Radio Frequency Exposure Evaluation Report

FOR:
Garmin International, Inc.

Model Number:
A03675

Product Description:
N/A

FCC ID: IPH-06375
IC ID: 1792A-03675

Per:

CFR Part Part1 (1.1307 &1.1310), Part 2 (2.1091),
FCC KDB 447498 D01 General RF Exposure Guidance v06
ISEDC RSS-102 Issue 5

Report number: EMC_GARMI-064-19001_FCC_ISED_MPE_REV6

DATE: 2020-05-22

***CETECOM* Inc.**
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1 Assessment

This RF Exposure evaluation report provides evidence for compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 &1.1310), Part 2 (2.1091) and IC standard RSS-102 issue 5 under worst case conditions (measured or rated RF output power, antenna gain, distance towards human body, multiple transmitter information as presented by the applicant).
In addition, maximum antenna gain or minimum distance towards the human body is calculated respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and IC rule parts based on available specifications for worst case conditions at 20cm distance to the body.

Company	Description	Model #
Garmin International Inc.	N/A	A03675

Report reviewed by:

Date	Section	Name	Signature
2020-05-22	Compliance	Cindy Li (Lab Manager)	Cindy Li Digitally signed by cindy.li@cetecom.com DN: CN=cindy.li@cetecom.com Reason: I am approving this document Location: Date: 2020-05-22 18:14:19

Responsible for the Report:

Date	Section	Name	Signature
2020-05-22	Compliance	Kevin Wang (EMC Engineer)	Kevin Wang Digitally signed by: Kevin Wang DN: CN = Kevin Wang email = kevin.wang@cetecom.com C = US O = Cetecom Inc. Date: 2020.05.22 17:49:49 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the 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
Lab Manager:	Cindy Li
Responsible Project Leader:	Sangeetha Sivaraman

2.2 Identification of the Client / Manufacturer

Client's Name:	Garmin International, Inc.
Street Address:	1200 East 151st Street
City/Zip Code	Olathe, KS 66062
Country	USA

Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Assessment

Marketing name:	N/A
HW Version :	1
SW Version :	1.20
Firmware Version Identification Number (FVIN):	N/A
Hardware Version Identification Number (HVIN):	A03675
Product Marketing Name (PMN):	N/A
Regulatory Band:	❖ **Cellular Module:** ▪ WCDMA/UMTS FDD BAND II: 1852.4 ~ 1907.6 MHz ▪ WCDMA/UMTS FDD BAND IV: 1712.4 ~ 1752.6 MHz ▪ WCDMA/UMTS FDD BAND V: 826.4 ~ 846.6 MHz ▪ LTE BAND 2: 1850 ~ 1910 MHz ▪ LTE BAND 4: 1710 ~ 1755 MHz ▪ LTE BAND 5: 824 ~ 849 MHz ▪ LTE BAND 12: 699 ~ 716 MHz ❖ **WLAN:** ▪ Nominal band: 2400 MHz – 2483.5 MHz; ▪ Center to center: 2412 MHz (ch 1) – 2462 MHz (ch 11), 11 channels ❖ **BTLE / ANT:** ▪ Nominal band: 2400 MHz – 2483.5 MHz; ▪ Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 channels
Integrated Module Info:	❖ **Cellular Module:** ▪ Module name: Quectel ▪ Model number: EG25-G ▪ FCC/IC ID: XMR201903EG25G / 10224A-201903EG25G ❖ **WLAN:** ▪ Module name: Marvell ▪ Model number: 88W8997 ▪ FCC/IC ID: IPH-06375 / 1792A-03675 ❖ **Bluetooth / ANT:** ▪ Module name: Nordic Semiconductor ▪ Model number: nRF51422 ▪ FCC/IC ID: TFB-TIWI1-01 / 5969A-TIWI101

Antenna Type:	❖ **Cellular:** ▪ Antenna maximum gain: o WCDMA II: 0.4 dBi o WCDMA IV: 0.2 dBi o WCDMA V: -1.0 dBi o LTE Band 2: 0.4 dBi o LTE Band 4: 0.2 dBi o LTE Band 5: -1.0 dBi o LTE Band 12: -2.1 dBi ❖ **WLAN:** ▪ Antenna gain: 3.7 dBi ❖ **BTLE / ANT:** ▪ Antenna gain: 4.0 dBi
Target TX Output Power [Note 1]:	❖ **Cellular:** ▪ WCDMA Band II: 25 dBm ▪ WCDMA Band IV: 25 dBm ▪ WCDMA Band V: 25 dBm ▪ LTE Band 2: 25 dBm ▪ LTE Band 4: 25 dBm ▪ LTE Band 5: 25 dBm ▪ LTE Band 12: 25 dBm
Maximum Conducted Output Power [Note 2]:	❖ **WLAN:** ▪ 802.11n HT20: 12.35 dBm ❖ **BTLE:** ▪ BTLE: 4.95 dBm ❖ **ANT:** ▪ ANT: 1.75 dBm
Power Supply/ Rated Operating Voltage Range:	Low: 10 VDC, Nominal: 12 VDC, High: 32 VDC
Operating Temperature Range:	Low -15º C, Nominal 25º C, High 55º C
Sample Revision [Note 3]:	☐Prototype Unit; ☐Production Unit; ■Pre-Production

Note 1: Target TX Output Power leveraged from Test Report No. "HR/2019/1001601" prepared by SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch for cellular module Quectel EG25-G (FCC ID: XMR201903EG25G, IC ID: 10224A-201903EG25G). Tune-up tolerance has been taken into account.
Note 2: Maximum Conducted Output Power leveraged from Operation Description.
Note 3: Pre-production PCB has new communication circuit that was made functional using wire mods. From a radio perspective the units tested are production quality per client communication.

4 RF Exposure Limits and FCC and IC Basic Rules

For the specific described radio apparatus the following basic limits and rules apply for both, FCC and IC where not indicated differently.

4.1 Power Density Limits acc. to FCC 1.1310(e) / RSS-102 i5, cl. 4:

FCC

Frequency Range (MHz)	Power density (mW/cm²)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100000	1.0	30

IC

300 – 6000	0.02619 x f (MHz) $^{0.6834}$	6

4.2 Routine Environmental Evaluation Categorical Exclusion Limits acc. to FCC 2.1091(c) / RSS-102, cl. 2.5 (rounded to 1 decimal point):

FCC
operating frequency < 1.5GHz: excluded if ERP < 1.5W / 31.8dBm (EIRP: 33.9 dBm);
operating frequency > 1.5GHz: excluded if ERP < 3.0W / 34.8dBm (EIRP: 36.9 dBm);

IC
300MHz < = operating frequency < 6 GHz: excluded if EIRP < 0.0131 x f (MHz) $^{0.6834}$ W

4.3 RF Exposure Estimation (MPE Estimation)

Having available the source based average output power and peak antenna gain or the ERP/EIRP of the specified device and for a known minimum distance of its radiating structures from the body of persons according to its use cases (at least 20cm) the power density at that distance can be estimated by the following formula for plane-wave equivalent conditions (far-field conditions), when ground reflection is neglected.

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

where: S = power density (mW/cm² or W/m²)
P = power input to the antenna (mW or W)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (cm or m)

5 Evaluations

5.1 Analysis of RF Exposure for simultaneous transmission

- Evaluations are based on worst case power density limits for Canada.
- Calculations are made for 20cm.
- Evaluations are based on ERP/EIRP measured or calculated from known gain and conducted output power.
- Cellular can transmit simultaneously with WLAN.

Radio	freq [MHz]	Max Conducted power [W]	Gain [dBi]	Gain [lin]	EIRP [W]	IC Limit [W/m2]	FCC LImit [W/m2]	Actual [W/m2]^2	How much of limit is used up
WCDMA II	1852.4	0.3162	0.4	1.096	0.347	4.480	10.000	0.690	15.40%
WCDMA IV	1712.4	0.3162	0.2	1.047	0.331	4.246	10.000	0.659	15.51%
WCDMA V	826.4	0.3162	-1.0	0.794	0.251	2.581	5.509	0.500	19.36%
LTE 2	1850	0.3162	0.4	1.096	0.347	4.476	10.000	0.690	15.41%
LTE 4	1710	0.3162	0.2	1.047	0.331	4.242	10.000	0.659	15.53%
LTE 5	824	0.3162	-1.0	0.794	0.251	2.576	5.493	0.500	19.40%
LTE 12	699	0.3162	-2.1	0.617	0.195	2.302	4.660	0.388	16.85%
WLAN Note 1	2400	0.0342 Note 2	6.7 Note 3	4.68	0.160	5.348	10.000	0.318	5.95%
BTLE	2400	0.00312 Note 4	4.0	2.51	0.008	5.348	10.000	0.016	0.28%
ANT	2400	0.00149 Note 5	4.0	2.51	0.004	5.348	10.000	0.007	0.13%

Note 1: 802.11n HT20 is worst-case modulation after applying Antenna Gain and Beamforming Gain, and is therefore used for evaluation
Note 2: From Operational Description, Max Conducted Power 12.35dBm per port for 802.11n HT20 was used. And additional 3 dB was added for MIMO.
Note 3: Combined Gain = 3.7 dBi Antenna Gain + 3 dB Beamforming Gain
Note 4: From Operational Description, Max Conducted Power 4.95dBm was used for BTLE.
Note 5: From Operational Description, Max Conducted Power 1.75dBm was used for ANT.
Note 6: Max Conducted Average Output Power for WCDMA and LTE bands based on Target TX Output Power
Note 7: Calculation based on distance of 20cm and highest power

5.2 Conclusion:

The worst-case simultaneous transmission is LTE Band 5 simultaneous with WLAN and BTLE, which is using 25.63% of a limit of 100%. The equipment is passing RF exposure requirements for 20cm distance.

6 Revision History

Date	Report Name	Changes to report	Report prepared by
2020-04-16	EMC_GARMI-064-19001_FCC_ISED_MPE	Initial Release	Chin Ming Lui
2020-04-20	EMC_GARMI-064-19001_FCC_ISED_MPE_REV1	Modified sample revision note for pre-production PCB from N2K to communication circuit	Chin Ming Lui
2020-04-29	EMC_GARMI-064-19001_FCC_ISED_MPE_REV2	Modified antenna gains for LTE and UMTS bands based on operational description	Chin Ming Lui
2020-04-30	EMC_GARMI-064-19001_FCC_ISED_MPE_REV3	Modified WLAN evaluation. Evaluated 802.11n HT20 instead of 802.11g. Add 3dB beamforming gain to output power for 802.11n HT20 operating mode.	Chin Ming Lui
2020-05-06	EMC_GARMI-064-19001_FCC_ISED_MPE_REV4	Modified antenna gains for LTE and UMTS bands based on operational description	Chin Ming Lui
2020-05-11	EMC_GARMI-064-19001_FCC_ISED_MPE_REV5	Updated EUT SW version from Test Rev 7 to 1.20	Chin Ming Lui
2020-05-22	EMC_GARMI-064-19001_FCC_ISED_MPE_REV6	Updated antenna gain for WiFi and Max output power for WiFi, BTLE and ANT	Kevin Wang

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