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TNB Test Report

Class 2 Permissive Change

Prepared for: **Garmin International Inc.**

Address: **1200 E. 151st Street**
Olathe, Kansas, 66062, USA

Product: **A03302**

Test Report No: **R20190123-20-04C**

Approved By:

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DATE: **16 May 2019**

Total Pages: **12**

ilac-MRA A2LA ACCREDITED TESTING LABORATORY CERTIFICATE NO. 1953.01

Revision Page

Rev. No.	Date	Description
Original	10 MAY 2019	Original – Njohnson Prepared by KVepuri
A	15 MAY 2019	Removed irrelevant note under test methods on page 3. Includes NCEE Labs report R20190123-20-04 and its amendment in full. -NJ
B	16 MAY 2019	Updated spurious emissions at antenna terminals section Includes NCEE Labs report R20190123-20-04A and its amendment in full. -NJ
C	16 MAY 2019	Removed spurious emissions from antenna terminals measurements because they were not relevant to this Class II permissive change application. Corrected Part 25.212 references Corrected unit for limit in Tables 1 and 2 Includes NCEE Labs report R20190123-20-04A and its amendment in full. -NJ

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1 Summary of Test Results

The following information is submitted for consideration in processing Class 2 Permissive Change (C2PC) to authorized equipment. The module model: A03302, was granted a module authorization operating under 47CFR part 25 and Industry Canada RSS-170 operations in the 1616.0-1626.5 MHz frequency band. This report presents documentation supporting a change in the PCB trace leading to the antenna. The new trace includes no active components.

The equipment under test (EUT) was tested for compliance to FCC Part 25 and Part 2 as well as RSS-170. Below is a summary of the test results. Complete results can be found in Section 3.

Report Section	47 CFR FCC Rule Part	Description	Result
3	§ 2.1046, §25.202	Spurious emissions	Compliant
3	RSS-170 Issue 3, Section 5.4	Power and emissions	Compliant

Test Methods:

(1) ANSI C63.26-2015

2 EUT Description

The Equipment Under Test (EUT) was a battery-powered transceiver manufactured by GARMIN inc..

2.1 Equipment under Test (EUT)

EUT	A03302
EUT Received	22 March 2019
EUT Tested	26 March 2019- 1 May 2019
Serial No.	3985900303bw00 (used for radiated tests);
Operating Band	1616 MHz – 1626 MHz
Device Type	Iridium
Power Supply	Internal Battery/ Charger: Garmin (Phi Hong) MN: PSAI10R-050Q

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 Testing Location

All testing was performed at the NCEE Lincoln facility, which is an A2LA accredited EMC test laboratory accredited per scope 1953.01.

2.3 EUT Setup

The EUT was powered by 5 VDC, internal Battery for all the tests

2.4 Test Equipment

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	30 Jan 2018	30 Jan 2020
EMCO Biconilog Antenna	3142B	1647	02 Aug 2017	02 Aug 2019
EMCO Horn Antenna	3115	6416	26 Jan 2018	26 Jan 2020
EMCO Horn Antenna	3116	2576	31 Jan 2018	31 Jan 2020
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	09 Mar 2018*	09 Mar 2020*
Trilithic High Pass Filter	6HC330	23042	09 Mar 2018*	09 Mar 2020*
Rohde & Schwarz LISN	ESH3-Z5	836679/010	26 Jul 2018	26 Jul 2019
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Mar 2018*	09 Mar 2020*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Mar 2018*	09 Mar 2020*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Mar 2018*	09 Mar 2020*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Mar 2018*	09 Mar 2020*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Mar 2018*	09 Mar 2020*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Mar 2018*	09 Mar 2020*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Mar 2018*	09 Mar 2020*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Mar 2018*	09 Mar 2020*

*Internal Characterization

Notes:
All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

3 Test Results

Emissions Limitations Operation in the Band 1616.0-1626.5 MHz

Test: FCC Part 25.202, 2.1051, 2.1053
RSS-170, Clause 5.3
ANSI C63.26, Section 5.5, Annex B

Test Result: *Complies* Date: 6 May 2019

Test Description
25.202 Section 12(f) *Emission limitations.* Except for SDARS terrestrial repeaters and as provided for in paragraph (i), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

Test Environment
Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:
Relative humidity of 35 ± 5%
Temperature of 22 ± 2º C

Test Setup
The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuators. The spectrum analyzer was used to make power measurements using the channel power function. The resolution bandwidth was set to 1 MHz and the channel bandwidth was set to match the occupied bandwidth as measured in Section 3.3.

Spurious emissions were measured using a pre-test site path loss according to Section 5.5.4 and Annex B of ANSI C63.26.

Radiated emissions measurements were made from 9 kHz to 12.5 GHz at a distance of 3m inside a semi-anechoic chamber. The EUT was rotated 360º, the antenna height varied from 1 – 4 meters and both the vertical and horizontal antenna polarizations examined. The results were compared against the limits. Measurements were made by first using a spectrum analyzer to acquire the signal spectrum; individual frequencies were then measured using a CISPR 16.1 compliant receiver with the following bandwidth setting:
30MHz – 1GHz:120kHz IF bandwidth, 60kHz steps.

Limits were converted from EIRP to 3m field strength. Measurements were performed with a quasi-peak detector. Path loss was measured during ANSI C63.4-2014 Normalized Site Attenuation measurements.

Test Results

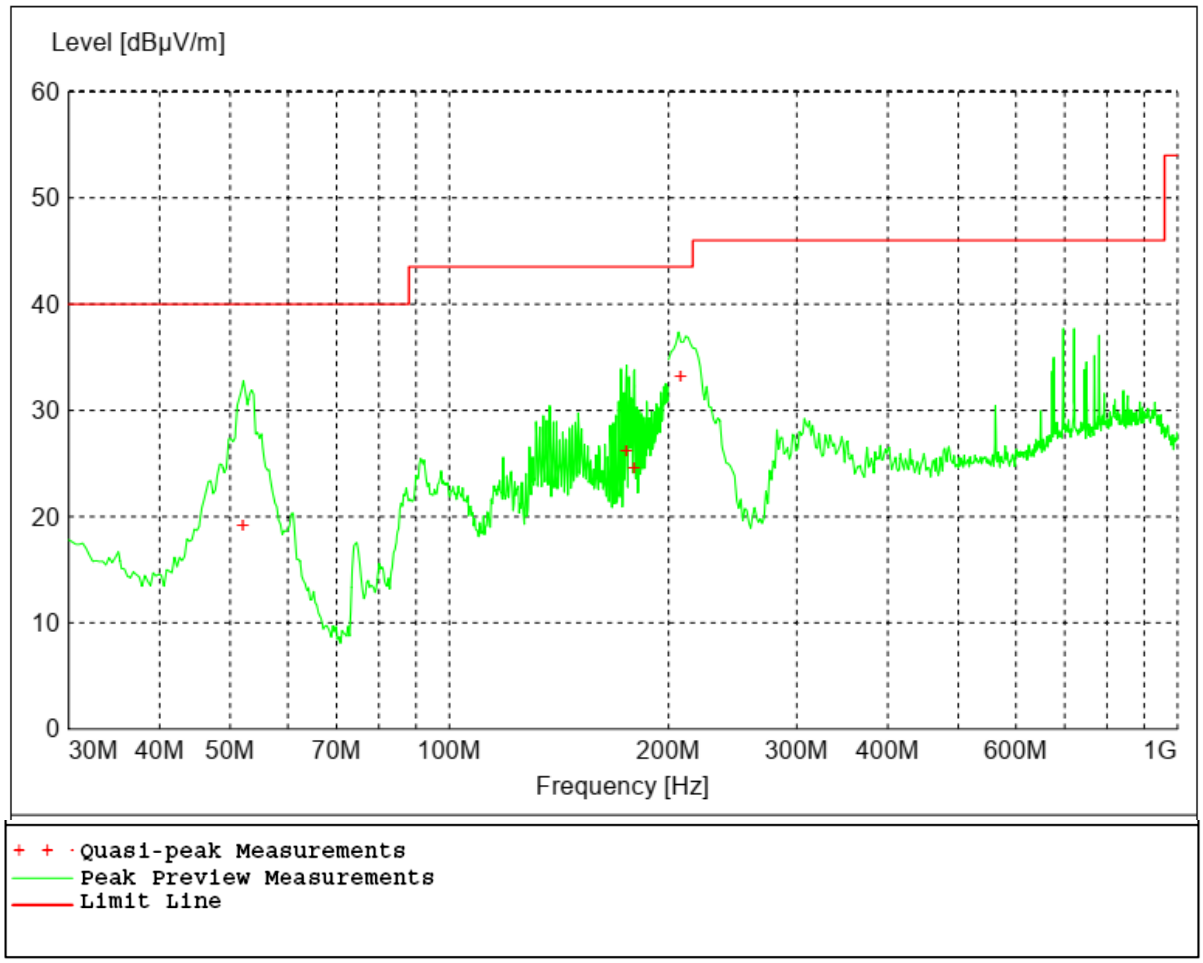

Figure 1 - Radiated Emissions Data Plot

All three channel were investigated and the channel with the highest emissions is shown for the 30 MHz – 1 GHz frequency range.

Table 1 - Radiated Emissions Measurements

Frequency	Pre-test Level	Emission Power Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBµV/m	dBm	dBm	dB	cm.	deg.		
52.140000	19.16	-76.07	-13.00	63.07	100	193	V	Mid
175.140000	26.16	-69.07	-13.00	56.07	213	0	H	Mid
179.400000	24.59	-70.64	-13.00	57.64	193	360	H	Mid
207.960000	33.29	-61.94	-13.00	48.94	138	0	H	Mid

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Emission Power Level = Pre-test level – Path Loss (94.23 dB)

Table 2 - Radiated Emissions Peak Measurements

Frequency	Level	Emission Power Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBµV/m	dBm	dBm	dB	cm.	deg.		
1616.400000	125.82	30.59	NA	NA	168	218	VERT	Low
1620.970000	125.94	30.71	NA	NA	168	218	VERT	Mid
1625.970000	126.18	30.95	NA	NA	168	218	VERT	High
3242.000000	57.77	-37.46	-13.00	24.46	174	218	V	Mid
3232.000000	58.43	-36.80	-13.00	23.80	171	197	H	Low
3252.000000	57.71	-37.52	-13.00	24.52	177	22	H	high

No other signals were detected above system sensitivity

Requirement from FCC Part 25.216

(c) The e.i.r.p. density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed −70 dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed −80 dBW, averaged over any 2 millisecond active transmission interval, in the 1559-1605 MHz band.

Measurements according to FCC Part 25.212(c)

Average measurements

1616.0208033 MHz

Frequency	Level (EIRP)	Limit	Margin
MHz	dBW	dBW	dB
1559	-100.998	-80.00	20.99789
1582	-101.202	-80.00	21.20222
1605	-101.305	-80.00	21.30482

1621.0208033 MHz

Frequency	Level (EIRP)	Limit	Margin
MHz	dBW	dBW	dB
1559	-101.034	-80.00	21.03399
1582	-102.169	-80.00	22.16928
1605	-100.058	-80.00	20.05779

1625.979167 MHz

Frequency	Level (EIRP)	Limit	Margin
MHz	dBW	dBW	dB
1559	-101.178	-80.00	21.17777
1582	-102.533	-80.00	22.53251
1605	-100.853	-80.00	20.85254

(g) <first section of paragraph removed because power density measurements are not applicable to permissive change validation>

…The e.i.r.p of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from −80 dBW at 1605 MHz to −20 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval.

Measurements according to FCC Part 25.212 (g)

Peak measurements

1616.0208033 MHz

Frequency	Level	Limit	Margin
MHz	dBW	dBW	dB
1605	-80.28	-80.00	0.28
1606	-80.57	-68.00	12.57
1607	-81.46	-56.00	25.46
1608	-81.56	-44.00	37.56
1609	-81.13	-32.00	49.13
1610	-81.38	-20.00	61.38

1621.0208033 MHz

Frequency	Level	Limit	Margin
MHz	dBW	dBW	dB
1605.00	-80.82	-80.00	0.82
1606.00	-79.49	-68.00	11.49
1607.00	-81.59	-56.00	25.59
1608.00	-80.17	-44.00	36.17
1609.00	-80.31	-32.00	48.31
1610.00	-79.37	-20.00	59.37

1625.979167 MHz

Frequency	Level	Limit	Margin
MHz	dBW	dBW	dB
1605.00	-80.70	-80.00	0.70
1606.00	-80.00	-68.00	12.00
1607.00	-81.86	-56.00	25.86
1608.00	-81.05	-44.00	37.05
1609.00	-80.41	-32.00	48.41
1610.00	-78.89	-20.00	58.89

Note:
the limits shown are for discrete emissions of less than 700 Hz bandwidth according to FCC Part 25.212(g). The bandwidth of the emissions was not measured, so the lowest limits were used. For FCC Part 25.212(g) the limits are 10 dB higher, so the margins would increase by 10 dB. These measurements are intended to show compliance with both parts using the lowest limit.

Resolution bandwidth of 1 MHz was used for all Part 25.216 measurements. The EMI receiver was set to scan across the band in 500 kHz steps using peak or average detector as stated.

Annex A – Sample Field Strength Calculation

Radiated Emissions

The field strength is calculated in decibels (dB) by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = R + AF – (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dBμV

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dBμV is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dBμV/m.

FS = 55.00 + 12.00 – (-1.10 + 20.00) = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20] = 254.1 μV/m

Annex B – Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44

Expanded uncertainty values are calculated to a confidence level of 95%.