ncee labs
Product Compliance Solutions

4740 Discovery Drive | Lincoln, NE 68521
tel- 402.323.6233 | tel -888.657.6860 | fax - 402.323.6238
info@nceelabs.com | http://nceelabs.com

Antenna Gain Test Report

Prepared for:	**Garmin International, Inc.**
Address:	**1200 E. 151st Street** **Olathe, Kansas, 66062, USA**
Product:	**A04659**
Test Report No:	**R20220628-20-A4**
Approved by:	 **Nic Johnson** **Technical Manager**
DATE:	**March 24, 2023**
Total Pages:	**11**

REVISION PAGE

Rev. No.	Date	Description
0	24 March 2023	Original – KVepuri Reviewed by KVepuri Prepared by FLane, GLarsen

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1.0 SUMMARY OF TEST RESULTS

Antenna Gain Measurements were reported for 2400-2483.5 MHz band.

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:
Device under test was a rechargeable battery powered transceiver manufactured by Garmin International, Inc.

EUT	A04659
FCC ID:	IPH-04659
EUT Received	21 July 2022
EUT Tested	21 July 2022 - 20 September 2022
Serial No.	3424308878 (Conducted Unit) 3424308866 (Radiated Unit)
Operating Band	2400 – 2483.5 MHz
Power Supply / Voltage	Internal Battery/ 5VDC Charger: Garmin (Phi Hong) MN: LACA046 (Representative Power Supply)
Antenna Gain (dBi)	+0.43dBi

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

3.0 LABORATORY AND GENERAL TEST DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:
Relative humidity of 35 ± 4%
Temperature of 22 ± 3° Celsius

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Karthik Vepuri	Test Engineer	Review/editing
2	Fox Lane	Test Engineer	Testing and Report
3	Blake Winter	Test Engineer	Testing
4	Grace Larsen	Test Engineer	Testing and Report
5	Ethan Schmidt	Test Technician	Testing

Notes:
All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (26.5GHz)***	N9038A	MY56400083	July 19, 2022	July 19, 2024
Keysight EXA Signal Analyzer**	N9010A	MY56070862	July 20, 2021	July 20, 2023
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
ETS-Lindgren Horn Antenna	3115	218655	July 21, 2022	July 21, 2023
Keysight MXG Analog Signal Generator	N5183B	MY59100122	July 19, 2022	July 19, 2024
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	March 21, 2022	March 21, 2024
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	September 24, 2021	September 24, 2023
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	September 24, 2021	September 24, 2023
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	September 24, 2021	September 24, 2023
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	September 24, 2021	September 24, 2023
N connector bulkhead (control room)*	PE9128	NCEEBH2	September 24, 2021	September 24, 2023

*Internal Characterization

**2 Year Cal Cycle

Notes:

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

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

Measurement type presented in this report (Please see the checked box below):

Conducted ☒

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

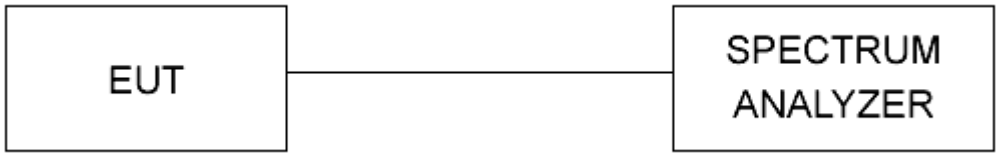


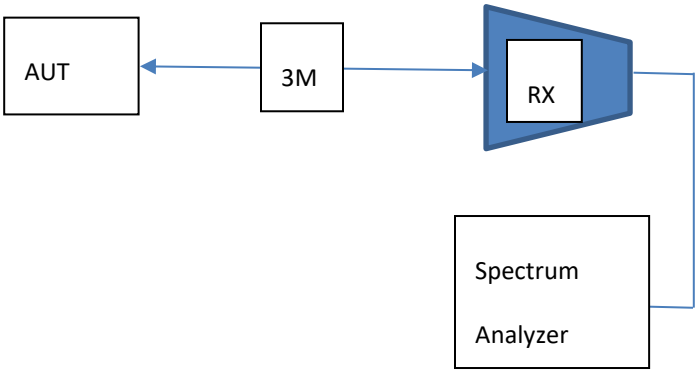
Figure 1 - Bandwidth Measurements Test Setup

Radiated ☒

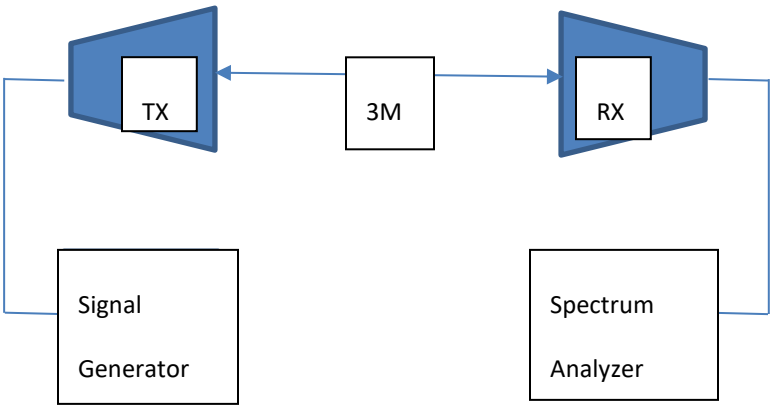
All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about

the section used can be found in the spectrum analyzer titles on the graph. Substitution method was used

.



Reference measurement setup (20 MHz channel power used on spectrum analyzer)



Antenna substitution setup

4.0 RESULTS

4.1 ANTENNA GAIN

Test procedures:
Device's conducted power was measured, and the same measurement was repeated through a substitution method measurement at 3m test distance.

Conducted measurements using the setup outlined in ANSI C63.10 Sec 11.9.2.2.2.

Substitution method calculations can be found in ANSI C63.10 Annex G.5.3, the reference value used to determine the target power for substitution was calculated using the method outlined in ANSI C63.10 Sec 11.9.2.2.2.

Corrected average level was measured with 20 MHz channel power setting and maximized at a 3m test distance. The AUT was then replaced with a calibrated signal generator and antenna. The signal generator was adjusted to reproduce the same corrected average value. The signal generator value was then corrected for transmit receive gain and cable loss to report the field strength value.

Test setup:
Details can be found in section 2.1 of this report.

EUT operating conditions:
Details can be found in section 2.1 and 2.2 of this report.

Test results:

Antenna Gain:
Radiated substitution method – Conducted Average Power = Antenna gain
19.54 dBm – 19.11 dBm = **0.43 dBi**

Comments:
1. Device was compared only on the highest power modulation/transmitter and the results were used for all other modulations/transmitters within that frequency band (2400 – 2483.5 MHz band)

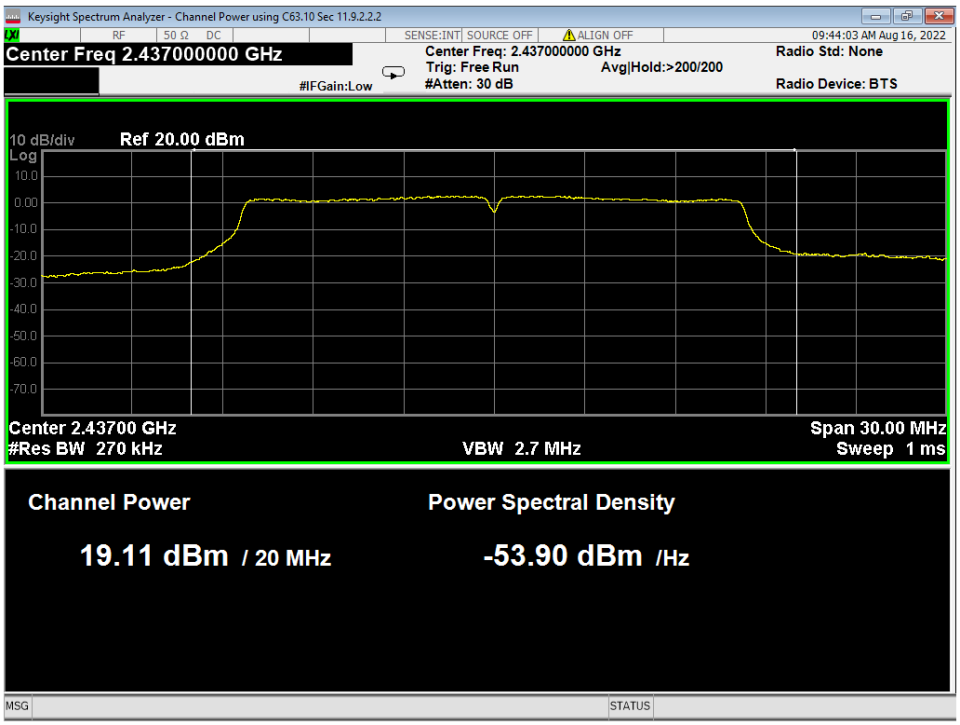


Figure 2 – Conducted Average Power Measurement, 802.11g 6MB

Radiated Measurement

	Transmitter Side		Receiver Side						
Frequency	Cable	Transmit Antenna gain	Preamp	Receive Transducer	Cable to Receiver	Total Receiver side correction	Corrected Average Level(dBuV)	Sig Gen Level (dBm)	Sig Gen Level corrected (dBm)
2437	2.572	9.614	0	27.616	8.85	36.466	20.33	12.50	19.54

REPORT END