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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address:

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

Product:

AA4308

Test Report No:

R20211006-20-E7A

Approved by:

1) || || | 201

Fox Lane EMC Test Engineer,

DATE:

May 13, 2022

Total Pages:

51

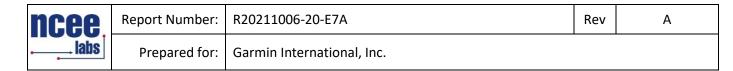
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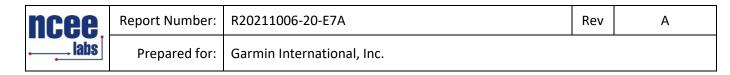
REVISION PAGE

Rev. No.	Date	Description			
0	3 March 2022	Original – KVepuri			
0	5 Warch 2022	Prepared by FLane and SProbst			
		Added DCCF to tabular data			
A	12 May 2022	Added comment to section 4.5			
		Corrected tabular data to match plots			



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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:

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	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)(1) RSS-247 Issue 2 Section 5.1(b)	Peak output power	Pass							
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.1 (b)	Bandwidth	Pass							
FCC Part 15.247(a)(1)(iii) RSS-247 Issue 2 Section 5.1(d)	Frequency Hopping System	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 15.209, 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	AA4308
EUT Received	6 December 2021
EUT Tested	8 December 2021- 2 March 2022
Serial No.	3392435192 (Radiated Measurements) 3392435208(Conducted Measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	GMSK GFSK BTBR BTEDR 2MB BTEDR 3MB 802.11x
Power Supply / Voltage	Internal Battery/ 5VDC Charger: Garmin (Phi Hong) MN: PSAI10R-050Q (Representative Power Supply)

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:

For BTBR Transmissions:					
Channel	Frequency				
Low	2402 MHz				
Mid	2440 MHz				
High	2480 MHz				

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 Electronics (NCEE Labs)							
4740 Discovery Drive	1740 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 PERSONNE								
No.	PERSONNEL	TITLE	ROLE						
1	Fox Lane	Test Engineer	Testing and Report						
2	Karthik Vepuri	Test Engineer	Review/Editing and Report						
3	Blake Winter	Test Engineer	Testing						
4	Grace Larsen	Test Technician	Testing and report						
5	Samuel Probst	Test Technician	Testing						
6	Matthew Emory	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.



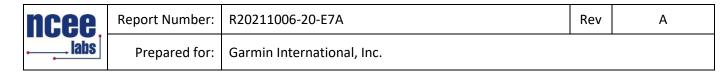
3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 21, 2021	July 21, 2023
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	May 5, 2020	May 5, 2022
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A091418	July 27, 2021	July 27, 2022
EMCO Horn Antenna	3115	6416	July 28, 2021	July 28, 2022
EMCO Horn Antenna	3116	2576	March 9, 2020	March 9, 2022
Com-Power LISN 50μH / 250μH - 50Ω	LI-220C	20070017	September 22, 2020	September 22, 2022
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	February 1, 2021	February 1, 2023
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
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	October 25, 2019	October 25, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	April 14, 2020	April 14, 2022
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

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.

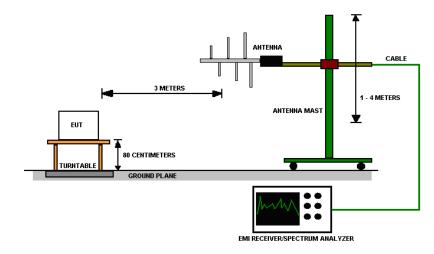
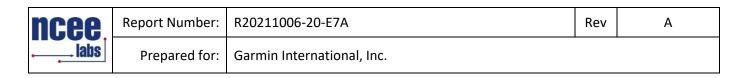


Figure 2 - Radiated Emissions Test Setup



4.0 RESULTS

DSS Radio Measurements														
CHANNEL	Transmitte	r	Occupied Bandwidth (kHz)		20 dB Bandwid (kHz)	dth	RESULI	r -		No. of Hopping Channels 79		ON Time (µs) 387		
Low	Continuous	\$	970.76		1123.00 PASS		Chan	nel Separa	tion	Time	of Occupancy			
Mid	Continuous	-	970.86		1114.0		PASS		Onan	(MHz)		Time	(s)	
High	Continuous		967.89		1128.0		PASS			1.020			.12384	
Occupied Bandwidth = N/A; Channel Separation Limit: > 2/3 * 20 dB Bandwidth. Time of Occupancy Limit < 0.4s; Time of Occupancy = ON Time * # of transmissions over, period of time of occupancy= 0.000387*32*10 (See Figure 11 in appendix C) =0.12384 s Period of Time of Occupancy = 0.4 * # of Channels = 0.4 * 79 = 31.6s														
					Unrestri	cted	Band-Edge							
CHANNEL	Mode	/M	Band edge easurement Frequency (MHz)		elative High t of band le (dBuV)	nd level Fundamental Delta (dB)		Delta IB)	Result					
Low	Continuous		2400.00		69.993		117.49	94	4	47.465	30	0.00	PASS	
Low	Hopping		2400.00		67.374		116.34	44	(67.374	30	0.00	PASS	
High	Continuous		2483.50		53.760		117.04	44	(63.284	30	0.00	PASS	
High	Hopping		2483.50		56.766		116.69	97	į	59.930		0.00	PASS	
					Peak Rest	ricte	d Band-Edge)						
CHANNEL	Band edge Highest out of band Measurement Limit*													
Low	Continuous		2390.00	1	52.857		Peak	7	3.98	21.123	3		PASS	
High	Continuous		2483.50		55.009		Peak	7	3.98	18.971		F	PASS	
*Limit shown	is the peak lim	it take	en from FCC Pa											
				-	Average Re	stric	ted Band-Edg	ge						
CHANNEL	Mode	/M	Band edge easurement Frequency (MHz)	Ċ	level		asurement Type	(dE	.imit 3uV/m 3m)*	Margir		F	Result	
Low	Continuous		2390.00		42.456		Average	5	3.98	11.52		F	PASS	
High	Continuous		2483.50		47.236		Average	5	3.98	6.74		F	PASS	
**Average H	is the average ighest out of ba for more inform	nd lev	el = SA Averag			F(For	Emissions). C	C63.10	0 Sec. 1	1.12.2.5.2				

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	Average Restricted Band-Edge											
СН	Mode	Band edge /Measurement Frequency (MHz)	Raw Average Highest out of band level (dBuV/m @ 3m)	ghest out band level BuV/m @ DCCF (For Emissions) out of band level level		Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result			
Low	Continuous	2390.00	40.186	-2.27	42.456	Average	53.98	11.558	PASS			
High	Continuous	2483.50	44.966	-2.27	47.236	Average	53.98	11.369	PASS			
**Aver	High Continuous 2483.50 44.966 -2.27 47.236 Average 53.98 11.369 PASS *Limit shown is the average limit taken from FCC Part 15.209 *											

	DTS Radio Measurements								
СН	Transmitter	RAW AVERAGE OUTPUT POWER (dBm)	DCCF (For Power)	AVERAGE OUTPUT POWER (dBm)	AVERAGE OUTPUT POWER (mW)	RESULT			
Low	BTBR	10.61	1.13	11.73	14.89	PASS			
Mid	BTBR	11.80	1.13	12.92	19.59	PASS			
High	BTBR	11.57	1.13	12.69	18.58	PASS			
	Peak Output Power Limit = 125mW; Average Output Power = (Raw Average Output Power) + (DCCF For Power)								



4.1 OUTPUT POWER

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

Limits of power measurements: For FCC Part 15.247 Device: The maximum allowed peak output power is 125mW.

Test procedures:

Details can be found in section 3.4 of this report. See section 4.3 for Duty cycle used.

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.



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:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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.

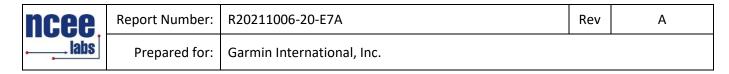
Test results:

Pass

Comments:

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

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4.3 DUTY CYCLE

Test Method:

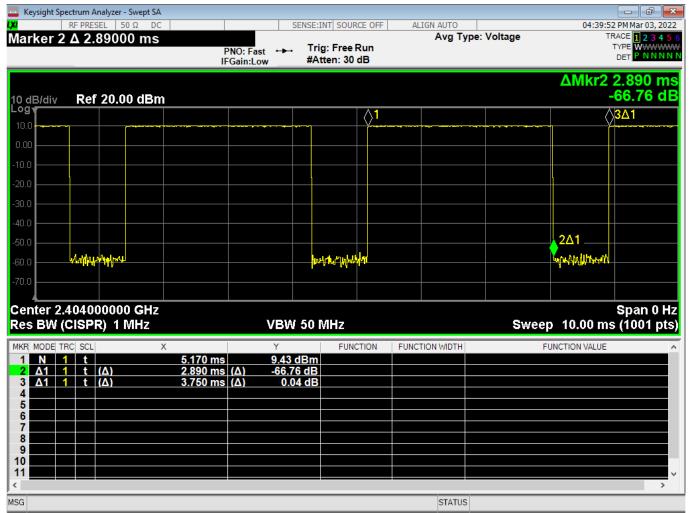


Figure 3 - Radiated Emissions Plot, BTBR, Duty Cycle

DCCF For Emissions (Duty Cycle Correction Factor) = 20 * Log(Duty Cycle / 100) -2.27 = 20 * Log(77 / 100)

DCCF For Power (Duty Cycle Correction Factor) = 10 * Log(Duty Cycle / 100) 1.13 = 10 * Log(1 / 0.77)



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.

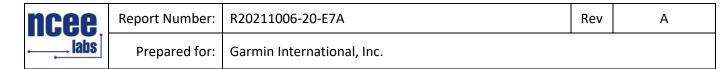
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

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:

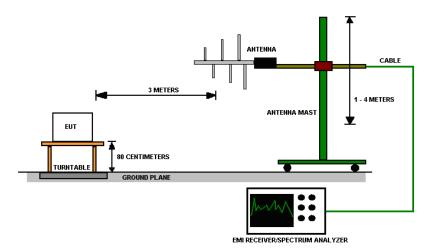


Figure 4 - Radiated Emissions Test Setup

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:

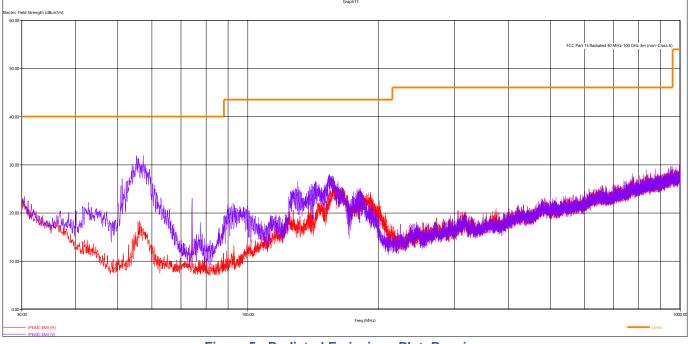
No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.



Test results:





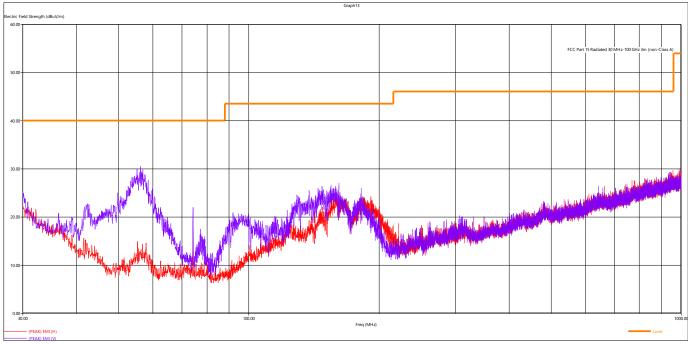


Figure 6 - Radiated Emissions Plot, BTBR, Low Channel

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 = Limit value Emission Level.
- 5. Emissions found to be at least 10dB below limit line and were not reported.

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Peak Measurements, BTBR									
Frequency Level Limit Margin Height Angle Pol Channel Modulation									
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2401.788000	107.99	NA	NA	400.00	113.00	Н	Low	BTBR	
2439.690000	107.58	NA	NA	132.00	117.00	Н	Mid	BTBR	
2480.690000	107.23	NA	NA	139.00	115.00	Н	High	BTBR	
All other emissions found to be at least 6dB below limit line									

Average Measurements, BTBR									
Frequency Level* Limit Margin Height Angle Pol Channel Modulation									
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2401.788000	105.72	NA	NA	400.00	113.00	Н	Low	BTBR	
2439.690000	105.31	NA	NA	132.00	117.00	Н	Mid	BTBR	
2480.690000	104.96	NA	NA	139.00	115.00	Н	High	BTBR	
*Average Levels Obtained from; Average Level = Peak Level + DCCF (For Emissions), for more information on DCCF see Sec 4.3 All other emissions found to be at least 6dB below limit line									



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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 30dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:

Test was performed with a 120kHz RBW

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:

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	eysight Spectrum Anal										a x
L <mark>XI</mark>	RF	50 Ω DC			SENSE:INT		Turney M. It.		03:1	9:03 PM Fe	
Sta	rt Freq 30.0	00000 M			Trig: Free Run		g Type: Volta Hold:>100/1				23456 WWWWW
):Fast 🖵 in:Low	#Atten: 20 dB						PNNNN
Pea	ak Table								Mkr1 8	304 35	5 MHz
	Freq (GHz)	dBm	∆Limit1(dB)	10 dB/div	Ref 10.00 dl	Bm			-6	8.518	dBm
1				Log							
2											
3				0.00							
4											
5				-10.0							
6											20.00 JD-
7				-20.0							-20.00 dBm
8											
9				-30.0							
10											
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15				-70.0					Laborator of) 	ي ي
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Figure 7 - Radiated Emissions Plot, BTBR, 30M – 1G

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	Prepared for:	Garmin International, Inc.		

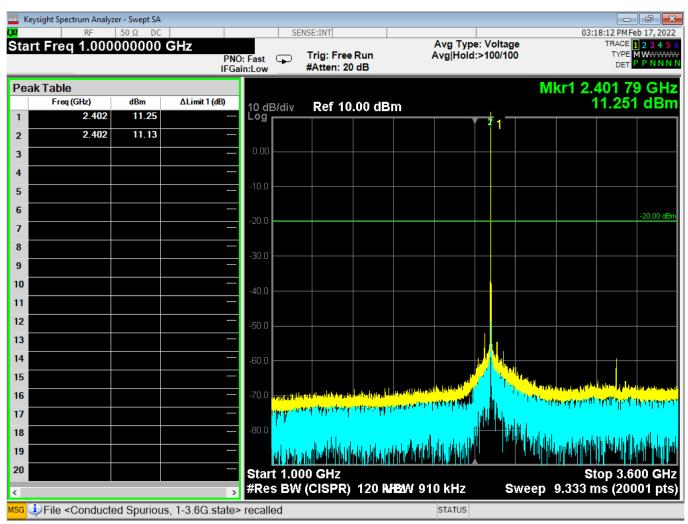


Figure 8 - Radiated Emissions Plot, BTBR, 1G - 3.6G

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

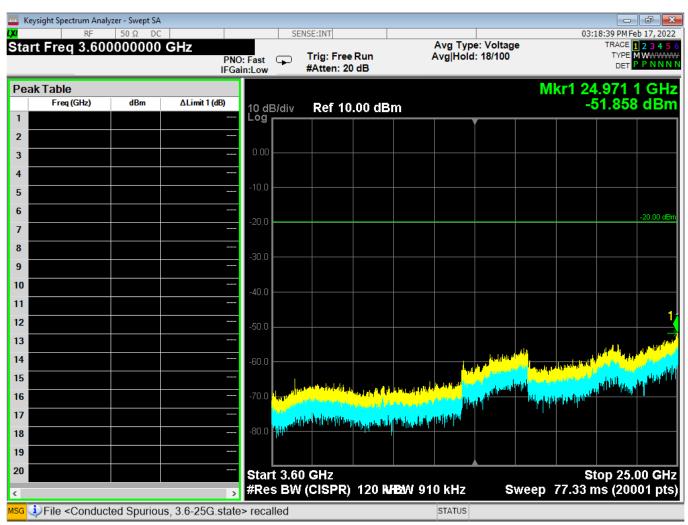


Figure 9 - Radiated Emissions Plot, BTBR, 3.6G - 25G



Rev

Prepared for: Garmin International, Inc.

4.6 BAND EDGES

Test Method: All the radio measurements were performed using the sections from ANSI C63.10. Restricted band edges are using Sec 6.10.5.

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.



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4.7 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, 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.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz3. 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.

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	Prepared for:	Garmin International, Inc.		

Test Results:

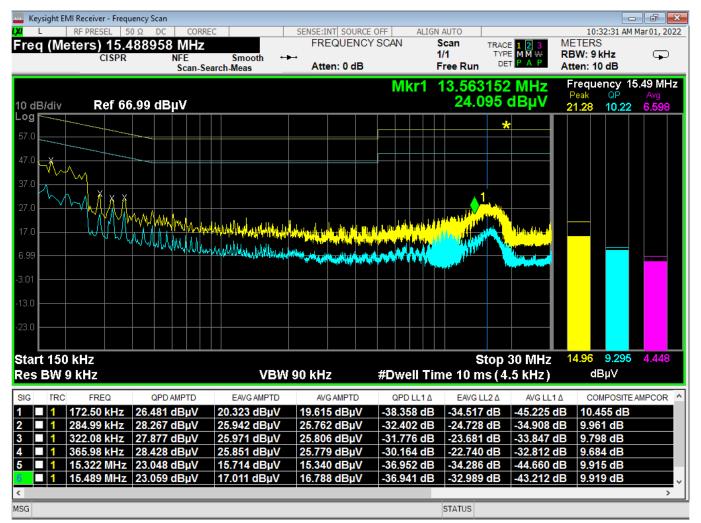
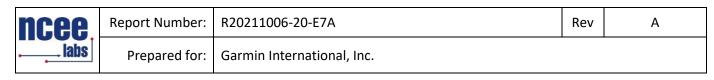


Figure 10 - Conducted Emissions Plot, Line, TX



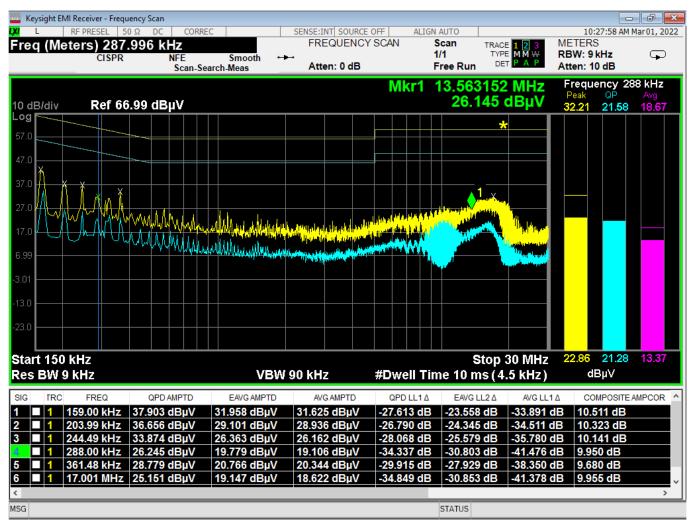
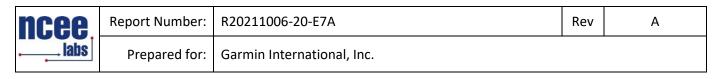


Figure 11 - Conducted Emissions Plot, Neutral, TX



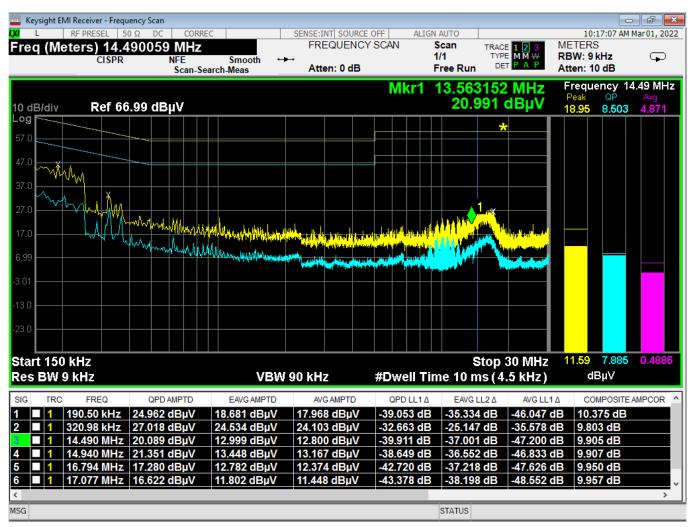
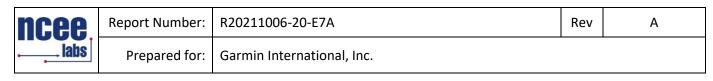
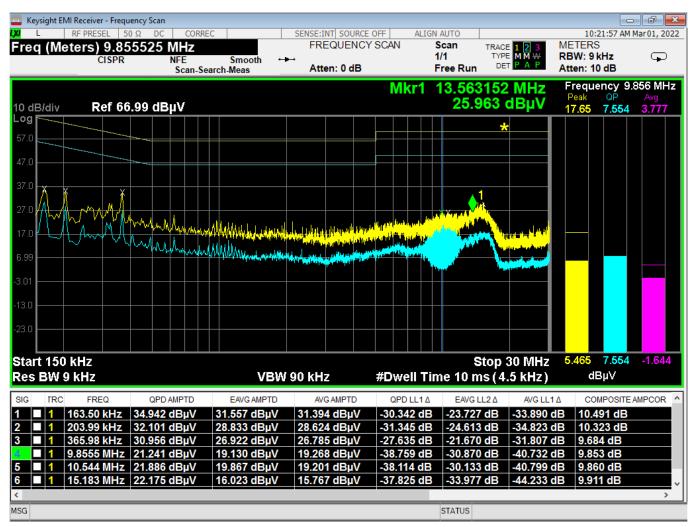


Figure 12 - Conducted Emissions Plot, Line, IDLE





ncee labs	Report Number:	R20211006-20-E7A	Rev	А
	Prepared for:	Garmin International, Inc.		

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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	Prepared for:	Garmin International, Inc.		

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

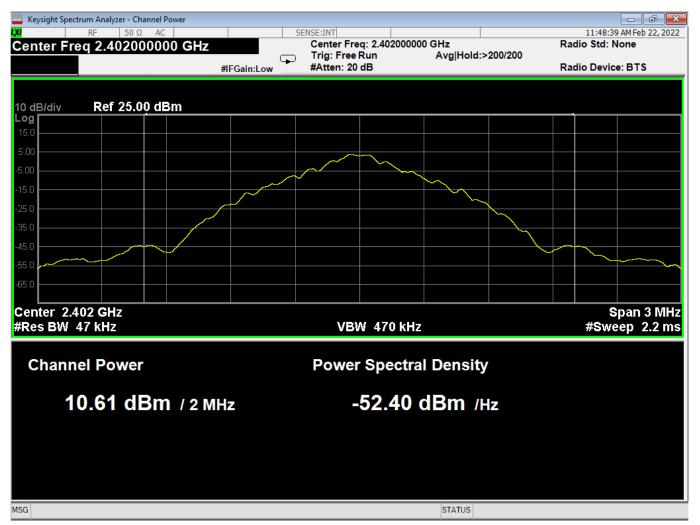
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

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

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	Prepared for:	Garmin International, Inc.		

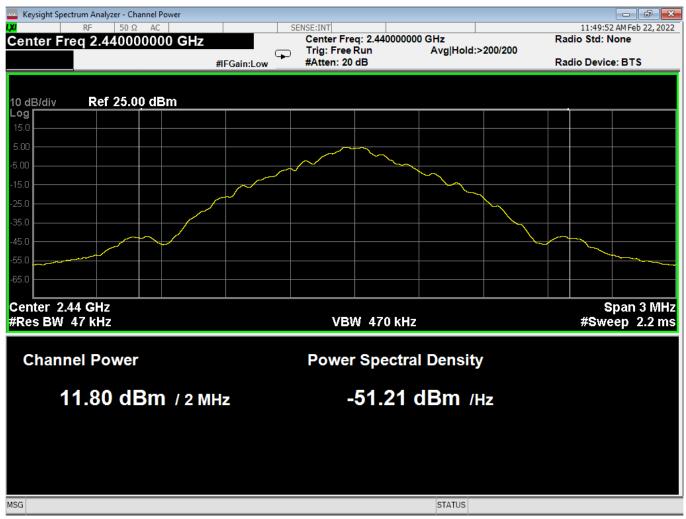
APPENDIX C – GRAPHS AND TABLES



01 Average Power, Low Channel, BTBR

Average Output Power = (Average Output Power on Analyzer) + (DCCF for power from section 4.3)

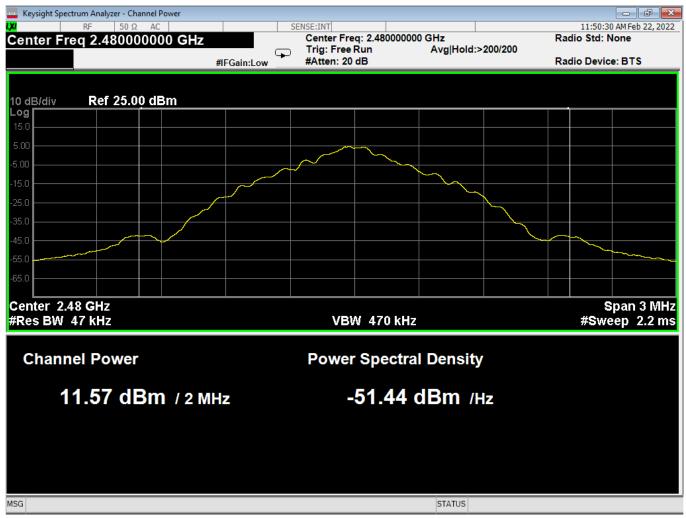




02 Average Power, Mid Channel, BTBR

Average Output Power = (Average Output Power on Analyzer) + (DCCF for power from section 4.3)





03 Average Power, High Channel, BTBR

Average Output Power = (Average Output Power on Analyzer) + (DCCF for power from section 4.3)

Incee.	Report Number:	R20211006-20-E7A	Rev	А
	Prepared for:	Garmin International, Inc.		

	um Analyzer - BW using (063.10 Sec 11.8.1							
L <mark>XI</mark>	RF 50 Ω DC			SENSE:INT				12:48:1	5 PM Feb 17, 2022
Center Freq 2.402000000 GHz					Center Freq: 2.402000000 GHz			Radio Std: None	
#IFGain:Low			Trig: Free Run Avg Hold:>10/10 #Atten: 20 dB			Radio Device: BTS			
10 dB/div	Ref 20.00 dB	m							
Log									
10.0									
0.00									
-10.0									
-20.0			J. Walk			- And -			
-30.0			ANN ^N			"www.m	m,		
-40.0		m					Munn		
-50.0	man man marken							and the second s	mound
-60.0									
-70.0									
Center 2.40									Span 5 MHz
#Res BW 1	00 kHz			VB	W 1 MHz			S	weep 1 ms
Occupi	ed Bandwid	th		Total F	ower	17.3 d	Bm		
Cocupi									
	970.76 kHz								
Transmi	Transmit Freq Error 5.495 kHz		95 kHz	% of OBW Power		99.00 %			
x dB Bar	x dB Bandwidth 1.123 MHz		x dB		-20.00 dB				
MSG						STATUS			

04 OBW-20dB, Low Channel, BTBR

ncee,	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C6	3.10 Sec 11.8.1			
LXI RF 50 Ω DC		SENSE:INT		12:48:48 PM Feb 17, 2022
Center Freq 2.44000000	GHz	Center Freg: 2.44000000	0 GHz	Radio Std: None
	#IFGain:Low	Trian Eres Dum	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBn	n			
0.00 -10.0 -20.0				
-30.0 -40.0 -50.0	www.www.		Mar Martin	Marthan Marthan
-70.0				
Center 2.44 GHz #Res BW 100 kHz		VBW 1 MHz		Span 5 MHz Sweep 1 ms
Occupied Bandwidt 9	^h 70.86 kHz	Total Power	16.0 dBm	
Transmit Freq Error	4.766 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	1.114 MHz	x dB	-20.00 dB	
MSG			STATUS	

05 OBW-20dB, Mid Channel, BTBR

ncee,	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum A	analyzer - BW using (C63.10 Sec 11.8.1							
LXI RF	50 Ω DC		S	SENSE:INT				12:49:2	21 PM Feb 17, 2022
Center Freq 2	2.48000000	0 GHz			eq: 2.48000000			Radio Std:	None
			n:Low	Trig: Free #Atten: 20		Avg Hold:>	•10/10	Radio Devi	ce: BTS
10 dB/div	lef 20.00 dB	m							
Log									
10.0									
0.00									
			, , , , , , , , , , , , , , , , , , ,	and the second se		v			
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-20.0						`			
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-40.0	and have ment	wy Wo w					W. W. Warner	Mumm	
-50.0 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		www.							Mr. Mar Man
-60.0									
-70.0									
1 0.0									
Center 2.48 G	Hz		1		1				Span 5 MHz
#Res BW 100				VB	N 1 MHz				weep 1 ms
Occupied	Bandwid	lth		Total P	ower	16.2 d	Bm		
Occupied									
		967.89 k	Hz						
Transmit F	req Error	2.707	kHz	% of O	BW Power	99.00	0 %		
x dB Bandy	width	1.128	MHz	x dB		-20.00	dB		
MSG						STATUS			
						011100			

06 OBW-20dB, High Channel, BTBR

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	ectrum Analyzer - Unres	tricted LBE using C63.	10 Sec 11.13.2								
Start Fre	RF 50 Ω q 2.3900000			SENSE:I	NT			Avg Type			26 PM Feb 08, 2022 TRACE 1 2 3 4 5
			PNO:Fast G FGain:Low		g: Free Ru ten: 30 di		,	Avg Hold:	>1000/1000		
									N	kr3 2.399	353 GHz
10 dB/div	Ref 126.99 c	IBμV									993 dBµ\
Log 117					<u> </u>						
107										<u> </u>	
97.0										1	
87.0											
									31	N	
77.0									~~~~ \	/	June June June June June June June June
67.0								~	have		1
57.0		when when	\sim		· · · · · · · · · · · · · · · · · · ·	᠆ᡢᢇᡘ᠊᠊ᠬ	m	A A A A A A A A A A A A A A A A A A A			
47.0											
37.0											
Start 2.39	90000 GHz									Stop 2.4	403767 GHz
#Res BW			VB	W 1.0	MHz				Swee	ep 1.000 m	s (1001 pts
MKR MODE T	RC SCL	Х	Y		FUNCT	ON	FUNCTION			FUNCTION VALUE	,
1 N 1 2 A1 1	1 f 1 f (Δ)	2.401 840 GHz -2.500 MHz		dBµV 65 dB							
3 N 1	1 f	2.399 353 GHz									
4 5											
6											
8											
9											
11											
<				_		_		CTATUC			>
SG								STATUS			

07 Lower Bandedge, Unrestricted, BTBR

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

www.www.www.www.www.www.www.www.www.ww	3.10 Sec 11.13.2		
RF 50 Ω AC Start Freq 2.478000000 GHz	PNO: Wide Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>1000/1000	02:18:35 PM Feb 08, 2022 TRACE 1 2 3 4 5 6 TYPE MA WWWW DET P A N N N
10 dB/div Ref 126.99 dBµV		Mkr1	2.479 842 5 GHz 117.044 dBµV
117			
97.0			
87.0 77.0			
67.0 67.0		Mar marine -	342
57.0 47 .0		- compression	man and a contraction of the con
37.0			
Start 2.478000 GHz #Res BW 100 kHz	VBW 1.0 MHz	Sweep	Stop 2.483500 GHz 1.000 ms (1001 pts)
MKR MODE TRC SCL X 1 N 1 f 2.479 842 5 GH	Y FUNCTION z 117.044 dBµV	FUNCTION WIDTH FU	NCTION VALUE
2 N 1 f 2.483 500 0 GH 3 Δ1 1 f (Δ) 3.657 5 MH 4	z 53.760 dBµV		
5 5 6 5 7 5			
8 9 10			
			→ ×
MSG		STATUS	

08 Higher Bandedge, Unrestricted, BTBR

ncee.	Report Number:	R20211006-20-E7A	Rev	А
	Prepared for:	Garmin International, Inc.		

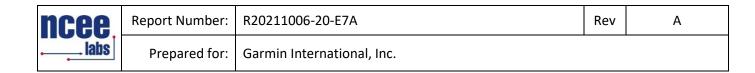
Keysight Spectrum Analyzer - Unrestricted LBE using C63	.10 Sec 11.13.2		
LXI RF 50 Ω AC	SENSE:INT		11:13:42 AM Feb 17, 2022
	PNO: Wide 🍙 Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>1000/1000	TRACE 1 2 3 4 5 6 TYPE MA WWWW DET P A N N N N
		Mkr1	2.480 156 0 GHz
10 dB/div Ref 126.99 dBµV			116.697 dBµV
		mal and a second	3∆2 Whromor
37.0			
Start 2.478000 GHz #Res BW 100 kHz	VBW 1.0 MHz	Sweep	Stop 2.483500 GHz 1.000 ms (1001 pts)
MKR MODE[TRC] SCL X 1 N 1 f 2.480 156 0 GH; 2 N 1 f 2.483 500 0 GH; 3 Δ1 1 f (Δ) 3.344 0 MH; 4 5 5 5 5 6 6 6 6 7 7 7 7 8 9 9 9 9 10 11	z 116.697 dBµV z 56.766 dBµV	JNCTION WIDTH FU	ACTION VALUE
MSG		STATUS	

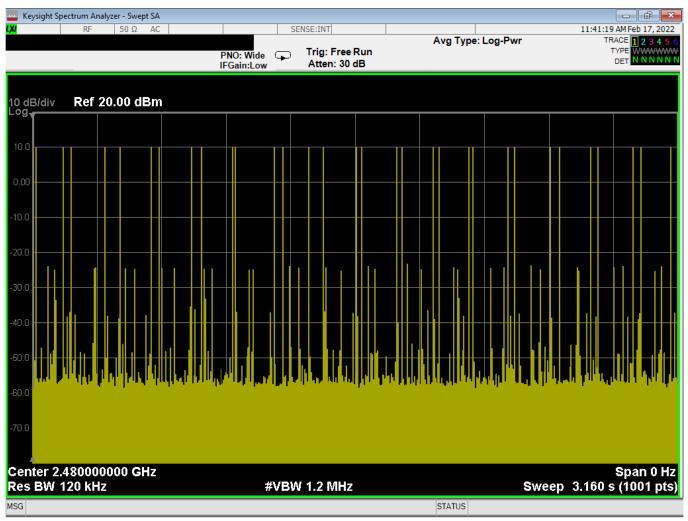
09 Lower Bandedge, Restricted, BTBR

ncee.	Report Number:	R20211006-20-E7A	Rev	А
	Prepared for:	Garmin International, Inc.		

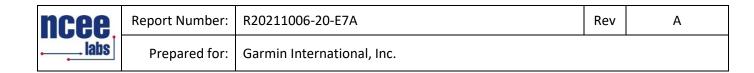
Keysight Spectrum Analyz	er - Restricted HBE C63.10 Se	ec 6.10.5				
RF	50 Ω AC CORREC	S	ENSE:INT	ALIGN OFF		01:16:30 PM Feb 14, 2
larker 2 2.4932	84500000 GHz			Avg Type	RMS	TRACE 1 2 3 4
		PNO: Fast	Trig: Free Run	AvgHold	:>1000/1000	
ASS PREA	MP	IFGain:High	#Atten: 0 dB	-		DET PANN
					Mkr2	2.493 383 5 G
0 dB/div Ref 11	4.99 dBµV					45.005 dBj
.00						
105 Trace 1 Pass						
Trace 2 Pass						
95.0						
35.0						
75.0						
i5.0 1						
55.0 manufational rational	al mapped and the second ways	man water barren and	alore marine marine	Junior 2 Revenues	mer malance -	des along the state of the second second
5.0						
		······				·
35.0						
25.0						
20.0						
			_			
tart 2.483500 Gl						Stop 2.500000 G
Res BW 1.0 MHz	2	VBW	50 MHz*		Sweep	1.000 ms (1001 p
KR MODE TRC SCL	X	Y	FUNCTION	FUNCTION WIDTH	EU.	NCTION VALUE
				FUNCTION WIDTH	FUI	
	2.483 516 5 G					
2 N 2 f	2.493 383 5 G	lz 45.006 d	Βμν			
4						
5						
6						
6						
7						
8						
7 8 9 1						
8						
7 8 9						
7				STATUS		3

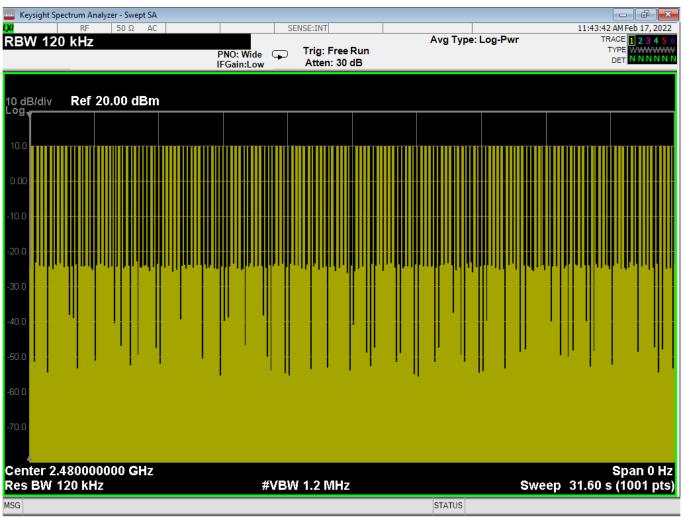
10 Higher Bandedge, Restricted, BTBR





11 Dwell Time, 3.16S (reported for better resolution)





12 Dwell Time, 31.6S

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Swept SA RF 50 Ω AC	SENSE:INT		11:30:46 AM Feb 17, 2022
Stop Freq 2.441500000 GHz	PNO: Fast IFGain:Low Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P NNNNN
10 dB/div Ref 20.00 dBm			
	Ĭ		
	M. M		
0.00			
-10.0			
-20.0			
-30.0			
-40.0			
-50.0			
-60.0			
-70.0			
Start 2.40021 GHz #Res BW 120 kHz	#VBW 910 kHz		Stop 2.44150 GHz 4.667 ms (1001 pts)
	#VBW 910 KH2	status	4.007 ms (1001 pts)

13 Channel Count, 2400-2441.5M

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	ight Spectrum A	nalyzer - Swept SA 50 Ω AC			SENSE:INT				11.37.45	AM Feb 17, 2022	
		41500000	GHz	PNO: Fast 🕞	TF	Avg Type: Log-Pwr Free Run Avg Hold:>100/100			TRACE 1 2 3 4 5 6 TYPE MWWWW DET P NNNNN		
10 dB/ Log –	'div Ref	20.00 dBm									
10.0	at nul be Wi	না শিং নং লি	n with M	<u>ታ መደጉ. ታ</u>	መ ግ ሌ ላ	ሌ ሰሀ ሥባ ሌ	with the state of the	51 M M Fa 1	rs An. Hal ⊅u Í	H M H	
	V. MAN	ally which	M M M	l kl"hyd V hy	IN V V W	ላጭ ላጭ	የምስ ለሆኑ		W W W	\mathbf{v}	
-10.00											
-20.0											
-30.0										4	
-40.0 —										\	
-50.0											
-60.0											
-70.0											
	2.44150 C BW 120 k			#VB	W 910 kHz			#Swee	Stop 2. p 4.667 ms	48200 GHz s (1001 pts)	
MSG							STATUS				

14 Channel Count, 2441.5-2482M

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Swept SA Ki RF PRESEL 50 Ω AC	SENSE:INT	ALIGN OFF	03:35:32 PM May 11, 2022
Marker 2 Δ 1.020000000 MHz NFE	PNO: Wide Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>1/1	TRACE 123456 TYPE MA WWWW DET P S N N N N
10 dB/div Ref 20.00 dBm			ΔMkr2 1.020 MHz 1.601 dB
		<u></u> 21	
-10.0	and when the providence of the second s	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	www.www.
-20.0			
-40.0			
-60.0			
Start 2.403500 GHz			Stop 2.405500 GHz
#Res BW 9.1 kHz	VBW 91 kHz		ep 22.33 ms (1001 pts)
MKR MODE TRC SCL X 1 N 1 f 2.403 998 GH 2 Δ1 1 f (Δ) 1.020 MH		FUNCTION WIDTH	FUNCTION VALUE
3 4 5			
6 7 8			
9 10 11			~
K MSG		STATUS	>

15 Frequency Separation

ncee.	Report Number:	R20211006-20-E7A	Rev	А
	Prepared for:	Garmin International, Inc.		

www. Keysight Spectrum Analyzer - Unrestricted LBE using C6	3.10 Sec 11.13.2		
IX RF 50 Ω AC	SENSE:INT		11:13:42 AM Feb 17, 2022
Start Freq 2.478000000 GHz	PNO: Wide 🕞 Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>1000/1000	TRACE 1 2 3 4 5 6 TYPE MA WWWW DET P A N N N
10 dB/div Ref 126.99 dBµV		Mkr	2.480 156 0 GHz 116.697 dBµV
Log 117 107 97.0 97.0 87.0 77.0 67.0 57.0 47.0 			3Δ2 ////////////////////////////////////
^{37.0} Start 2.478000 GHz #Res BW 100 kHz	VBW 1.0 MHz	Sweep	Stop 2.483500 GHz 1.000 ms (1001 pts)
MKR MODE TRC SCL X 1 N 1 f 2.480 156 0 GH 2 N 1 f 2.483 500 0 GH 3 Δ1 1 f (Δ) 3.344 0 MH 4 5 5 5 6 6 6 6 6 7	z 56.766 dBµV	FUNCTION WIDTH FU	UNCTION VALUE
MSG		STATUS	

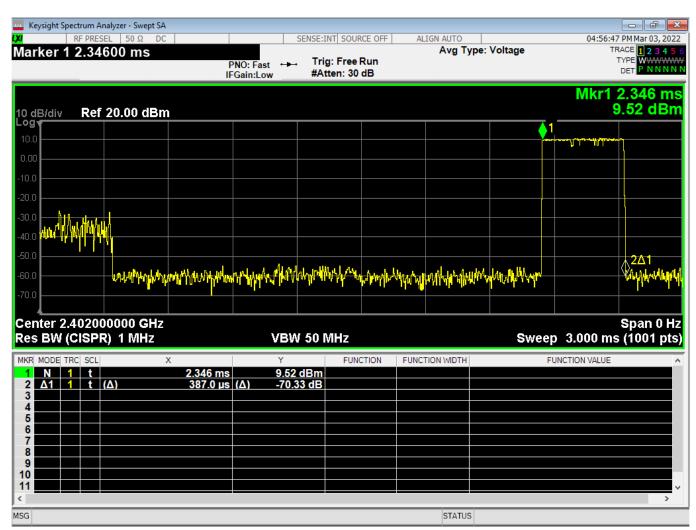
16 Higher Bandedge, Unrestricted, Hopping

ncee.	Report Number:	R20211006-20-E7A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	ectrum A	nalyzer - Unrestric	ted LBE using C63	3.10 Sec 11.13.2	2								
LXI	RF	50 Ω AC			SENSE	E:INT						11:11:4	5 AM Feb 17, 2022
Marker 1	2.40	18258976	68 GHz							e: Log-Pv		т	RACE 1 2 3 4 5 (
				PNO: Fast		rig: Free			Avg Hold	1:>1000/10	000		TYPE MA WWW
				IFGain:Low	#/	Atten: 30	dB						DET PANNN
												-4 0 404	
											INIK		826 GHz
10 dB/div Log	Ref	126.99 dB	μV									116.:	344 dBµV
							Ť					↓1	
117												~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Man
107												~· · v	A AA A AA AAAA AAAAA AAAAA
												d and	
97.0													
87.0												<u>بر</u>	
											ሊካ	ł	
77.0									<mark>3∆</mark>	1	~		
67.0									X^^	A-	<u>/</u>		
									~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	- hywyr			
57.0				<u> </u>			3 . 0 . 0	~ ~ ^^	~				
47.0	$\sim \gamma \sim \gamma$	mmmmmm	www.	mon	$\sim$	m v v v v	ቀጊሎ ለአሳ ~	• ጉ ጉ ነ					
47.0													
37.0													
							4						
Start 2.39	20000	GH7	·		·							Stop 24	03767 GHz
#Res BW				,	VBW 1.0	N NALI-					woon	1 000 m	s (1001 pts)
#Res DW	1001	Л								<u> </u>	sweep	1.000 III:	s (Tuur pis,
MKR MODE TH	RC SCL		х		Y	FUN	CTION	FUNCT	TION WIDTH		FU	NCTION VALUE	^
1 N 1	f		401 826 GHz	7 116	344 dBu\								
2 1 1	f	<u>(Λ)</u>	-2.845 MH		48.971 dE								
3 N 1	f		.398 981 GHz		374 dBµ\								
4													
5													
6													
7													
8													
9													
10													
11													v
<													>
MSG									STATUS				

17 Lower Bandedge, Unrestricted, Hopping

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