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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address:

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

Product:

A04112

Test Report No:

Approved by:

R20210128-20-E11A

Nic S. Johnson, NCE Technical Manager iNARTE Certified EMC Engineer #EMC-003337-NE

DATE:

December 6, 2021

60

Total Pages:

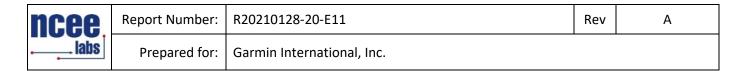
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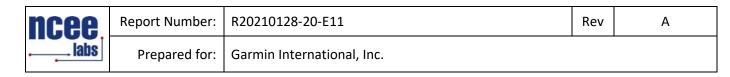
REVISION PAGE

Rev. No.	Date	Description		
0	21 October 2021	Original – NJohnson		
		Prepared by FLane		
А	6 December 2021	Commented on radiated spurious emissions		
		Added Conducted spurious emission section - FL		



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1.0 SUMMARY OF TEST RESULTS

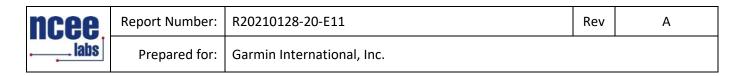
The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section (Please see the checked box below for the rule part used):

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(a)(1) RSS-247 Issue 2 Section 5.2	Peak output power	Pass			
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass			
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass			
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass			
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass			
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass			
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	Pass			



2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04112
EUT Received	9 March 2021
EUT Tested	9 March 2021- 6 October 2021
Serial No.	3319808469 (Radiated Measurements) 3319808431 (Radiated Measurements) 3319808429 (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) 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 Bluetooth Transmissions:				
Channel	Frequency			
Low	2402 MHz			
Mid	2440 MHz			
High	2480 MHz			

For 802.11x Transmissions:

Channel	Frequency
Low	2412 MHz
Mid	2437 MHz
High	2462 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 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

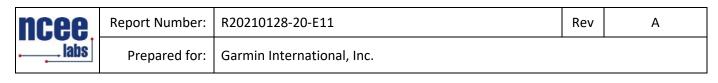


3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE	
1	Nic Johnson Technical Manage		Review/editing	
2			Testing and report	
3	Grace Larsen	Test Technician	Testing	
4	Samuel Probst	Test Technician	Testing	
5	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.



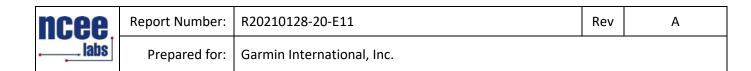
3.3 TEST EQUIPMENT

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	6415	March 16, 2020	March 16, 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, 2022
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA

*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 \boxtimes

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.

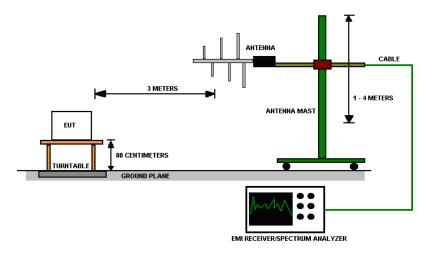


Figure 2 - Radiated Emissions Test Setup



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4.0 RESULTS

DTS Radio Measurements								
CHANNEL	Transmitter	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	PSD (dBm)	RESULT	
Low	2EDR	1.2482	1.0440	12.294	16.959	-5.256	PASS	
Mid	2EDR	1.2371	1.0380	12.055	16.051	-5.007	PASS	
High	2EDR	1.2373	1.0400	12.664	18.467	-4.660	PASS	
Low	3EDR	1.2385	1.0290	12.591	18.159	-4.864	PASS	
Mid	3EDR	1.2318	1.0230	12.579	18.109	-4.977	PASS	
High	3EDR	1.2307	1.0230	12.772	18.932	-4.647	PASS	
Occupied Ba	andwidth = N/A ;	6 dB Bandwidth Li	mit =500 kHz	Peak Output Pov	wer Limit = 3	0 dBm; PSD L	imit = 8 dBm	
			Unrestricted E	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	59.57	118.18	58.61	20.00	PASS	
Low	3EDR	2400.00	71.25	117.37	46.13	20.00	PASS	
High	2EDR	2483.50	71.97	118.19	46.22	20.00	PASS	
High	3EDR	2483.50	57.91	117.70	59.79	20.00	PASS	
		Р	eak Restricted	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	51.73	Peak	73.98	22.25	PASS	
Low	3EDR	2390.00	52.91	Peak	73.98	21.07	PASS	
High	2EDR	2483.50	55.68	Peak	73.98	18.30	PASS	
High	3EDR	2483.50	56.80	Peak	73.98	17.18	PASS	
*Limit shown	n is the peak limi	t taken from FCC	Part 15.209					
		Ave	erage Restricte	ed 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	42.60	Average	53.98	11.38	PASS	
Low	3EDR	2390.00	42.80	Average	53.98	11.18	PASS	
High	2EDR	2483.50	45.93	Average	53.98	8.05	PASS	
High	3EDR	2483.50	46.49		53.98	7.49	PASS	
*Limit shown **Average Hig	High3EDR2483.5046.49Average53.987.49PASS*Limit shown is the average limit taken from FCC Part 15.209**Average Highest out of band level = SA Average Level – DCCF. C63.10 Sec. 11.12.2.5.2See Sec 4.3 for more information on DCCF							



4.1 OUTPUT POWER

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 allowed peak 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.



Garmin International, Inc.

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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

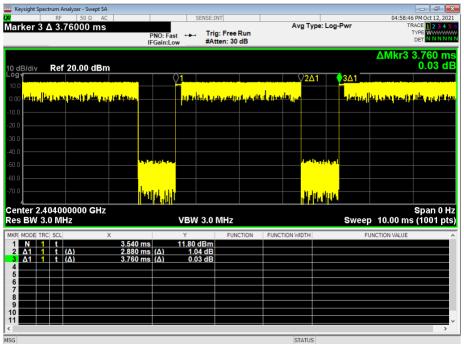


Figure 3 – 2EDR Duty Cycle DCCF (Duty Cycle Correction Factor) = 20 * Log(Duty Cycle / 100) -2.27 = 20 * Log(77 / 100)

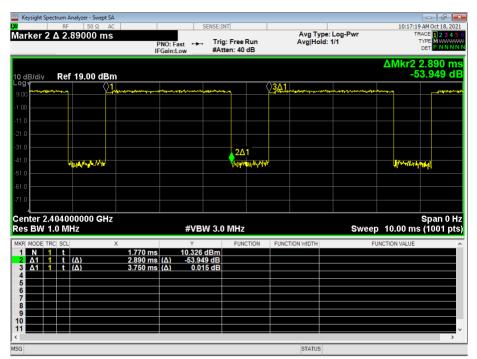


Figure 4 – 3EDR Duty Cycle

DCCF (Duty Cycle Correction Factor) = 20 * Log(Duty Cycle / 100)

-2.27 = 20 * Log(77 / 100)



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.

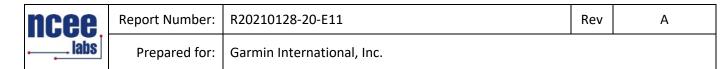
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

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:

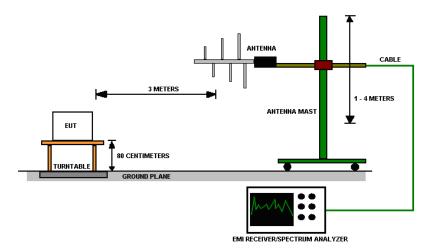


Figure 5 - Radiated Emissions Test Setup

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.

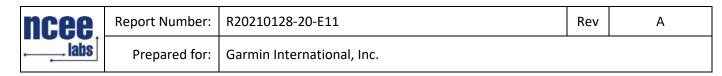
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

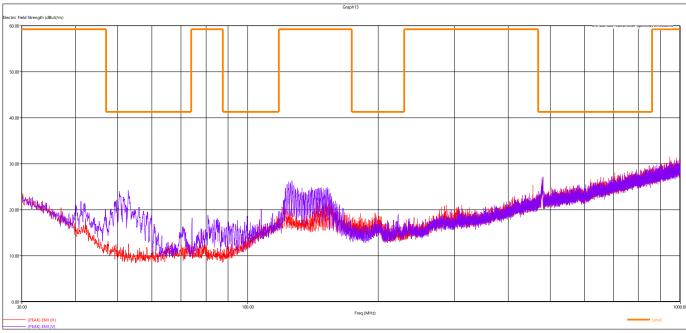
No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.



Test results:





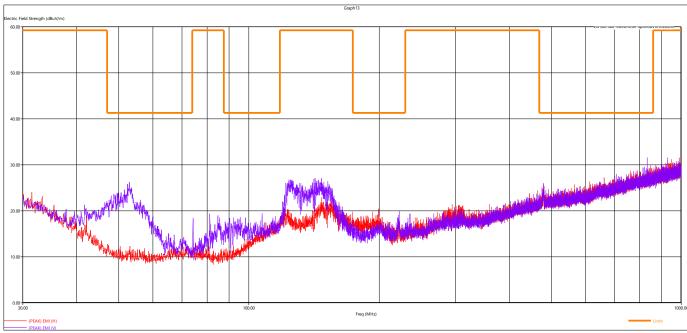
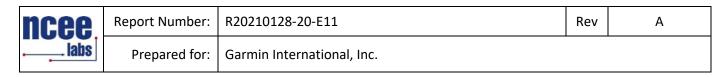
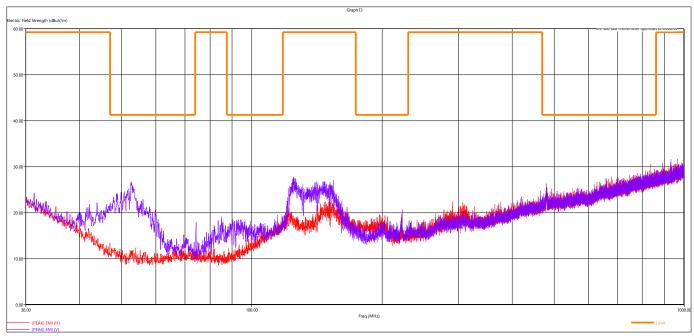


Figure 7 - Radiated Emissions Plot, BT EDR 2MB







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

	Peak Measurements, Bluetooth Classic									
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation		
MHz	dBµV/m	dBµV/m	dB	cm.	deg.					
2402.212000	101.39	NA	NA	140	152	Н	Low	BT EDR 2MB		
2439.934000	100.98	NA	NA	131	158	Н	Mid	BT EDR 2MB		
2479.856000	101.01	NA	NA	123	157	Н	High	BT EDR 2MB		
5418.652000	44.22	73.98	29.76	153	307	Н	Low	BT EDR 2MB		
4834.056000	42.53	73.98	31.45	326	193	Н	Mid	BT EDR 2MB		
9757.344000	49.28	73.98	24.70	540	287	V	Mid	BT EDR 2MB		
7451.334000	46.68	73.98	27.30	355	36	V	High	BT EDR 2MB		
2401.908000	105.87	NA	NA	173	166	Н	Low	BT EDR 3MB		
2440.784000	105.02	NA	NA	163	161	Н	Mid	BT EDR 3MB		
2480.082000	105.61	NA	NA	190	160	Н	High	BT EDR 3MB		
7189.066000	46.00	73.98	27.98	217	333	V	Low	BT EDR 3MB		
4885.270000	42.21	73.98	31.77	258	134	Н	Mid	BT EDR 3MB		
4811.536000	42.18	73.98	31.80	407	325	Н	High	BT EDR 3MB		

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Average Measurements, Bluetooth Classic									
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation	
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2402.212000	99.11	NA	NA	140	152	Н	Low	BT EDR 2MB	
2439.934000	98.70	NA	NA	131	158	Н	Mid	BT EDR 2MB	
2479.856000	98.73	NA	NA	123	157	Н	High	BT EDR 2MB	
5418.652000	41.94	53.98	12.04	153	307	н	Low	BT EDR 2MB	
4834.056000	40.25	53.98	13.73	326	193	Н	Mid	BT EDR 2MB	
9757.344000	47.00	53.98	6.98	540	287	V	Mid	BT EDR 2MB	
7451.334000	44.40	53.98	9.58	355	36	V	High	BT EDR 2MB	
2401.908000	103.59	NA	NA	173	166	Н	Low	BT EDR 3MB	
2440.784000	102.74	NA	NA	163	161	Н	Mid	BT EDR 3MB	
2480.082000	103.33	NA	NA	190	160	Н	High	BT EDR 3MB	
7189.066000	43.72	53.98	10.26	217	333	V	Low	BT EDR 3MB	
4885.270000	39.93	53.98	14.05	258	134	Н	Mid	BT EDR 3MB	
4811.536000	39.90	53.98	14.08	407	325	н	High	BT EDR 3MB	

See Sec 4.3 for more information on DCCF

4.5 CONDUCTED SPURIOUS EMISSIONS

Test Method: ANSI C63.10-2013, Section 7.8.8

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.

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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:

The highest value measured was 12.104 dBm at the fundamental emissions. All other values were at least 20 dB lower. Testing was performed on the low, middle and high channels with all modulation settings. The worst-case results are reported.

Keysight Spectrum Analy RF	50 Ω DC		S	SENSE:INT				12:	02:44 PM Nov 30, 20
tart Freq 30.00	00000 MI	PN	0:Fast 🖵 ain:Low	Trig: Free Ru #Atten: 20 di		Avg Typ Avg Hol	e: Voltage d:>100/100		TRACE 1 2 3 4 TYPE MWWW DET P P N N
eak Table									743.29 MH
Freq (GHz)	dBm	ΔLimit 1 (dB)	10 dB/div	Ref 10.0	0 dBm			-	68.290 dBi
1									
2			0.00						
3			0.00						
			-10.0						
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		>	Res BW	(CISPR) 12	0 kNV2BW	910 kHz	Swe	ep 4.000 r	ms (20001 pt
G 🕕 File <conduc< td=""><td>ted Spuriou</td><td>s. 30M-1G.state</td><td>e> recalled</td><td></td><td></td><td>STATUS</td><td></td><td></td><td></td></conduc<>	ted Spuriou	s. 30M-1G.state	e> recalled			STATUS			

Figure 9 - Radiated Emissions Plot, 2EDR, 30M – 1G



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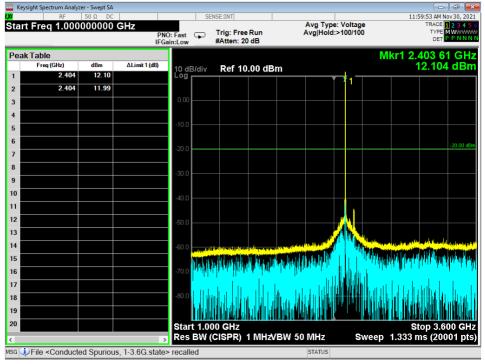


Figure 10 - Radiated Emissions Plot, 2EDR, 1G - 3.6G

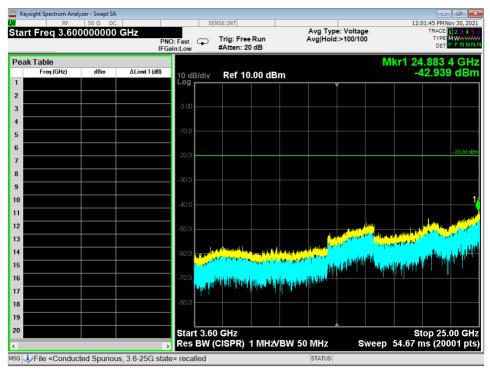


Figure 11 - Radiated Emissions Plot, 2EDR, 3.6G - 25G



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art Freq 30.0		PNO	D:Fast 🖵 ain:Low	Trig: Free Run #Atten: 20 dB	Avg H	old:>100/100	T' I	
eak Table							Mkr1 786	
Freq (GHz)	dBm	ΔLimit 1 (dB)	10 dB/div Log	Ref 10.00 dE	3m		-67.8	393 dB
			0.00					
			-10.0					
			-20.0					-20.00
			-30.0					
			-40.0					
			-50.0					
			-60.0					
							€	
			-70.0 destate	a ter fill som en fill som en fill state som for	I GIGTO CARE AND	and a first second for the first		i la state de la seconda d
			NYTE	llaði lei de stað ski	AND ANNALLAL ALLAL ALLAL		na destructures de la constante de	i Malini Malini A
			-80.0					
				and the last	ta shinad.	الدارية المتحجيل	يبابآ البرياب ألبر	واللي والأروار
			Start 0.0	300 GHz			Stop 1	.0000 GI



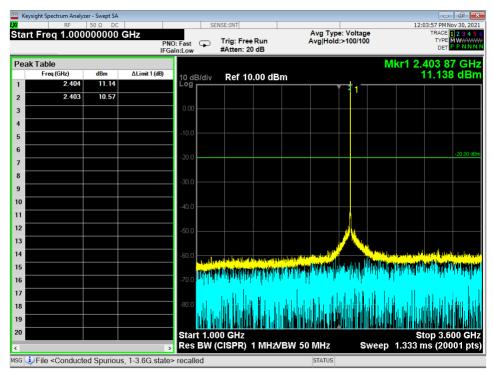


Figure 13 - Radiated Emissions Plot, 3EDR, 1G – 3.6G



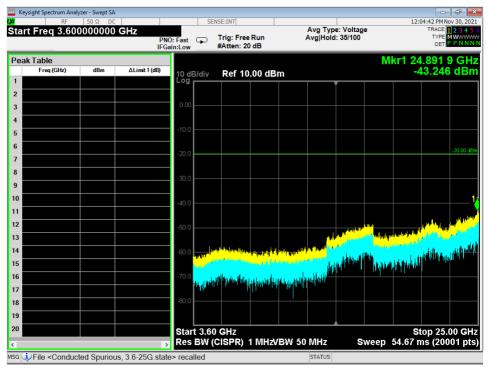


Figure 14 - Radiated Emissions Plot, 3EDR, 3.6G – 25G



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4.5 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.



4.6 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:

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



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.

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.

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Test Results:

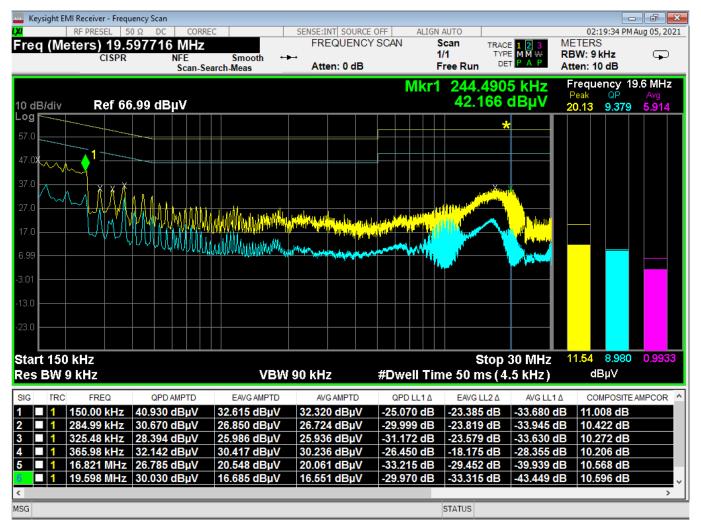
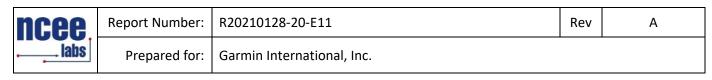
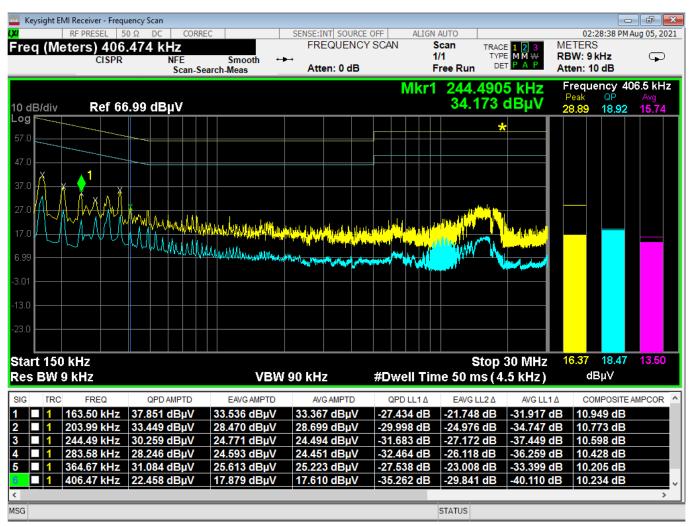
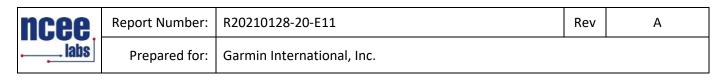


Figure 15 - Conducted Emissions Plot, Line, TX







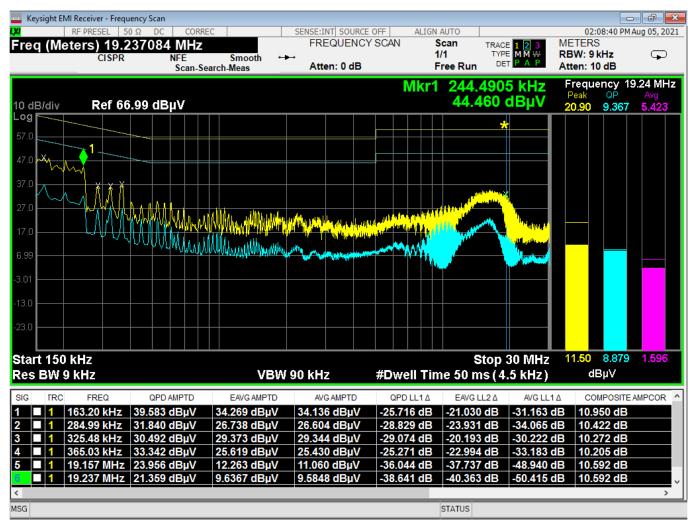
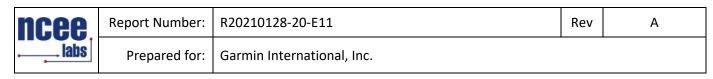


Figure 17 - Conducted Emissions Plot, Line, IDLE



Keysight EMI Receiver - Frequency Sci	an				
RF PRESEL 50 Ω D	C CORREC	SENSE:INT SOURCE OFF	ALIGN AUT		01:58:46 PM Aug 05, 202
req (Meters) 365.978 CISPR		FREQUENCY SCA	N Scan 1/1 Free		METERS RBW: 9 kHz Atten: 10 dB
) dB/div Ref 66.99 d	IBμV			44.4905 kHz 35.634 dBµV	Frequency 366 kHz Peak QP Avg 29.80 19.66 16.41
pg 7.0 7.0 7.0 7.0 7.0 7.0 7.0	MWWWW.wardelling				
01		/ 90 kHz #D	well Time (Stop 30 MHz 50 ms (4.5 kHz)	16.79 19.36 13.74 dBµV
01 3.0 3.0 tart 150 kHz es BW 9 kHz				50 ms (4.5 kHz) EAVG LL2 AVG LL1A	dBµV COMPOSITE AMPCOR
01 3.0 3.0 tart 150 kHz es BW 9 kHz G TRC FREQ QF 1 163.50 kHz 41.23	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV	AVG AMPTD C 33.891 dBµV -24	2PD LL1 Δ	50 ms (4.5 kHz) EAVG LL2 AVG LL1 A 1.264 dB -31.393 dB	dBµV COMPOSITE AMPCOR 10.949 dB
01 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV 58 dBµV 29.582 dBµV	AVG AMPTD C 33.891 dBµV -24 29.422 dBµV -27	2PD LL1 A I .048 dB -2 .289 dB -2	50 ms (4.5 kHz) EAVG LL2 AVG LL1A 1.264 dB -31.393 dE 3.865 dB -34.024 dE	dBµV COMPOSITE AMPCOR 10.949 dB 10.773 dB
art 150 kHz es BW 9 kHz 3 IRC FREQ QF 1 163.50 kHz 41.23 1 203.99 kHz 36.16 1 244.49 kHz 32.84	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV 58 dBµV 29.582 dBµV 49 dBµV 27.580 dBµV	АVG AMPTD G 33.891 dBµV -24 29.422 dBµV -27 27.417 dBµV -29	QPD LL1A I I.048 dB -2' I.289 dB -2' I.093 dB -2'	50 ms (4.5 kHz) EAVG LL2 AVG LL1A 1.264 dB -31.393 dE 3.865 dB -34.024 dE 4.363 dB -34.525 dE	dBµV COMPOSITE AMPCOR 10.949 dB 10.773 dB 10.598 dB
art 150 kHz sart 150 kHz s BW 9 kHz G TRC FREQ QF 1 163.50 kHz 41.23 1 203.99 kHz 36.15 1 244.49 kHz 32.84 1 284.99 kHz 28.50	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV 58 dBµV 29.582 dBµV 49 dBµV 27.580 dBµV 25.155 dBµV	АVG AMPTD G 33.891 dBµV -24 29.422 dBµV -27 27.417 dBµV -29 24.910 dBµV -32	APD LL1A I 0.048 dB -2' 2.289 dB -2' 0.093 dB -2' 2.163 dB -2'	50 ms (4.5 kHz) EAVG LL2 AVG LL1A 1.264 dB -31.393 dE 3.865 dB -34.024 dE 4.363 dB -34.525 dE 5.514 dB -35.759 dE	dBµV COMPOSITE AMPCOR 10.949 dB 10.773 dB 10.598 dB 10.422 dB
art 150 kHz es BW 9 kHz 3 IRC FREQ QF 1 163.50 kHz 41.23 1 203.99 kHz 36.16 1 244.49 kHz 32.84 1 284.99 kHz 28.50 1 324.17 kHz 30.89	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV 58 dBµV 29.582 dBµV 49 dBµV 27.580 dBµV 26 dBµV 25.155 dBµV 26 dBµV 28.840 dBµV	AVG AMPTD C 33.891 dBµV -24 29.422 dBµV -27 27.417 dBµV -29 24.910 dBµV -32 28.725 dBµV -28	OPD LL1A I 0.048 dB -2' 2.89 dB -2' 0.093 dB -2' 2.163 dB -2' 3.707 dB -2'	SOms (4.5 kHz) EAVG LL2 Δ AVG LL1 Δ 1.264 dB -31.393 dB 3.865 dB -34.024 dB 4.363 dB -34.525 dB 5.514 dB -35.759 dB 0.760 dB -30.874 dB	dBµV COMPOSITE AMPCOR 10.949 dB 10.773 dB 10.598 dB 10.422 dB 10.276 dB
art 150 kHz es BW 9 kHz 3 IRC FREQ QF 1 163.50 kHz 41.23 1 203.99 kHz 36.16 1 244.49 kHz 32.84 1 284.99 kHz 28.50 1 324.17 kHz 30.89	VBW PD AMPTD EAVG AMPTD 36 dBµV 34.020 dBµV 58 dBµV 29.582 dBµV 49 dBµV 27.580 dBµV 25.155 dBµV	AVG AMPTD C 33.891 dBµV -24 29.422 dBµV -27 27.417 dBµV -29 24.910 dBµV -32 28.725 dBµV -28	OPD LL1A I 0.048 dB -2' 2.89 dB -2' 0.093 dB -2' 2.163 dB -2' 3.707 dB -2'	50 ms (4.5 kHz) EAVG LL2 AVG LL1A 1.264 dB -31.393 dE 3.865 dB -34.024 dE 4.363 dB -34.525 dE 5.514 dB -35.759 dE	dBµV COMPOSITE AMPCOR 10.949 dB 10.773 dB 10.598 dB 10.422 dB 10.276 dB

Figure 18 - Conducted	I Emissions	Plot,	Neutral, IDLE	5
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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

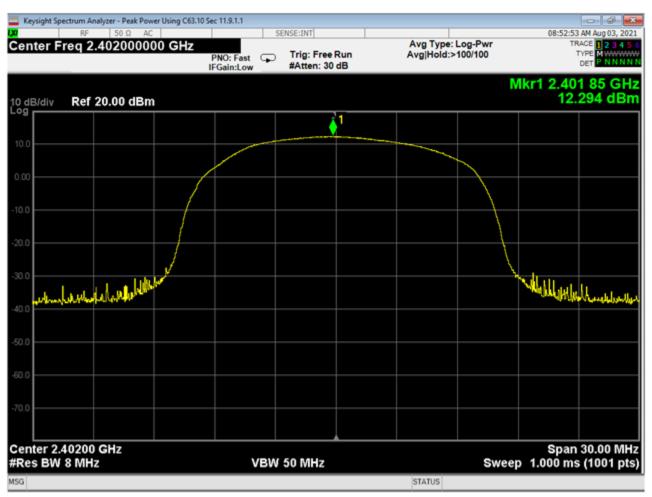
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	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%.

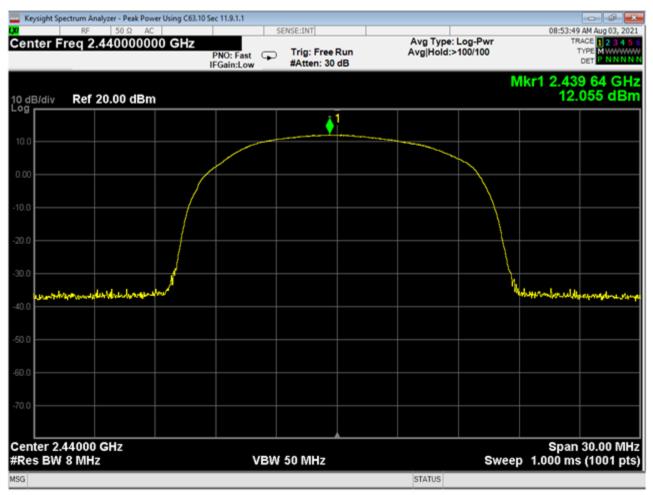
ncee labs	Report Number:	R20210128-20-E11	Rev	А
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APPENDIX C – GRAPHS AND TABLES



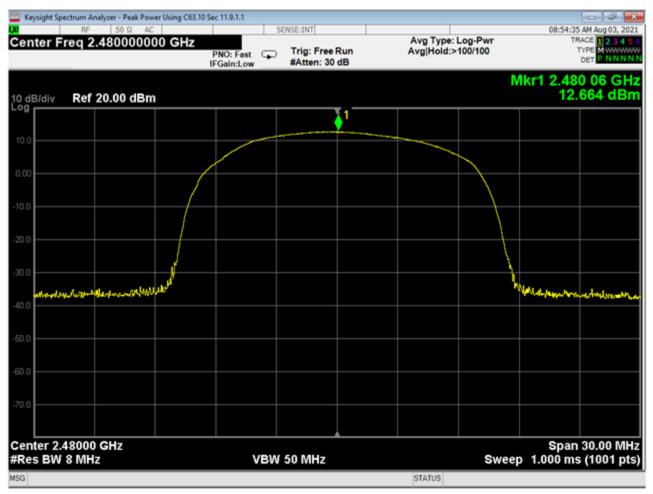
01 Peak Output Power, Low Channel, 2EDR

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02 Peak Output Power, Mid Channel, 2EDR

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03 Peak Output Power, High Channel, 2EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63	10 Sec 11.8.1			- 0
RF 50 Ω AC	011-	SENSE:INT Center Freq: 2.402000000	0W-	08:56:43 AM Aug 03, 202 Radio Std: None
enter Freq 2.402000000	GHZ	Tain: Eres Dun	Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
0 dB/div Ref 20.00 dBm				
0.0				
0.0				
	~			
and a surface of the second				
0.0				
0.0				
1.0				
0.0				
0.0				
enter 2.402 GHz				Span 3 MH
Res BW 100 kHz		VBW 1 MHz		Sweep 1 m
Occupied Bandwidth		Total Power	17.6 dBm	
1.2	2482 MHz			
Transmit Freq Error	-4.045 kHz	% of OBW Power	99.00 %	
			6 00 dB	
x dB Bandwidth	1 044 MHz	Y NB		
x dB Bandwidth	1.044 MHz	x dB	-6.00 dB	
x dB Bandwidth	1.044 MHz	X dB	-6.00 dB	
x dB Bandwidth	1.044 MHz	хав	-6.00 dB	
x dB Bandwidth	1.044 MHz	X dB	-6.00 dB	

04 Bandwidth, Low Channel, 2EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
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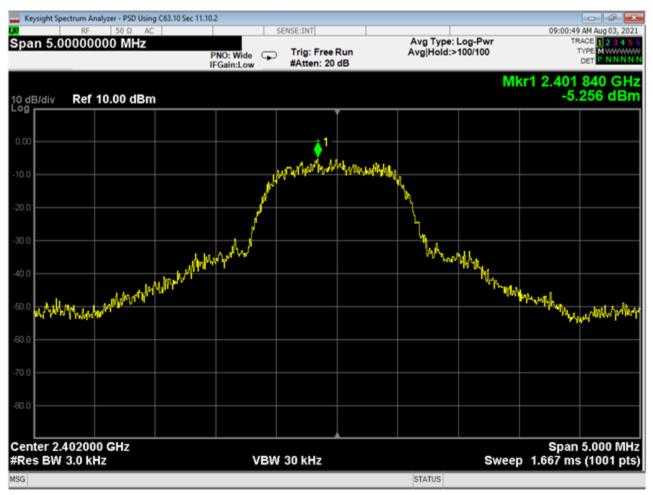
05 Bandwidth, Mid Channel, 2EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



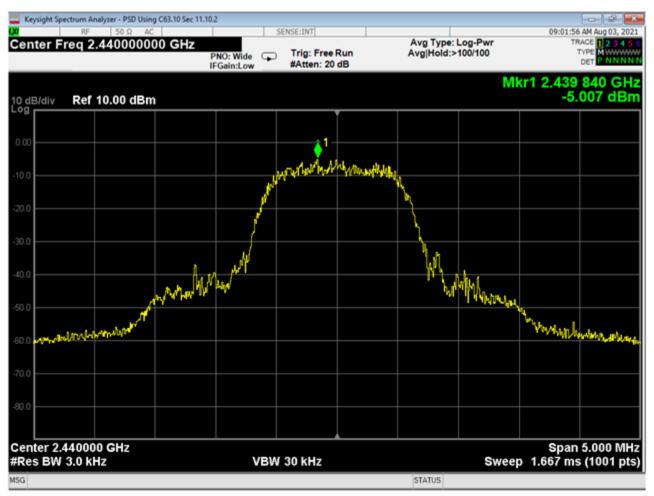
06 Bandwidth, High Channel, 2EDR

Incee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



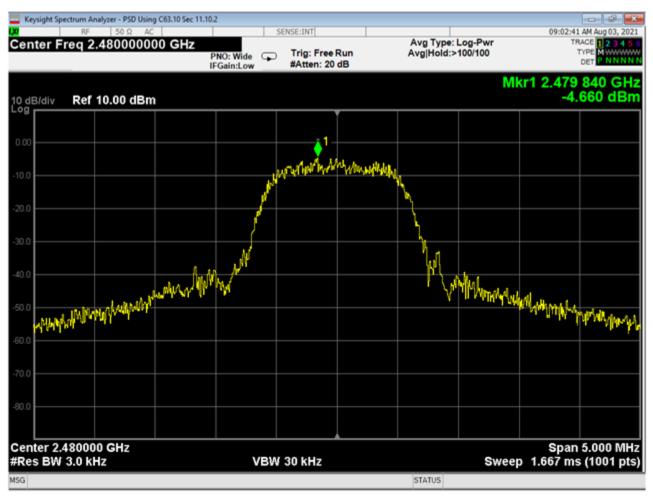
07 PSD, Low Channel, 2EDR

Incee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



08 PSD, Mid Channel, 2EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



09 PSD, High Channel, 2EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analy	zer - Restricted LBE using C63.1	10 Sec 6.10.5				
arker 2 2.3895	50 Ω AC CORREC 5800000000 GHz MP	PNO: Fast IFGain:High	ENSE:INT Trig: Free Run #Atten: 0 dB	ALIGN OFF Avg Type Avg Hold:	: RMS >1000/1000	02:12:05 PM Aug 02, 20 TRACE 2 3 4 TYPE MA
dB/div Ref 1	15.55 dBµV				M	kr2 2.389 34 GH 40.329 dBµ
Trace 1 Pass Trace 2 Pass	5					
5.5						
5.5	1		the state of the second se	ang mang ten digi katalan seri seri perta	•••	himmolynikthromaki.Lag 2
art 2.380000 G Res BW 1.0 MH		#VBV	V 50 MHz*		Sweep	Stop 2.390000 GI 1.000 ms (1001 pt
N 1 f	X 2,387 09 GH 2,389 34 GH			FUNCTION WIDTH	FU	ICTION VALUE
				STATUS		>

10 Lower Bandedge Restricted, 2EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Anal	yzer - Restricted HBE C63.10 Sec	6.10.5				- 4
arker 2 2.483	50 Ω AC CORREC 5000000000 GHz AMP	PNO: Fast IFGain:High	NSE:INT Trig: Free Run #Atten: 0 dB	ALIGN OFF Avg Typ Avg Hold	e: RMS :>1000/1000	02:13:55 PM Aug 02, 20 TRACE 1 2 3 4 TYPE MA **** DET P A N N
dB/div Ref 1	14.99 dBµV				Mkr2	2.483 500 0 GH 43.665 dBµ
no Trace 1 Pass Trace 2 Pass 5.0	S S					
.0 1						
10 2	aller and an and a second second		1907 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 - 1908 -		*******	
art 2.483500 G Res BW 1.0 MH		VBW	50 MHz*		Sweep	Stop 2.500000 GI 1.000 ms (1001 pt
R MODE TRC SCL N 1 F N 2 F	× 2.483 500 0 GH 2.483 500 0 GH			FUNCTION WIDTH	FUN	ICTION VALUE
				STATUS		>

11 Higher Bandedge Restricted, 2EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Unrestricted LBE Using C	63.10 Sec 11.13.2				- 0
arker 1 2.401830871248 GHz		rT g: Free Run ten: 30 dB	Avg Type: Log Avg Hold:>100	Pwr	02:05:28 PM Oct 12, 202: TRACE 12 3 4 5 TYPE MA
dB/div Ref 126.99 dBµV					.401 831 GH; 18.186 dBµ\
09				η –	
77.0					
7.0			3Δ1 M	h	
57.0		man			man hours
17.0					
tart 2.390000 GHz Res BW 100 kHz	VBW 1.01	MHz		Sto Sweep 1.00	p 2.406758 GH 00 ms (1001 pts
KR MODE TRC SCL X 1 N 1 1 7 2.401 831 GH	Y 118,186 dBµV	FUNCTION F	UNCTION WIDTH	FUNCTION	VALUE
2 N 1 f 2.399 497 G 3 Δ1 1 f (Δ) -2.333 M 4 5 6	lz 71.969 dBuV				
1 1					>

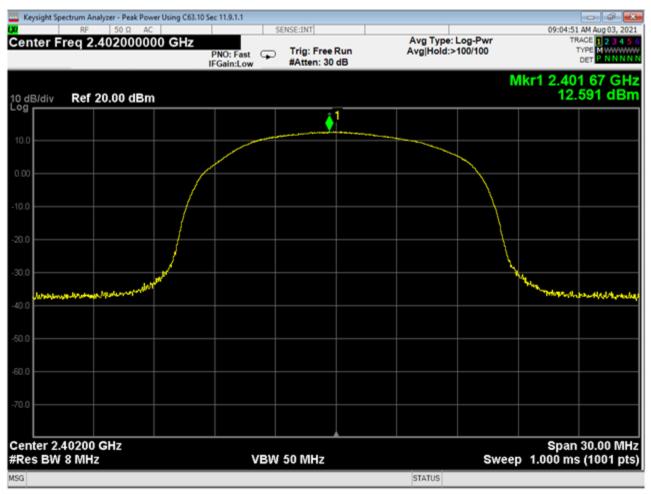
12 Lower Bandedge Unrestricted, 2EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Unrestricted HBE Using C					- 4
arker 1 2.479833176428 GHz		g: Free Run ten: 30 dB	Avg Type Avg Hold:	: Log-Pwr >1000/1000	02:07:08 PM Oct 12, 202 TRACE 234 TYPE MA WWW DET PANN
) dB/div Ref 126.99 dBµV				Mk	r1 2.479 833 GH 118.177 dBµ
og 1 117					
107					
7.0		wany			
7.0		··· ~~	mm	m	
7.0					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
7.0					
tart 2.478744 GHz					Stop 2.483500 GH
Res BW 100 kHz	#VBW 30	0 kHz		Sweep	1.000 ms (1001 pt
KR MODE TRC SCL X 1 N 1 f 2.479 833 GH		FUNCTION	FUNCTION WIDTH	FUI	ICTION VALUE
2 N 1 f 2.483 500 GH 3 N 1 f 2.483 500 GH					
4 5 6					
7					
9					
					>

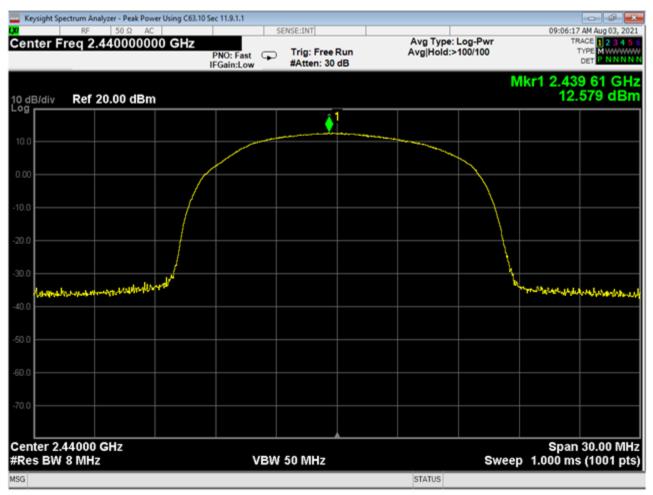
13 Higher Bandedge Unrestricted, 2EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



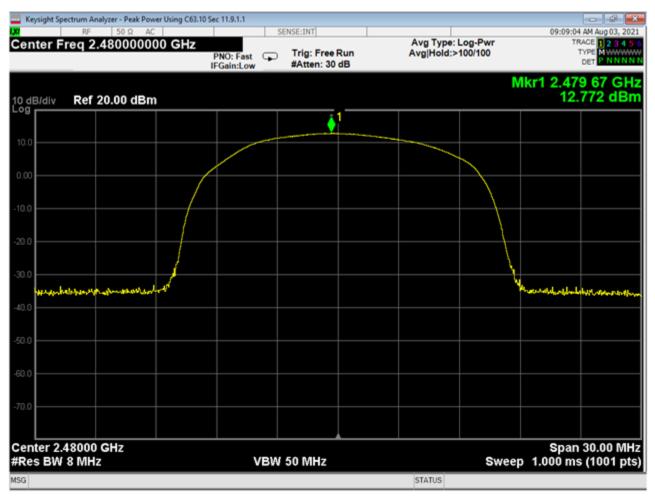
14 Peak Output Power, Low Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



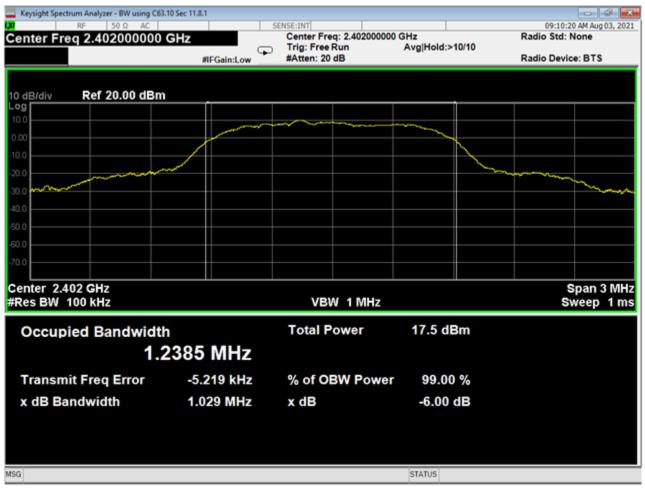
15 Peak Output Power, Mid Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



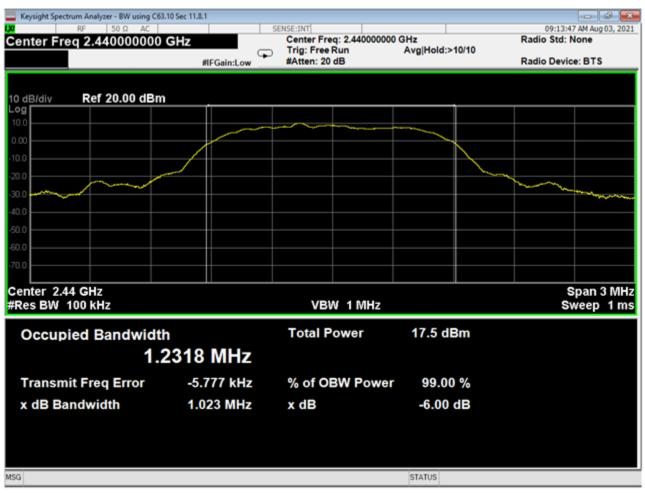
16 Peak Output Power, High Channel, 3EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



17 Bandwidth, Low Channel, 3EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



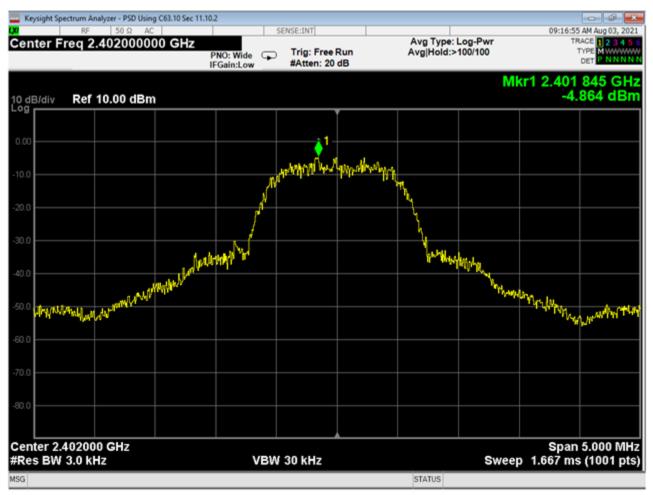
18 Bandwidth, Mid Channel, 3EDR

ncee labs	Report Number:	R20210128-20-E11	Rev	А
	Prepared for:	Garmin International, Inc.		



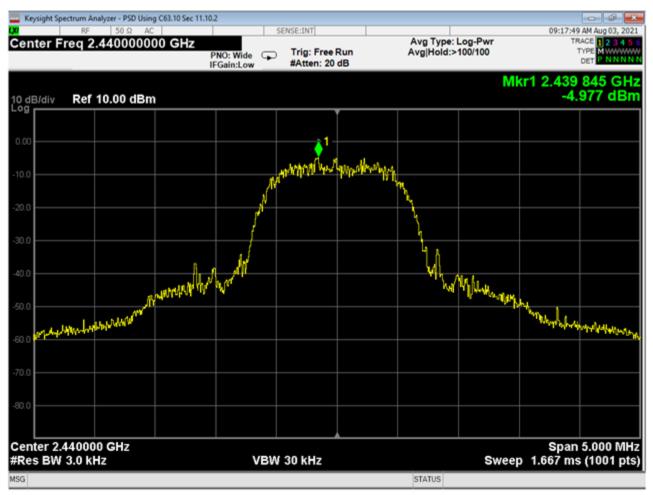
19 Bandwidth, High Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



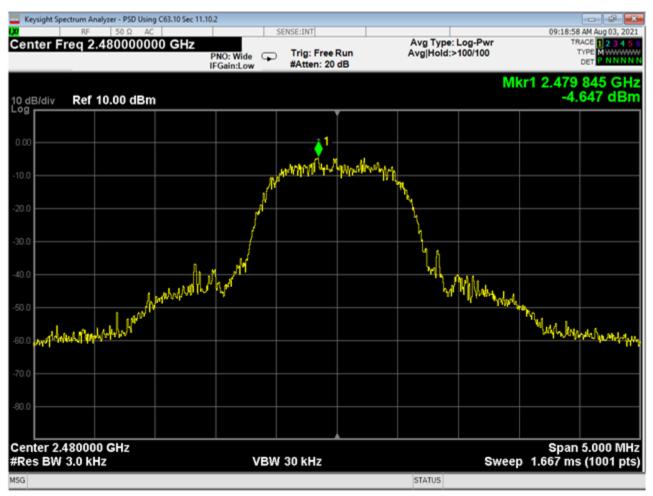
20 PSD, Low Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



21 PSD, Mid Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



22 PSD, High Channel, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	- Restricted LBE using C63.10					- 4
arker 2 2.38924	F	NO: Fast	SE:INT Trig: Free Run #Atten: 0 dB	ALIGN OFF Avg Type: Avg Hold:>		02:18:38 PM Aug 02, TRACE 1 2 3 TYPE MA W DET P A N
dB/div Ref 115	.55 dBµV				M	kr2 2.389 70 G 40.537 dB
g Trace 1 Pass Trace 2 Pass						
5						
5	Petrologia (1997)	*****	-1-10-1-10-1400-0-1	\ \		↓ ²
art 2.380000 GHz	,					Stop 2.390000 0
es BW 1.0 MHz		#VBW	50 MHz*		Sweep	1.000 ms (1001 p
R MODE TRC SCL N 1 f N 2 f	X 2.386 77 GHz 2.389 70 GHz	¥ 52,914 dBj 40,534 dBj		FUNCTION WIDTH	FUN	ICTION VALUE
				STATUS		

23 Lower Bandedge Restricted, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Restricted	d HBE C63.10 Sec 6.10.5				- 4
RF 50 Ω AC arker 2 2.4835495000 ASS PREAMP		SENSE:INT Trig: Free R #Atten: 0 dB		e: RMS d:>1000/1000	02:16:05 PM Aug 02, 20: TRACE 2 3 4 5 TYPE MA
dB/div Ref 114.99 dB	μV			Mkr2	2.483 549 5 GH 44.218 dBµ
Dg Trace 1 Pass 105 Trace 2 Pass 5.0					
5.0 5.0 1					
50 2	n durb hand bland an an adding a	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	مركومه ومراجع مراجع فعراره	alayahayaa ayayaa ahayaa	yung myangan yana dipatra mangini a
art 2.483500 GHz					Stop 2.500000 GF
Res BW 1.0 MHz	V	BW 50 MHz*		Sweep	1.000 ms (1001 pt
1 N 1 f 2.4 2 N 2 f 2.4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	83 582 5 GHz 56.	Y FUNC 797 dBµV 217 dBµV	TION FUNCTION WIDTH	FUN	ICTION VALUE

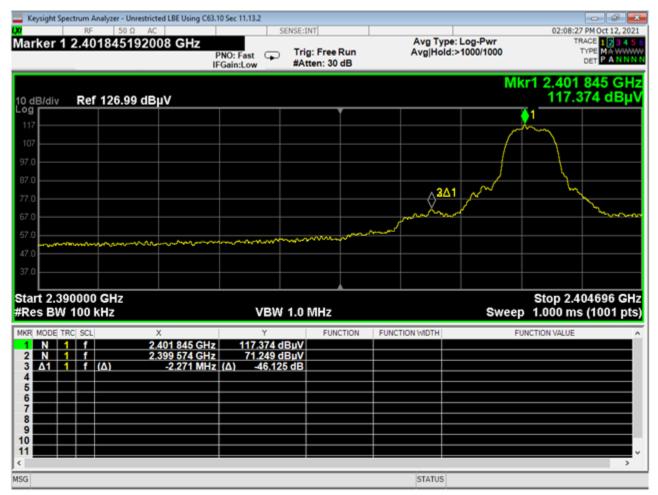
24 Higher Bandedge Restricted, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



25 Higher Bandedge Unrestricted, 3EDR

ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		



ncee.	Report Number:	R20210128-20-E11	Rev	А
labs	Prepared for:	Garmin International, Inc.		

REPORT END