

EMC Test Report

Project Number: 2721762

Report Number: 2721762EMC01

Revision Level: 2

Client: Garmin

Equipment Under Test: Automotive Radio/CD Player/Navigation system

Model Name: Suzuki Infotainment System

Model Number: A2AVGB02NA3A and A2AVGB02NA1

Applicable Standards: § 15.249 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.

ANSI C63.10: 2009

Report issued on: 27 June 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.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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1 Summary of Test Results

Test Description	Test Specification	Test Result
Field strength of fundamental	15.249(a) RSS 210, A2.9 (1)	Compliant
Field strength of spurious radiation	15.249 (a) and 15.209 RSS 210 2.6, A2.9 (1)(2)	Compliant
Fixed, point-to-point	15.249(b)	Not applicable
20 dB bandwidth	15.215(c)	Report data only
99% Occupied bandwidth	RSS GEN 4.4.1	Report data only
Duty Cycle	15.35(c)	Report data only

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Garmin
 Address: 1200 E 151st Street
 City, State, Zip, Country: Olathe, KS 66062

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: Automotive Bluetooth Device
 Model Name: A2AVGB02NA3A
 Serial Number: 2NM000119
 Hardware Version: Rev. A
 Software Version: Not provided
 FCC ID: IPH-02023
 IC ID: 1792A-02023
 Rated Voltage: 12 Vdc
 Test Voltage: 13.9VDC

Sample Received Date: 16 April 2012
 Dates of testing: 23 April to May 9, 2012

Note: This report is also representative of Model: A2AVGB02NA1. This Family includes models A2AVGB02NA3A and A2AVGB02NA1 which differ only in areas unrelated to the Bluetooth performance. The model differences affect only the way in which the backlighting of the front panel is configured.

Operating Modes and Conditions

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

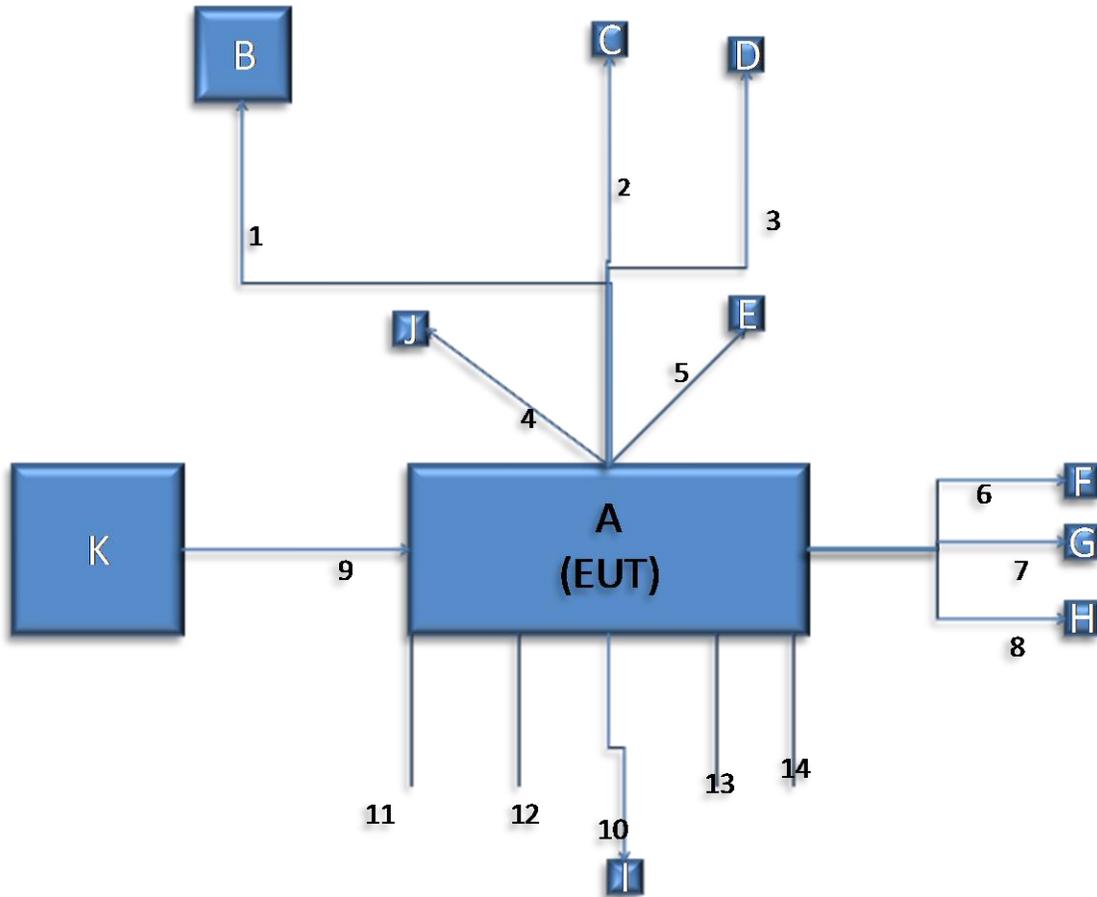
During testing, the hopping sequence was stopped in accordance with Section 5.1 of ANSI C63.10-2009 so that the low, mid and high channels could be tested independently.

Modulations used: For fundamental and spurious measurements, the EUT was configured to operate continuously with Bluetooth modulation enabled.

As specified in Section 5.10.5 of ANSI C63.10:2009:

- Software was designed to allow the EUT to operate
 - at 100 % duty cycle
 - at the worst-case duty cycle to allow measurements in instances where an average correction factor needs to be determined to calculate the average field strength from the measured peak field strength
- The software allowed configuration and operation on all available unlicensed wireless device channels.
- The software allowed configuration and operation using all available modulations and data rates
- The software allowed configuration and operation on all available power out levels
- Since this is a frequency hopping system, the software allowed the hopping sequence to be turned off

2.4 EUT Connection Block Diagram



2.5 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Garmin	EUT	A2AVGB02NA3A	2NM000119
B	MTX	Automotive Speaker Rear Left	Road Thunder	NA
C	NA	4Ω Resistor Load Front Right	NA	NA
D	NA	4Ω Resistor Load Front Left	NA	NA
E	NA	4Ω Resistor Load Rear Right	NA	NA
F	Garmin	Resistive load value unknown Ext. Microphone	NA	NA
G	Garmin	Camera simulating resistive load	NA	NA
H	Garmin	AM/FM antenna resistive load value unknown	NA	NA
I	Garmin	GPS antenna	013-00202-00-GA25MCX	NA
J	Garmin	Unk load SW audio in	NA	NA
K	TDK Lambda	Variable Power Supply	UP20-10	LOC-224A133-0008

2.6 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	RF Speaker	EUT	B	1.0m	No	No
2	FL Speaker	EUT	C	1.0m	No	No
3	RR Speaker	EUT	D	1.0m	No	No
4	RL Speaker	EUT	J	1.0m	No	No
5	SW Audio in/SW HF in	EUT	E	1.0m	No	No
6	EXT. Microphone	EUT	F	.1m	No	No
7	Camera	EUT	G	.1m	No	No
8	AM/FM ant	EUT	H	.1m	No	Yes
9	DC Power (12VDC POS: Ant PWR, ACC, VBATT) (12VDC NEG: GND, Reverse light, Ant pwr gnd)	K	A (EUT)	1.0m	No	No
10	GPS antenna	EUT	I	3.25m	No	Yes
11	USB	EUT	UNTERM	.5m	No	Yes
12	Red/Green twisted pair	EUT	UNTERM	1.0m	No	No
13	Orange wire	EUT	UNTERM	1.0m	No	No
14	Brown wire Speed signal in	EUT	UNTERM	1.0m	No	No

3 Field Strength of Fundamental

3.1 Test Result

Test Description	Test Specification	Test Result
Field strength of fundamental	15.249(a) RSS 210, A2.9 (1)	Compliant

3.2 Test Method

The test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. Average measurements were made by correcting the peak value with the duty cycle correction factor. 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.

Test distance: The EUT to measurement antenna distance is 3 meters.

Fundamental Frequency	Average Limits at 3m			Peak Limits at 3m dBuV/m
	Millivolts/meter	Microvolts/m	dBuV/m	
902 - 928 MHz	50	50000	94	114
2400 - 2483.5 MHz	50	50000	94	114
5725 - 5875 MHz	50	50000	94	114
24 - 24.25 GHz	250	250000	108	128

3.3 Test Site

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

Environmental Conditions

Temperature: 23.1 °C
 Relative Humidity: 60.0 %
 Atmospheric Pressure: 97.3 kPa

3.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Bilog Antenna	JB6	Sunol	B079689	24 Aug 2012
Receiver	ESU40	R & S	B079629	25 AUG 2012
Pre-Amplifier	NSP1800-25-HG	Miteq	B085930	14 Oct 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079712	12 Aug 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079711	12 Aug 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B085888	26 Sep 2012

Note: The calibration period equipment is 1 year.

3.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

3.6 Test Data

Peak Test Data at a distance of 3m

Frequency MHz	Level (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Peak Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2402.00	55.6	V	131.1	201.4	32.3	2.6	0.0	90.5	114.0	-23.5
2402.00	50.8	H	156.0	371.0	32.3	2.6	0.0	85.7	114.0	-28.3
2440.90	56.6	V	215.0	205.0	32.3	2.7	0.0	91.6	114.0	-22.4
2440.90	50.2	H	170.0	226.0	32.3	2.7	0.0	85.2	114.0	-28.8
2480.00	58.4	V	179.5	187.3	32.3	2.7	0.0	93.4	114.0	-20.6
2480.00	52.4	H	32.9	199.6	32.3	2.7	0.0	87.4	114.0	-26.6
Peak detector, 1 MHz RBW, 1 MHz VBW										
Peak Value = Level + AF + CL - Amp										
Margin = Peak Value - Limit										

Average Test Data

Frequency MHz	Level (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2402.00	55.6	V	131.1	201.4	32.3	2.6	0.0	-17.4	73.1	94.0	-20.9
2402.00	50.8	H	156.0	371.0	32.3	2.6	0.0	-17.4	68.3	94.0	-25.7
2440.90	56.6	V	215.0	205.0	32.3	2.7	0.0	-17.4	74.2	94.0	-19.8
2440.90	50.2	H	170.0	226.0	32.3	2.7	0.0	-17.4	67.8	94.0	-26.2
2480.00	58.4	V	179.5	187.3	32.3	2.7	0.0	-17.4	76.0	94.0	-18.0
2480.00	52.4	H	32.9	199.6	32.3	2.7	0.0	-17.4	70.0	94.0	-24.0
Peak detector, 1 MHz RBW, 1 MHz VBW											
Avg Value = Level + AF + CL - Amp + DCCF											
Margin = Avg Value - Limit											

4 Field Strength of Spurious Radiation

4.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.249 (a) and 15.209 RSS 210 2.6, A2.9 (1)(2)	Compliant

4.2 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 detector above 1GHz. For harmonics of the fundamental, Average measurements were made by correcting the peak value with the duty cycle correction factor. For emissions other than harmonics of the fundamental, the Average measurements were made using the Average detector. 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.

Test distance:

30 MHz to 1 GHz - The EUT to measurement antenna distance is 3 meters

1 to 18 GHz - The EUT to measurement antenna distance is 3 meters

18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

Frequency	Limits ⁽¹⁾		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽²⁾	--
88 - 216 MHz	150	43.5 ⁽²⁾	--
216 - 960 MHz	200	46 ⁽²⁾	--
960 - 1000 MHz	500	54 ⁽²⁾	--
1 - 40 GHz	500	54 ⁽³⁾	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

4.3 Test Site

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

Environmental Conditions

Temperature: 23.3 °C

Relative Humidity: 60.2 %

Atmospheric Pressure: 98.2 kPa

4.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Bilog Antenna	JB6	Sunol	B079689	24 Aug 2012
Receiver	ESU40	R & S	B079629	25 AUG 2012
Pre-Amplifier	NSP1800-25-HG	Miteq	B085930	14 Oct 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079712	12 Aug 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B079711	12 Aug 2012
Coaxial Cable	Sucoflex 106	Huber+Suhner	B085888	26 Sep 2012

Note: The calibration period equipment is 1 year.

4.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

4.6 Test Data

Peak Data

Channel	Frequency MHz	Level (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Peak Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Low	4804.00	61.5	H	170.0	208.0	34.5	3.8	44.6	55.2	74.0	-18.8
Low	4804.00	53.6	V	299.0	281.0	34.5	3.8	44.6	47.3	74.0	-26.7
Mid	4882.80	54.9	H	257.0	295.0	34.5	3.8	44.6	48.6	74.0	-25.5
Mid	4882.80	60.3	V	132.0	204.0	34.5	3.8	44.6	54.0	74.0	-20.0
High	4960.10	63.8	H	168.0	243.0	34.5	3.8	44.6	57.5	74.0	-16.5
High	4960.10	57.5	V	57.5	30.0	34.5	3.8	44.6	51.2	74.0	-22.8
Low, Mid, High	2400.00	63.2	H	131.1	201.4	32.3	2.6	44.2	53.9	74.0	-20.1
Low, Mid, High	2400.00	60.8	V	156.0	371.0	32.3	2.6	44.2	51.5	74.0	-22.5
Low, Mid, High	2483.50	61.7	H	179.5	187.0	32.3	2.6	44.2	52.4	74.0	-21.6
Low, Mid, High	2483.50	58.9	V	32.9	199.6	32.3	2.6	44.2	49.5	74.0	-24.5

Peak detector, 1 MHz RBW, 1 MHz VBW

Peak Value = Level + AF + CL - Amp

Margin = Peak Value - Limit

Measurements made at bandedge were noise floor.

Average Data

Channel	Frequency MHz	Level (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	DCCF (dB)	Avg Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Low	4804.00	61.5	V	131.1	201.4	34.5	3.8	44.6	-17.4	37.8	54.0	-16.2
Low	4804.00	53.6	H	156.0	371.0	34.5	3.8	44.6	-17.4	29.9	54.0	-24.1
Mid	4882.80	54.9	V	215.0	205.0	34.5	3.8	44.6	-17.4	31.2	54.0	-22.9
Mid	4882.80	60.3	H	170.0	226.0	34.5	3.8	44.6	-17.4	36.6	54.0	-17.4
High	4960.10	63.8	V	179.5	187.3	34.5	3.8	44.6	-17.4	40.1	54.0	-13.9
High	4960.10	57.5	H	32.9	199.6	34.5	3.8	44.6	-17.4	33.8	54.0	-20.2
Low, Mid, High	2400.00	63.2	H	131.1	201.4	32.3	2.6	44.2	-17.4	36.5	54.0	-17.5
Low, Mid, High	2400.00	60.8	V	156.0	371.0	32.3	2.6	44.2	-17.4	34.1	54.0	-19.9
Low, Mid, High	2483.50	61.7	H	179.5	187.0	32.3	2.6	44.2	-17.4	35.0	54.0	-19.0
Low, Mid, High	2483.50	58.9	V	32.9	199.6	32.3	2.6	44.2	-17.4	32.1	54.0	-21.9

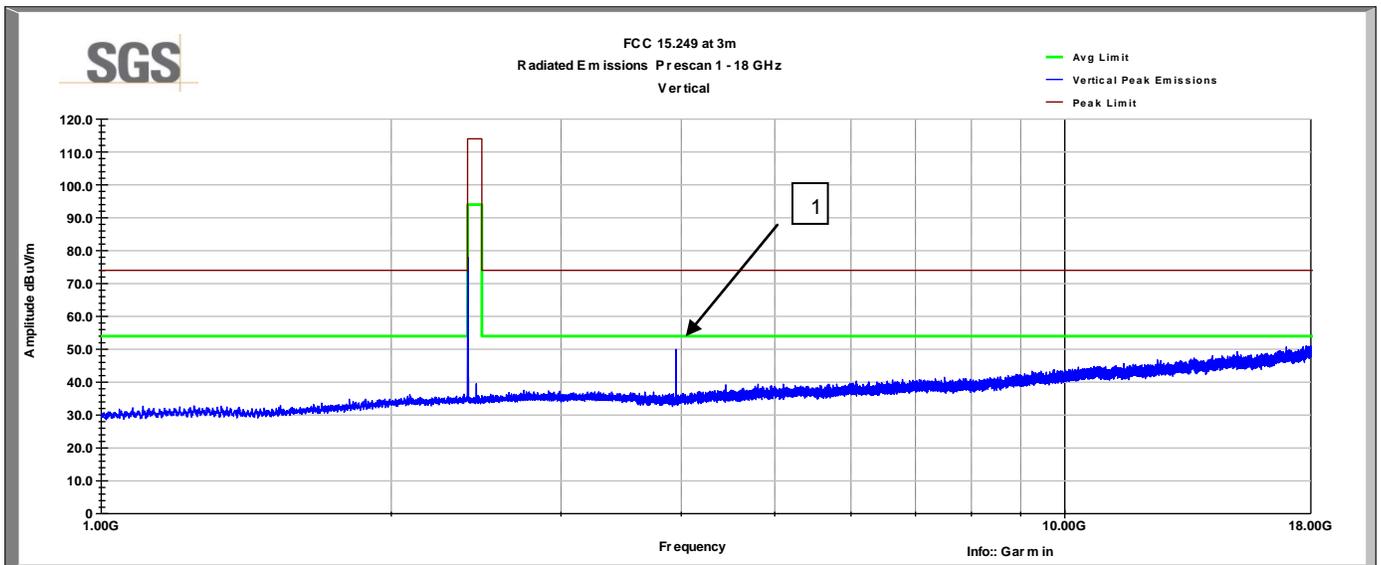
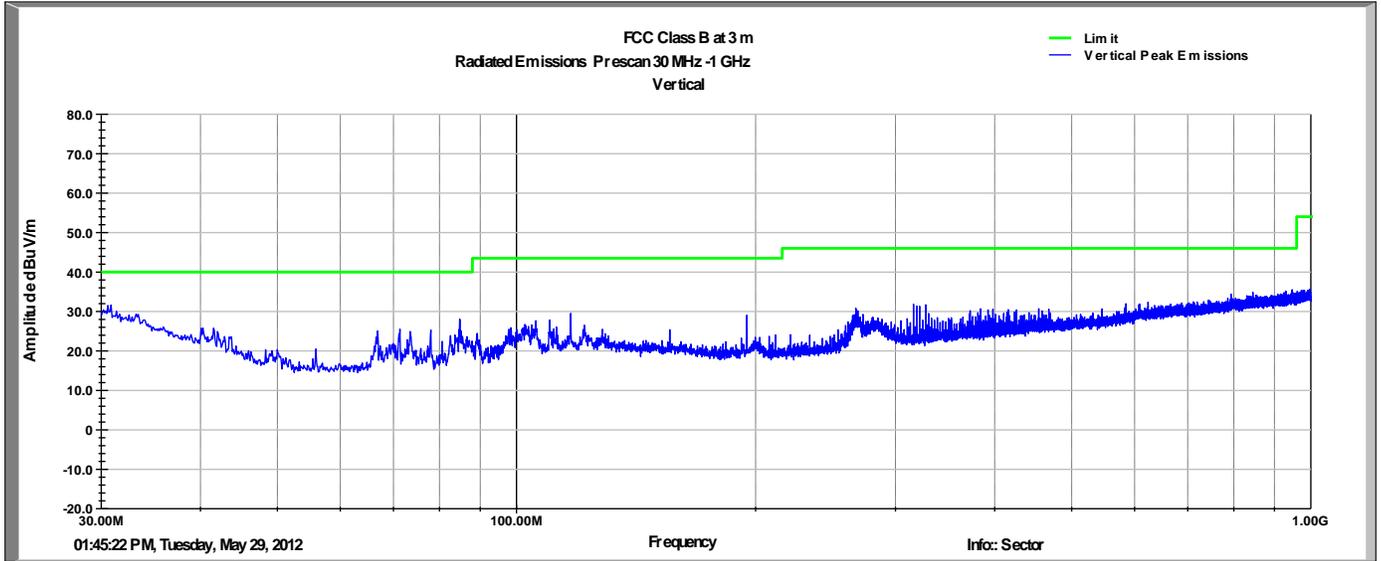
Peak detector, 1 MHz RBW, 1 MHz VBW

Avg Value = Level + AF + CL - Amp + DCCF

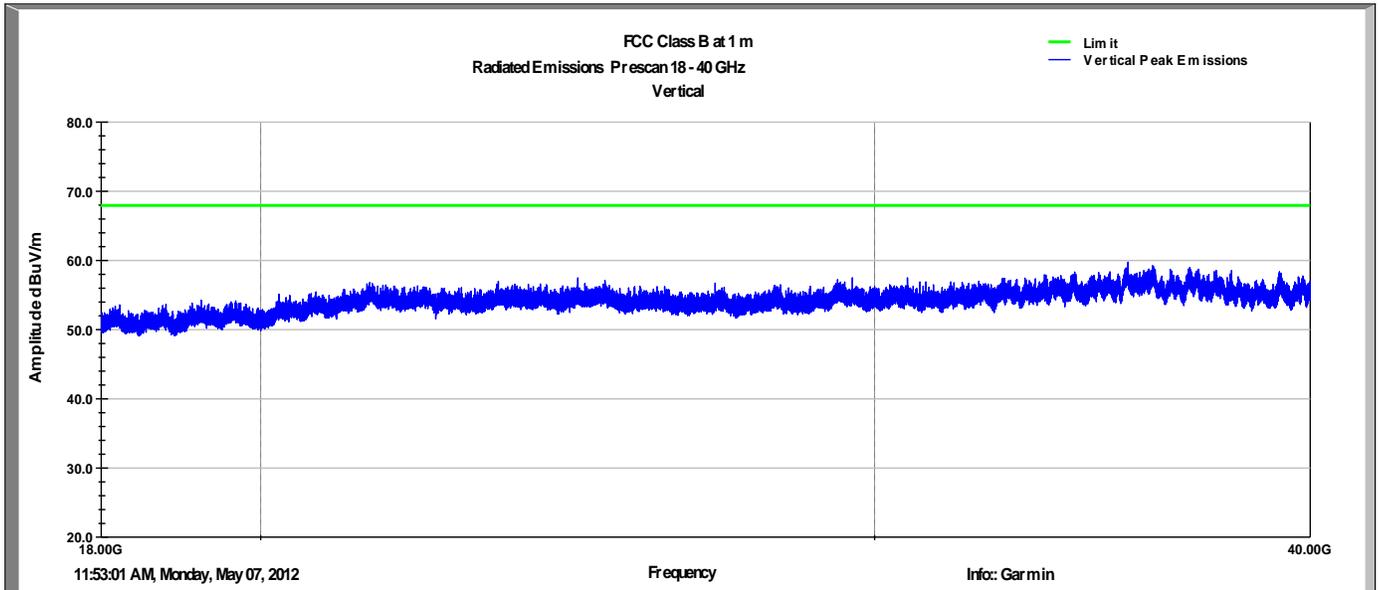
Margin = Avg Value - Limit

Measurements made at bandedge were noise floor.

Vertical - Low Channel

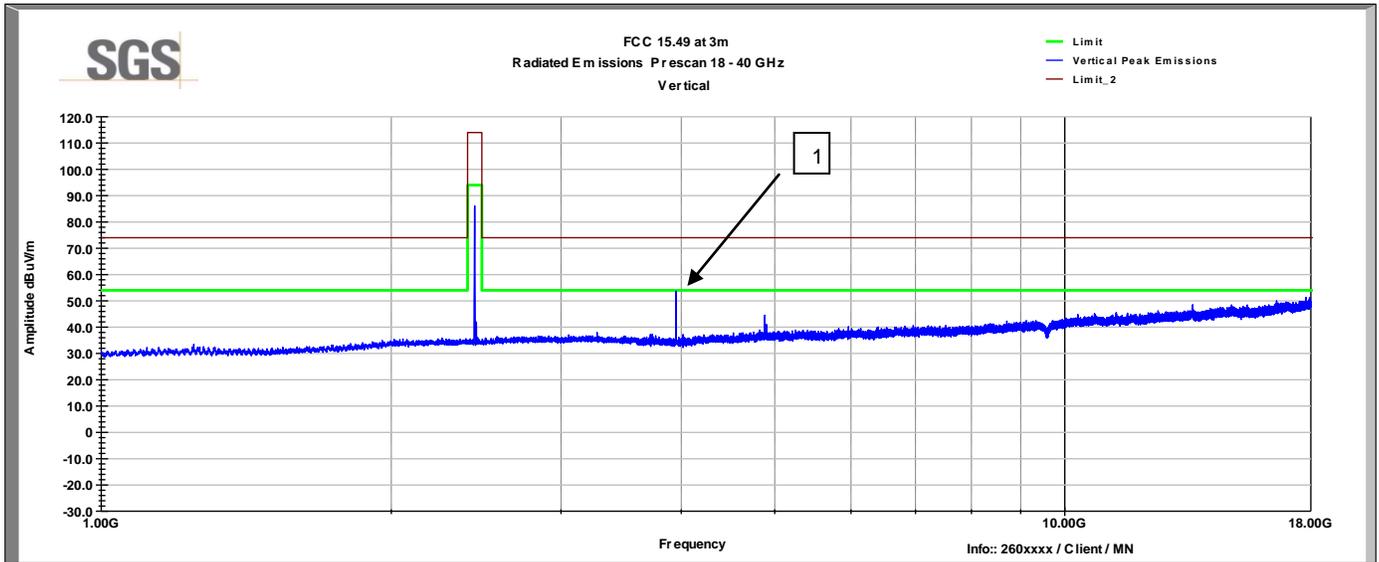
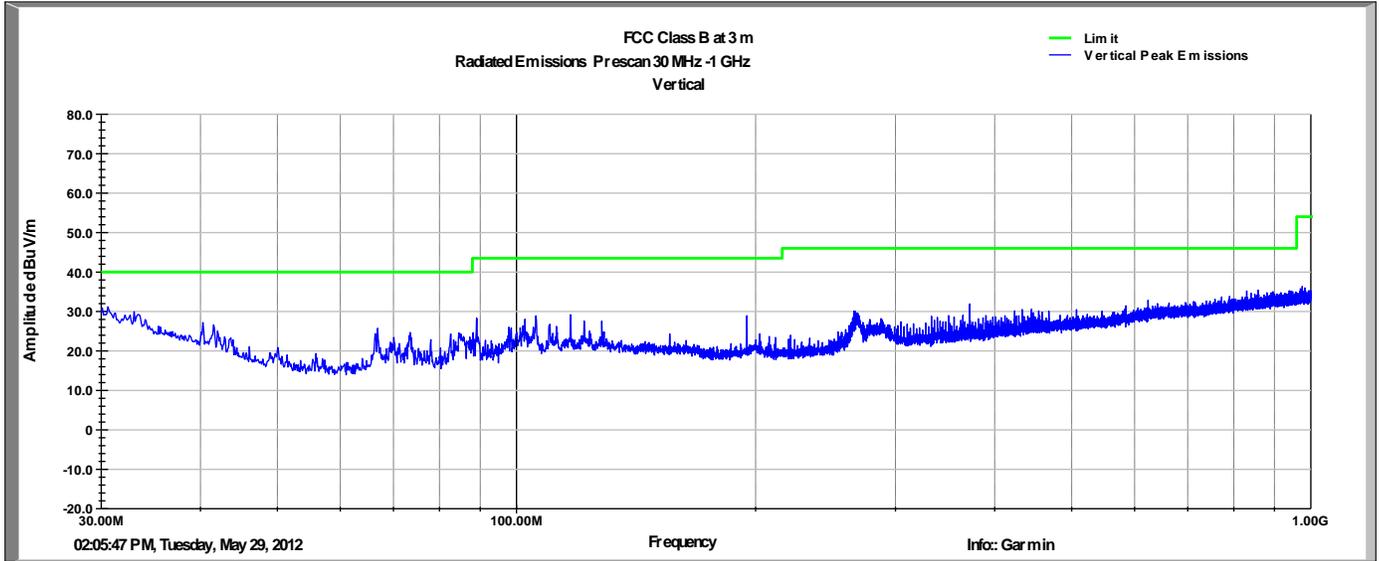


Note: (1) 3949 MHz signal is unrelated to Bluetooth functionality

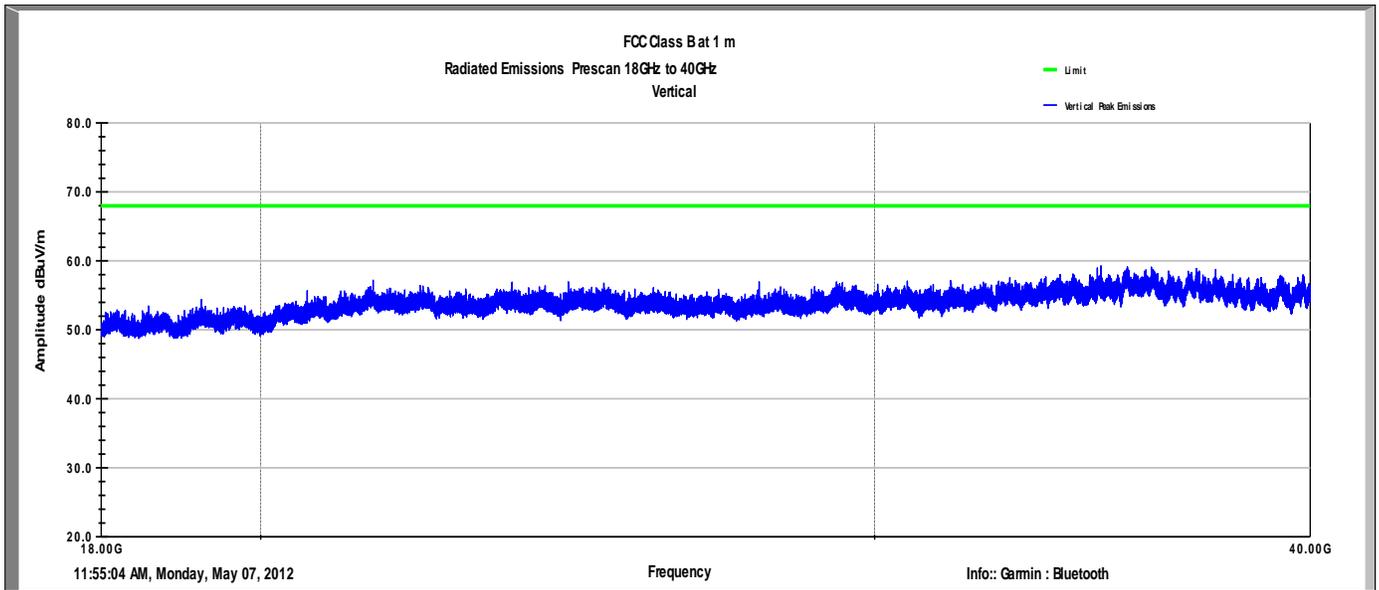


Note: No emissions were measured above the equipment noise floor.

Mid Channel

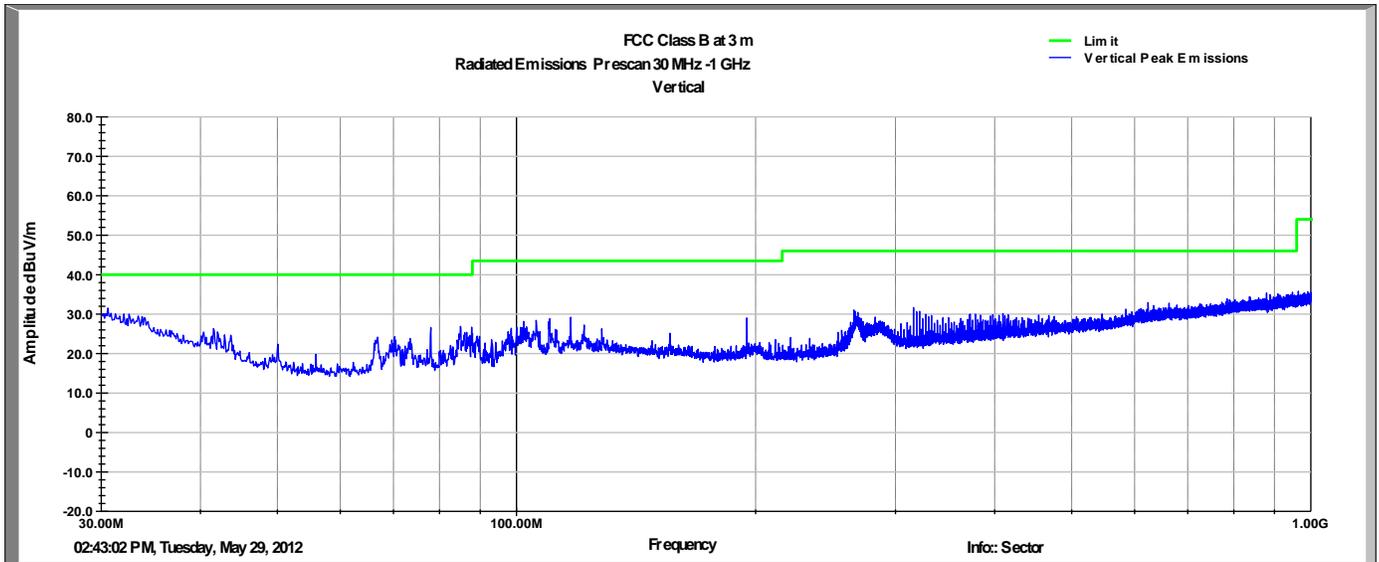


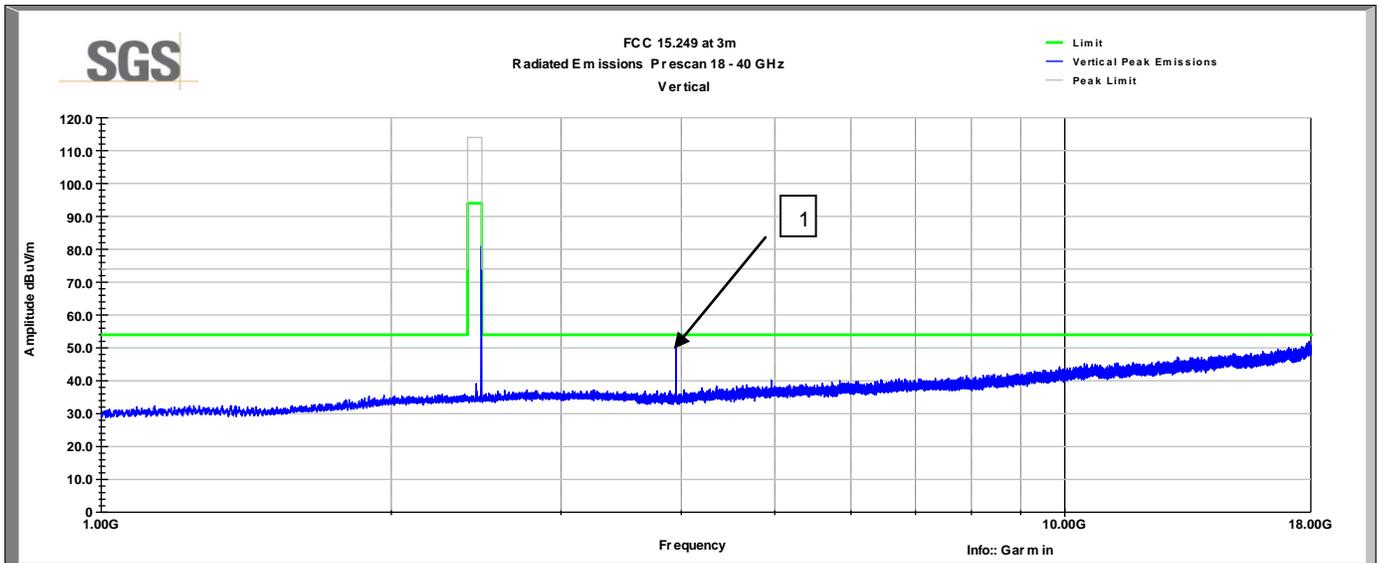
Note: (1) 3949 MHz signal is unrelated to Bluetooth functionality



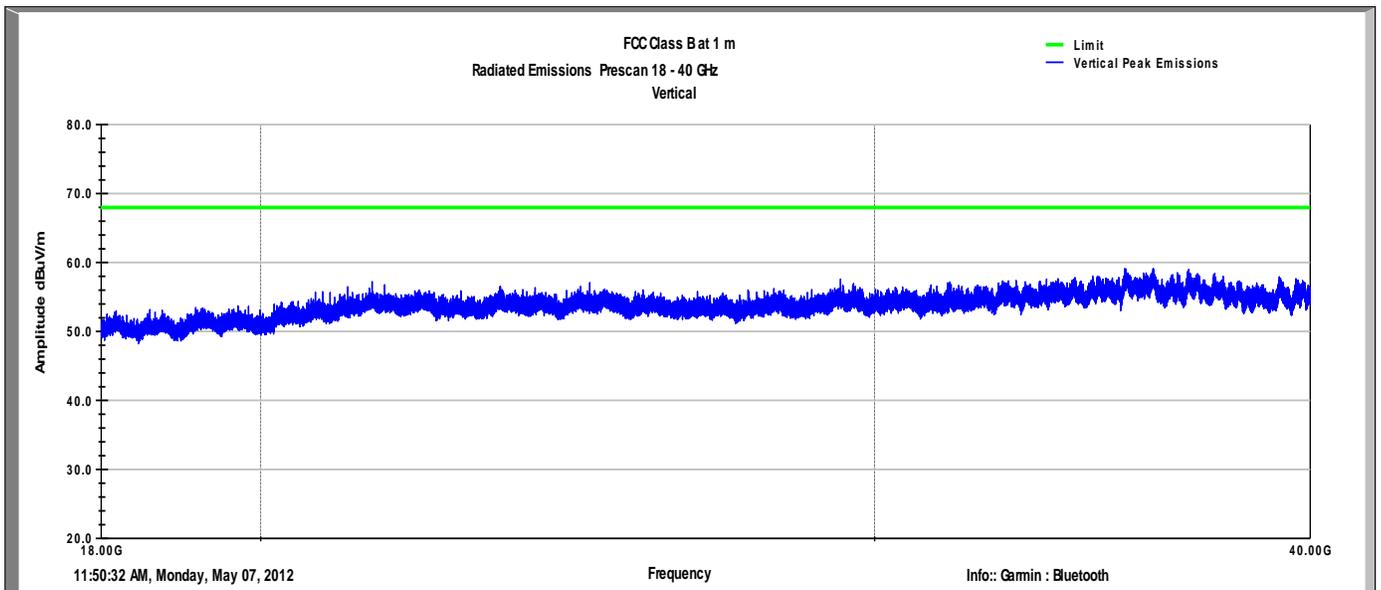
Note: No emissions were measured above the equipment noise floor.

High Channel



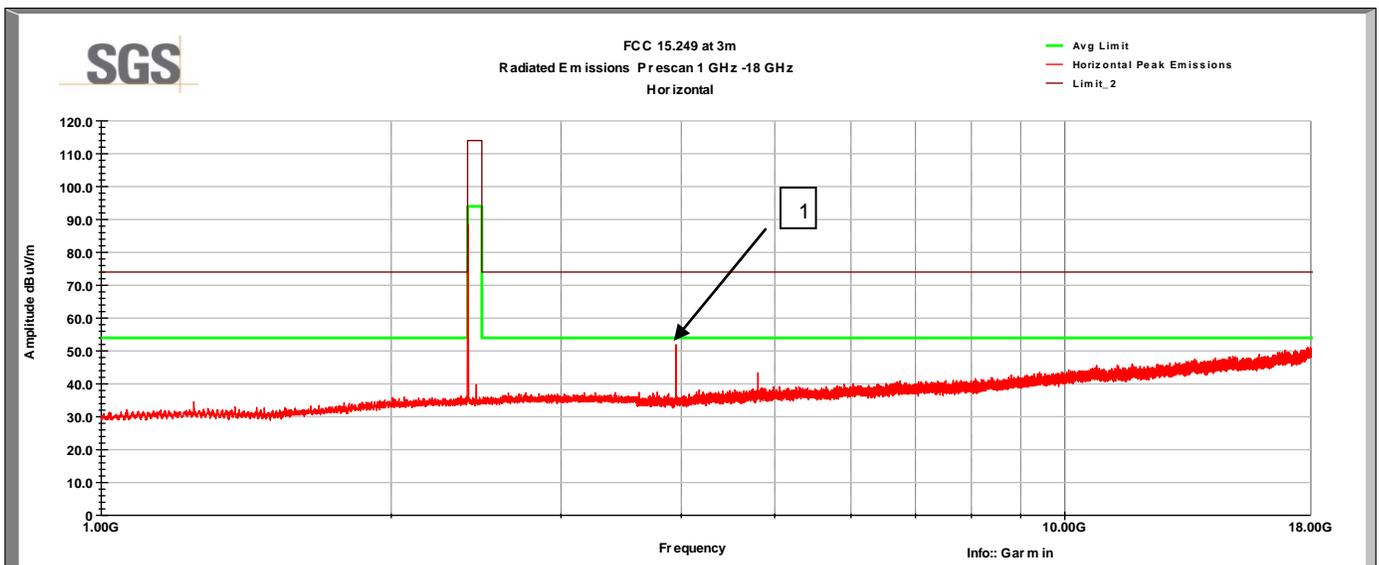
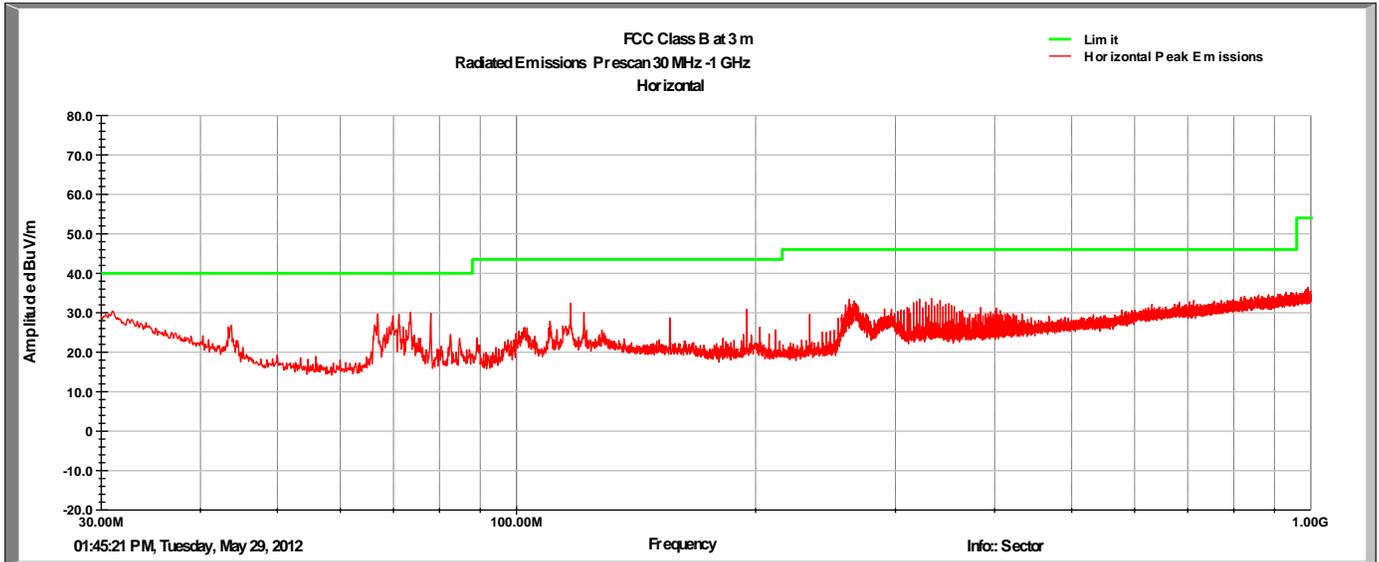


Note: (1) 3949 MHz signal is unrelated to Bluetooth functionality

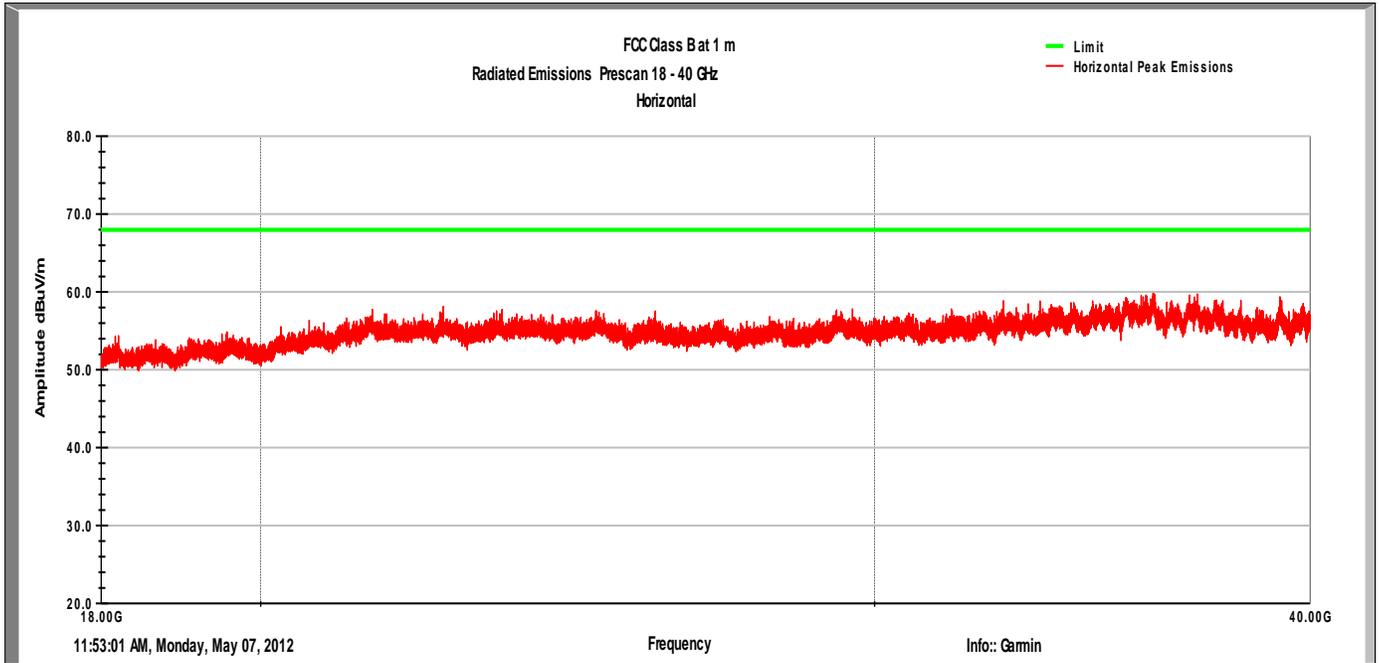


No emissions measured above the equipment noise floor

Horizontal Data - Low Channel

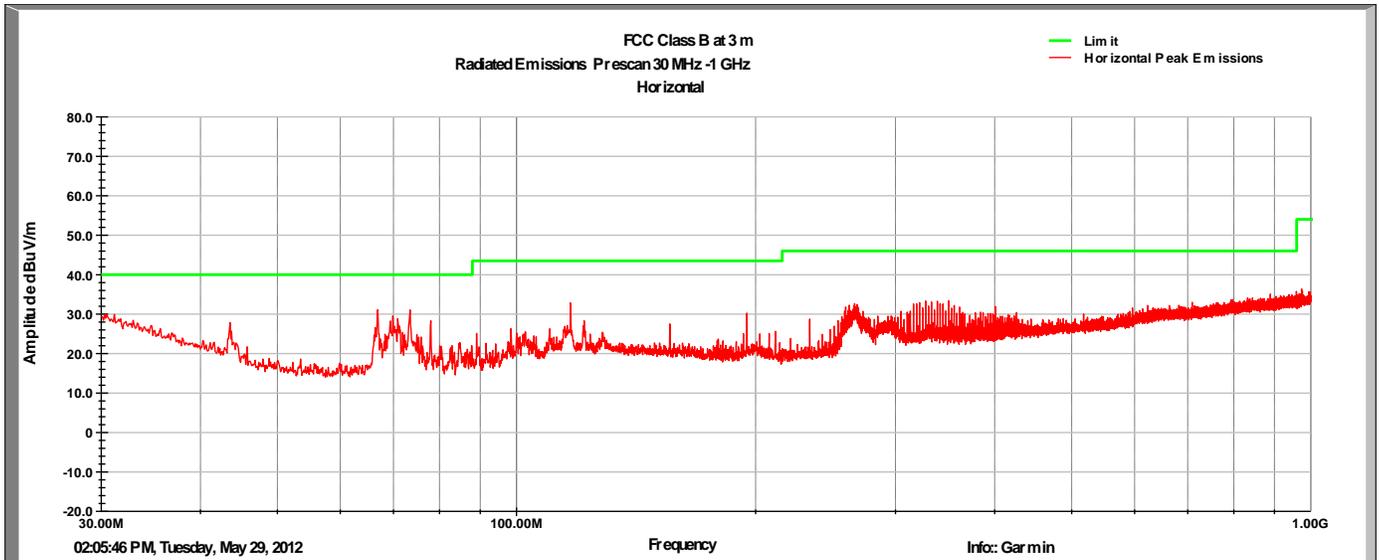


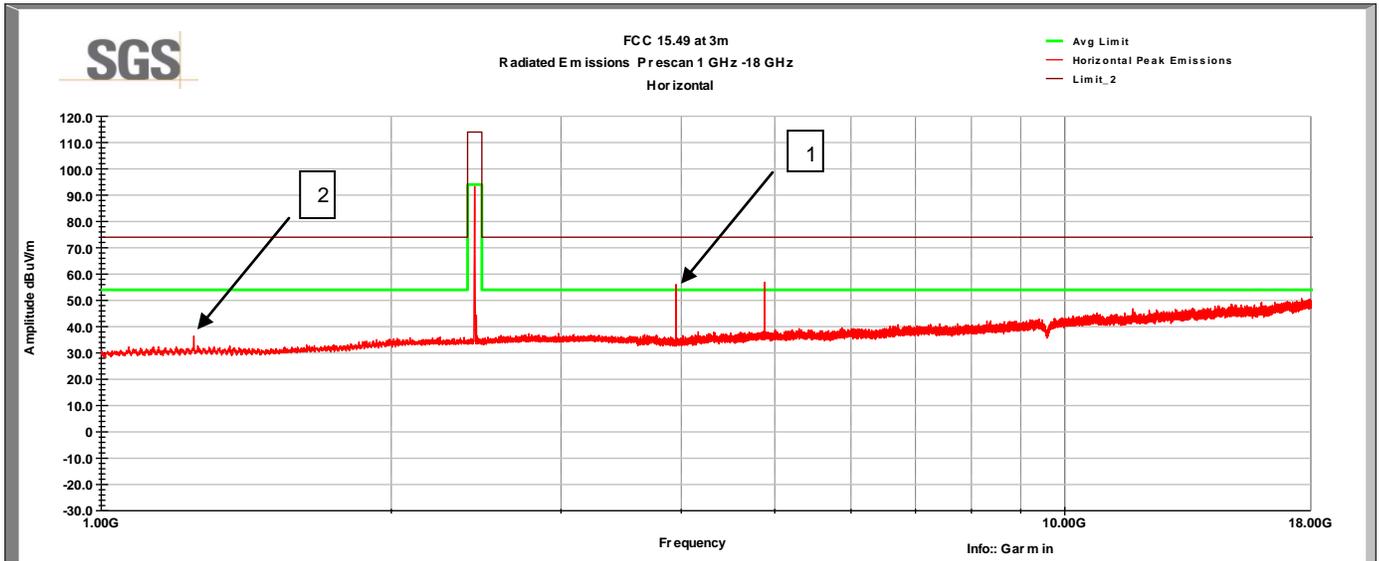
Note: (1) 3949 MHz signal is unrelated to Bluetooth functionality



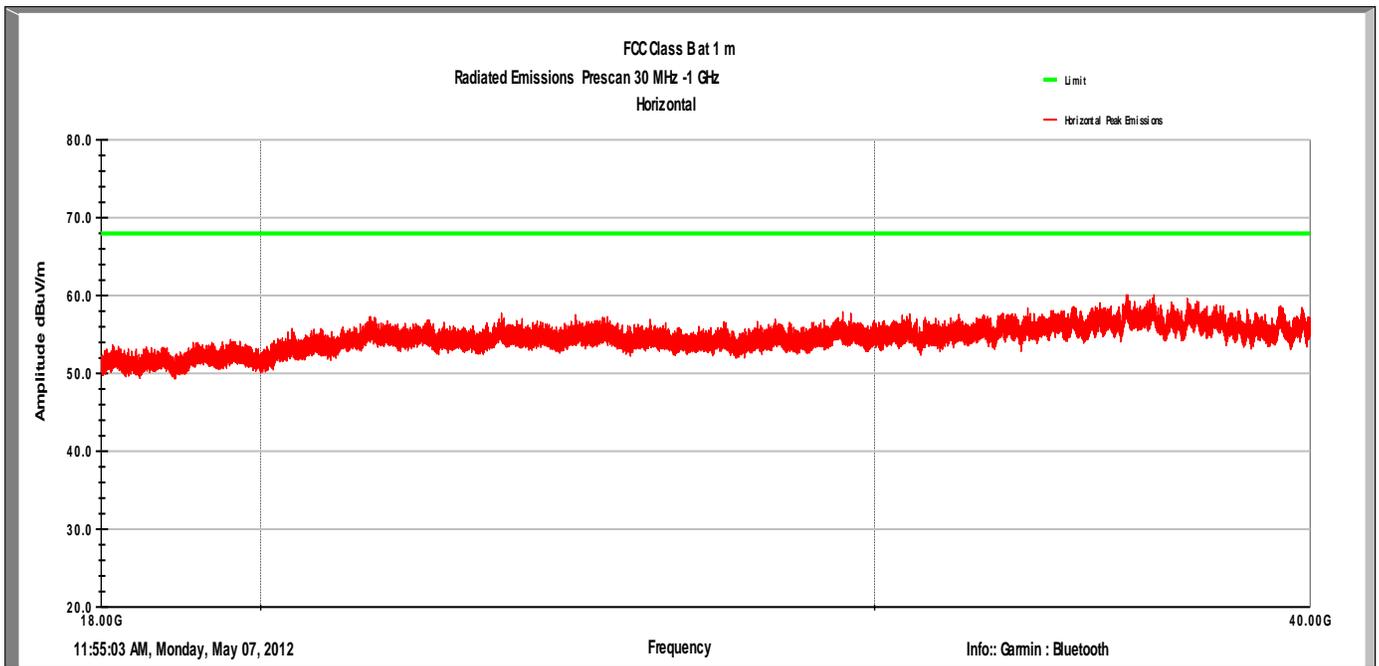
No emissions measured above the equipment noise floor

Mid Channel



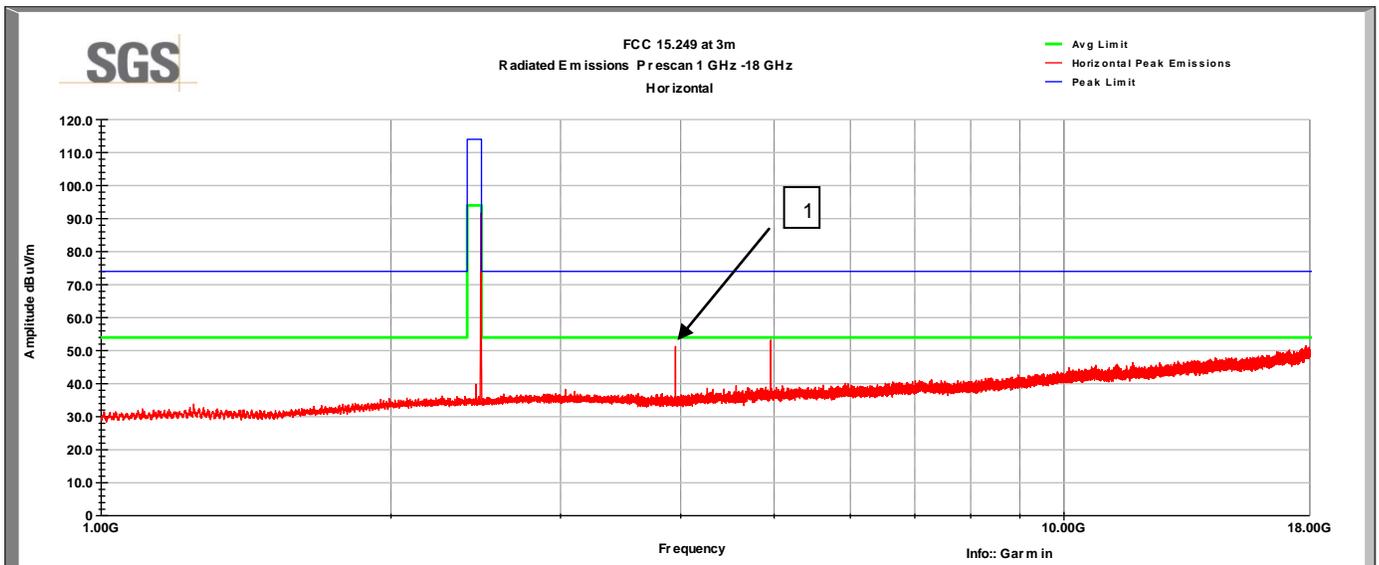
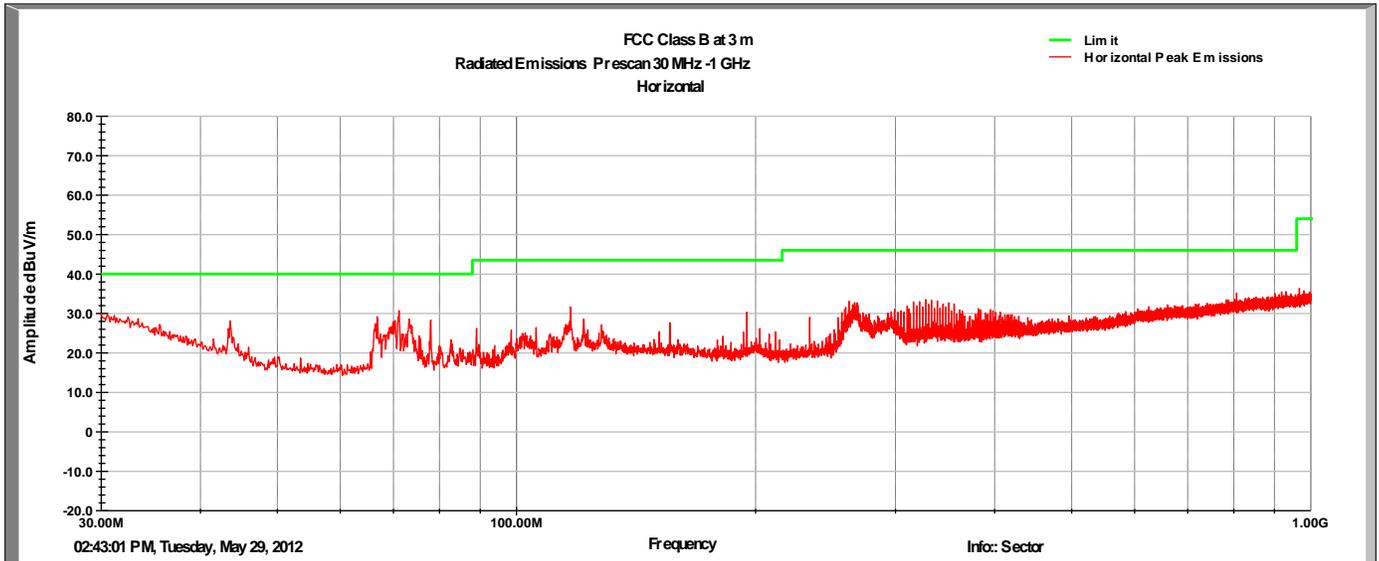


Note: (1) 3949 MHz signal is unrelated to Bluetooth functionality
 (2) 1247 MHz signal is not EUT generated

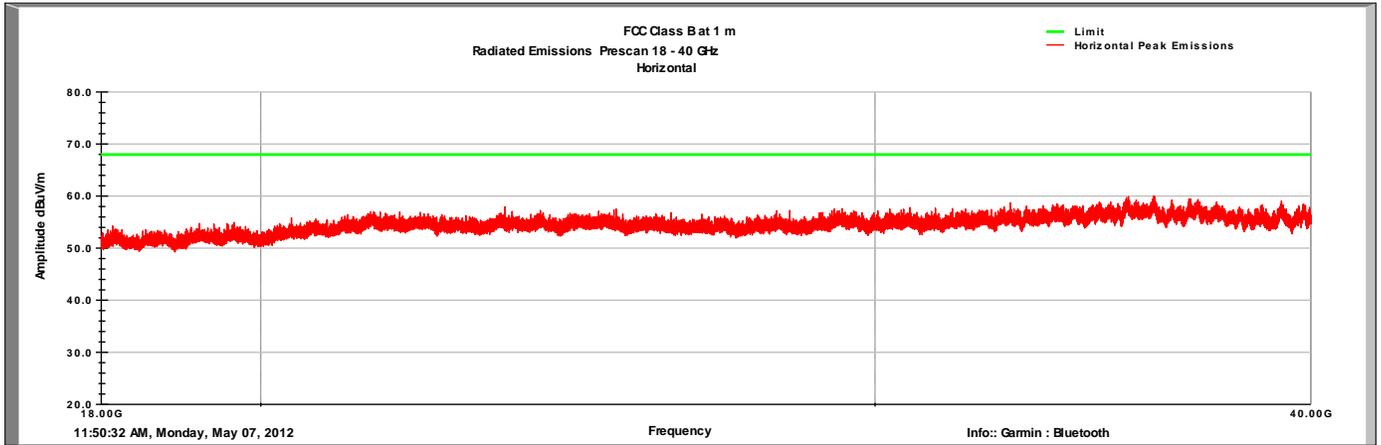


No emissions measured above the equipment noise floor

High Channel



Note: 3949 MHz signal is unrelated to Bluetooth functionality



No emissions measured above the equipment noise floor

5 20 dB Bandwidth

5.1 Test Result

Test Description	Basic Standards	Test Result
20 dB bandwidth	15.215(c)	Low 797.06 kHz
20 dB bandwidth	15.215(c)	Mid 801.27 kHz
20 dB bandwidth	15.215(c)	High 794.42 kHz

5.2 Test Method

The procedures from ANSI C63.10 (2009) clause 6.9 were used to determine the 20 dB bandwidth.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0 °C
 Relative Humidity: 48.0 %
 Atmospheric Pressure: 97.8 kPa

5.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Receiver	ESU40	R & S	B079629	25 AUG 2012

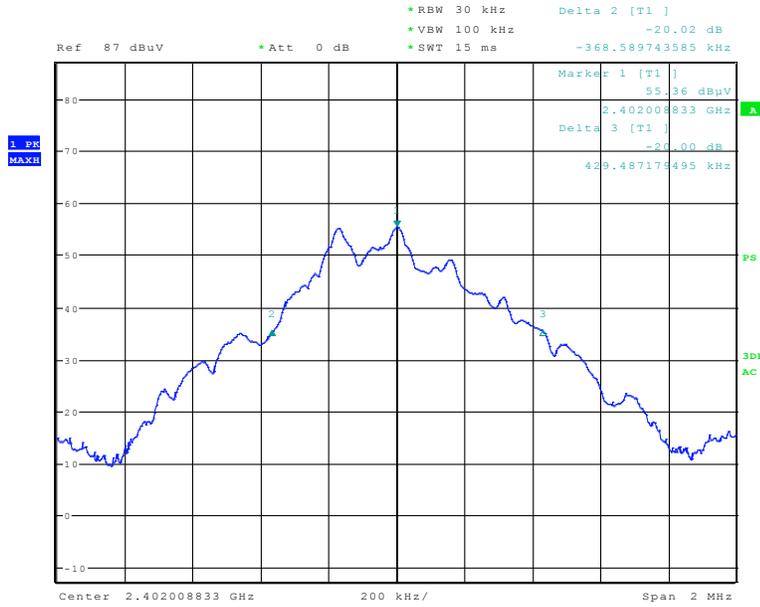
Note: The calibration period equipment is 1 year.

5.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

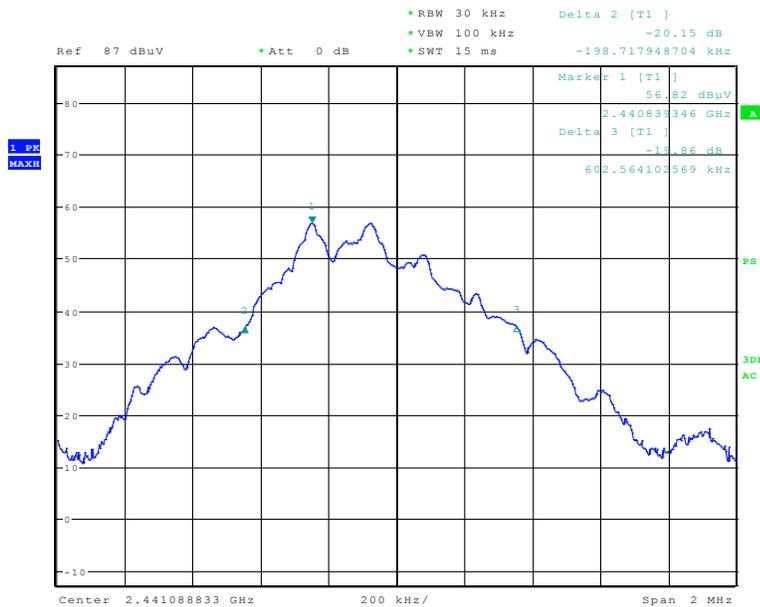
5.6 Test Data

20 dB Bandwidth Plot, Low Channel



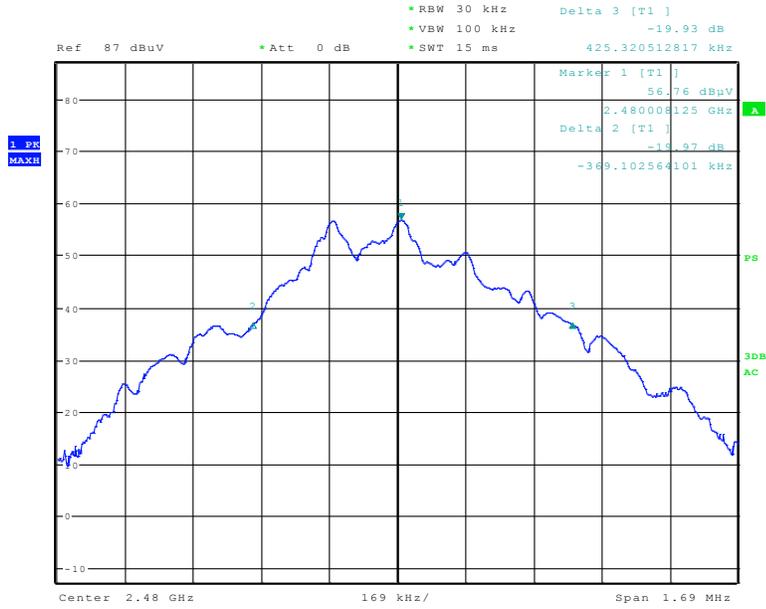
Date: 25.APR.2012 16:48:23

20 dB Bandwidth Plot, Mid Channel



Date: 25.APR.2012 16:55:48

20 dB Bandwidth Plot, High Channel



Date: 25.APR.2012 16:59:35

6 99% Bandwidth

6.1 Test Result

Test Description	Basic Standards	Test Result
99% Occupied bandwidth Low Channel	RSS GEN 4.4.1	829.4 kHz
99% Occupied bandwidth Mid Channel	RSS GEN 4.4.1	838.2 kHz
99% Occupied bandwidth High Channel	RSS GEN 4.4.1	835.4 kHz

6.2 Test Method

The 99% bandwidth function of the receiver was used.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.4 °C

Relative Humidity: 54.6 %

6.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Receiver	ESU40	R & S	B079629	25 AUG 2012

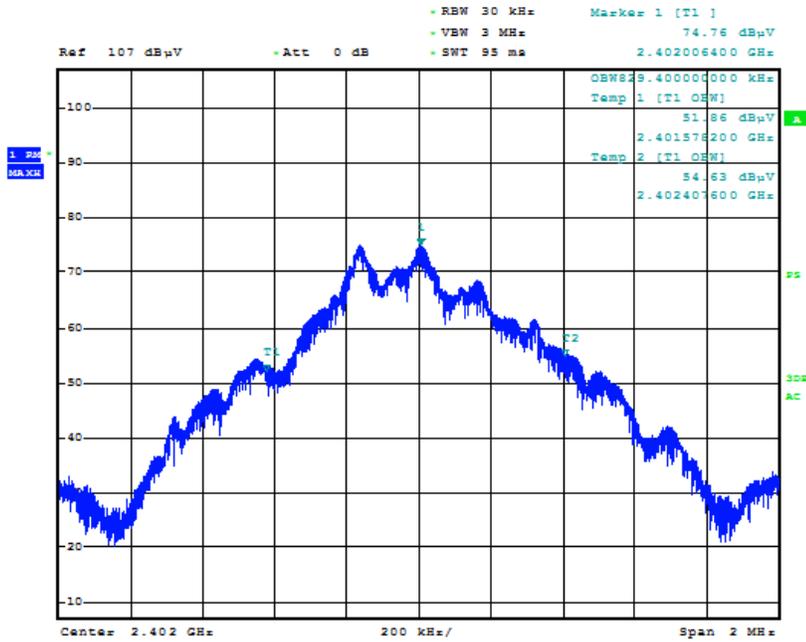
Note: The calibration period equipment is 1 year.

6.5 Test Setup Photographs

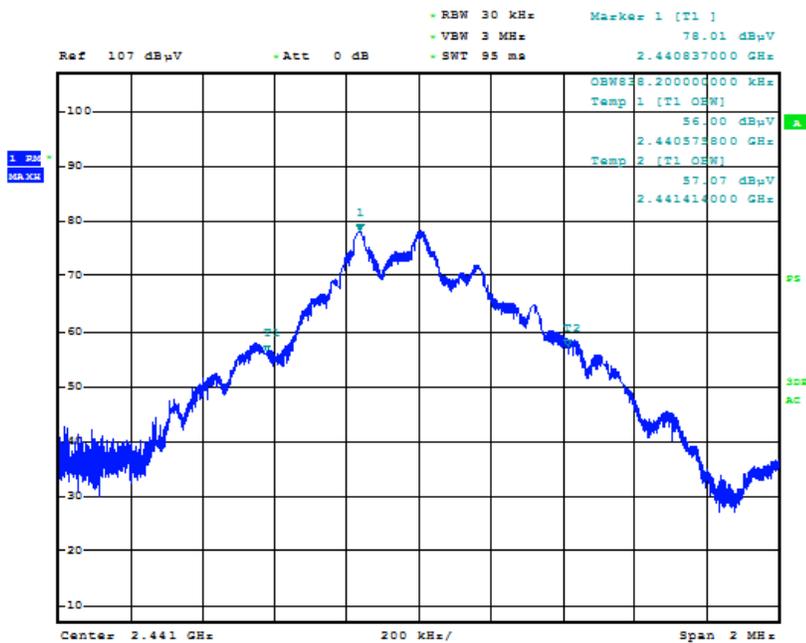
Test setup photographs are located in a separate exhibit.

6.6 Test Data

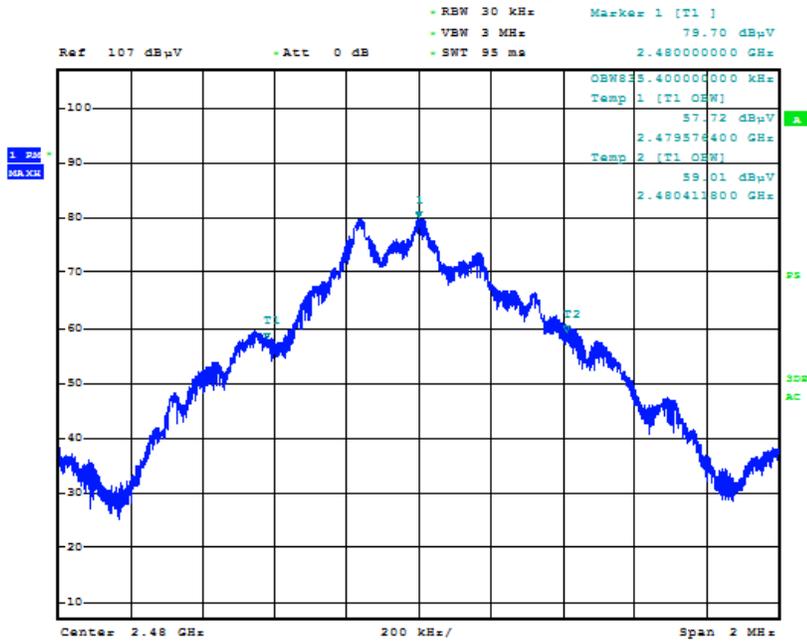
99% Bandwidth Plot, Low Channel



99% Bandwidth Plot, Mid Channel



99% Bandwidth Plot, High Channel



7 Duty Cycle

7.1 Test Result

Test Description	Test Standard	Test Result
Duty Cycle	ANSI C63.10:2009	Report data only

7.2 Test Method

Clause 7.5 of ANSI C63.10 (2009) was used.

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0 °C

Relative Humidity: 48.0 %

Atmospheric Pressure: 97.8 kPa

7.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Receiver	ESU40	R & S	B079629	25 AUG 2012

Note: The calibration period equipment is 1 year.

7.5 *Test Data*

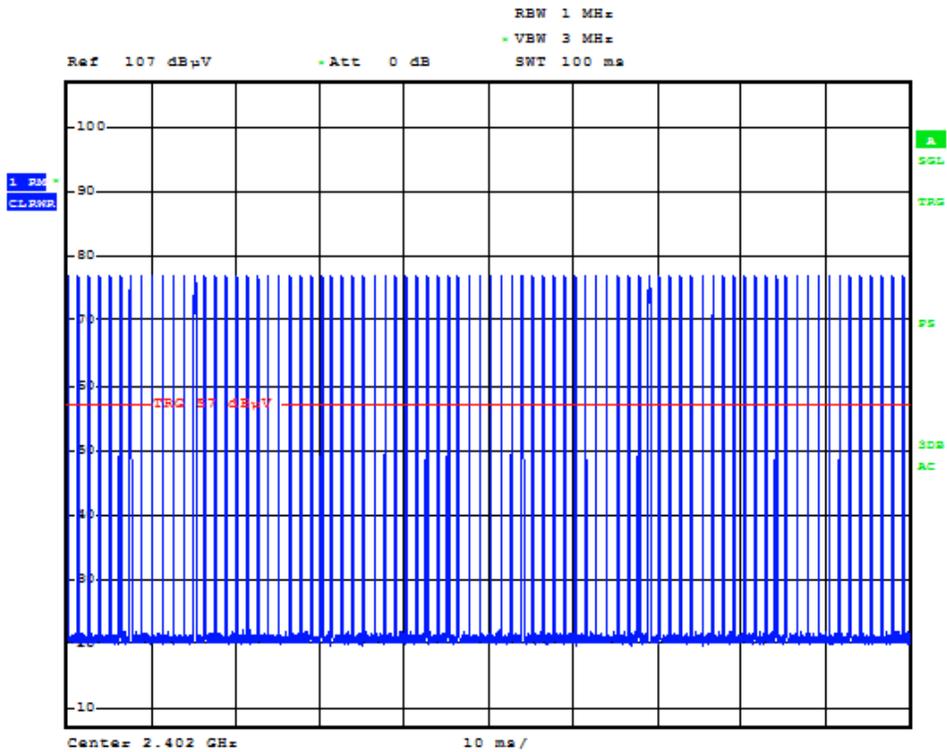
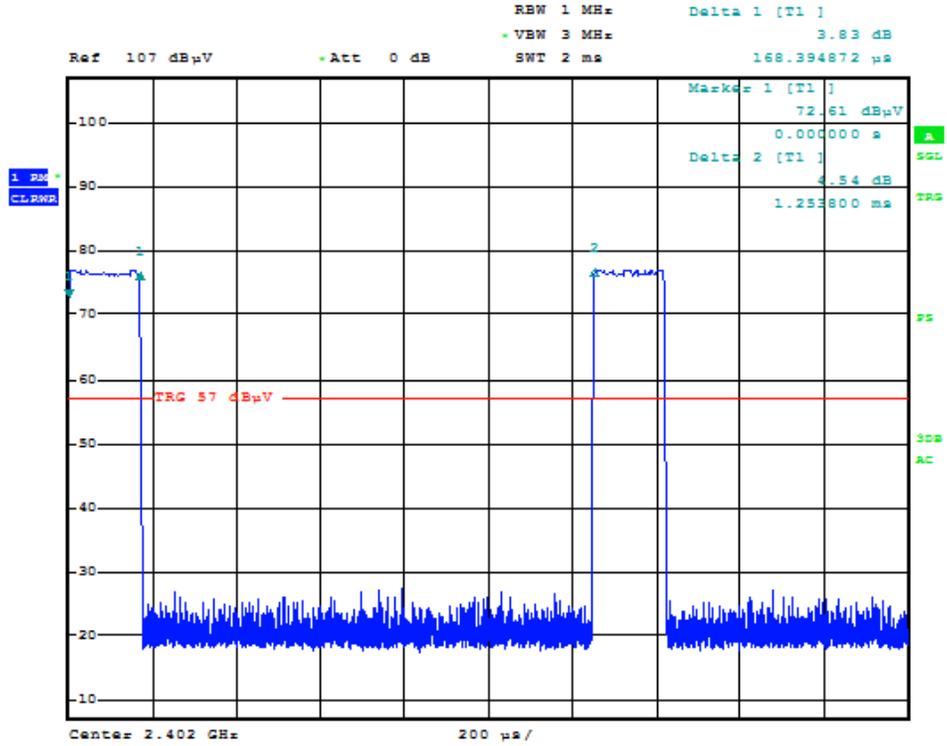
Transmission total time: 1.2538 ms

Transmission on time: 0.1684 ms

Duty cycle = On time / Total time = $(0.1684 / 1.2538) = 0.1343$

Duty Cycle Correction Factor = $20 * \text{Log}_{10}(0.1343) = -17.43 \text{ dB}$

Duty Cycle Plots



8 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	11 June 2012
1	Corrected the model number from A2AVGB02 to A2AVGB02NA3A. Added modulation information and test distance information. Added missing and removed duplicate spurious emissions data tables.	20 June 2012
2	Added note in Section 2.3 regarding justification of covering second model in this report. Corrected the model number listed in Section 2.6 System Configuration from A2AVGB02 to A2AVGB02NA3A.	27 June 2012