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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address:

1200 E. 151st Street Olathe, Kansas, 66062, USA

Product:

A04542

Test Report No:

R20230109-20-E3B

Approved by:

Inne

Fox Lane, EMC Test Engineer

DATE:

April 13, 2023

46

Total Pages:

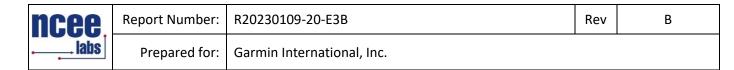
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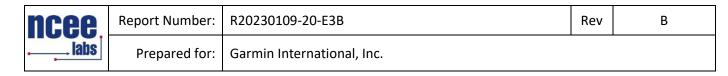
REVISION PAGE

Rev. No.	Date	Description		
		Issued by FLane		
0	31 March 2023	Reviewed by FLane		
		Prepared by FLane, GLarsen		
A	10 April 2023	Updated Antenna Gain - FL		
В	13 April 2023	Corrected FCC/IC ID - FL		



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1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section (Please see the checked box below for the rule part used):

FCC Part 15.247 🛛

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISED RSS-Gen, Issue 5
- (3) ISED RSS-247, Issue 2

APPLIED STANDARDS AND REGULATIONS								
Standard Section	Test Type	Result						
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass						
FCC Part 15.247(b)(3) RSS-247 Issue 2 Section 5.4(d)	Peak output power	Pass						
FCC Part 15.247(a)(2) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass						
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass						
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass						
FCC Part 15.247(e) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass						
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 5.5	Band Edge Measurement	Pass						
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	Pass						



2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04542
FCC ID	IPH-04542
IC ID	1792A-04542
EUT Received	13 February 2023
EUT Tested	15 February 2023- 23 March 2023
Serial No.	3436744035 (Radiated Measurements) 3436743817 (Conducted Measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	□ GMSK □ GFSK □ BT BR ⊠ BT EDR 2MB □ BT EDR 3MB □ 802.11x
Power Supply / Voltage	Internal Battery / 5VDC Charger: Garmin (Phi Hong) Model: AQ27A-59CFA GPN: 362-00118-00 (Representative Power Supply)
Antenna Type / Gain (dBi)	-1.88dBi Trace Antenna Antenna Gain value based off Customer provided AUT Report. Results may differ.

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

2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

FOI DIUEIOUITI HAIISIIIISSIUIIS.					
Channel	Frequency				
Low	2402 MHz				
Mid	2440 MHz				
High	2480 MHz				

For Bluetooth	Transmissions:
---------------	----------------

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

2.3 DESCRIPTION OF SUPPORT UNITS

None



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 Electro	onics (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-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of $35 \pm 4\%$ Temperature of $22 \pm 3^{\circ}$ Celsius



3.2	TEST PERSONNEL		
No.	PERSONNEL TITLE		ROLE
1	Karthik Vepuri	Test Engineer	Review
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

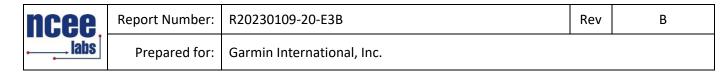
DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)**	N9038A	MY59050109	July 19, 2022	July 19, 2024
Keysight MXE Signal Analyzer (26.5GHz)**	N9038A	MY56400083	July 19, 2022	July 19, 2024
Keysight EXA Signal Analyzer**	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A082918-1	July 26, 2022	July 26, 2023
EMCO Horn Antenna	3115	6416	July 28, 2021	July 28, 2022
EMCO Horn Antenna***	3116	2576	March 9, 2020	March 9, 2023
Com-Power LISN, Single Phase**	LI-220C	20070017	July 18, 2022	July 18, 2024
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	March 21, 2022	March 21, 2024
Rohde & Schwarz Preamplifier**	TS-PR18	3545700803	August 22, 2022	August 22, 2024
Trilithic High Pass Filter*	6HC330	23042	March 21, 2022	March 21, 2024
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi- anechoic chamber- VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2023
NCEE Labs-NSA on 10m Chamber*	10m Semi- anechoic chamber- NSA	NCEE-001	May 25, 2022	May 25, 2024
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	90-195-040	August 22, 2022	August 22, 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)* *Internal Characterization	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.

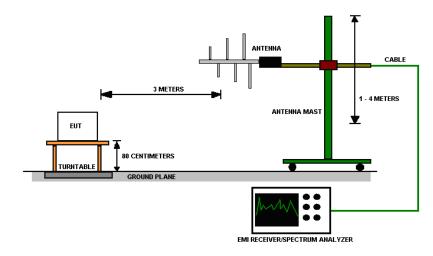


Figure 2 - Radiated Emissions Test Setup



4.0 RESULTS

	DTS Radio Measurements									
CH.	Mode	Occupied Bandwidth (MHz)	6 dB Bandwic (MHz)		AVG Output Power	AVG Output Power (mW)	PSD (dBm)	RESULT		
Low	2EDR	1287.00	1092.0	0	4.880	3.076	-10.601	PASS		
Mid	2EDR	1303.00	1081.0	0	4.760	2.992	-10.169	PASS		
High	2EDR	1272.40	1080.0	0	4.680	2.938	-10.293	PASS		
	Occupied Bandwidth = N/A; 6 dB Bandwidth Limit > 500 kHz Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm									

Unrestricted Band-Edge									
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Delta (dB)	Min Delta (dB)	Result		
Low	2EDR	2400.00	59.066	102.892	43.827	30.00	PASS		
High	2EDR	2483.50	44.407	103.572	59.164	30.00	PASS		
		Pe	ak Restricted I	Band-Edge					
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result		
Low	2EDR	2390.00	52.70	Peak	73.98	21.28	PASS		
High	2EDR	2483.50	61.84	Peak	73.98	12.14	PASS		
*Limit shown is	the peak limi	t taken from FCC	Part 15.209						
	•	Ave	age Restricted	d Band-Edge					
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result		
Low	2EDR	2390.00	41.10	Average	53.98	12.88	PASS		
High	2EDR	2483.50	44.37	Average	53.98	9.61	PASS		
*Limit shown is	s the peak limi	t taken from FCC	Part 15.209						



4.1 OUTPUT POWER

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, Sec. 11.9.2.2.4

Limits of power measurements:

For FCC Part 15.247 Device:

The maximum allowed output power is 30 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the output power plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. The measurements are listed in the tables below.
- 4. Compiled values can be found in the Results section, 4.0.



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4.2 BANDWIDTH

Prepared for:

Test Method: 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.

Limits of bandwidth measurements:

For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational purpose only. The 6dB bandwidth of the signal must be greater than 500 kHz.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

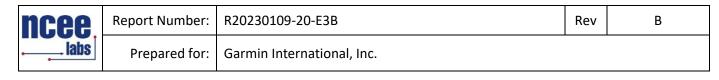
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the bandwidth plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.



4.3 DUTY CYCLE

All modulation(s)/Transmitter(s) shown in this report have a duty cycle of >98%



4.4 RADIATED EMISSIONS

Test Method: ANSI C63.10-2013, Section 6.5, 6.6

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (µV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.

2. Emission level (dBuV/m) = 20 * log * Emission level (μ V/m).

3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worse-case emissions were produced while running off of USB power, so results from this mode are presented.



Test procedures:

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semianechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

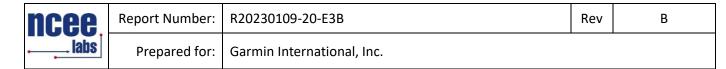
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.



Test setup:

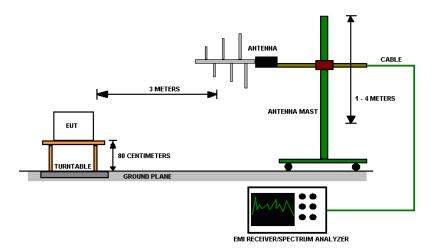


Figure 3 - Radiated Emissions Test Setup

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

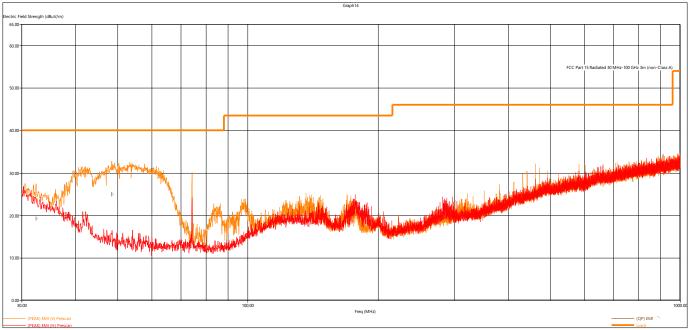
No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.

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Test results:





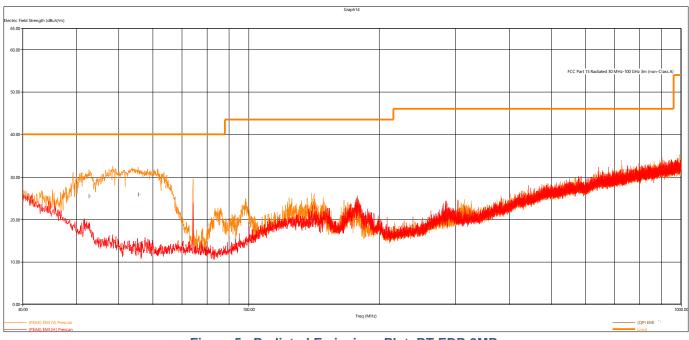


Figure 5 - Radiated Emissions Plot, BT EDR 2MB

REMARKS:

- 1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
- 3. The other emission levels were very low against the limit.
- 4. Margin value = Emission level Limit value

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Quasi-Peak Measurements								
Frequency Level Limit Margin Height Angle Pol Channel Modulati							Modulation	
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
42.643200	25.38	40.00	14.62	104.00	107.00	V	Low	2EDR
55.471680	25.83	40.00	14.17	120.00	149.00	V	Low	2EDR
48.424560	24.92	40.00	15.08	131.00	217.00	V		Rx

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above. All other emissions found to be at least 6dB below limit line

	Peak Measurements										
Frequency	Frequency Level Limit Margin Height Angle Pol Channel M										
MHz	dBµV/m	dBµV/m	dB	cm.	deg.						
2402.250000	93.08	NA	NA	291.00	175.00	Н	Low	2EDR			
2440.190000	96.08	NA	NA	513.00	140.00	V	Mid	2EDR			
2480.110000	95.05	NA	NA	193.00	221.00	Н	High	2EDR			
4803.812000	51.31	73.98	22.67	210.00	175.00	Н	Low	2EDR			
4879.464000	53.64	73.98	20.34	276.00	176.00	Н	Mid	2EDR			
4960.420000	52.50	73.98	21.48	120.00	18.00	V	High	2EDR			

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above. All other emissions found to be at least 6dB below limit line

Average Measurements									
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation	
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2402.250000	88.55	NA	NA	291.00	175.00	Н	Low	2EDR	
2440.190000	91.82	NA	NA	513.00	140.00	V	Mid	2EDR	
2480.110000	91.06	NA	NA	193.00	221.00	Н	High	2EDR	
4803.812000	37.51	53.98	16.47	210.00	175.00	Н	Low	2EDR	
4879.464000	38.99	53.98	14.99	276.00	176.00	Н	Mid	2EDR	
4960.420000	37.72	53.98	16.26	120.00	18.00	V	High	2EDR	
All other emission	ns found to be	at least 6dB	helow limit li	ne					

All other emissions found to be at least 6dB below limit line

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above. All other emissions found to be at least 6dB below limit line



Test Method: ANSI C63.10-2013, Section 6.7

Limits of spurious emissions:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.205(c)).

Test procedures:

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 20dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:

None.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Please note; the line shown in the plot is merely a reference line, not a limit line

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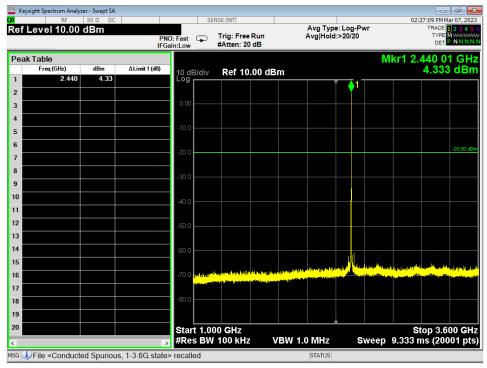
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Keysight Spectrum An	nalyzer - Swept SA 50 Ω DC		SE	NSE:INT				02:2	5:30 PM Mar 07, 202
ef Level 10.0		PNO IFGa	:Fast 🖵	Trig: Free Ru #Atten: 20 dB		Avg Type: Avg Hold:>	Log-Pwr 100/100		TRACE 2345 TYPE MWWW DET PSNN
Peak Table									53.39 MH
Freq (GHz)	dBm	ΔLimit1(dB)	10 dB/div Log	Ref 10.00	dBm			-6	7.310 dBr
2									
			0.00						
3			0.00						
5			-10.0						
6									
7			-20.0						-20.00 dE
)			-30.0						
0									
1			-40.0						
2									
3			-50.0						
4			-60.0						
5			-80.0						<u>^</u> 1
6			-70.0	a lin an a sa			يعامدوا والمحارب وال	L	
7			P pH too	an the state of th	in the state	and the projection of the	and the same of the first first state	otran of the second street, second	in the state of the second
8			-80.0						
9									
0			Start 0.03					Sto	
		>	#Res BW		VBW	1.0 MHz	Sweet	5.00 SIO	p 1.0000 GH s (20001 pt
G		2				STATUS			









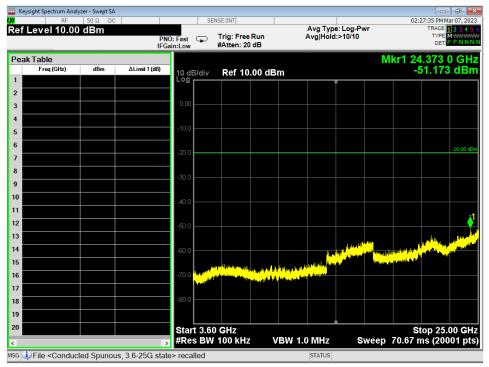


Figure 8 - Radiated Emissions Plot, 2EDR, 3.6G - 25G



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4.6 BAND EDGES

Test Method: 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.

Limits of band-edge measurements: For FCC Part 15.247 Device:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.205(c))

Test procedures:

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.



Test results:

Pass

Comments:

1. All the band edge plots can be found in the Appendix C.

- 2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
- 3. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209. The limit shown in the graph accounts for the antenna gain of the device.



4.7 **POWER SPECTRAL DENSITY**

Test Method: 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.

Limits of power measurements:

For FCC Part 15.247 Device: The maximum PSD allowed is 8 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the Power Spectral Density (PSD) plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. The measurements are reported on the graph.



4.8 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10, Section(s) 6.2

Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)			
	Quasi-peak	Average		
0.15-0.5	66 to 56	56 to 46		
0.5-5	56	46		
5-30	60	50		

Notes:

1. The lower limit shall apply at the transition frequencies.

The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
 All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

Test Procedures:

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

Deviation from the test standard:

No deviation

EUT operating conditions:

Details can be found in section 2.1 of this report.

Rev



Test Results:

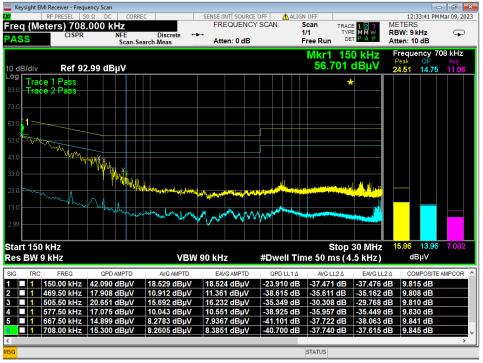






Figure 10 - Conducted Emissions Plot, Neutral, TX





Figure 11 - Conducted Emissions Plot, Line, IDLE

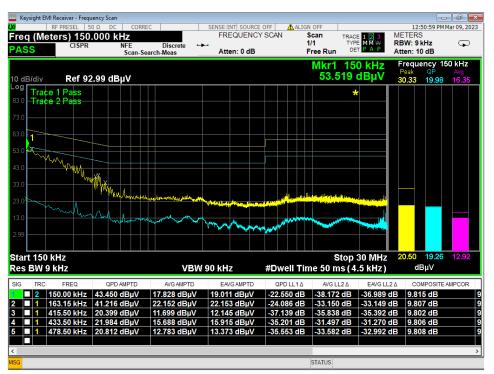


Figure 12 - Conducted Emissions Plot, Neutral, IDLE

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APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

The field strength is calculated 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 = RA + AF - (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude AF = Antenna Factor CF = Cable Attenuation Factor AG = Amplifier Gain AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB μ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB μ V/m.

 $FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

Level in μ V/m = Common Antilogarithm [(48.1 dB μ V/m)/20]= 254.1 μ V/m

AV is calculated by the taking the $20^{100}(T_{on}/100)$ where T_{on} is the maximum transmission time in any 100ms window.

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EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]² / 30

Power (watts) = $10^{Power} (dBm)/10] / 1000$

Voltage ($dB\mu V$) = Power (dBm) + 107 (for 50 Ω measurement systems)

Field Strength (V/m) = 10^{Field} Strength (dB μ V/m) / 20] / 10^{6}

Gain = 1 (numeric gain for isotropic radiator)

Conversion from 3m field strength to EIRP (d=3):

 $EIRP = [FS(V/m) \times d^2]/30 = FS[0.3]$ for d = 3

 $EIRP(dBm) = FS(dB\mu V/m) - 10(log 10^9) + 10log[0.3] = FS(dB\mu V/m) - 95.23$

10log(10^9) is the conversion from micro to milli



APPENDIX B - MEASUREMENT UNCERTAINTY

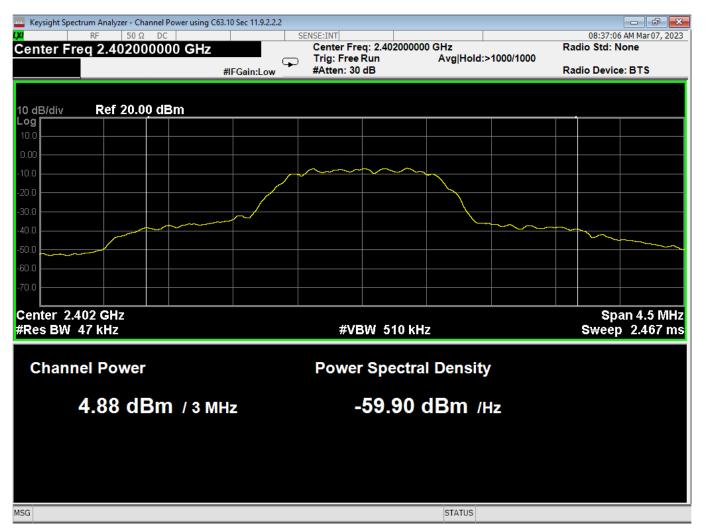
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08
Emissions limits, conducted	30MHz – 18GHz	±3.03

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

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APPENDIX C – GRAPHS AND TABLES



01 Power, Low Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs		Garmin International, Inc.		

Keysight Spectrum Analyzer - Channel Power usin RF 50 Ω DC C Center Freq 2.4400000000 GH	SENSE:INT	09:11:18 AM Mar07, 2023 Radio Std: None 00/1000 Radio Device: BTS
10 dB/div Ref 20.00 dBm		
0.00 -10.0 -20.0		
-30.0 -40.0 -50.0		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
-60.0 -70.0 Center 2.44 GHz		Span 4.5 MHz
#Res BW 47 kHz Channel Power	#VBW 510 kHz Power Spectral Density	Sweep 2.467 ms
4.76 dBm / 3	мнz -60.01 dBm /нz	
MSG	STATUS	

02 Power, Mid Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs		Garmin International, Inc.		

Keysight Spectrum Analyzer	50 Ω DC		SENSE:INT Center Freq: 2.48000000 GHz Trig: Free Run Avg Hold:>1000/1000			•1000/1000	09:13:20 AM Mar 07, 2023 Radio Std: None Radio Device: BTS		
10 dB/div Ref 2 Log	0.00 dBm								
-10.0			<u></u>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~					
-30.0		~							
-50.0									
Center 2.48 GHz #Res BW 47 kHz			#VB	W 510 kHz	2				n 4.5 MHz 2.467 ms
Channel Pow				Spectral					
4.68	dBm / 3 N	IHz	_	60.09 d	dBm /⊦	lz			
мsg 🧼 File <state ant<="" th=""><th>BLE AVG Power</th><th>_change rbw to 1</th><th>-5% OBW_11</th><th>.9.2.2.state>.</th><th> STATUS</th><th></th><th></th><th></th><th></th></state>	BLE AVG Power	_change rbw to 1	-5% OBW_11	.9.2.2.state>.	STATUS				

03 Power, High Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs		Garmin International, Inc.		

	ım Analyzer - BW using C63."	10 Sec 11.8.1							
	RF 50 Ω DC		SE	ENSE:INT					9 AM Mar 07, 2023
Center Fred	q 2.402000000	GHz		Center Freq: 2.40200000				Radio Std: I	None
	·		P	Trig: Free Run #Atten: 20 dB	A	/g Hold:>1	0/10	Radio Devid	e: BTS
10 dB/div	Ref 20.00 dBm								
Log 10.0									
0.00									
			/		Z				
-10.0						and a			
-20.0		- And				ww	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
-30.0	mm							America	monor
-50.0									
-60.0									
-70.0									
Center 2.40	2 GHz							5	an 5 MHz
#Res BW 10				VBW 1 MHz				S	weep 1ms
Occupie	ed Bandwidth			Total Power		11.8 dE	m		
		191 MHz							
	1.5								
Transmit	t Freq Error	3.643 kHz		% of OBW Power		99.00	%		
x dB Ban	dwidth	1.092 MHz		x dB		-6.00 (B		
MSG DFile <st< td=""><td>ate ANT_BLE DTS 6</td><td>dB bandwidth 11.8</td><td>1.sta</td><td>te> recalled</td><td>5</td><td>STATUS</td><td></td><td></td><td></td></st<>	ate ANT_BLE DTS 6	dB bandwidth 11.8	1.sta	te> recalled	5	STATUS			
4									

04 6dB Bandwidth, Low Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

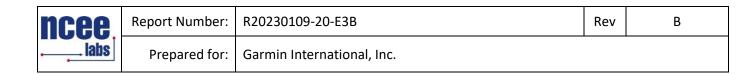
Keysight Spectrum Analyzer - BW using C63.	10 Sec 11.8.1							
RF 50 Ω DC		S	ENSE:INT					3 AM Mar 07, 2023
Center Freq 2.440000000	GHz		Center Freq: 2.44000000				Radio Std: N	lone
	#IFGain:Low	•	Trig: Free Run #Atten: 20 dB		vg Hold:>	10/10	Radio Devic	e: BTS
10 dB/div Ref 20.00 dBm								
_og								
10.0								
0.00				~				
10.0	/				<i>ر</i>			
20.0					James -			
30.0	······································					hourser	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
40.0							and the second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
50.0								
60.0								
70.0								
Center 2.44 GHz #Res BW 100 kHz			VBW 1 MHz				5	pan 5 MHz veep 1 ms
Res BW TOO KHZ							01	veep ims
Occupied Bandwidth			Total Power		12.0 dE	3m		
1.	3172 MHz							
Transmit Freq Error	-1.167 kHz		% of OBW Power		99.00	%		
Transmit Freq Error x dB Bandwidth	-1.167 kHz 1.081 MHz		% of OBW Power x dB		99.00 -6.00			

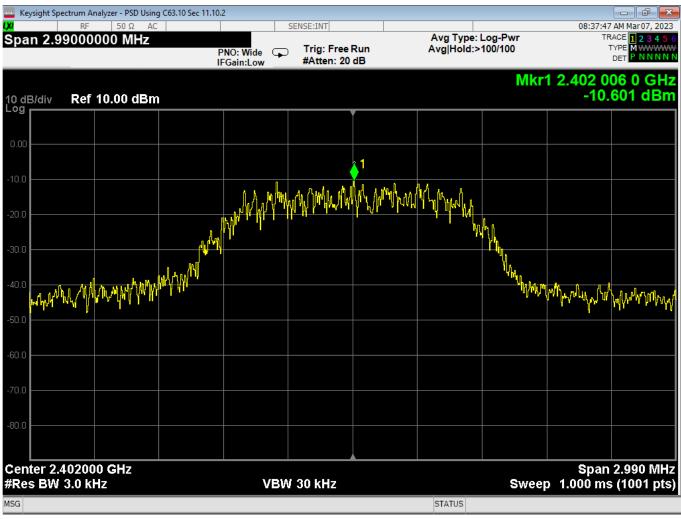
05 6dB Bandwidth, Mid Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

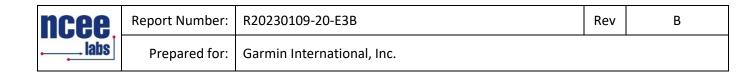
www.www.com analyzer - BV	/ using C63.10 Sec 11	.8.1								
	DC		SE	ENSE:INT						2:54 AM Mar 07, 2023
Center Freq 2.48000	00000 GHz				q: 2.48000000			40440	Radio St	d: None
		#IFGain:Low	P	Trig: Free F #Atten: 20 (vg Hold:>	•10/10	Radio De	vice: BTS
10 dB/div Ref 20.0	0 dBm									
Log										
10.0										
0.00			1			~~~				
-10.0			~							
-20.0		_					- J.J.			
-30.0							****~	mmm	hand	
-40.0 Margaran Margara									~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	moherman
-50.0										
-60.0										
-70.0										
Center 2.48 GHz										Span 5 MHz
#Res BW 100 kHz				VBV	1 MHz					Sweep 1 ms
Occupied Band	width			Total P	ower		11.7 d	Bm		
		7 MHz								
	1.234									
Transmit Freq Er	ror -{	3.641 kHz		% of OE	BW Power		99.00	0 %		
x dB Bandwidth	1	.080 MHz		x dB			-6.00	dB		
	-									
MSG							STATUS			

06 6dB Bandwidth, High Channel, 2EDR



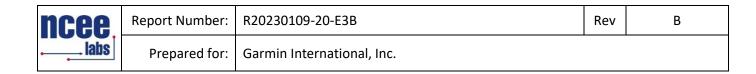


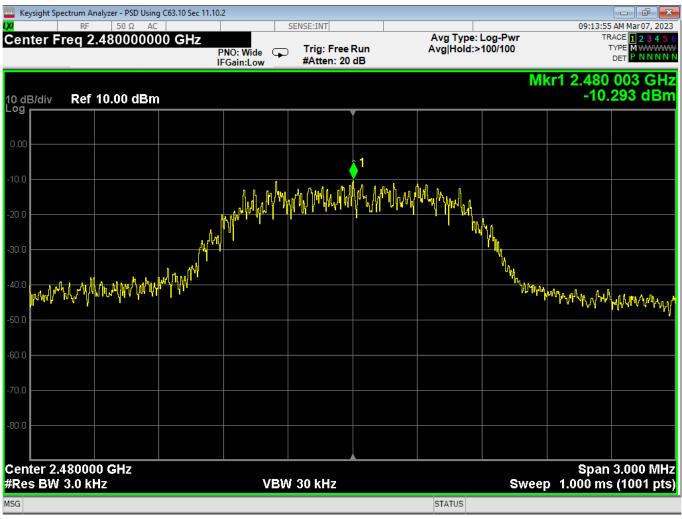
07 PSD, Low Channel, 2EDR





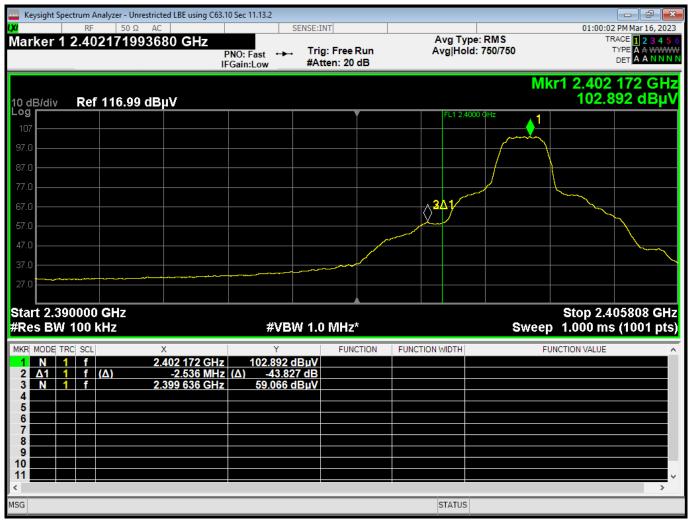
08 PSD, Mid Channel, 2EDR





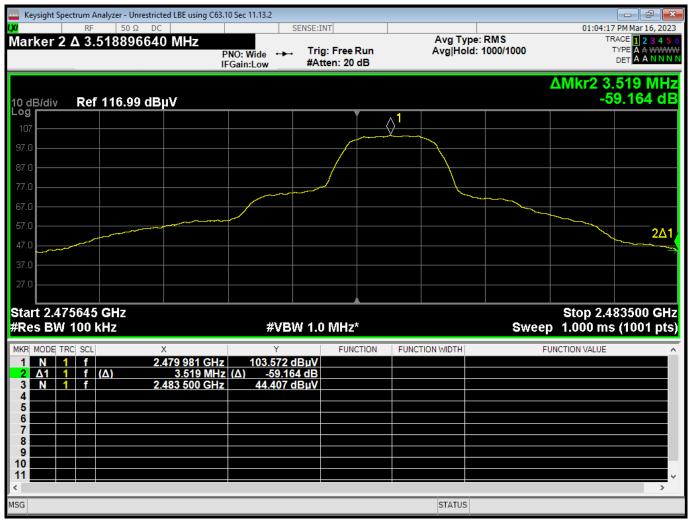
09 PSD, High Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		



10 Lower Bandedge, Unrestricted, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		



11 Higher Bandedge, Unrestricted, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

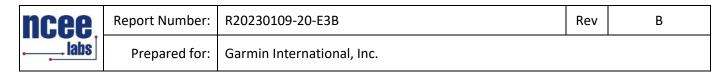
	-	ec 6.10.5					- F
RF 50 Ω		SENSE:I	NT	ALIGN OFF			AM Feb 28, 2
ASS PREAMP	PN		g: Free Run tten: 0 dB	Avg Type: Avg Hold:>			ACE 1 2 3 4 TYPE MA WW DET PANN
Ref Offset 36 dB/div Ref 88.11					М	kr2 2.38 41.1	9 69 GI 06 dBj
Trace 1 Pass							
3.1							
3.1 3.1 Emperadore habelitory	mal and a second and a second second	medan har mark for myra	fully mary argebly and any	man alan and and and and and and and and and a	amment all many and	ferner hours	a halan la hajina ya
3.1	·			<u> </u>		,	
.1							
.1							
11 89							
art 2.380000 GHz Res BW 1.0 MHz		#VBW 50	MHz*		Sweep	Stop 2.3 1.000 ms	90000 G (1001 p
R MODE TRC SCL	X	Y 50 704 JDwV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f	× 2.386 67 GHz 2.389 69 GHz	γ 52.704 dBμV 41.104 dBμV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f	2.386 67 GHz	52.704 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f	2.386 67 GHz	52.704 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f	2.386 67 GHz	52.704 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
N 1 f N 2 f	2.386 67 GHz	52.704 dBµV	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	

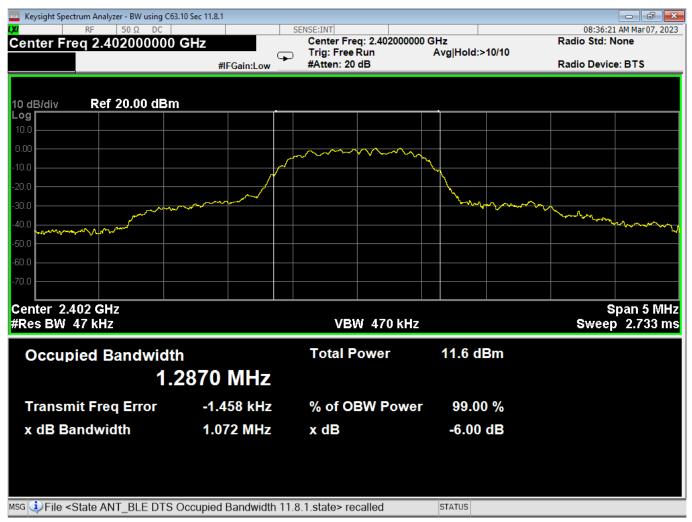
12 Lower Bandedge, Restricted, 2EDR

ncee,	Report Number:	R20230109-20-E3B	Rev	В
	Prepared for:	Garmin International, Inc.		

Keysight Spec	trum Analyzer - R	estricted HBE C63.10 Se	c 6.10.5						·
		Ω AC		SENSE:1	NT	ALIGN OFF		04:36:55 PM	
irker 2	2.483516	500000 GHz					pe: RMS	TRACE	1234
			PNO: Fast		g: Free Run	Avg Ho	ld:>1000/1000		MAWV
SS	PREAMP		IFGain:High	#A1	ten: 0 dB			DET	PAN
							Miles	0 0 400 540	FA
	Ref Offset 3	6.65 dB					INIKE	2 2.483 516	
dB/div	Ref 103.6							44.374	l dB
	e 1 Pass								
	e 2 Pass								
.6									
.6									
.0									
.6									
Mr. Men									
.6 2	Merter warder war	han mar hall and have been a	and all and the state	****	and the second	March Labordon - marchan - Partela	Telaseteranden brede Trimit	مهاور میرون موجه مارور الارون الدور	-
.6									
.6									
.6									
.6									
art 2.48:	3500 GHz							Stop 2.500	000 G
es BW 1	1.0 MHz		V	BW 50 I	MH7*		Swee		001 r
NODE TRO		Х	۲ <u>ا</u>		FUNCTION	FUNCTION WIDTH	F	UNCTION VALUE	
N 1	f	2.483 500 0 GH		35 dBµV					
<u>N 2</u>	f (Δ)	2.483 516 5 GH	IZ (Δ) 44.3	74 dBµV					

13 Higher Bandedge, Restricted, 2EDR





14 Occupied Bandwidth, Low Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs		Garmin International, Inc.		

🔤 Keysight Spectrum Analyzer - BW using C63	3.10 Sec 11.8.1			- F ×
LX/ RF 50 Ω DC		SENSE:INT		09:10:20 AM Mar 07, 2023
Center Freq 2.44000000	GHz	Center Freq: 2.44000000		Radio Std: None
		 Trig: Free Run #Atten: 20 dB 	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm Log				
10.0				
0.00				
			γ.	
-10.0				
-20.0				
-30.0	har martin			
-40.0				mar land have been have been
-50.0				
-60.0				
-70.0				
Center 2.44 GHz #Res BW 47 kHz		VBW 470 kHz		Span 5 MHz Sweep 2.733 ms
Occupied Bandwidt	h	Total Power	12.0 dBm	
1	3030 MHz			
Transmit Freq Error	3.064 kHz	% of OBW Power	99.00 %	
Transmit Freq Error		% of OBW Power x dB		
	3.064 kHz		99.00 % -6.00 dB	
Transmit Freq Error	3.064 kHz			
Transmit Freq Error	3.064 kHz			
Transmit Freq Error	3.064 kHz			

15 Occupied Bandwidth, Mid Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs		Garmin International, Inc.		

🔤 Keysight Spectru	um Analyzer - BW using	C63.10 Sec 11.8.1							- 6 💌
l XI	RF 50 Ω DC			SE:INT					:25 AM Mar 07, 2023
Center Free	q 2.48000000	0 GHz		Center Freq: 2.48000				Radio Std:	None
		#IFGain:Low		Trig: Free Run #Atten: 20 dB		Avg Hold::	>10/10	Radio Dev	ice: BTS
10 dB/div	Ref 20.00 dB	łm							
Log						1			
10.0									
0.00									
			por s		~~				
-10.0					<u></u>				
-20.0		/				\uparrow			
-30.0		- manna				Warren			
	للمسمر	***** V					- myson where	Mar way	
-40.0	John Rolling and Star								monter
-50.0									
-60.0									
-70.0									
-70.0									
Center 2.48									Span 5 MHz
	1 GEL/								ep 2.733 ms
#Res BW 4				VBW 470 k	Hz			Swee	·p 2.100 m3
#Res BW 4	7 kHz	lth		VBW 470 k Total Power	Hz	11.2 d	Bm	Swee	.p 2.1 00 m3
#Res BW 4	7 kHz ed Bandwic				Hz	11.2 d	Bm	Swee	,p 2.100 m3
#Res BW 4	7 kHz ed Bandwic	ith .2724 MHz			Hz	11.2 d	Bm	Swet	,
#Res BW 4	^{7 kHz} ed Bandwic 1	.2724 MHz		Total Power				Swel	<i>p</i> 2.100 m3
#Res BW 4 Occupie Transmit	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz -6.023 kHz		Total Power % of OBW Pow		99.0	0 %	GWE	
#Res BW 4	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz		Total Power			0 %	GWE	
#Res BW 4 Occupie Transmit	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz -6.023 kHz		Total Power % of OBW Pow		99.0	0 %	GWE	<i>p</i> 2.100 ms
#Res BW 4 Occupie Transmit	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz -6.023 kHz		Total Power % of OBW Pow		99.0	0 %	GWE	,p 2.100 113
#Res BW 4 Occupie Transmit	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz -6.023 kHz		Total Power % of OBW Pow		99.0	0 %	GWE	,p 2.100 113
#Res BW 4 Occupie Transmit	7 kHz ed Bandwic 1 t Freq Error	.2724 MHz -6.023 kHz		Total Power % of OBW Pow		99.0	0 %	GWE	,p 2.1 00 113

16 Occupied Bandwidth, High Channel, 2EDR

ncee.	Report Number:	R20230109-20-E3B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

REPORT END