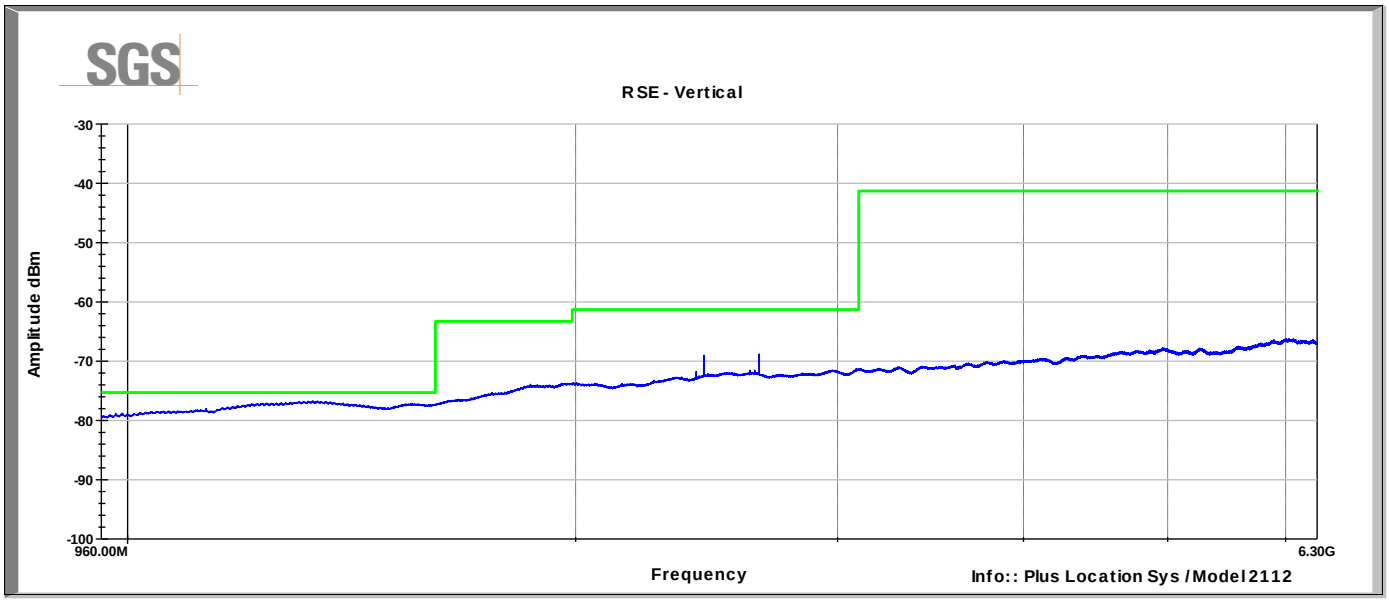
Test Date: 11-Jan-2016 Tester: DJS

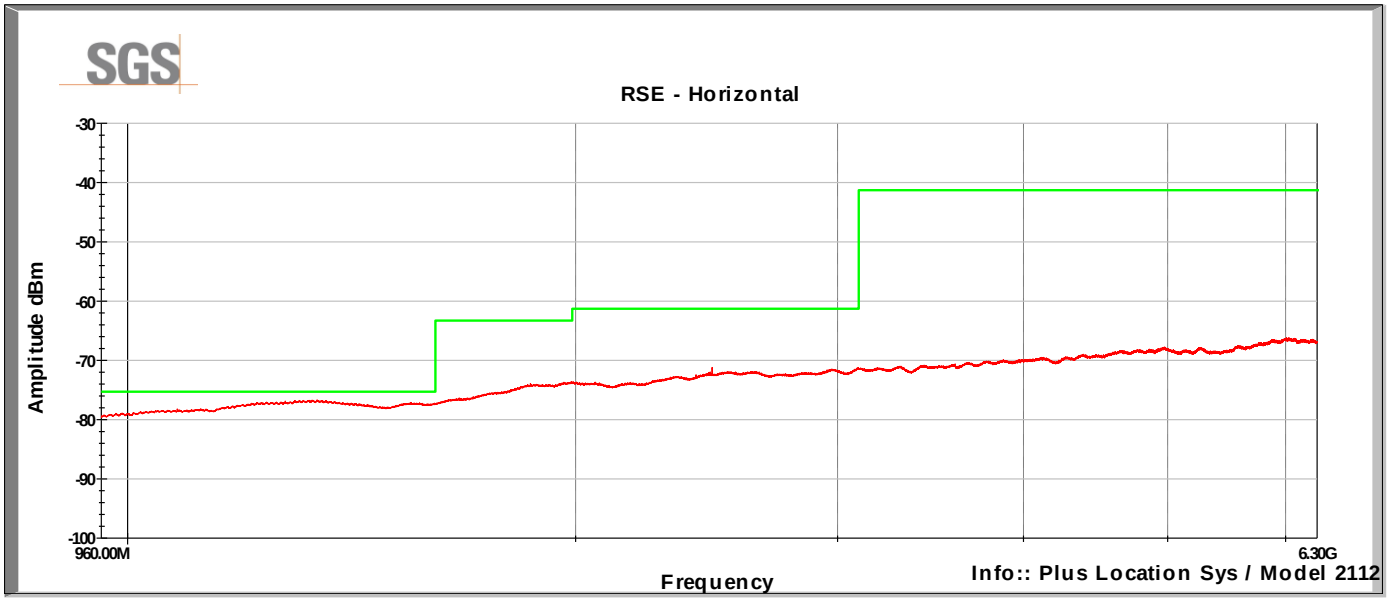
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	4-Aug-2016
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	4-Aug-2016
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	3-Aug-2016
PREAMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	16-Feb-2017
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016
SMALL HORN	LB-180400-20-C_KF	A-INFO	15007	11-Mar-2016
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	15-Oct-2016
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079823	4-Aug-2016
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	4-Aug-2016

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

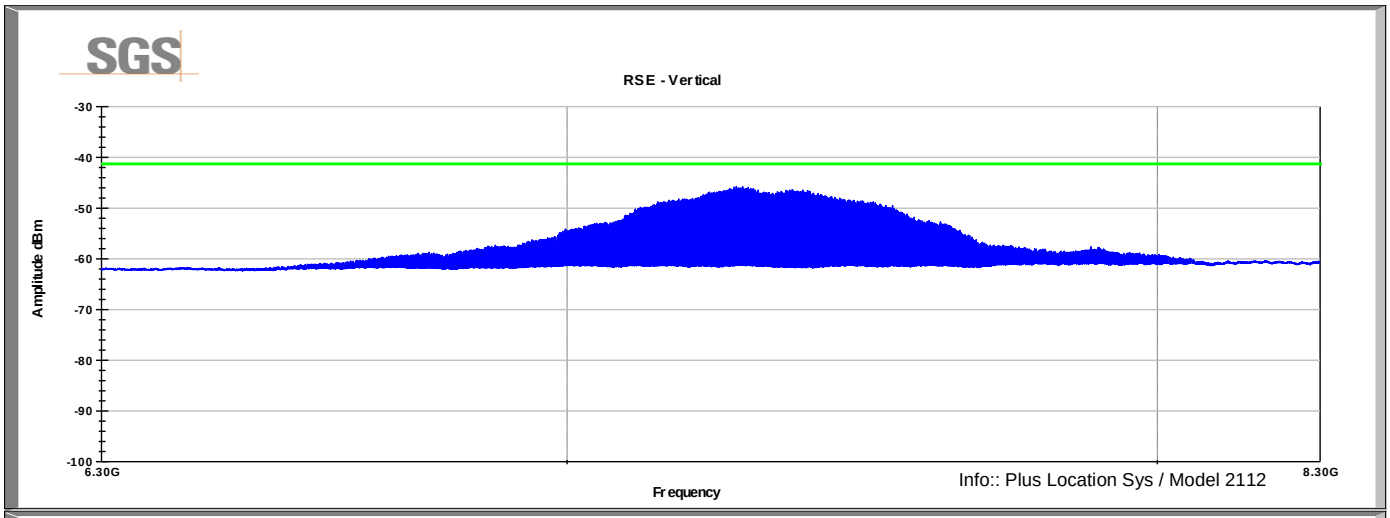
6.5 *Test Data*

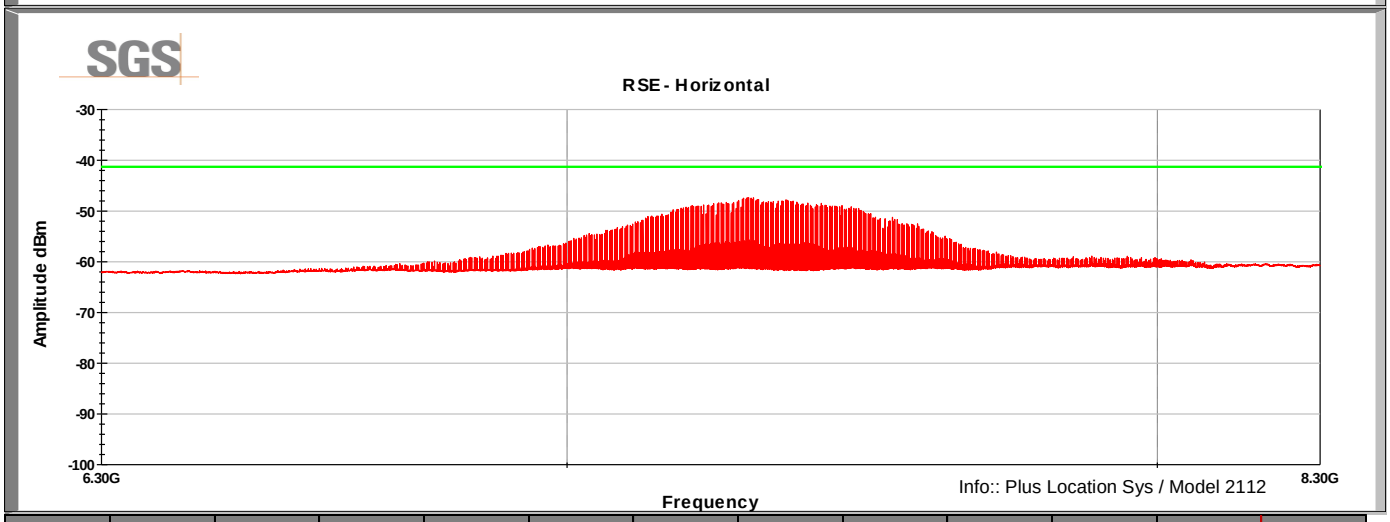
960 to 6300 MHz
Test distance: 1m





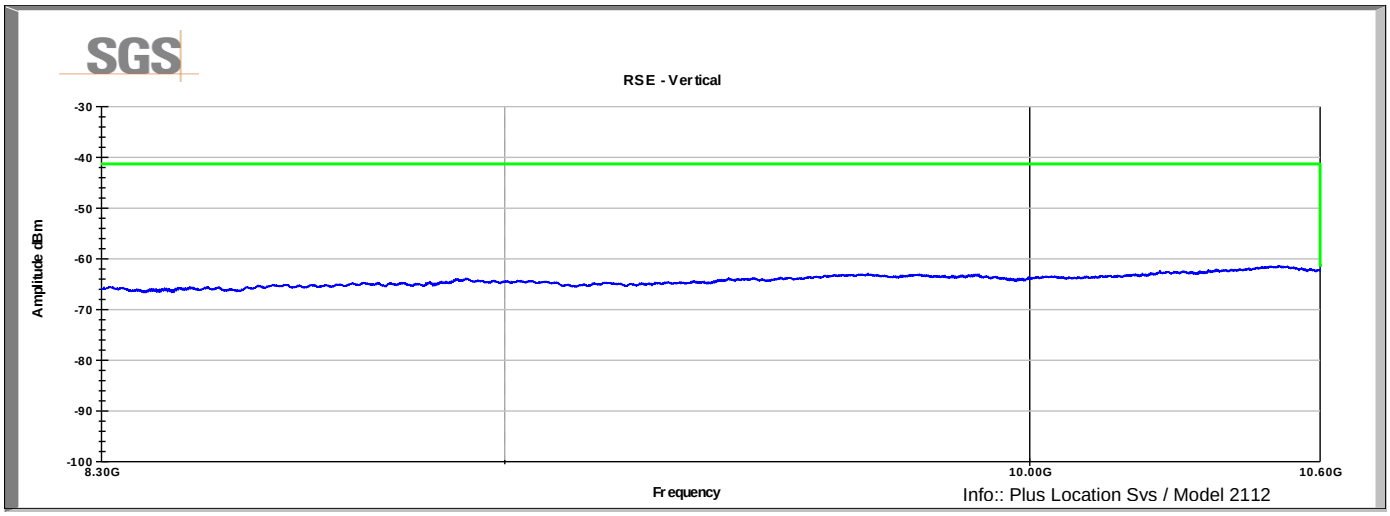
6300 to 8300 MHz
Test distance: 1m

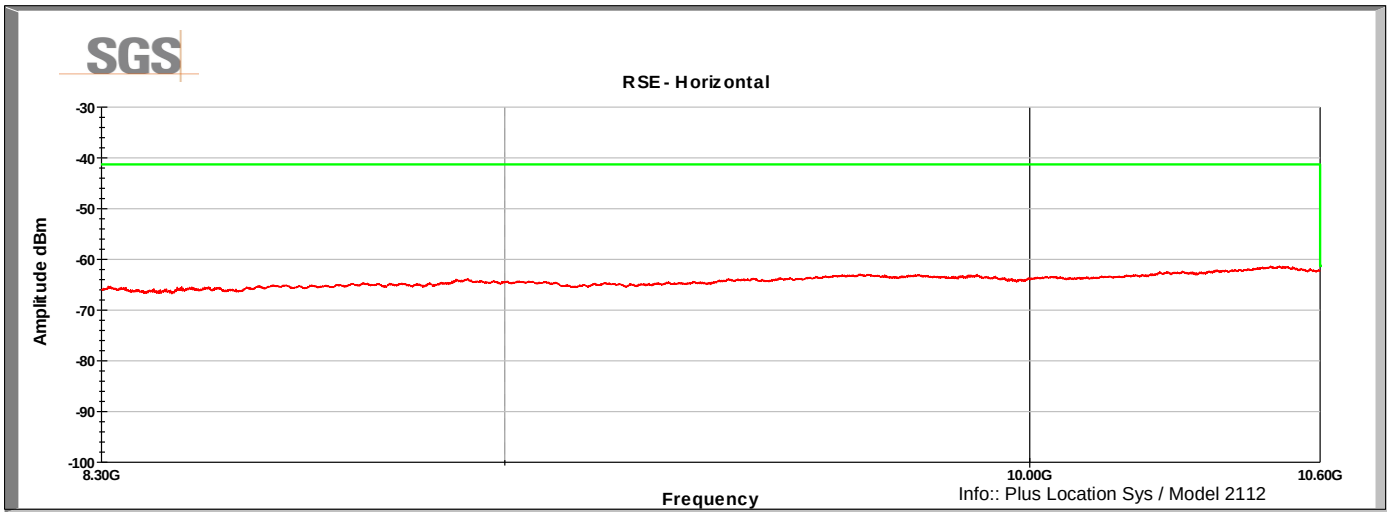




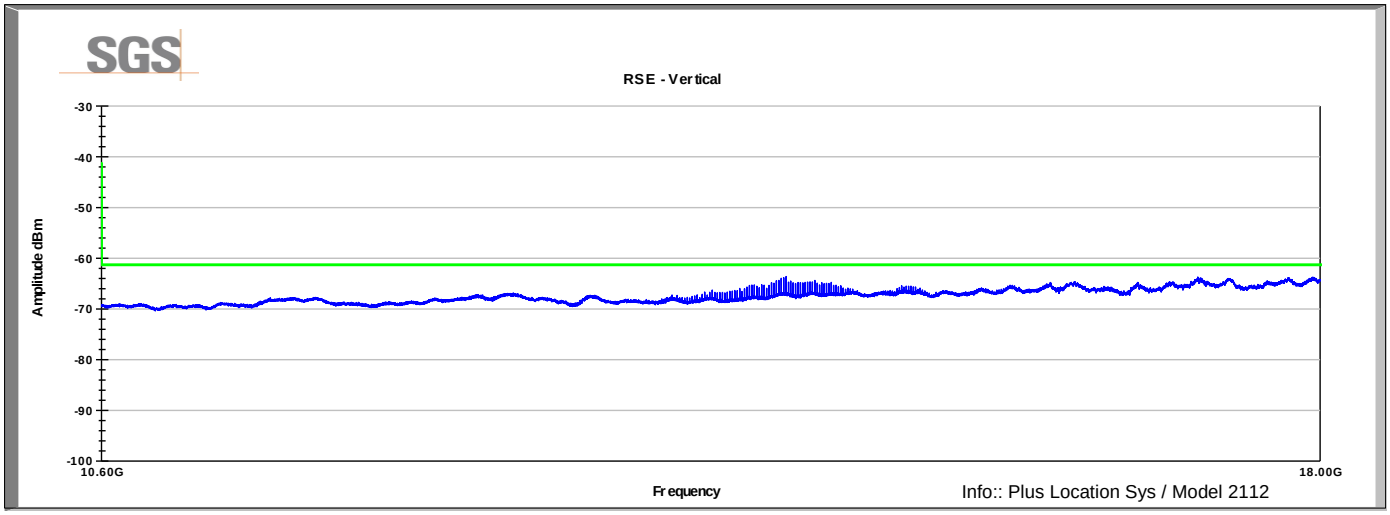
Frequency MHz	Raw Peak (dBuV)	Orientation x,y,z	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Conversion F.S. to EIRP	Peak Value dBm	Limit (dBm)	Margin (dB)
7276.00	47.6	Z	V	45.8	171.6	35.5	6.3	33.1	104.7	-48.4	-41.3	-7.1
7294.00	37.6	Z	H	45.8	171.6	35.5	6.3	33.1	104.7	-58.4	-41.3	-17.1
7329.00	46.0	Y	H	45.8	171.6	35.6	6.3	33.1	104.7	-50.0	-41.3	-8.7
7293.00	42.9	Y	V	45.8	171.6	35.5	6.3	33.1	104.7	-53.1	-41.3	-11.8
7310.00	38.4	X	V	45.8	171.6	35.6	6.3	33.1	104.7	-57.5	-41.3	-16.2
7327.00	46.9	X	H	45.8	171.6	35.6	6.3	33.1	104.7	-49.0	-41.3	-7.7
Peak Value = Raw Peak + AF + CL - Amp + FStoEIRP Conv												
Margin = Peak Value - Limit												

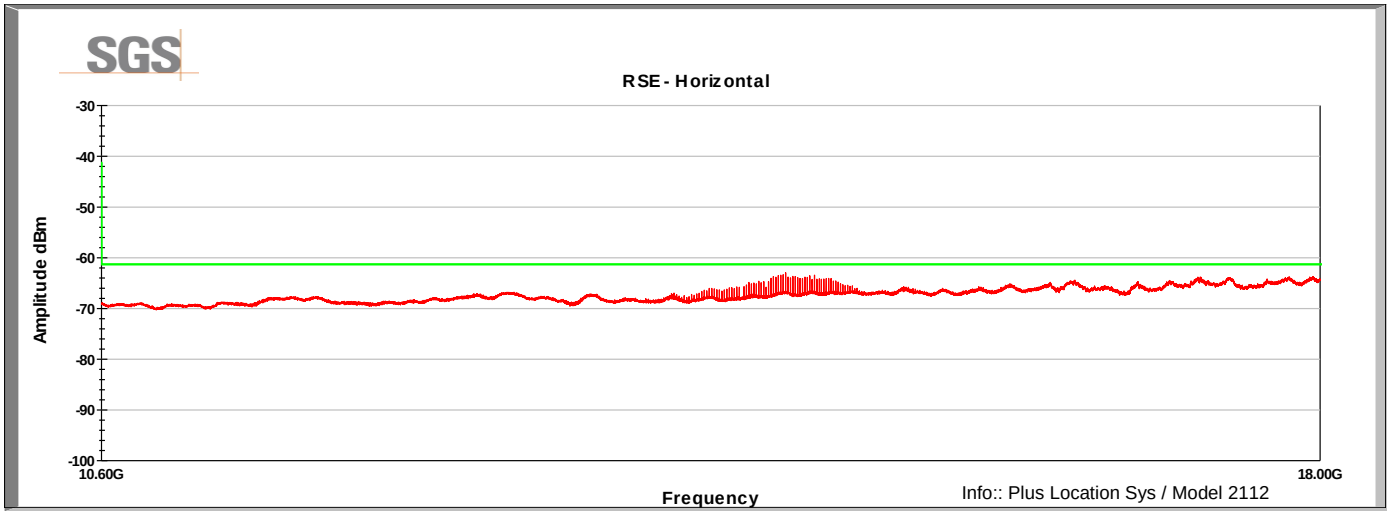
8300 to 10600 MHz
Test distance: 1m





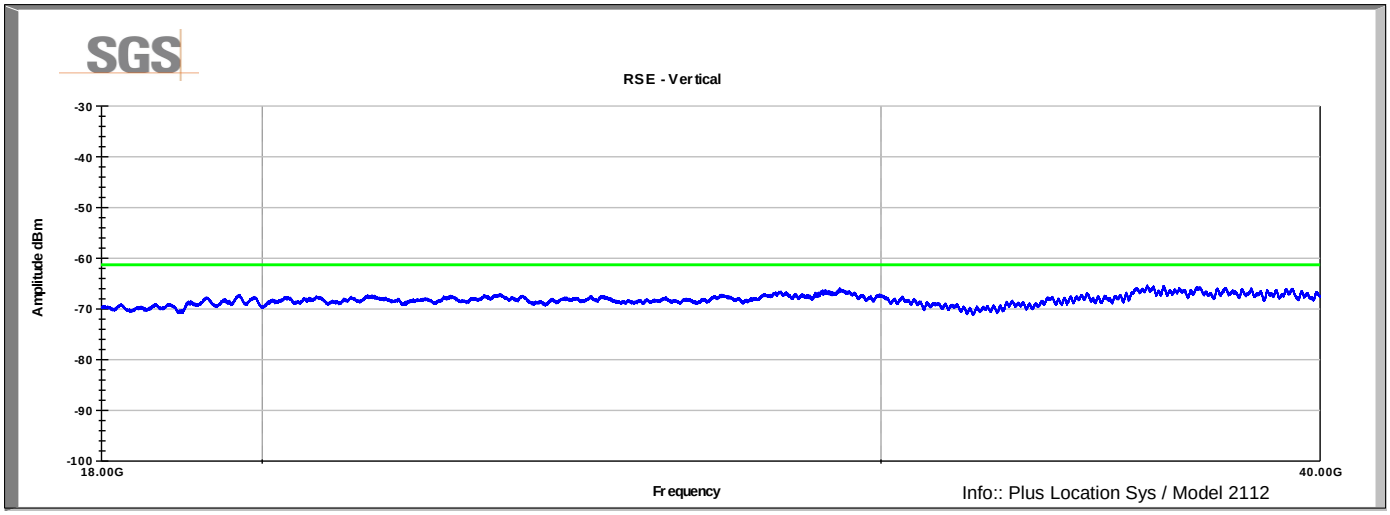
10.6 to 18 GHz
Test distance: 1m

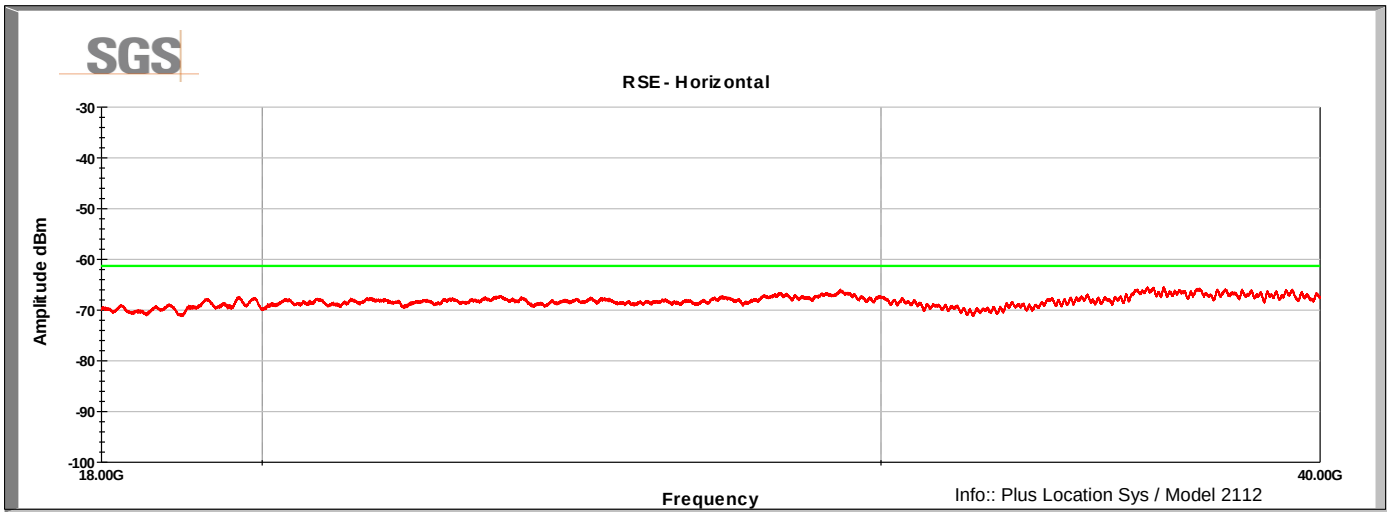




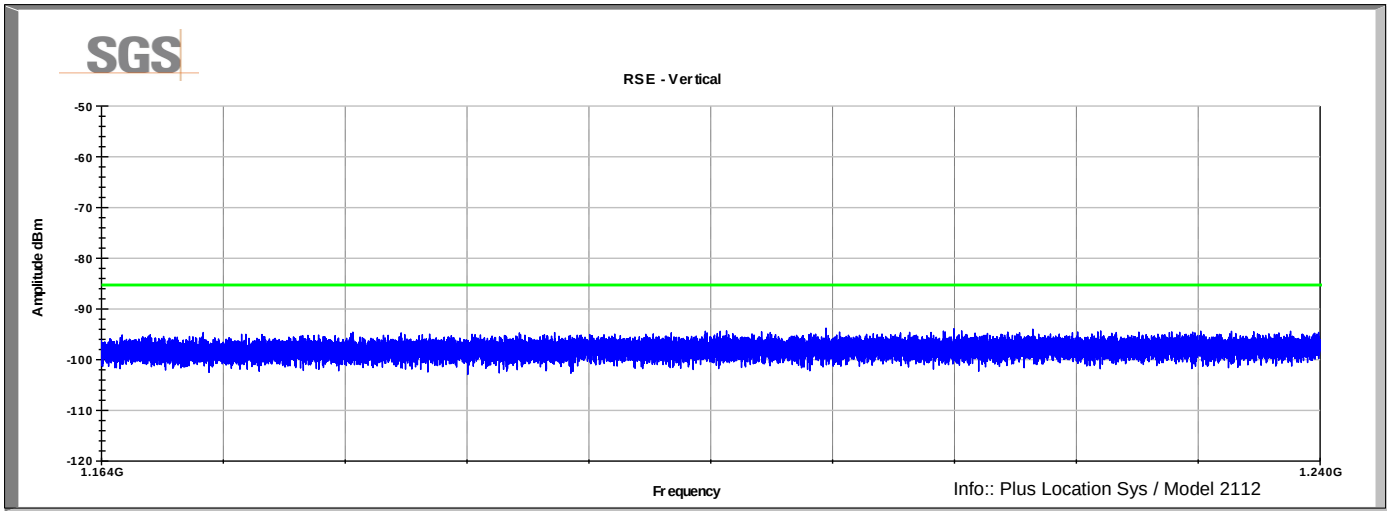
Frequency MHz	Raw Peak (dBuV)	Orientation x,y,z	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Conversion F.S. to EIRP	Peak Value dBm	Limit (dBm)	Margin (dB)
14273.00	32.2	Z	V	20.4	161.2	39.6	0.6	32.8	104.7	-65.1	-61.3	-3.8
14270.00	34.3	Y	H	338.0	165.4	39.6	0.6	32.8	104.7	-63.0	-61.3	-1.7
Peak Value = Raw Peak + AF + CL - Amp + FStoEIRP Conv												
Margin = Peak Value - Limit												

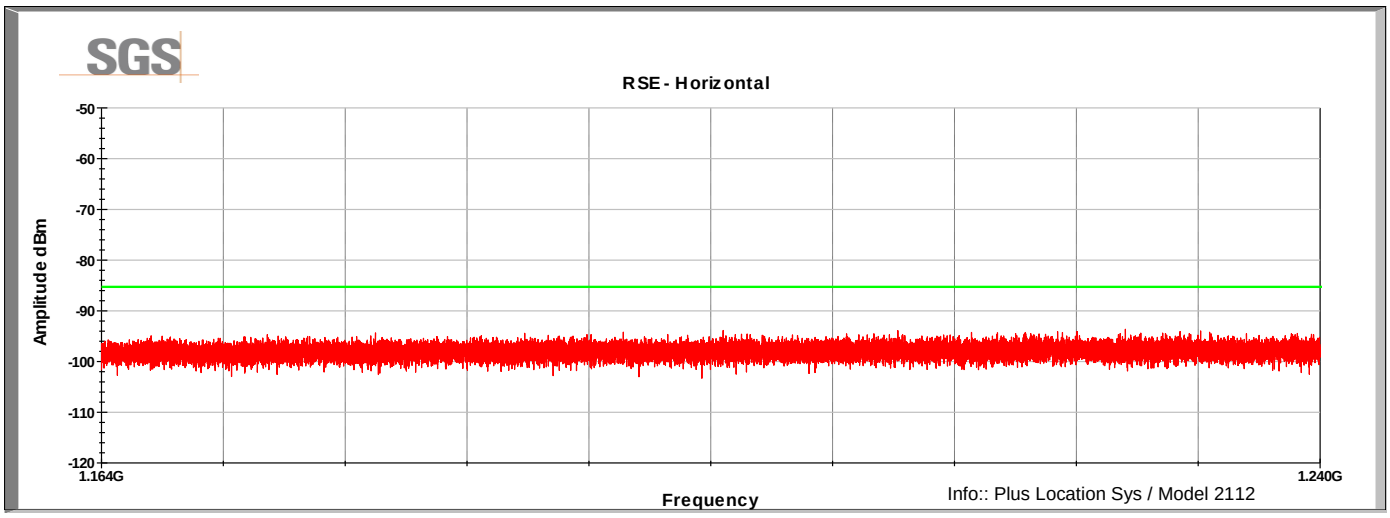
18 to 40 GHz
Test distance: 1m



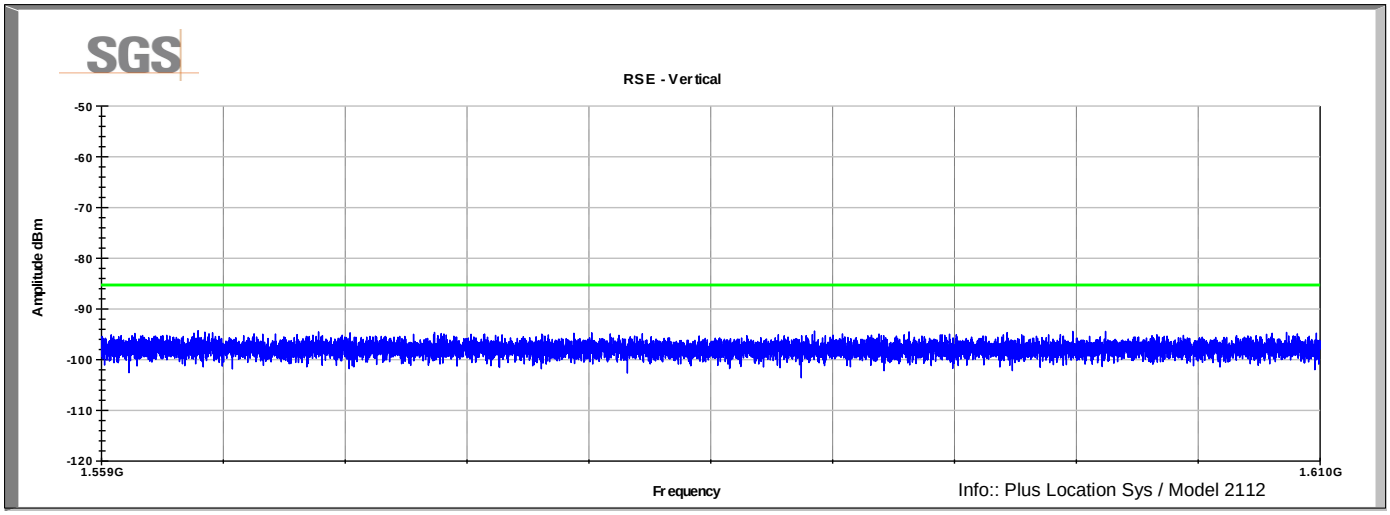


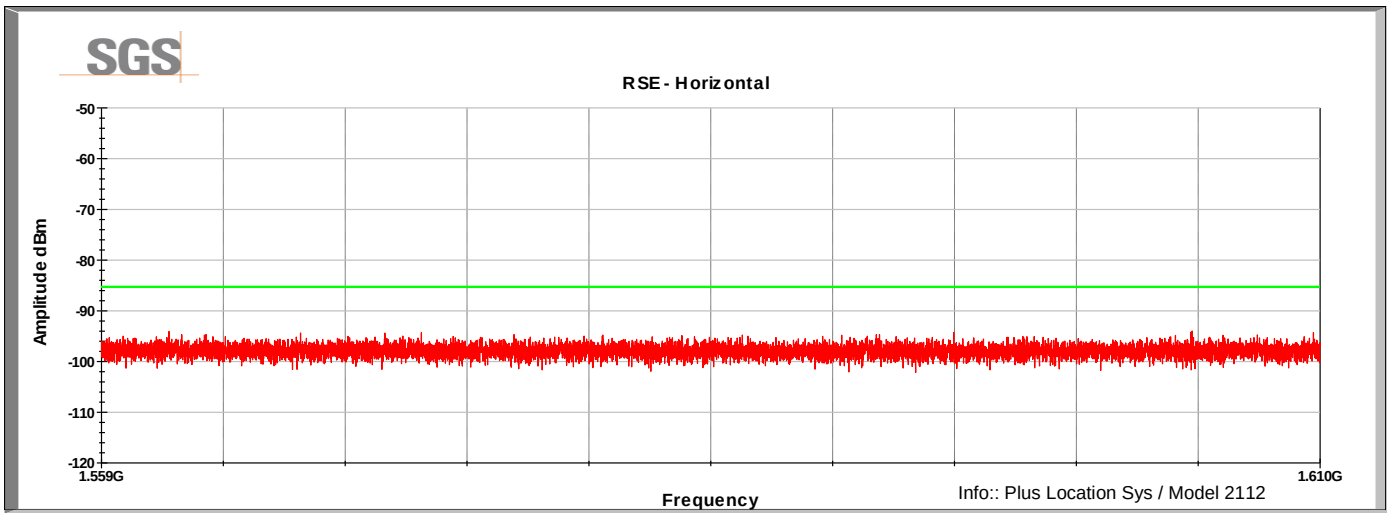
Lower GPS Band
Test distance: 1m





Upper GPS Band
Test distance: 1m





7 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	20 January 2016
1	- Added 18-40GHz test equipment to equipment table on page 16. - Added references to ANSI C63.10: 2013, Clause 10 to the results tables on pages 5, 9, 12, and 15.	17 March 2016