



NFC (Near Field Communications)
FCC / IC Test Report

FOR:

Garmin International

Model Name:

AA3111

Product Description:

Personal Navigation Device

FCC ID: IPH-A3111

IC ID: 1792A-A3111

Applied Rules and Standards:

47 CFR Part 15 Subpart C Section 15.225
RSS-210 Issue 9, Annex B.6, RSS-Gen Issue 4

REPORT #: EMC_GARMI-047-17001_15.225_NFC

DATE: 2017-11-01



A2LA Accredited

IC recognized #
3462B-2

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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571



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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.225 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-210 Issue 9, Annex B.6.

No deviations were ascertained.

Company	Description	Model #
Garmin International	Personal Navigation Device	AA3111

Responsible for Testing Laboratory:

Peter Nevermann

2017-11-01 Compliance (Director Radio Communications and EMC)

Date	Section	Name	Signature
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Responsible for the Report:

Elijah Garcia

2017-11-01 Compliance (EMC Engineer)

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Director Radio Com. and EMC:	Peter Nevermann
Responsible Project Leader:	Laith Saman

2.2 Identification of the Client

Applicant's Name:	Garmin International
Street Address:	100 Regency Forest Drive, Suite 350
City/Zip Code	Cary, NC 27518
Country	USA
Contact Person:	Jay Everett
Phone No.	(919) 337-0163
e-mail:	jay.everett@garmin.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Garmin Corporation
Manufacturers Address:	No. 68, Jangshu 2nd road
City/Zip Code	Xizhi District, New Taipei City 221
Country	Taiwan

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	AA3111
HW Version :	0
SW Version :	2.30
FCC-ID :	IPH-A3111
IC-ID:	1792A-A3111
HVIN:	AA3111 ¹
PMN:	fleet™ 790 xy, fleet™ 780 xy, and fleet™ 770 xy
Product Description:	Personal Navigation Device
Frequency Range / number of channels:	Nominal band: 2400 MHz – 2483.5 MHz; Center to center: 2402 MHz (Ch. 0) – 2480 MHz (Ch. 39), 40 channels
Type(s) of Modulation:	GFSK
Modes of Operation:	Bluetooth LE
Antenna Information as declared:	max gain 1.575 dBi
Max. Peak Output Power:	Conducted Power 7.0 dBm
Power Supply/ Rated Operating Voltage Range:	4.5 V dc (min) / 5 V dc (nom) / 5.5 V dc (max)
Operating Temperature Range:	-10 °C to 55 °C
Other Radios included in the device:	Bluetooth Basic / EDR: GFSK, $\pi/4$ DQPSK, 8DPSK
Sample Revision:	<input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production

¹ Fleet™ 790 xy was fully tested and a spot-check was performed on, fleet™ 780 xy, and fleet™ 770 xy, refer to section 3.5

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	39F003818	0	2.30	Radiated and AC Conducted Emissions
2	39F003830	0	2.30	Conducted RF

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	AC/DC Adapter	PSAF10R-050Q	Phihong	P164604044A1

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#2 + AE#1	The radio of the EUT was configured to a fixed channel transmission with 100% duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#1 + AE#1	The radio of the EUT was configured to a fixed channel transmission with 100% duty cycle using software that is not available to the end user. The internal antenna was connected.

3.5 Miscellaneous EUT Information

Only Fleet™ 790 xy was fully tested and based on the information that were provided by Garmin about the differences, the lab concluded that only a spot check is needed which was performed on, fleet™ 780 xy, and fleet™ 770 xy.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.225 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 Issue 9, Annex B.6 of ISED Canada.

This test report is to support a request for new equipment authorization under the FCC ID: IPH-A3111 IC ID: 1792A-A3111

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.225(a) RSS-210 B.6(a)	In Band Emissions	Nominal	NFC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.209 §15.225(d) RSS-Gen 6.13	Tx Radiated Spurious Emissions	Nominal	NFC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.225(e) RSS-210 B.6(a)	Frequency Tolerance	Nominal	NFC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions	Nominal	NFC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies

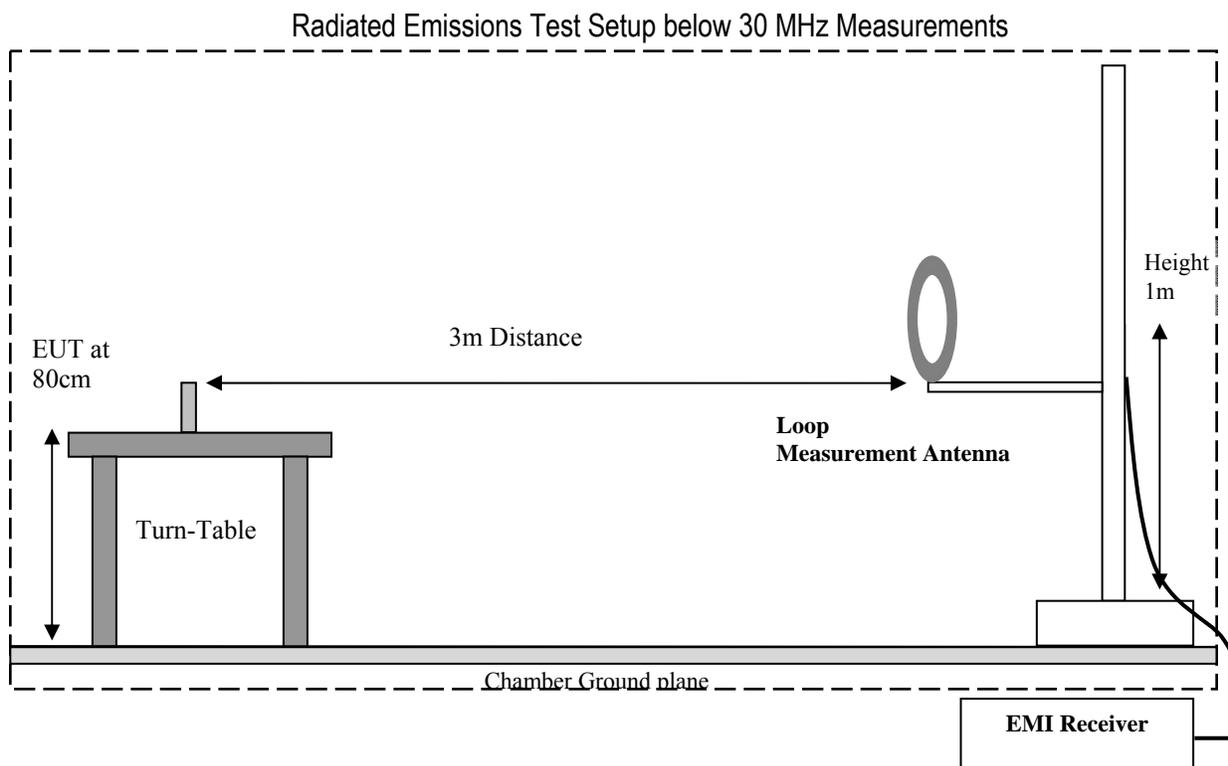
Note: NA= Not Applicable; NP= Not Performed.

6 Measurement Procedures

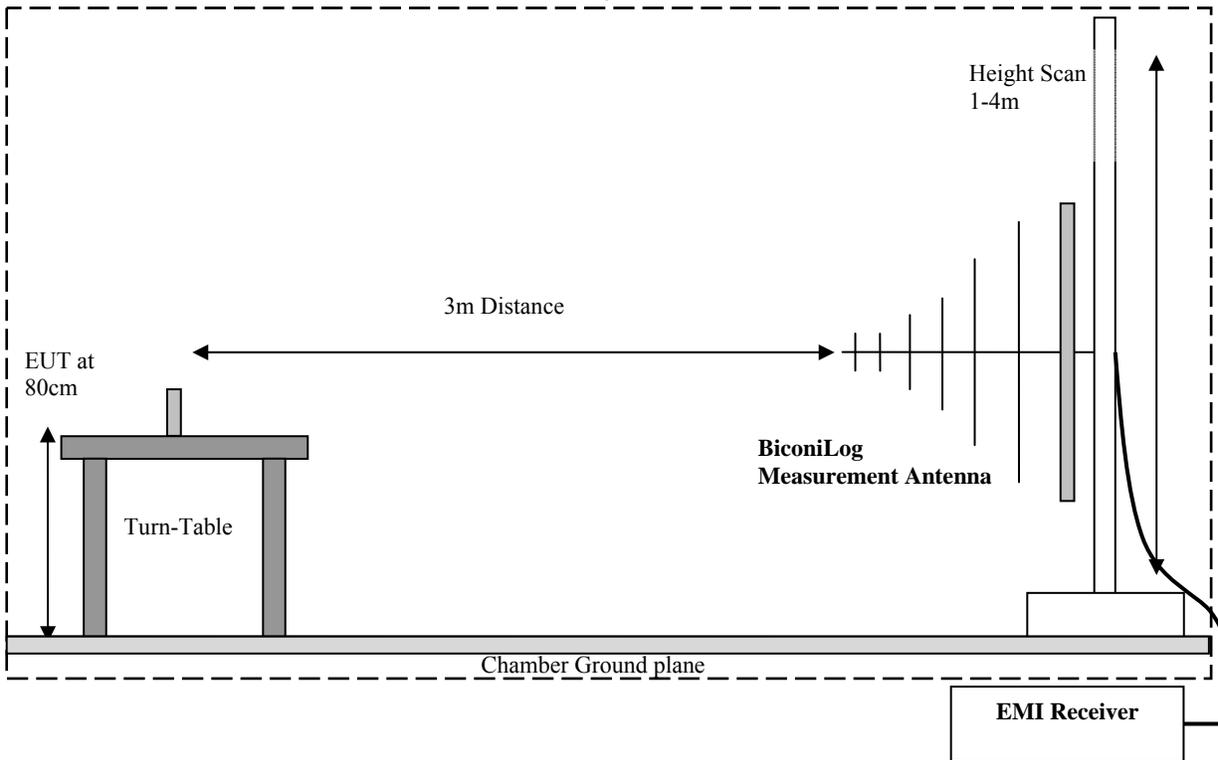
6.1 Radiated Measurement

The radiated measurement is performed according to: ANSI C63.10 (2013)

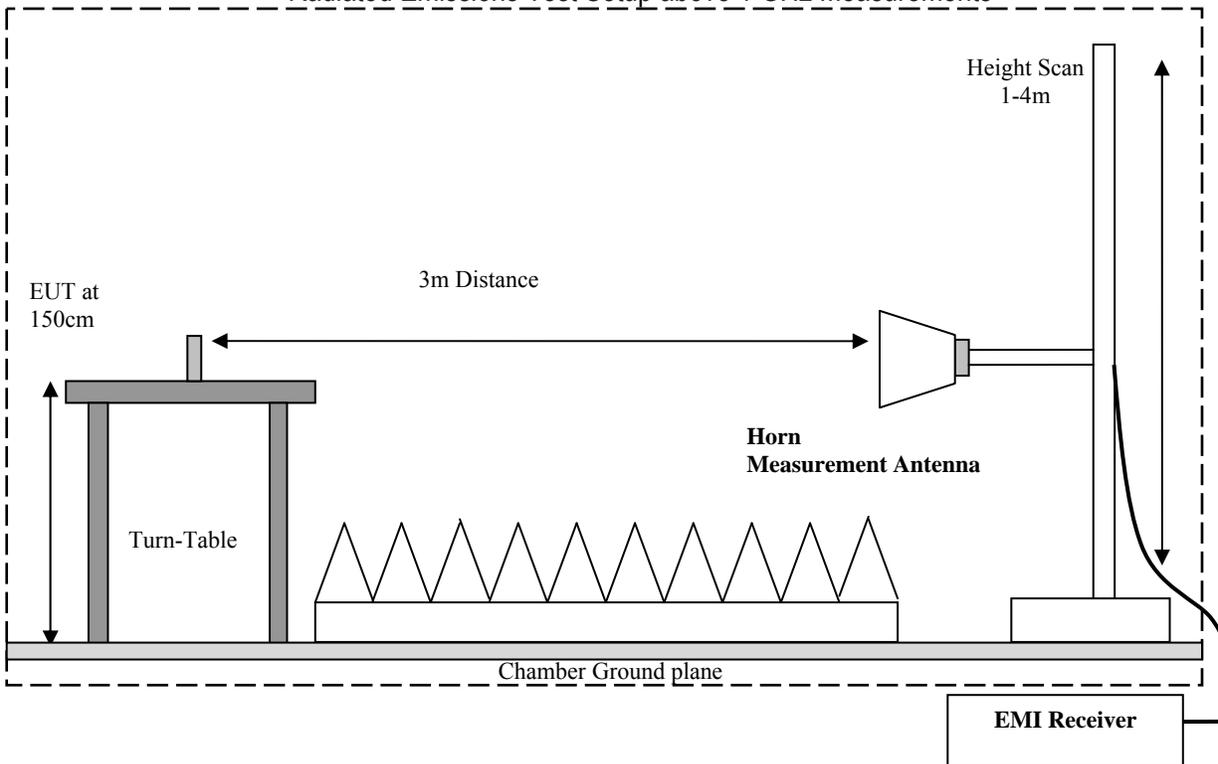
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.



Radiated Emissions Test Setup 30 MHz-1 GHz Measurements



Radiated Emissions Test Setup above 1 GHz Measurements



6.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer / Receiver readings, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and Spectrum Analyzer in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

7 In-band Field Strength (Fundamental)

7.1 References

FCC: 15.225 (a)

RSS 210: B.6 (a)

7.2 Limits

FCC: The field strength of any emission within band 13.553-13.567 MHz shall not exceed 15, 848 microvolts/meter (84 dB μ V/m) at 30 meters distance.

RSS 210: The final strength of any emission shall not exceed the following limits:

(a) 15.848 microvolts/m at (84 dB μ V/m) at 30 meters distance within the band 13.553-13.567 MHz.

The 30m limit is converted to 3m using the 40 dB/decade extrapolation factor formula as specified by FCC 15.31 (f) (2) for frequencies below 30 MHz

Therefore, 40 dB shall be added to the specified limit (84 dB μ V/m @ 30m) to convert to actual test limit 124 dB μ V/m @ 3m

7.3 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

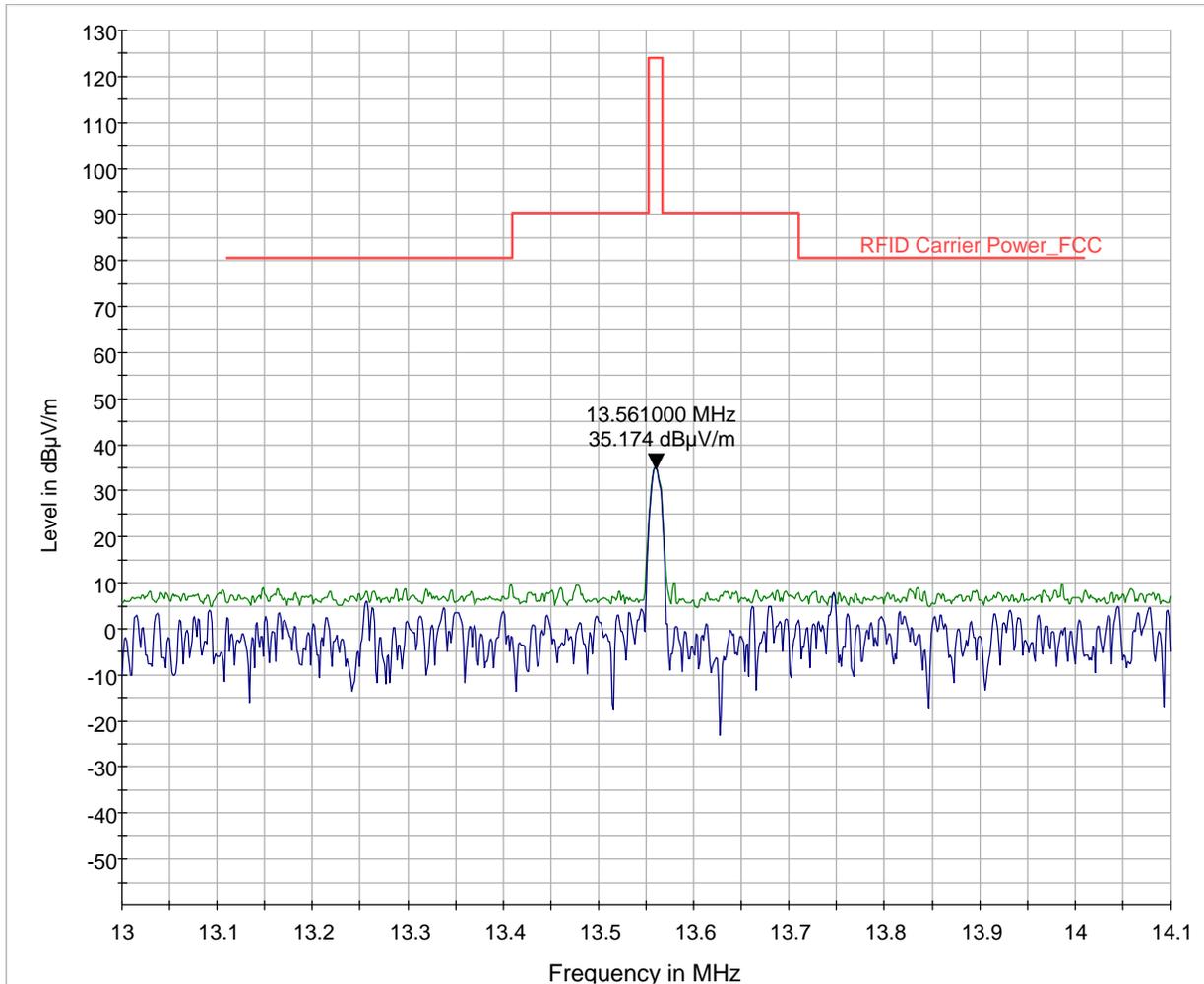
- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

7.4 Dates of Testing:

08/16/2017 - 10/09/2017



7.4.1 Measurement Plots:



— PK+_MAXH — PK+_CLRWR — RFID Carrier Power_FCC

7.5 Transmitter Spurious Emissions and Restricted Bands

7.5.1 Measurement according to ANSI C63.10 (2013)

Analyzer Settings:

- Frequency = 9 kHz – 30 MHz
- RBW = 9 kHz
- Detector = Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW = 120 kHz (<1 GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT. Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

7.5.2 Limits: FCC 15.247(d)/15.209(a)

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
- PEAK LIMIT= 74dB μ V/m
- AVG. LIMIT= 54dB μ V/m

Frequency (MHz)	Field strength (μ V/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.

The highest (or worst-case) data rate shall be recorded for each measurement.

For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation as follow:

$$\text{Conversion factor (CF)} = 40 \log (D/d) = 40 \log (300 \text{ m} / 3 \text{ m}) = 80 \text{ dB}$$

7.5.3 Test conditions and setup:

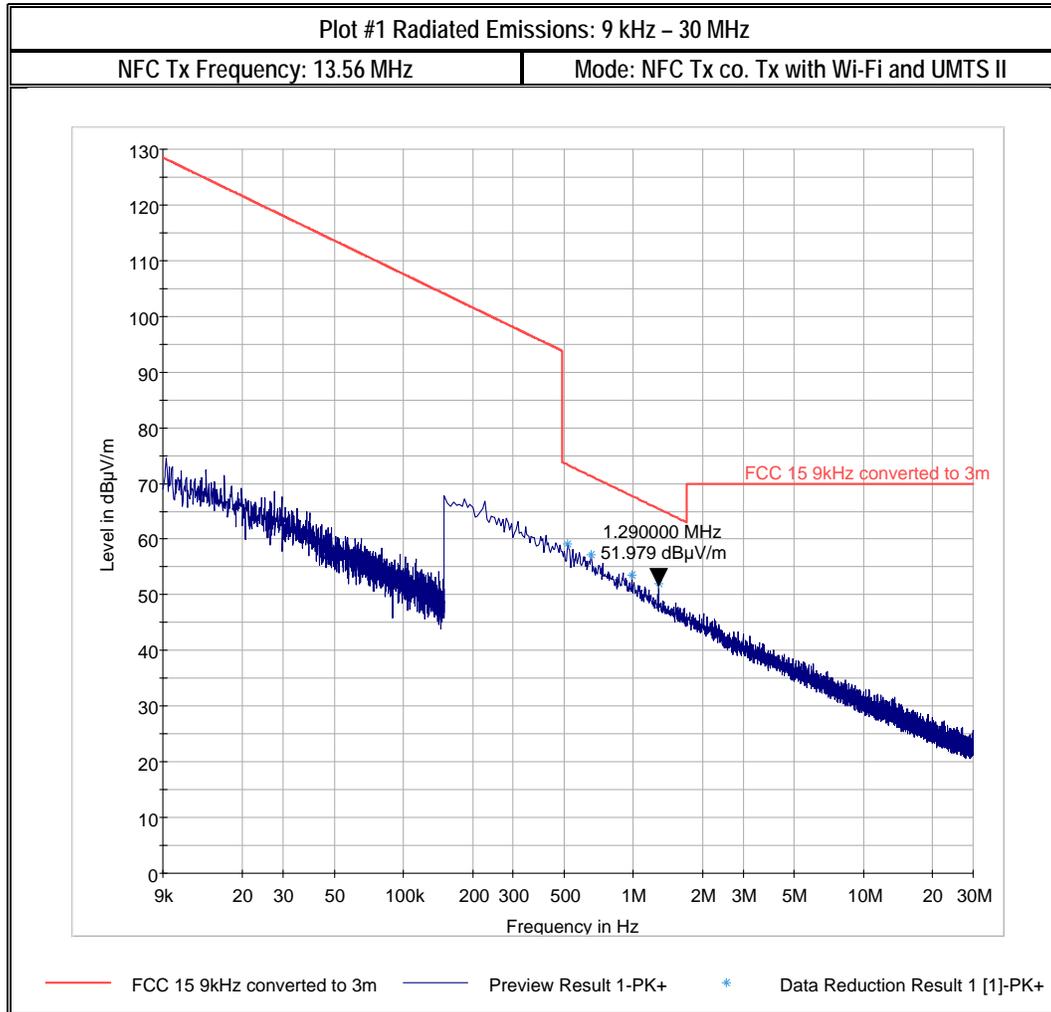
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	2	NFC Tx co. Tx with Wi-Fi and UMTS II	5 VDC

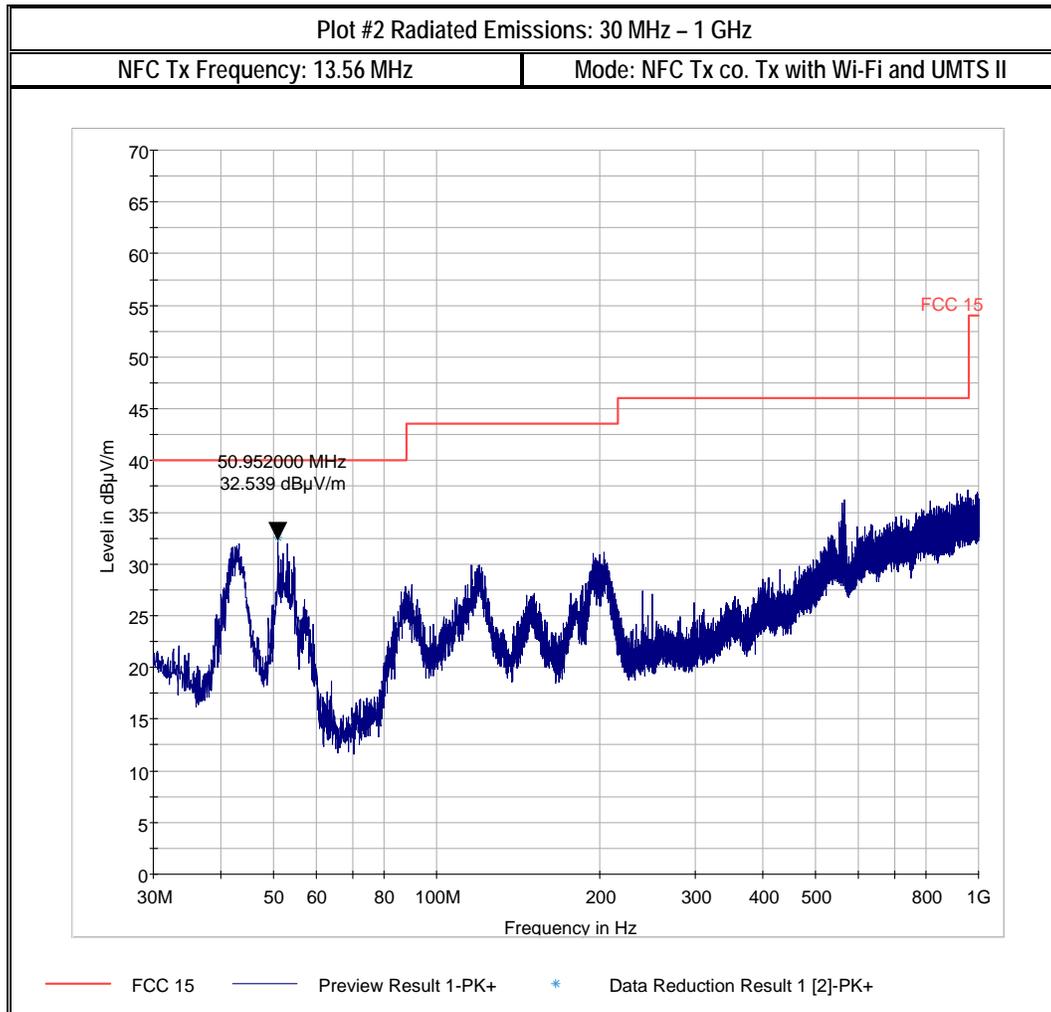
7.5.4 Measurement result:

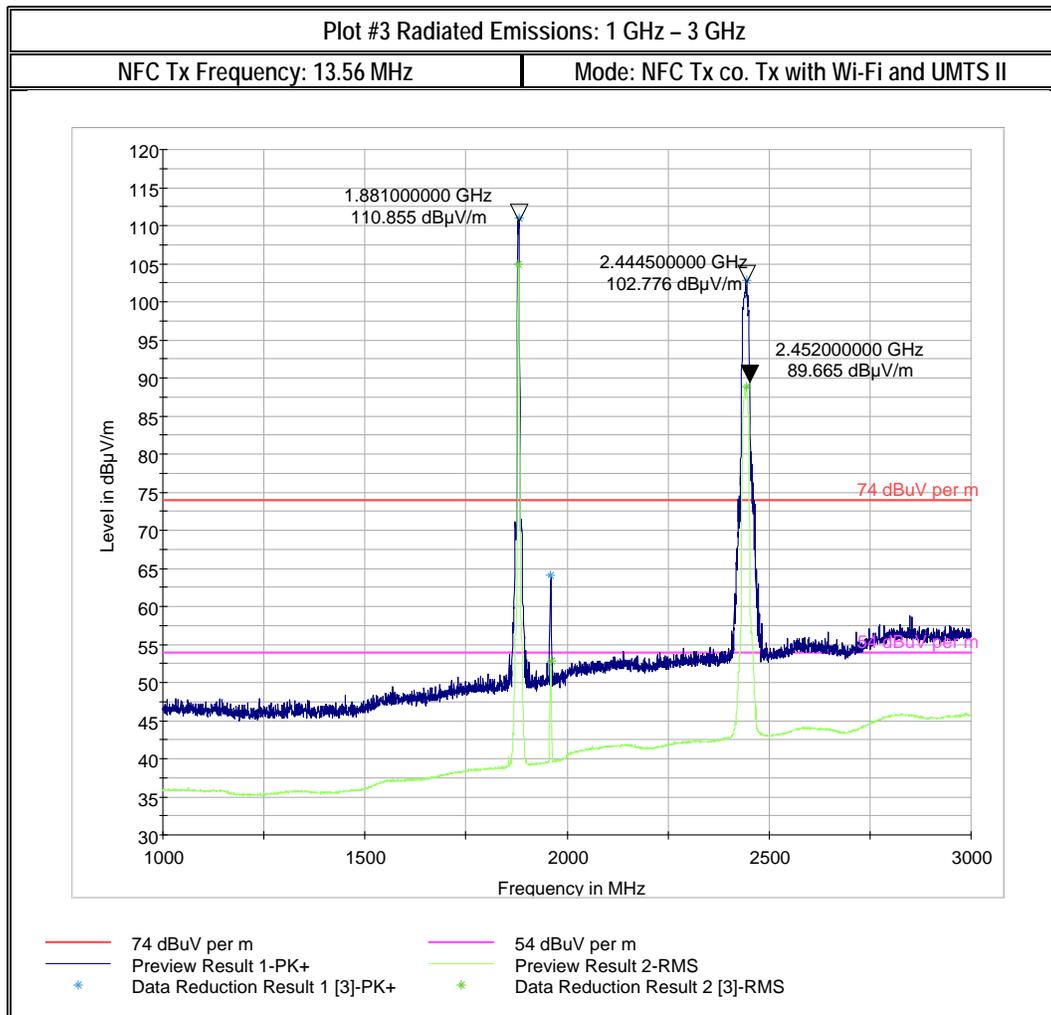
Plot #	Scan Frequency	Limit	Result
1	9 kHz – 30 MHz	See section 7.5.2	Pass
2	30 MHz – 1 GHz	See section 7.5.2	Pass
3	1 GHz – 3 GHz	See section 7.5.2	Pass
4	3 GHz – 18 GHz	See section 7.5.2	Pass

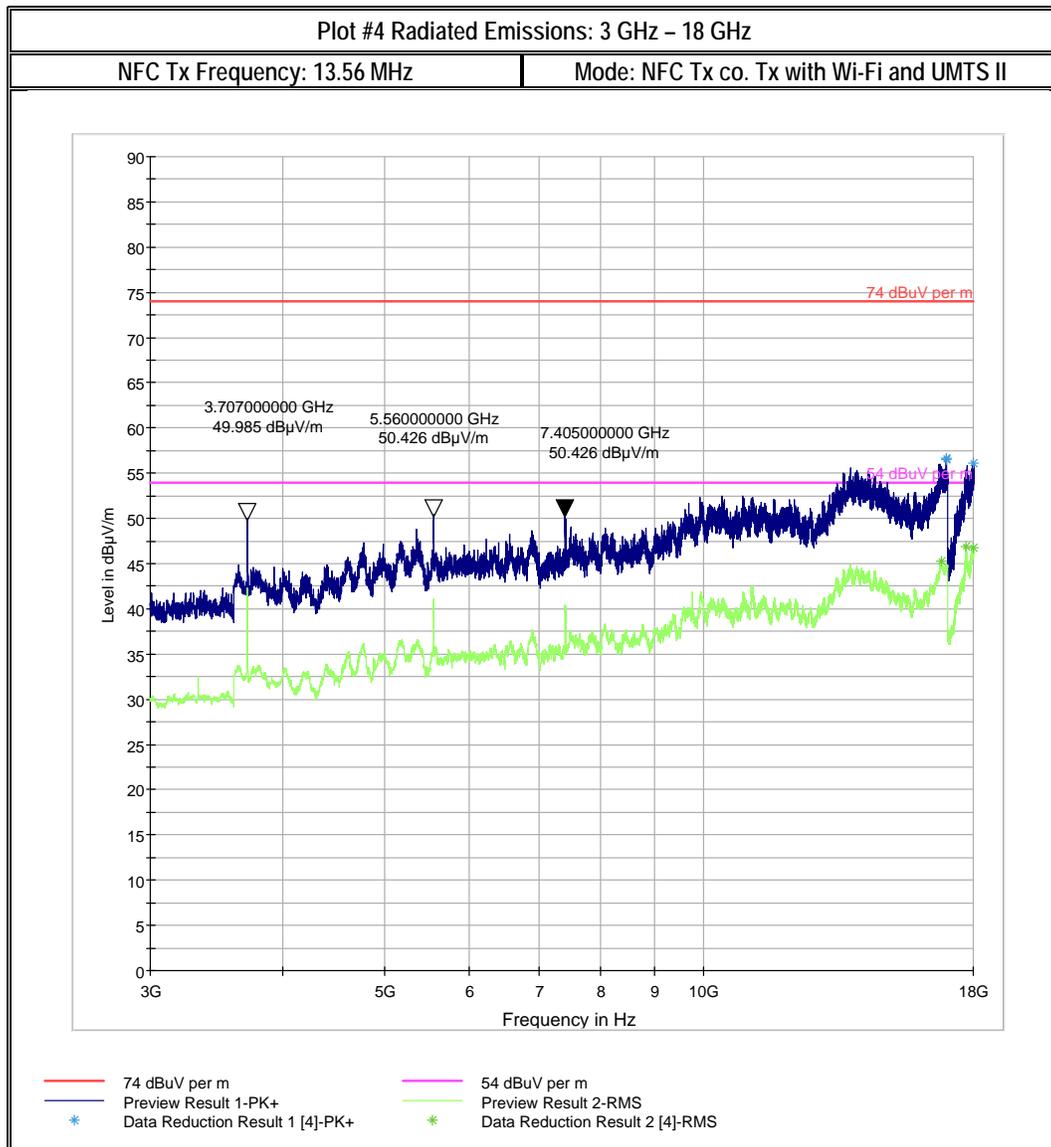


7.5.5 Measurement Plots:









7.6 Frequency Tolerance

7.6.1 References

FCC: 15.225 (e)
RSS-210 B.6

Measurements according to ANSI C63.10 Section 6.8

7.6.2 Limits:

FCC: +/- 0.01 %
RSS-210: +/- 0.01 %

7.6.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	2	NFC Tx co. Tx with Wi-Fi and UMTS II	5 VDC

7.6.4 Test data:

Frequency Tolerance vs. Voltage Source		
Voltage Source (VDC)	Measured Frequency (MHz)	Tolerance Deviation (%)
Vmin = 4.5	13.56	0
Vnom = 5	13.56	0
Vmax = 5.5	13.56	0

Frequency Tolerance vs. Temperature						Maximum Deviation (%)
Voltage Source (VDC)	Temperature (°C)	Measured Frequency (MHz) over Time				
		0 min	2 min	5 min	10 min	
4.5	-10°C	13.56	13.56	13.56	13.56	0
4.5	-10°C	13.56	13.56	13.56	13.56	0
4.5	-10°C	13.56	13.56	13.56	13.56	0
5.5	55°C	13.56	13.56	13.56	13.56	0
5.5	55°C	13.56	13.56	13.56	13.56	0
5.5	55°C	13.56	13.56	13.56	13.56	0

7.7 AC Power Line Conducted Emissions

7.7.1 Measurement according to ANSI C63.10 (2013)

Analyzer Settings:

- RBW = 9 kHz (CISPR Bandwidth)
- Pre-scan Detector = Peak / Average
- Final Measurements Detector = Quasi-Peak / Average

7.7.2 Limits: FCC 15.207 & RSS-Gen 8.8

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

7.7.3 Test conditions and setup:

Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22	2	NFC	Line & Neutral	5 VDC

7.7.4 Measurement Result:

Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	2	NFC	150 kHz – 30 MHz	See section 8.8.2	Pass

7.7.5 Measurement Plots:

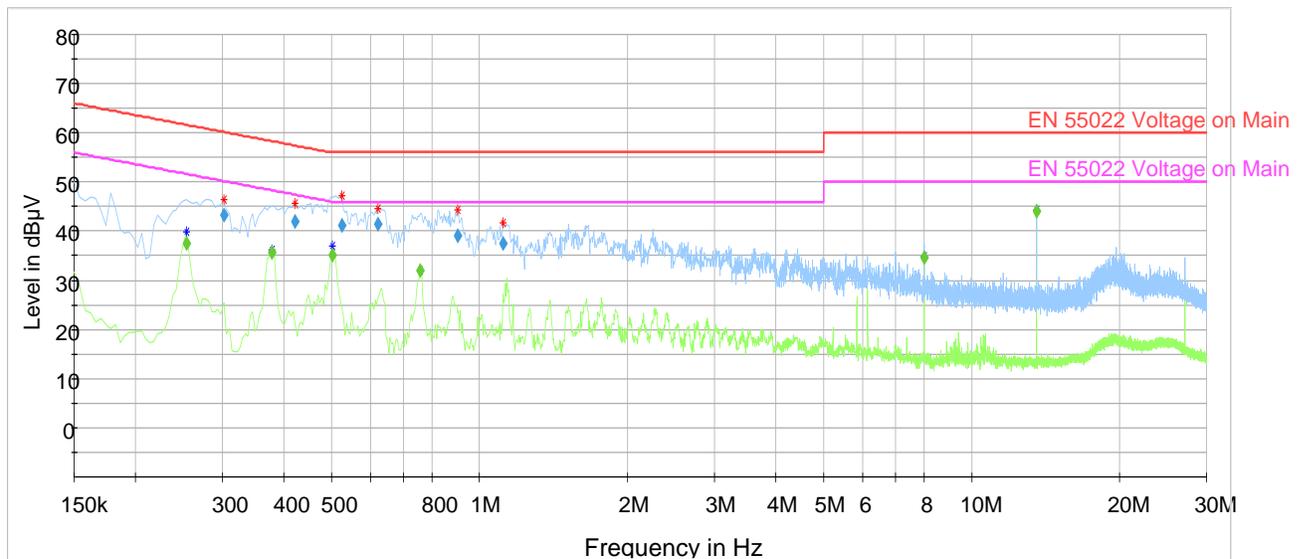
Plot # 1

EUT Information

EUT Serial Number: 39F003818
 Manufacturer: Garmin International
 Comment: 120 V, 60 Hz

Frequency (MHz)	Quasi-Peak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.254000	---	37.61	51.63	14.01	500.0	9.000	N	GND	5.4
0.302000	43.31	---	60.19	16.88	500.0	9.000	L1	GND	4.0
0.378000	---	35.63	48.32	12.69	500.0	9.000	L1	GND	3.1
0.422000	41.97	---	57.41	15.43	500.0	9.000	N	GND	2.7
0.502000	---	35.24	46.00	10.76	500.0	9.000	N	GND	2.1
0.526000	41.16	---	56.00	14.84	500.0	9.000	N	GND	2.0
0.622000	41.35	---	56.00	14.65	500.0	9.000	L1	GND	1.5
0.758000	---	32.08	46.00	13.92	500.0	9.000	L1	GND	1.3
0.902000	39.05	---	56.00	16.95	500.0	9.000	N	GND	1.0
1.118000	37.60	---	56.00	18.40	500.0	9.000	N	GND	0.8
8.006000	---	34.69	50.00	15.31	500.0	9.000	L1	GND	0.7
13.558000	---	44.11	50.00	5.89	500.0	9.000	N	GND	0.6

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



— Preview Result 2-AVG
 — Preview Result 1-PK+
 * Critical_Freqs AVG
 * Critical_Freqs PK+
— EN 55022 Voltage on Mains
— EN 55022 Voltage on Mains
◆ Final_Result QPK
◆ Final_Result AVG

8 Test setup photos

Setup photos are included in supporting file name: "EMC_GARMI-047-17001_15.226_NFC_Setup_Photos.pdf"

9 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Biconilog 3142E	BiconiLog Antenna	EMCO	3142E	166067	3 years	6/27/2017
Magnetic Loop Antenna	Loop Antenna	ETS Lindgren	6512	00049838	3 years	7/28/2017
Antenna Horn 3115	Horn Antenna	EMCO	3115	35111	3 years	7/24/2015
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116	70497	3 years	7/22/2015
Digital Barometer, Temperature, Humidity	Compact Digital Barometer	Control Company	35519-055	91119547	1 Years	06/08/2017
FSU26	Spectrum Analyzer	R&S	FSU26	200256	2 years	07/04/2017
LISN	Line Impedance Stabilization Network	FCC	FCC-LISN-50-25-2-08	8014	1 Year	11/10/2016

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.



10 Revision History

Date	Report Name	Changes to report	Report prepared by
2017-11-01	EMC_GARMI_047_17001_15.225_NFC	Initial report	Elijah Garcia