Excellence in Compliance Testing

Certification Test Report

FCC ID: IPH-01375
IC: 1792A-01375

FCC Rule Part: 15.249
IC Radio Standards Specification: RSS-210

ACS Report Number: 08-0282-15C

Manufacturer: Garmin International Inc.
Model: 01102032

Test Begin Date: July 15, 2008
Test End Date: July 31, 2008

Report Issue Date: August 5, 2008

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

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This report contains 18 pages

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Internal Photographs
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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15.249 of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

1.2 Product Description

1.2.1 General

The model 01102032 is a GPS navigation system used for location and navigation. The 01102032 incorporates a low power transmitter operating under the Bluetooth design specification allowing short-range communications.

Applicant Information:
Garmin International Inc.
1200 East 151st St.
Olathe KS 66062

Test Sample Serial Number(s):
3470760015

Test Sample Condition:
The test sample and accessories were provided in good working order with no discernable defects.

1.2.2 Intended Use

The 01102032 is a GPS navigation system used for location and navigation.

1.3 Test Methodology and Considerations

The 01102032 can be operated with multiple accessories and in multiple orientations. Testing was performed using all available accessories and in all orientations of the EUT with worst case data presented in this report.

For configurations of the 01102032 in which a direct connection to a personal computer is required, a separate Declaration of Conformity (DoC) test report will be issued. In this configuration the Bluetooth transceiver is inactive.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

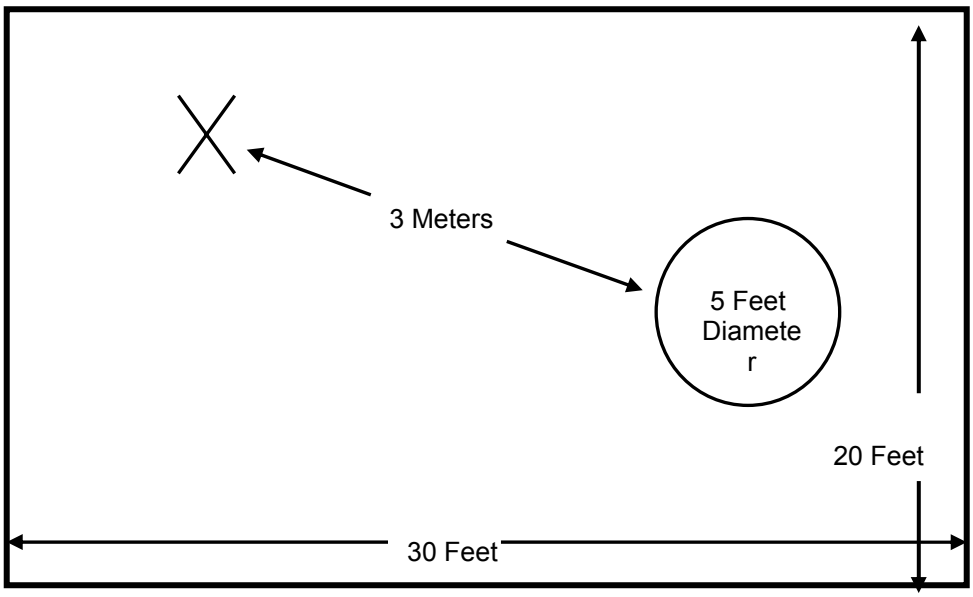

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

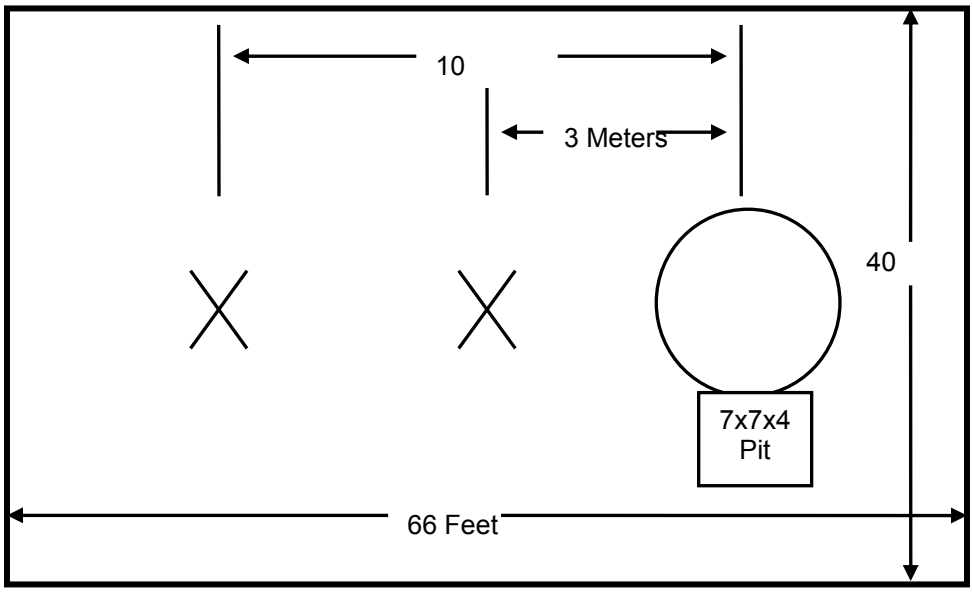

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

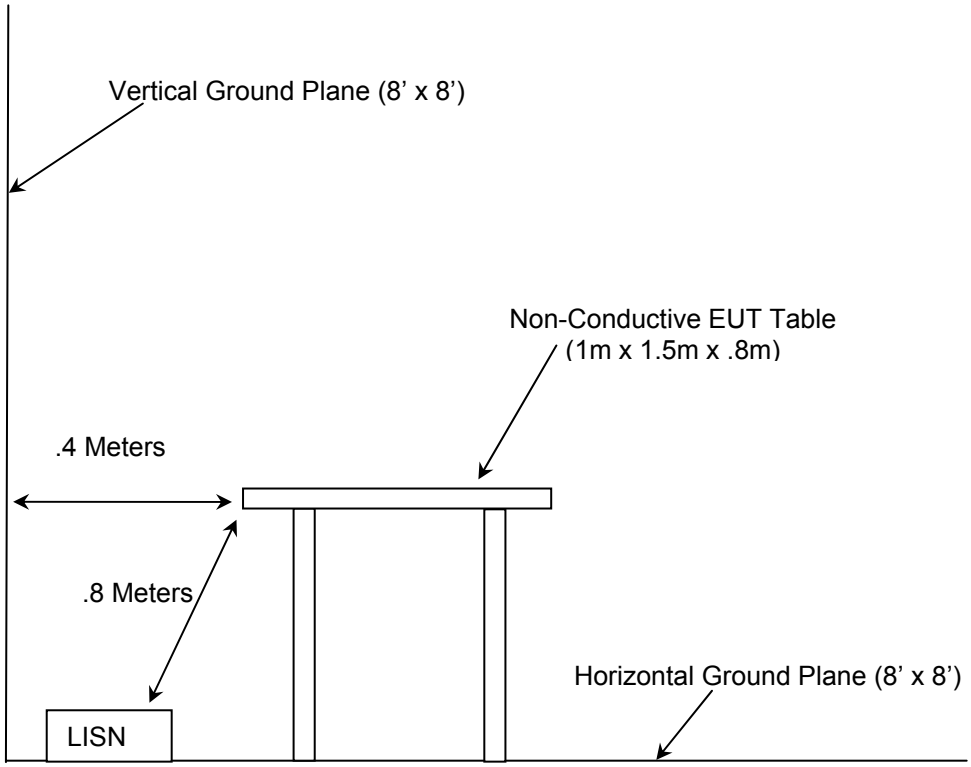

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15: Radio Frequency Devices, 2008
- RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7, June 2007
- RSS-Gen - General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 2, June 2007

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS #	**Mfg.**	**Model**	**S/N**	**Equipment Type**	**Cal. Due**
3	Rohde & Schwarz	ESMI-Display	839379/011	Spectrum Analyzer	10/26/08
4	Rohde & Schwarz	ESMI-Receiver	833827/003	Spectrum Analyzer	10/26/08
22	Aglient	8449B	3008A00526	Pre-Amplifier	10/25/08
25	Chase	Antennas	CBL6111	1043	08/08/08
30	Spectrum Technologies	DRH-0118	970102	Antenna	05/07/09
73	TEC	PA 102	44927	Pre-Amplifier	12/19/08
152	EMCO	LISN	Feb-25	9111-1905	03/26/09
167	ACS	Cables	Chamber EMI Cable Set	167	01/04/09
168	Hewlett Packard	Attenuators	11947A	44829	02/18/09
282	Microwave Circuits	H2G020G4	74541	Filter	02/25/09
291	Florida RF Cables	SMRE-200W-12.0-SMRE		Cables	11/21/08
283	Rohde & Schwarz	FSP40	1000033	Spectrum Analyzer	11/09/08
292	Florida RF Cables	SMR-290AW-480.0-SMR		Cables	11/21/08
324	ACS	Cables	324	Conducted EMI Cable	07/28/09
422	Florida RF Cables	SMS-200AW-72.0-SMR	0805	Cables	02/25/09

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Part Number
1	Cigarette Lighter Adaptor (CLA)	Garmin	NA	320-00239-22
2	Wall Adaptor	Garmin	FSY120100UU15-3	362-00039-00
3	Wall Adaptor	Garmin	PSC05R-050A1	362-00043-04

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAMS

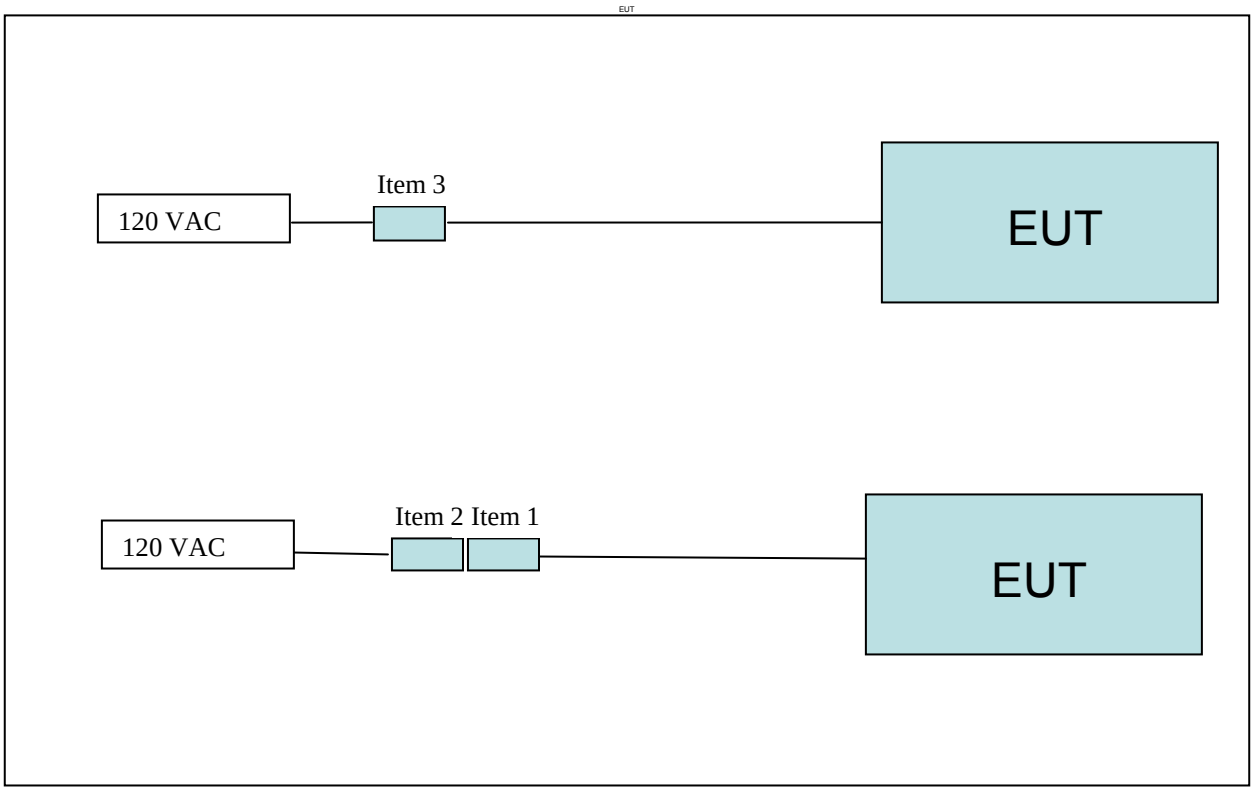

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement

The 01102032 uses a permanent, non-removable, integral Chip antenna with gain of -8dBi. This antenna satisfies the requirement of 15.203.

7.2 Power Line Conducted Emissions – FCC CFR 47 Part 15.207 / RSS-Gen 7.2.2

7.2.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

The EUT can be powered by two different configurations. One configuration is a wall adaptor and the other is a cigarette lighter adaptor (CLA) and wall adaptor combination.

7.2.2 Test Results

Results of the test are shown below in and Table 7.2-1 and Table 7.2.2.

Table 7.2-1: Power Line Conducted Emissions – Wall Adaptor 362-00043-04

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)		Line
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
Line 1										
0.18	24.5	14.9	9.80	34.30	24.70	64.49	54.49	30.2	29.8	FLO
0.2	21.9	11.8	9.80	31.70	21.60	63.61	53.61	31.9	32.0	FLO
0.26	20.4	14.5	9.80	30.20	24.30	61.43	51.43	31.2	27.1	FLO
0.47	19.3	13.7	9.80	29.10	23.50	56.51	46.51	27.4	23.0	FLO
0.51	23.7	16.7	9.80	33.50	26.50	56.00	46.00	22.5	19.5	FLO
2.79	17	8.9	9.80	26.80	18.70	56.00	46.00	29.2	27.3	FLO
Line 2										
0.18	20	10.3	9.80	29.80	20.10	64.49	54.49	34.7	34.4	FLO
0.2	26.5	15.2	9.80	36.30	25.00	63.61	53.61	27.3	28.6	FLO
0.26	21.1	12.3	9.80	30.90	22.10	61.43	51.43	30.5	29.3	FLO
0.45	20	10.5	9.80	29.80	20.30	56.88	46.88	27.1	26.6	FLO
0.52	22.5	15.8	9.80	32.30	25.60	56.00	46.00	23.7	20.4	FLO
2.92	15.6	8.9	9.80	25.40	18.70	56.00	46.00	30.6	27.3	FLO

Table 7.2-2: Power Line Conducted Emissions – CLA 320-00239-22 & Wall Adaptor 362-00039-00

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)		Line
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
Line 1										
0.17	39.6	27.6	9.80	49.40	37.40	64.96	54.96	15.6	17.6	FLO
0.21	34.9	22.2	9.80	44.70	32.00	63.21	53.21	18.5	21.2	FLO
0.25	30.2	17.3	9.80	40.00	27.10	61.76	51.76	21.8	24.7	FLO
0.34	25.1	15.7	9.80	34.90	25.50	59.20	49.20	24.3	23.7	FLO
0.48	25.1	22.4	9.80	34.90	32.20	56.34	46.34	21.4	14.1	FLO
3.21	14.7	5.6	9.80	24.50	15.40	56.00	46.00	31.5	30.6	FLO
Line 2										
0.17	38.7	26.6	9.80	48.50	36.40	64.96	54.96	16.5	18.6	FLO
0.2	33.8	21.1	9.80	43.60	30.90	63.61	53.61	20.0	22.7	FLO
0.25	28.6	13.8	9.80	38.40	23.60	61.76	51.76	23.4	28.2	FLO
0.29	24.5	11.5	9.80	34.30	21.30	60.52	50.52	26.2	29.2	FLO
0.48	19.7	16.1	9.80	29.50	25.90	56.34	46.34	26.8	20.4	FLO
2.2	13.2	5.4	9.80	23.00	15.20	56.00	46.00	33.0	30.8	FLO

7.3 Radiated Emissions (Unintentional Radiation) – FCC CFR 47 Part 15.109 / RSS-Gen Section 7.2.3

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 12500MHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz a Quasi-peak detector was enabled and measurements were taken with the Spectrum Analyzer's resolution bandwidth set to 120 KHz. For frequencies above 1000MHz, measurements were made using an average detector and peak detector with RBW of 1 MHz.

7.3.2 Test Results

Results of the test are given in Table 7.3-1 below:

Table 7.3-1 – Radiated Emissions (Unintentional Radiation)

Frequency (MHz)	Antenna Polarity (H/V)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
		pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
31.04	V	---------	21.50	---------	40.0	---------	18.50
60.64	V	---------	19.50	---------	40.0	---------	20.50
65.92	V	---------	24.30	---------	40.0	---------	15.70
121.6	V	---------	25.90	---------	43.5	---------	17.60
138.64	H	---------	27.50	---------	43.5	---------	16.00
228.8	H	---------	30.30	---------	46.0	---------	15.70
300	H	---------	34.80	---------	46.0	---------	11.20
400	H	---------	40.10	---------	46.0	---------	5.90
797.76	H	---------	43.90	---------	46.0	---------	2.10
951.68	H	---------	27.50	---------	46.0	---------	18.50

* Note: All emissions above 951.68MHz were not detected above the noise floor of the measurement equipment and therefore attenuated below the permissible limit.

7.4 20dB and 99% Occupied Bandwidth – FCC CFR 47 Part 15.215(c) / RSS-210 Section 4.6.1

7.4.1 Test Methodology

The spectrum analyzer span was set to 2 to 3 times the estimated 20 dB bandwidth of the emission. The RBW was to ≥ 1% of the estimated 20 dB bandwidth. The trace was set to max hold with a peak detector active. The measurement function of the analyzer was utilized to determine the 20 dB and 99% occupied bandwidths.

7.4.2 Test Results

Results are shown below in Table 7.4-1 and Figures 7.4-1 through 7.4-6.

Table 7.4-1 – Occupied Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
2402	1098	930
2441	1104	924
2480	1104	930

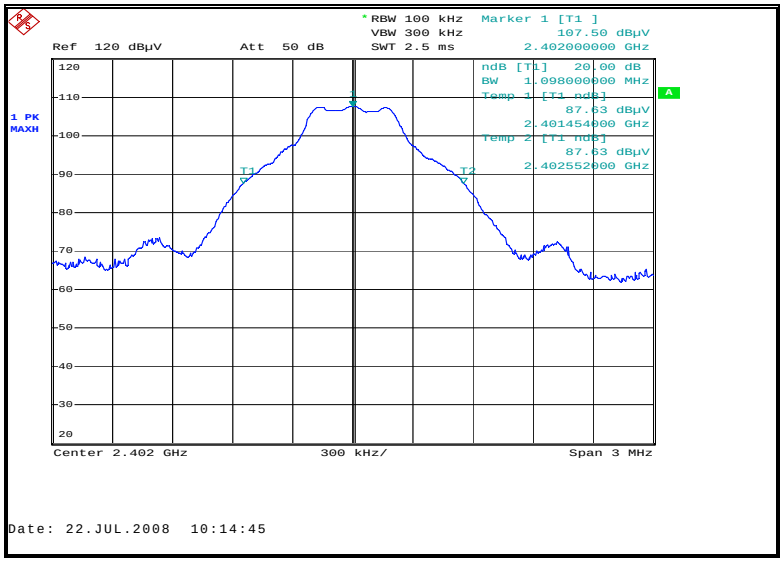

Figure 7.4-1: 20dB Bandwidth Low Channel

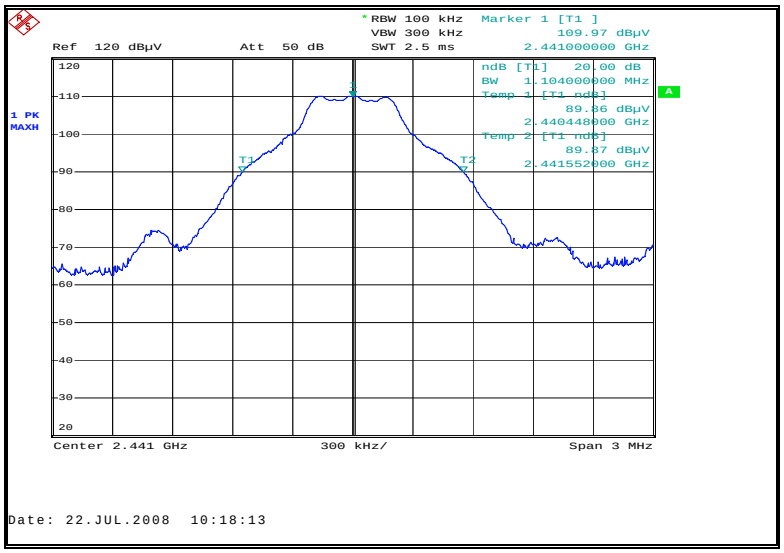

Figure 7.4-2: 20dB Bandwidth Mid Channel

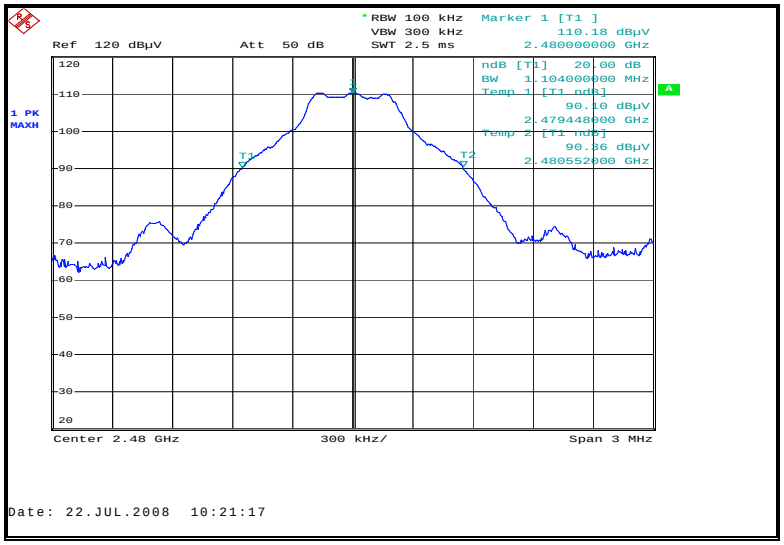

Figure 7.4-3: 20dB Bandwidth High Channel

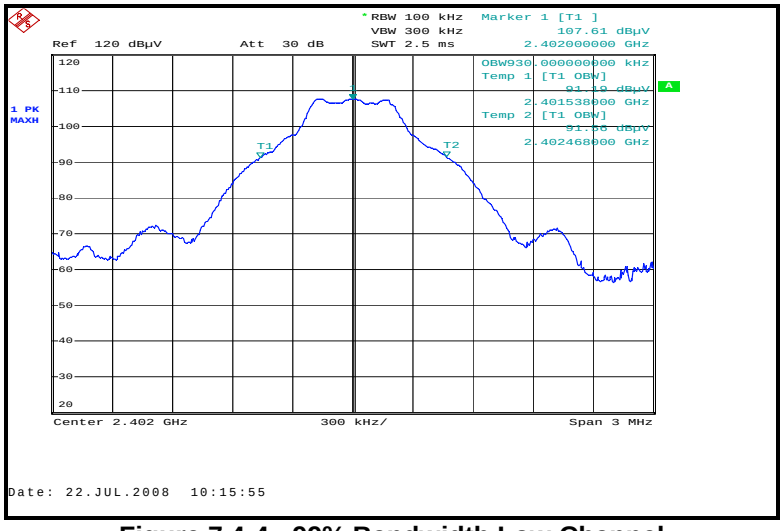

Figure 7.4-4: 99% Bandwidth Low Channel

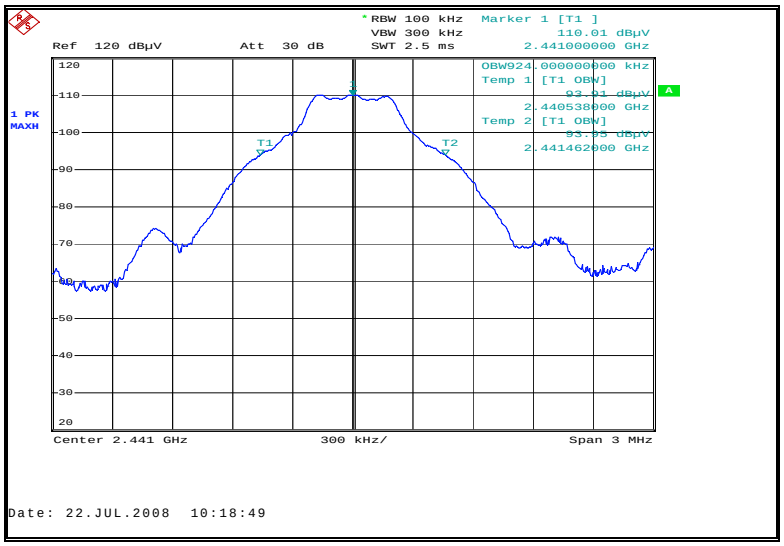

Figure 7.4-5: 99% Bandwidth Mid Channel

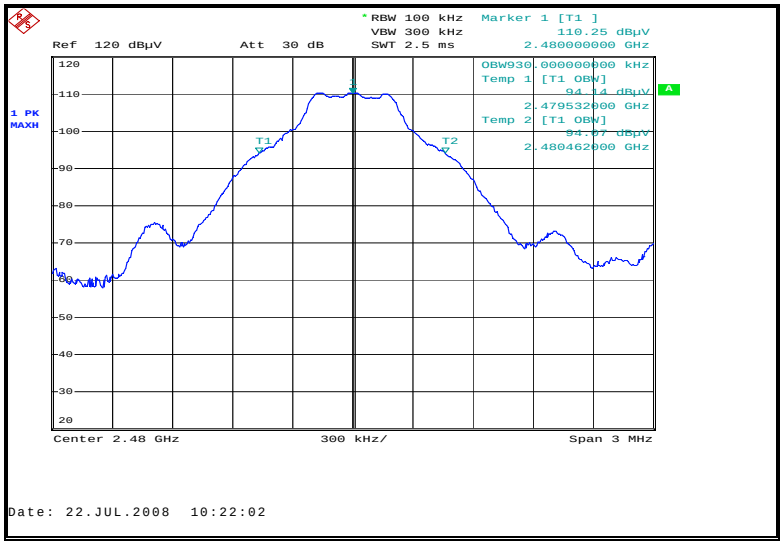

Figure 7.4-6: 99% Bandwidth High Channel

7.5 Fundamental Field Strength – FCC CFR 47 Part 15.249(a) / RSS-210 Section A2.9(a)

7.5.1 Test Methodology

Radiated emissions tests were made on the low, middle, and high channels in the 2400MHz to 2483.5MHz frequency range.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Average measurements were made using an RBW of 1 MHz and a VBW of 10 Hz and peak measurements were made with RBW of 1 MHz and a VBW of 1 MHz.

7.5.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 30.10dB to account for the duty cycle of the EUT. The duty cycle was determined to be 3.125% or 3.125ms with a 100ms period. The duty cycle correction factor is determined using the formula: 20log (3.125) = -30.10dB.

The duty cycle is determined from the Bluetooth maximum channel dwell time. The maximum channel dwell time using the DH 5 modulation is 3.125ms with a maximum time between re-use of 247ms.

7.5.3 Test Results

Results are shown below in table 7.5-1 below:

Table 7.5-1: Fundamental Field Strength

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Field Strength - Low Channel										
2402	108.06	97.87	H	-0.90	107.16	66.87	114.0	94.0	6.84	27.13
2402	99.61	89.07	V	-1.08	98.53	57.89	114.0	94.0	15.47	36.11
Fundamental Field Strength - Mid Channel										
2441	110.38	100.31	H	-0.71	109.67	69.50	114.0	94.0	4.33	24.50
2441	98.99	89.92	V	-0.90	98.09	58.92	114.0	94.0	15.89	35.06
Fundamental Field Strength - High Channel										
2480	110.48	100.37	H	-0.52	109.96	69.75	114.0	94.0	4.04	24.25
2480	98.47	88.14	V	-0.71	97.76	57.33	114.0	94.0	16.24	36.67

7.6 Band-Edge Compliance and Spurious Emissions

7.6.1 Band-Edge Compliance - FCC CFR 47 Part 15.249(d) / RSS-210 Section A2.9(b)

7.6.1.1 Test Methodology

The EUT was investigated at the low and high channels of operation to determine band-edge compliance.

Band-edge compliance for the lower and upper band-edge was determined using the radiated mark-delta method as outlined in FCC DA 00-705. The radiated field strength of the fundamental emission was first determined and then the mark-delta method was used to determine the field strength of the band-edge emissions as compared to the emission limits.

7.6.1.2 Test Results

Band-edge compliance is displayed in Tables 7.6.1-1 to 7.6.1-2 and Figures 7.6.1-1 – 7.6.1-2.

Table 7.6.1-1: Lower Band-edge Marker Delta Method

Frequency (MHz)	Uncorrected Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Fundamental Level (dBuV/m)		Marker-Delta (dB)	Band-Edge Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg		pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2402	108.06	97.87	H	-0.90	107.16	66.87	40.00	67.16	26.87	74.0	54.0	6.84	27.13

Table 7.6.1-2: Upper Band-edge Marker Delta Method

Frequency (MHz)	Uncorrected Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Fundamental Level (dBuV/m)		Marker-Delta (dB)	Band-Edge Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg		pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2480	110.57	100.37	H	-0.52	110.05	69.75	45.11	64.94	24.64	74.0	54.0	9.06	29.36

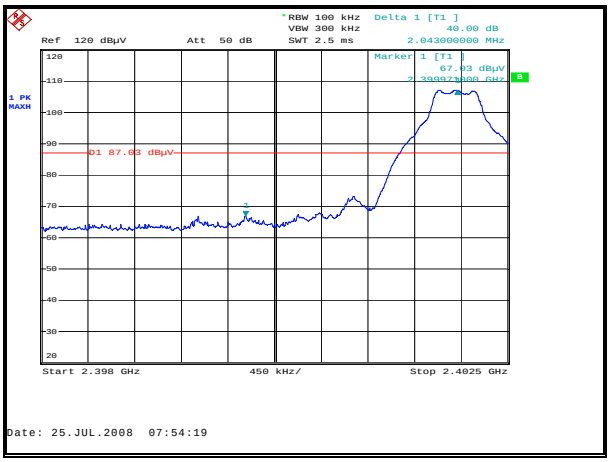

Figure 7.6.1-1 Lower Band-edge

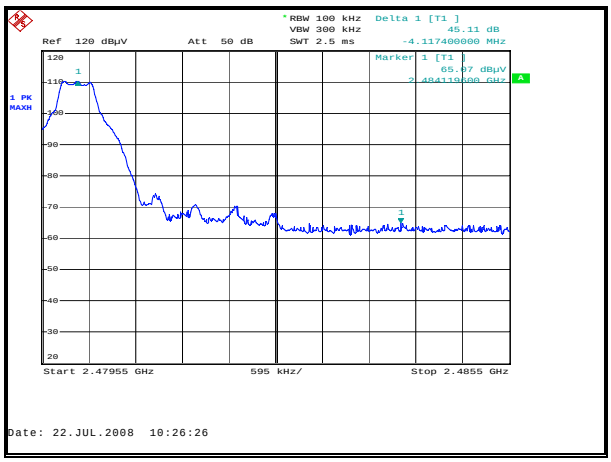

Figure 7.6.1-2 Upper Band-edge

7.6.2 Radiated Spurious Emissions – FCC CFR 47 Part 15.249(a),(d) / RSS-210 Section A2.9(a)

7.6.2.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, average measurements were made using an RBW of 1 MHz and a VBW of 10 Hz and peak measurements were made with RBW of 1 MHz and a VBW of 1 MHz.

7.6.2.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 30.10dB to account for the duty cycle of the EUT. The duty cycle was determined to be 3.125% or 3.125ms with a 100ms period. The duty cycle correction factor is determined using the formula: 20log (3.125) = -30.10dB.

The duty cycle is determined from the Bluetooth maximum channel dwell time. The maximum channel dwell time using the DH 5 modulation is 3.125ms with a maximum time between re-use of 247ms.

7.6.2.3 Test Results

Results are shown below in Table 7.6.2-1.

Table 7.6.2-1 - Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions - Low Channel										
4804	47.08	33.72	H	6.94	54.02	10.56	74.0	54.0	19.98	43.44
4804	46.17	32.91	V	7.04	53.21	9.85	74.0	54.0	20.79	44.15
Spurious Emissions - Mid Channel										
4882	48.36	36.08	H	7.18	55.54	13.16	74.0	54.0	18.46	40.84
4882	47.58	34.98	V	7.28	54.86	12.16	74.0	54.0	19.14	41.84
Spurious Emissions - High Channel										
4960	47.91	35.05	H	7.42	55.33	12.37	74.0	54.0	18.67	41.63
4960	46.53	33.83	V	7.52	54.05	11.25	74.0	54.0	19.95	42.75

The magnitude of all emissions not reported were below the noise floor of the measurement system.

7.6.2.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation

PEAK:
Corrected Level: 47.08 + 6.94 = 54.02dBuV
Margin: 74dBuV – 54.02dBuV = 19.98dB

AVERAGE:
Corrected Level: 33.72 + 6.94 -30.10= 10.56dBuV
Margin: 54dBuV – 10.56dBuV = 43.44dB

8.0 CONCLUSION
In the opinion of ACS, Inc. model 01102032 manufactured by Garmin International Inc. meets the requirements of FCC Part 15.249 and Industry Canada's Radio Standards Specification RSS-210.

END REPORT