FCC PART 80
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RSS-182, ISSUE 5 JANUARY 2012
MEASUREMENT AND TEST REPORT

TEST REPORT

For

Garmin International Inc

1200 E. 151st. Street, Olathe, KS 66062, United States

FCC ID:IPH-01653
IC: 1792A-01653

Report Type:	**Product Type:**
Class II Permissive Change	Marine VHF Radio

Report Number:	RDG161009001-A1
Report Date:	2016-12-30
Reviewed By:	Oscar Ye Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road, Kunshan, Jiangsu province, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Garmin International Inc*'s product, model number: *A01654 (FCC ID: IPH-01653, IC:1792A-01653)* or the "EUT" in this report was a *Marine VHF Radio,* which was measured approximately: 192 mm (L) × 168 mm (W) × 96 mm (H), rated with input voltage: DC 12 V.

** All measurement and test data in this report was gathered from production sample serial number: 161009001 (Assigned by Kunshan BACL). The EUT supplied by the applicant was received on 2016-10-09.*

Objective

This test report is prepared on behalf of *Garmin International Inc* in accordance with Part 2 and Part 80 of the Federal Communication Commissions rules and in accordance with RSS-182 of the Innovation, science and Economic Development Canada..

The objective of the manufacturer is to determine the compliance of the EUT with FCC Part 80 and RSS-182.

This is a CIIPC application of the device, the differences between the original device and the current one are as follows:

1. Changing the model number from "A01653"to "A01654".

2. Adding the function of AIS and the related circuit plate.

3. Changing the model measure from "170mm (L) x 146mm (W) x 85mm(H)"to "192 mm (L) × 168 mm (W) × 96 mm (H)".

4. Changing the Front key modules and backend interface.

For the change made to the device, the test item "Radiated Spurious Emissions" and "Receiver Spurious Emissions"were performed. So other test data are referred to FCC ID: IPH-01653, IC: 1792A-01653 granted on 2016-10-04 and 2016-12-06, report No.: RDG160623001, which was tested by Bay Area Compliance Laboratories Corp. (Dongguan).

Related Submittal(s)/Grant(s)

No related submittal(s)

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the RSS-182 and the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 80 –Stations in the Maritime Services Applicable Standards: TIA 603-D and ANSI 63.4-2014.

Applicable Standards: RSS-182, Issue5 January 2012. Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 156-162.5 MHz.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		±3.26 dB
RF conducted test with spectrum		±0.9dB
RF Output Power with Power meter		±0.5dB
Radiated emission	30MHz~1GHz	±5.91dB
	Above 1G	±4.92dB
Occupied Bandwidth		±0.5kHz
Temperature		±1.0℃
Humidity		±6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on November 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Equipment Modifications

No modification was made to the EUT tested.

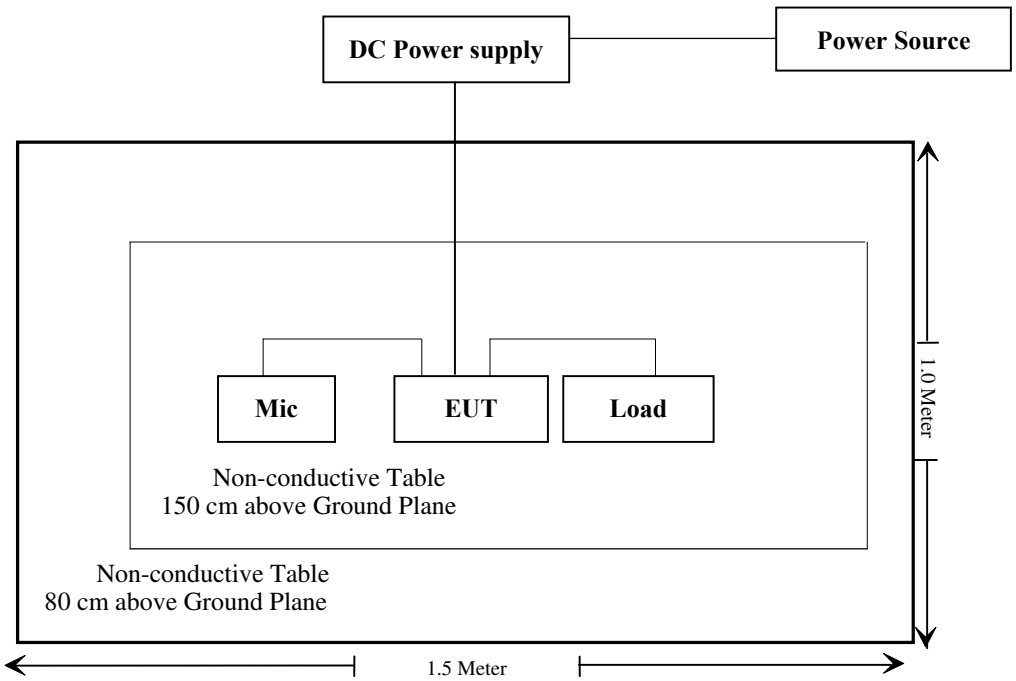
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
YISHITE	DC Power Supply	MCH-303D-II	14070562

External I/O Cable

Cable Description	Length (m)	From/Port	To
Shielded Detachable RF Cable	0.5	EUT Transmitter port	Load
Un-shielded Detachable DC Power Cable	3.0	DC Power Supply	EUT
Un-shielded Detachable AC Power Cable	2.0	Power Source	DC Power Supply

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC Part §1.1307 (b)(1), §2.1091;RSS-102	Maximum Permissible Exposure (MPE)	Compliance
FCC Part §2.1046,§80.215; RSS-182 § 7.5	RF Output Power	Compliance*
FCC Part §2.1047,§80.213; RSS-182 § 7.3,7.8	Modulation requirements	Compliance*
FCC Part §2.1049,§80.205; RSS-182 § 7.3	Bandwidth	Compliance*
FCC Part §2.1051,§80.211 RSS-182 § 7.9	Emission limitations	Compliance*
FCC Part §80.217	Suppression of Interference Aboard Ships	Compliance*
FCC Part §2.1051,§80.211; RSS-182 § 7.9	Radiated Spurious Emissions	Compliance
FCC Part §2.1055,§80.209; RSS-182 § 7.4	Transmitter Frequency Tolerances	Compliance*
RSS-182 § 7.11; RSS-Gen §7	Receiver Spurious Emissions	Compliance

Note:

Compliance*: The device is identical to the previously certified device except for Adding the AIS Components, the FCC ID: IPH-01653, IC: 1792A-01653 granted on 2016-10-04 and 2016-12-06, report No.: RDG160623001.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Sonoma Instrunent	Amplifier	330	171377	2016-09-16	2017-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-11	2017-11-10
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2016-01-09	2019-01-08
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-09-08	2017-09-08
EMCO	Horn Antenna	3116	9510-2384	2015-11-07	2018-11-06
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2016-11-11	2017-11-10
ETS	Horn Antenna	3115	6229	2016-01-11	2017-01-10
ETS	Horn Antenna	3115	9311-4159	2016-01-11	2017-01-10
R&S	Auto test Software	EMC32	V 09.10.0	NCR	NCR
BACL	RF cable	KS-LAB-012	KS-LAB-012	2015-12-15	2016-12-15
Ducommun technologies	RF Cable	104PEA	218124002	2016-04-22	2017-04-22
HP	Signal Generator	E4421B	US38440505	2016-11-11	2017-11-10

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§1.1307 (b) (1) & §2.1091& RSS-102 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

According to RSS-102:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Table 6: RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[23]	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f^{0.25}$	$0.3444/f^{0.25}$	$44.72/f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60f^{0.25}$	$0.04138f^{0.25}$	$0.6455f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f^{1.2}$
150000-300000	$0.354f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2 for FCC, and W/m2 for IC)
P = power input to the antenna (in appropriate units, e.g., mW for FCC, and W for IC).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm for FCC, and m for IC)

For FCC calculation:

Frequency (MHz)	Antenna Gain		Rated Power (W)	The minimum Distance (cm)	MPE Limit (mW/cm^2)	Note
	(dBi)	(numeric)				
156.8	6	3.98	25	89	1.0	Controlledled Environrment
156.8	6	3.98	25	199	0.2	UnControlledled Environrment

For IC calculation:

Frequency (MHz)	Antenna Gain		Rated Power (W)	The minimum Distance (m)	MPE Limit (W/m^2)	Note
	(dBi)	(numeric)				
156.8	6	3.98	25	0.99	8.083	Controlledled Environrment
156.8	6	3.98	25	2.48	1.291	UnControlledled Environrment

Note: The Maximum power is 25 W which declared by manufacture

Radiation Exposure Statement:

To comply with RF exposure requirements, the minimum permissible distance is 2.48 m required between the antenna and the body of the user or nearby persons.

Result: Compliance

FCC §2.1053&§80.211&RSS-182§7.9 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, § 80.211 and RSS-182 §7.9

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT .The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB =10 1g (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =43+10 Log_{10} (power out in Watts)

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Layne Li on 2016-11-23

Test Mode: Transmitting

30 MHz – 2 GHz:

Frequency (MHz)	Receiver Reading (dBμV)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 80/RSS-182	
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		Limit (dBm)	Margin (dB)
Radio telephony: 156.8 MHz										
470.40	56.42	74	1.9	H	-40.6	0.31	4.65	-36.26	-13	23.26
470.40	52.28	162	1.1	V	-44.7	0.31	4.65	-40.36	-13	27.36
1254.40	54.83	70	2.4	H	-53.1	0.27	7.50	-45.87	-13	32.87
1254.40	57.72	341	1.9	V	-50.7	0.27	7.50	-43.47	-13	30.47
DSC: 156.525 MHz										
469.575	55.84	88	1.5	H	-41.2	0.31	4.65	-36.86	-13	23.86
469.575	51.61	250	2.4	V	-45.4	0.31	4.65	-41.06	-13	28.06
1252.20	51.44	211	1.9	H	-49.8	0.27	7.50	-42.57	-13	29.57
1252.20	56.93	329	2.1	V	-51.5	0.27	7.50	-44.27	-13	31.27

Note:
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

RSS-182 §7.11, RSS-GEN §7 – RECEIVER SPURIOUS EMISSION

Applicable Standard

According to RSS-182 Issue 4 §7.11 and RSS-Gen §7

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The data was recorded in the QP detection mode for below 1 GHz, and Peak & Average for above 1GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Layne Li on 2016-11-23.

Test Mode: Receiving

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	RSS-GEN	
(MHz)	Reading (dBμV)	Detector (PK/QP/Ave.)	Degree	Height (m)	Polar (H / V)			Limit (dBμV/m)	Margin (dB)
210.20	41.68	QP	231	1.4	H	-12.31	29.37	43.5	14.13
858.71	33.21	QP	127	1.2	V	-1.16	32.05	46	13.95
1033.85	33.45	PK	153	1.8	H	0.03	33.48	74	40.52
1033.85	19.00	Ave.	153	1.8	H	0.03	19.03	54	34.97
1033.85	32.67	PK	324	1.8	H	0.03	32.70	74	41.30
1033.85	18.56	Ave.	324	1.8	H	0.03	18.59	54	35.41

******* END OF REPORT *******