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FCC/ISED Test Report

Prepared for:

Garmin International, Inc.

Address:

EUT:

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

A04111

Test Report No:

Approved by:

R20210128-20-E6A

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

DATE:

November 29, 2021

Total Pages:

49

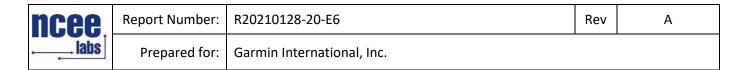
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labs	Prepared for:	Garmin International, Inc.		

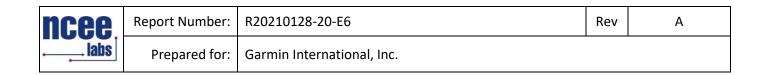
REVISION PAGE

Rev. No.	Date	Description
0	29 October 2021	Original – NJohnson
		Prepared by FLane
A	24 November 2021	Added Conducted Spurious section
		Added calculation for Time of occupancy
		Updated text regarding frequency separation limit in Results - FL



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1.0 SUMMARY OF TEST RESULTS

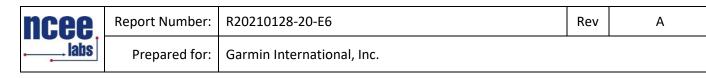
The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section (Please see the checked box below for the rule part used):

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			
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2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04111
EUT Received	9 March 2021
EUT Tested	9 March 2021- 6 October 2021
Serial No.	3378818230 (Radiated Sample) 3378818167 (Conducted Sample)
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 Manager	Review/editing
2	Fox Lane	Test Engineer	Testing and report
3	Karthik Vepuri	Test Engineer	Testing
4	Grace Larsen	Test Technician	Testing
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	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
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	April 14, 2020	April 14, 2022
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	April 14, 2020	April 14, 2022
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	April 14, 2020	April 14, 2022
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	April 14, 2020	April 14, 2022
N connector bulkhead (control room)*	PE9128	NCEEBH2	April 14, 2020	April 14, 2022

*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 \boxtimes

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.

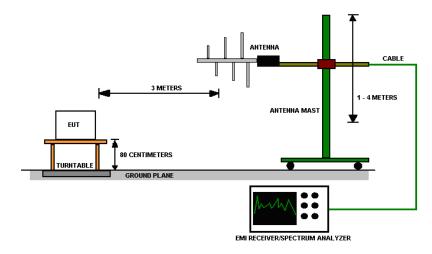
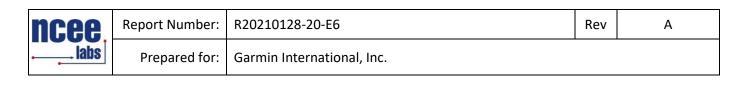


Figure 2 - Radiated Emissions Test Setup



4.0 RESULTS

	Radio Measurements							
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	20 dB Bandwidth (kHz)	POWER	PEAK OUTPUT POWER	RESULT	No. of Hopping Channels	Time of Occupancy (s)
				(dBm)	(mW)		79	0.1216
Low	Continuous	966.44	1122.00	11.009	12.615	PASS	Frequency Separation	On Time
Mid	Continuous	967.11	1119.00	10.644	11.598	PASS	(kHz)	
High	Continuous	965.73	1124.00	11.278	13.421	PASS	998.0	380.0us
	andwidth = N/A; Separation Limit:	> 2/3 * Occupied	Time Time	 Output Power Live of Occupancy Live of Occupancy = of Occupancy = od of Time of Occupancy 	mit < 0.4s; ON Time * (# of transmi		
			Unrestrie	ted Band-Edge				
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Delta (dB)	Min Delta (dB)	Re	sult
Low	Continuous	2390.00	71.02	117.49	46.48	20.00		SS
Low	Hopping	2390.00	67.33	115.53	48.20	20.00	PASS	
High High	Continuous Hopping	2483.50 2483.50	53.99 51.71	117.18 115.37	63.18 63.66	20.00 20.00		<u>ISS</u>
High Hopping 2483.50 51.71 115.37 63.66 20.00 PASS								
			Peak Rest	ricted Band-Edge	;			
CHANNEL	Band edge Out of Measurement Limit							
Low	Continuous	2390.00	51.89	Peak	73.98	22.09		SS
High	Continuous	2483.50	53.71	Peak	73.98	20.27	PA	SS
*Limit showr	n is the peak limit	taken from FCC F						
Average 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	Re	sult
		0000.00	42.31	Average	53.98	11.67	PA	<u> </u>
Low High	Continuous Continuous	2390.00 2483.50	44.53	Average	53.98	9.45		ISS ISS



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 15.249 Device: For Informational Purposes only 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.



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4.2 BANDWIDTH

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 15.249 Device:

For Informational Purposes only

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:

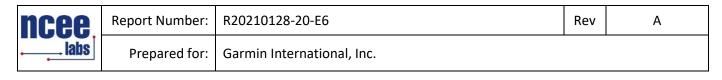
Details can be found in section 2.1 of this report.

Test results:

Pass

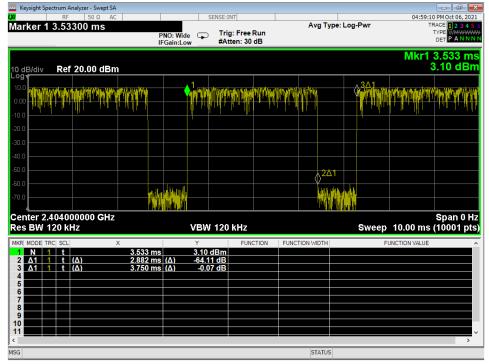
Comments:

- 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

Test Method:



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

-2.281 = 20 * Log(76.9 / 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.

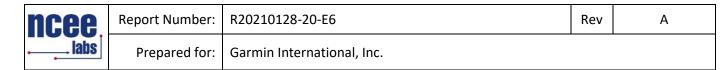
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

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:

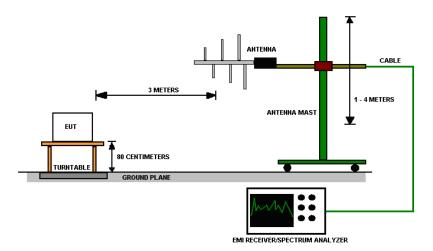


Figure 3 - Radiated Emissions Test Setup

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.

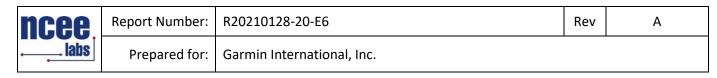
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

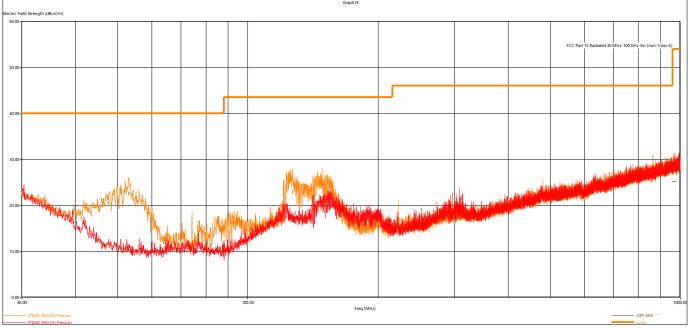
No deviation.

EUT operating conditions

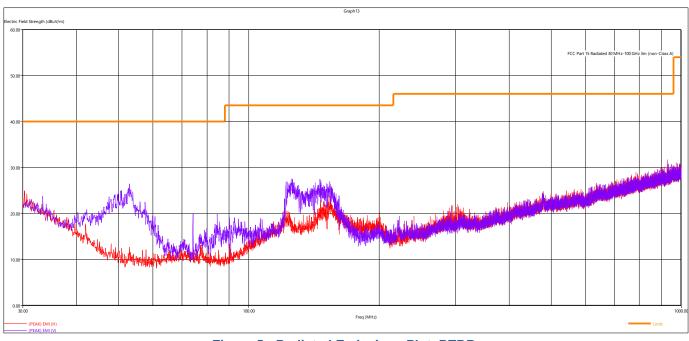
Details can be found in section 2.1 of this report.



Test results:









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, Bluetooth Classic											
Frequency	Level	Level Limit Margin Height Angle Pol					Channel	Modulation				
MHz	dBµV/m	dBµV/m	dB	cm.	deg.							
967.069920	25.06	53.98	28.92	369.00	133.00	Н	NA	Receive				
53.054880	22.51	40.00	17.49	112.00	325.00	V	NA	Receive				
126.889680	22.88	43.52	20.64	104.00	196.00	V	NA	Receive				

Peak Measurements, Bluetooth Classic											
Frequency	Level	Limit	Pol	Channel	Modulation						
MHz	dBµV/m	dBµV/m	dB	cm.	deg.						
2401.858000	104.37	NA	NA	269	151	V	Low	BT BR			
2440.400000	102.52	NA	NA	307	181	V	Mid	BT BR			
2479.892000	101.21	NA	NA	254	142	V	High	BT BR			

Average Measurements, Bluetooth Classic											
Frequency	Level* Limit Margin Height Angle Pol					Channel	Modulation				
MHz	dBµV/m	dBµV/m	dB	cm.	deg.						
2401.858000	102.09	NA	NA	269	151	V	Low	BT BR			
2440.400000	100.24	NA	NA	307	181	V	Mid	BT BR			
2479.892000	98.93	NA	NA	254	142	V	High	BT BR			
*Average Level		•		ak Level +	DCCF						

For more information on DCCF, see Sec. 4.3

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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)).

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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:

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:



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-										Ĭ				
				0.00										
-														
-				-10.0										
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Figure 6 - Radiated Emissions Plot, BTBR, 30M – 1G

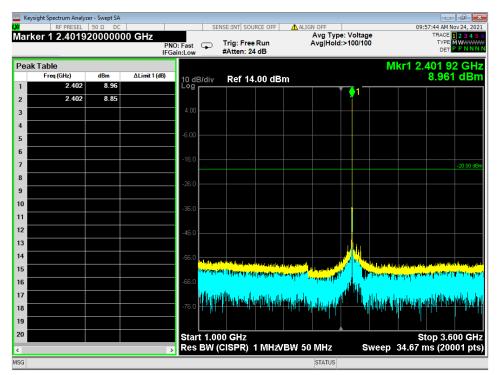


Figure 7 - Radiated Emissions Plot, BTBR, 1G - 3.6G



Keysight Spectrum Analyzer - Swept SA DE DDI ALIGN OFF Avg Type: Voltage Avg|Hold: 31/100 09:58:06 AM Nov 24, TRACE 1 2 3 SENSE:INT SOURCE OFF Marker 1 23.983500000000 GHz 1234 Trig: Free Run #Atten: 20 dB PNO: Fast 😱 IFGain:Low TYP DE Mkr1 23.983 5 GHz -54.619 dBm Peak Table ΔLimit 1 (dB) Frea (GHz Ref 10.00 dBm l0 dB/div 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Minilia Map 11) a hitalaya 17 الايتأن الأنمأأتل 18 19 20 Stop 25.00 GHz Sweep 42.67 ms (20001 pts) Start 3.60 GHz Res BW (CISPR) 1 MHzVBW 50 MHz MSG 🗼 File < Conducted Spurious, 3.6-25G.state> recalled

Figure 8 - Radiated Emissions Plot, BTBR, 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 15.249 Device:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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.



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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. If the device falls under FCC Part 15.249 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 50 dB between peak and the band edge.
- 4. 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 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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Test Results:

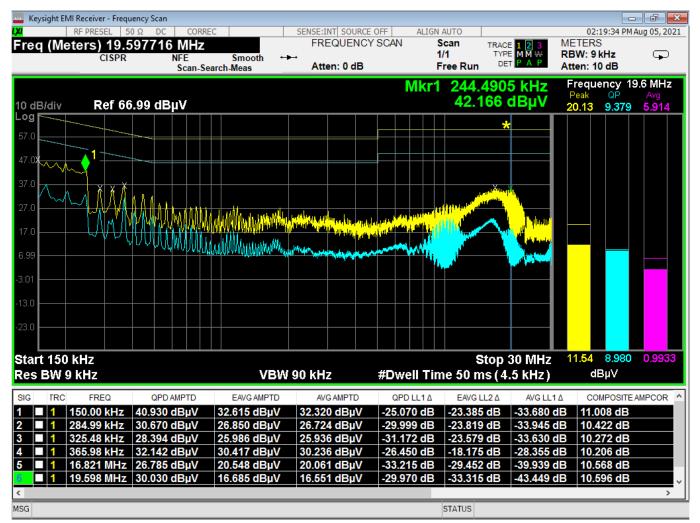
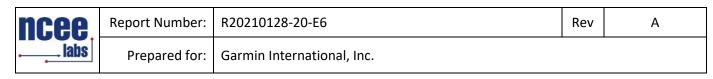


Figure 9 - Conducted Emissions Plot, Line, TX



	can			
RF PRESEL 50 Ω	DC CORREC	SENSE:INT SOURCE OFF	ALIGN AUTO	02:28:38 PM Aug 05
req (Meters) 406.474 CISPR	KHZ NFE Smooth Scan-Search-Meas	FREQUENCY SCAN	1/1 TYP	E 1 2 3 METERS E MM₩ RBW: 9 kHz C T P A P Atten: 10 dB
0 dB/div Ref 66.99	dBµV		Mkr1 244.490 34.173	
-og 57.0 47.0 37.0 77.0 17.0 6.99 3.01	Marina Marina Langu Kaling			
23.0				
	VBV	N 90 kHz #Dw	Stop /ell Time 50 ms (4	30 MHz 16.37 18.47 13. .5 kHz) αΒμν
23.0 Start 150 kHz Res BW 9 kHz	VEV DPD AMPTD EAVG AMPTD			
and tart 150 kHz tart 150 kHz tes BW 9 kHz		AVG AMPTD QF	rell Time 50 ms (4	.5 kHz) dΒμ∨
3.0 tart 150 kHz es BW 9 kHz ig IRC FREQ C 1 163.50 kHz 37.8	QPD AMPTD EAVG AMPTD	AVG AMPTD QF 33.367 dBµV -27.4	Vell Time 50 ms (4	.5 kHz) dBμV AVG LL1Δ COMPOSITE AMPCO
3.0 tart 150 kHz es BW 9 kHz IG TRC FREQ C I 1 163.50 kHz 37.8 I 203.99 kHz 33.4	EAVG AMPTD EAVG AMPTD 251 dBµV 33.536 dBµV	AVGAMPTD QF 33.367 dBµV -27.4 28.699 dBµV -29.9	Vell Time 50 ms (4 DLL1A EAVG LL2A 434 dB -21.748 dB	.5 kHz) dBμV AVG LL1Δ COMPOSITE AMPCO -31.917 dB 10.949 dB
3.0 tart 150 kHz es BW 9 kHz IG TRC FREQ C 1 163.50 kHz 37.8 1 203.99 kHz 33.4 1 244.49 kHz 30.2	DPD AMPTD EAVG AMPTD 351 dBµV 33.536 dBµV 49 dBµV 28.470 dBµV	AVG AMPTD QF 33.367 dBµV -27.4 28.699 dBµV -29.9 24.494 dBµV -31.0	Coll Time 50 ms (4 DLL1A EAVG LL2A 434 dB -21.748 dB 998 dB -24.976 dB 583 dB -27.172 dB 464 dB -26.118 dB	.5 kHz) dBμV AVG LL1Δ COMPOSITE AMPCO -31.917 dB 10.949 dB -34.747 dB 10.773 dB
3.0 Image: second state of the second st	EAVG AMPTD EAVG AMPTD 351 dBµV 33.536 dBµV 149 dBµV 28.470 dBµV 259 dBµV 24.771 dBµV 246 dBµV 24.593 dBµV 084 dBµV 25.613 dBµV	AVG AMPTD OF 33.367 dBµV -27.4 28.699 dBµV -29.9 24.494 dBµV -31.0 24.491 dBµV -32.4 25.223 dBµV -27.5	Xell Time 50 ms (4 DLL10 EAVG LL20 434 dB -21.748 dB 998 dB -24.976 dB 583 dB -27.172 dB 464 dB -26.118 dB 538 dB -23.008 dB	.5 kHz) dBμV AVG LL1Δ COMPOSITE AMPCI -31.917 dB 10.949 dB -34.747 dB 10.773 dB -37.449 dB 10.598 dB -36.259 dB 10.428 dB -33.399 dB 10.205 dB
3.0 tart 150 kHz es BW 9 kHz IG TRC FREQ C 1 163.50 kHz 37.8 1 203.99 kHz 33.4 1 244.49 kHz 30.2 1 283.58 kHz 28.2 1 364.67 kHz 31.0	DPD AMPTD EAVG AMPTD 351 dBµV 33.536 dBµV 149 dBµV 28.470 dBµV 259 dBµV 24.771 dBµV 246 dBµV 24.593 dBµV	AVG AMPTD OF 33.367 dBµV -27.4 28.699 dBµV -29.9 24.494 dBµV -31.0 24.491 dBµV -32.4 25.223 dBµV -27.5	Coll Time 50 ms (4 DLL1A EAVG LL2A 434 dB -21.748 dB 998 dB -24.976 dB 583 dB -27.172 dB 464 dB -26.118 dB	.5 kHz) dBμV AVG LL1Δ COMPOSITE AMPCO -31.917 dB 10.949 dB -34.747 dB 10.773 dB -37.449 dB 10.598 dB -36.259 dB 10.428 dB

Figure 10 - Conducted Emissions Plot, Neutral, TX



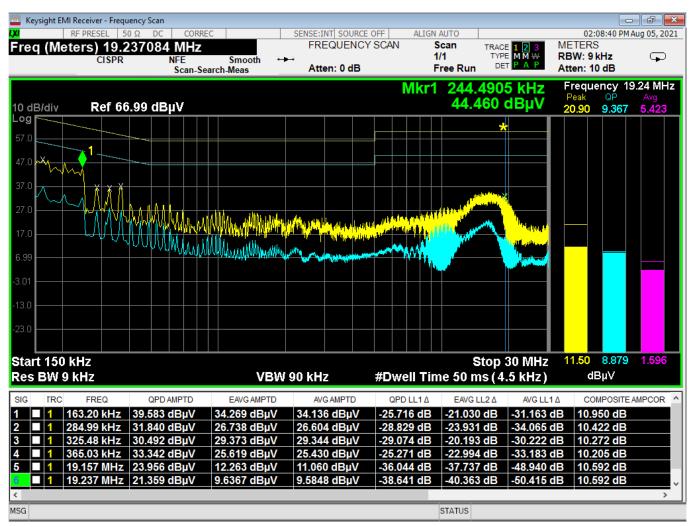
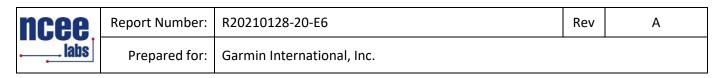


Figure 11 - Conducted Emissions Plot, Line, IDLE



Keysight EN	MI Receiver - Fi	requency	Scan																	- F
	RF PRESEL	50 Ω			RREC		_		SE:INT S				GN A							Aug 05, 2
req (Me	eters) 36	65.97	8 kH	z				I	FREQU	JENCY	SCAN			an	TRACE	1 2 3 M M ₩		TERS		_
	CISE	PR		IFE	-		oour -	÷	Atten:				1/1	1 'ee Run		PAP		W: 9 k en: 10		Ģ
				Scan	-Sear	ch-Mea	s		Atten:	Jab										
												Mki	r1	244	490	5 kHz				66 kHz
) dB/div	Ref	66.99	dBu	iV										35.	634 (dBµV		eak).80	QP 19.66	Avg 16.4 1
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		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	UUU I	MM	UU.	adMire	wanter and a state of the second s	alle from the first	, white a second second	****	~~~~	<b>*</b> ~~W								
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01 3.0 3.0 tart 150 es BW 9	9 kHz						G AMPTD		AVG AM		QF	D LL1 Z	Δ	e 50 r EAVG	ns (4	5 kHz	) _L1A	dE COM		13.74 AMPCOR
<b>1</b>	9 kHz FREQ 163.50 kH		236 d	IBμV		34.020	GAMPTD <b>dΒμV</b>	33	AVG AM .891 di	BμV	QF -24.(	D LL12 048 dE	A B	e 50 r EAVG -21.26	ns (4. LL2A 4 dB	5 kHz ^{AVG L}	) L1A 3 dB	dE coM <b>10.9</b> 4	3µ∨ IPOSITE <b>49 dB</b>	
a.0 a.0 cart 150 es BW 9 g rrc 1 1	9 kHz FREQ 163.50 kH 203.99 kH	z 36.	236 d 158 d	IBμV IBμV		34.020 29.582	g amptd ) dBµV 2 dBµV	33.	AVG AM .891 dl .422 dl	3μV 3μV	QF -24.( -27.)	D LL12 048 dE 289 dE	A B B	e 50 r EAVG -21.26 -23.86	ns(4 LL2A 4 dB 5 dB	5 kHz ^{AVG L} -31.39	) L1A 3 dB 4 dB	dE COM 10.94	3µ∨ IPOSITE <b>49 dB</b> 73 dB	
art 150 es BW 9 arc 11	9 kHz FREQ 163.50 kH 203.99 kH 244.49 kH	z 36. z 32.	236 d 158 d 849 d	IBμV IBμV IBμV		34.020 29.582 27.580	GAMPTD ) dBµV 2 dBµV ) dBµV	33 29 27	AVG AM .891 dl .422 dl .417 dl	3μV 3μV 3μV	QF -24.0 -27.2 -29.0	D LL12 048 dE 289 dE 093 dE	A B B B	e 50 r EAVG -21.26 -23.86 -24.36	ns (4 LL2A 4 dB 5 dB 3 dB	5 kHz ^{AVG L} -31.39 -34.02 -34.52	) 3 dB 4 dB 5 dB	dE COM 10.94 10.71 10.59	3µ∨ 1POSITE 49 dB 73 dB 98 dB	
01 3.0 3.0 4 art 150 es BW 9 G TRC 1 1 1	9 kHz FREQ 163.50 kH 203.99 kH	z 36. z 32. z 28.	236 d 158 d 849 d 506 d	ΙΒμV ΙΒμV ΙΒμV ΙΒμV		34.020 29.582 27.580 25.155	GAMPTD ) dBµV 2 dBµV ) dBµV 5 dBµV	33. 29. 27. 24.	AVG AM .891 dl .422 dl .417 dl .910 dl	3μV 3μV 3μV 3μV	QF -24.0 -27.2 -29.0 -32.1	D LL12 048 dE 289 dE 093 dE 163 dE	∆ B B B B	e 50 r EAVG -21.26 -23.86 -24.36 -25.51	ns (4. 4 dB 5 dB 3 dB 4 dB	5 kHz AVG L -31.39 -34.02 -34.52 -35.75	) 3 dB 4 dB 5 dB 9 dB	dE COM 10.94 10.77 10.59 10.42	8µ∨ 1POSITE 49 dB 73 dB 98 dB 22 dB	
art 150 es BW 9 3 rrc 1 1 1	9 kHz FREQ 163.50 kH 203.99 kH 244.49 kH	z 36. z 32. z 28.	236 d 158 d 849 d	ΙΒμV ΙΒμV ΙΒμV ΙΒμV		34.020 29.582 27.580 25.155	GAMPTD ) dBµV 2 dBµV ) dBµV	33. 29. 27. 24.	AVG AM .891 dl .422 dl .417 dl	3μV 3μV 3μV 3μV	QF -24.0 -27.2 -29.0 -32.1	D LL12 048 dE 289 dE 093 dE	∆ B B B B	e 50 r EAVG -21.26 -23.86 -24.36	ns (4. 4 dB 5 dB 3 dB 4 dB	5 kHz AVG L -31.39 -34.02 -34.52 -35.75 -30.87	) 3 dB 4 dB 5 dB 9 dB 4 dB	dE COM 10.94 10.77 10.59 10.42	3µ∨ 1POSITE 49 dB 73 dB 98 dB	
art 150 es BW 9 s IRC 1 1 1 1	9 kHz FREQ 163.50 kH 203.99 kH 244.49 kH 284.99 kH	z 36. z 32. z 28. z 30.	236 d 158 d 849 d 506 d	ВµV  ВµV  ВµV  ВµV  ВµV		34.020 29.582 27.580 25.155 28.840	GAMPTD ) dBµV 2 dBµV ) dBµV 5 dBµV	33 29 27 27 24 28	AVG AM .891 dl .422 dl .417 dl .910 dl	3µV 3µV 3µV 3µV 3µV	QF -24.0 -27.2 -29.0 -32.2	D LL12 048 dE 289 dE 093 dE 163 dE	A B B B B B B B B B B C	e 50 r EAVG -21.26 -23.86 -24.36 -25.51	ns (4, 4 dB 5 dB 3 dB 4 dB 0 dB	5 kHz AVG L -31.39 -34.02 -34.52 -35.75	) 3 dB 4 dB 5 dB 9 dB 4 dB	dE COM 10.94 10.75 10.55 10.42 10.22	8µ∨ 1POSITE 49 dB 73 dB 98 dB 22 dB	
art 150 es BW 9 i I i 1 i 1 i 1 i 1 i 1 i 1 i 1 i 1 i 1 i 1	9 kHz FREQ 163.50 kH 203.99 kH 244.49 kH 284.99 kH 324.17 kH	z 36. z 32. z 28. z 30.	236 d 158 d 849 d 506 d 892 d	ВµV  ВµV  ВµV  ВµV  ВµV		34.020 29.582 27.580 25.155 28.840	GAMPTD ) dBµV 2 dBµV ) dBµV 5 dBµV ) dBµV	33 29 27 27 24 28	AVG AM .891 dl .422 dl .417 dl .910 dl .725 dl	3µV 3µV 3µV 3µV 3µV	QF -24.0 -27.2 -29.0 -32.2	D LL12 048 dE 289 dE 093 dE 163 dE 707 dE	A B B B B B B B B B B C	e 50 r EAVG -21.26 -23.86 -24.36 -25.51 -20.76	ns (4, 4 dB 5 dB 3 dB 4 dB 0 dB	5 kHz AVG L -31.39 -34.02 -34.52 -35.75 -30.87	) 3 dB 4 dB 5 dB 9 dB 4 dB	dE COM 10.94 10.75 10.55 10.42 10.22	8µ∨ 49 dB 73 dB 98 dB 22 dB 76 dB	

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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 $\mu$ 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 $\mu$ V/m.

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

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

Level in  $\mu$ V/m = Common Antilogarithm [(48.1 dB $\mu$ V/m)/20]= 254.1  $\mu$ 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 $\Omega$  measurement systems)

Field Strength (V/m) =  $10^{Field}$  Strength (dB $\mu$ 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

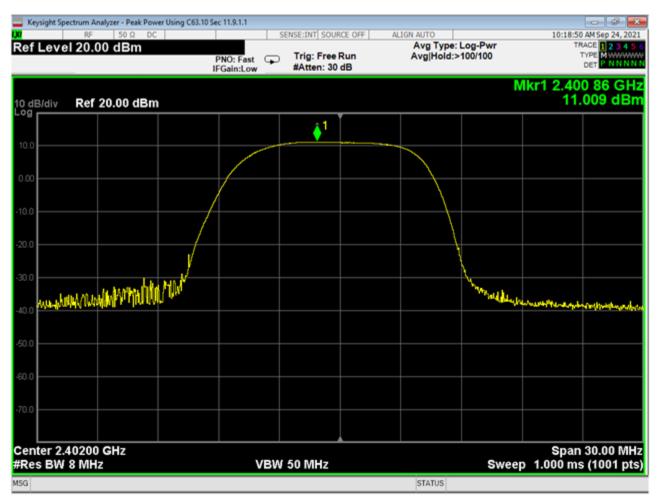
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

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

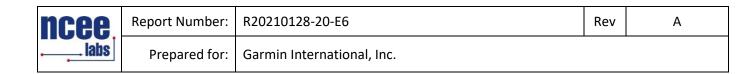
Expanded uncertainty values are calculated to a confidence level of 95%.

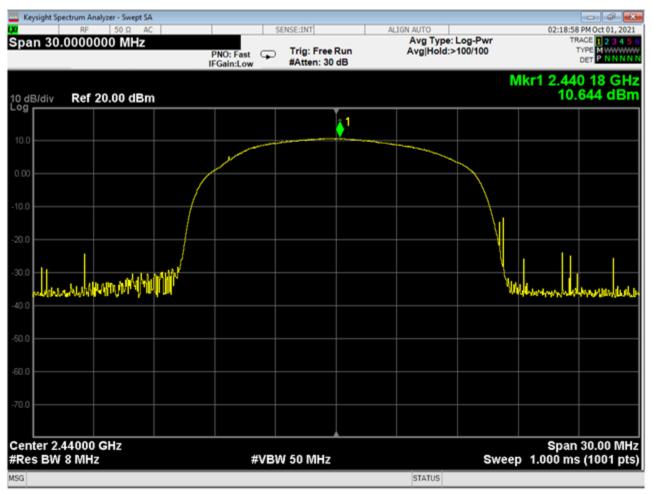
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#### APPENDIX C – GRAPHS AND TABLES



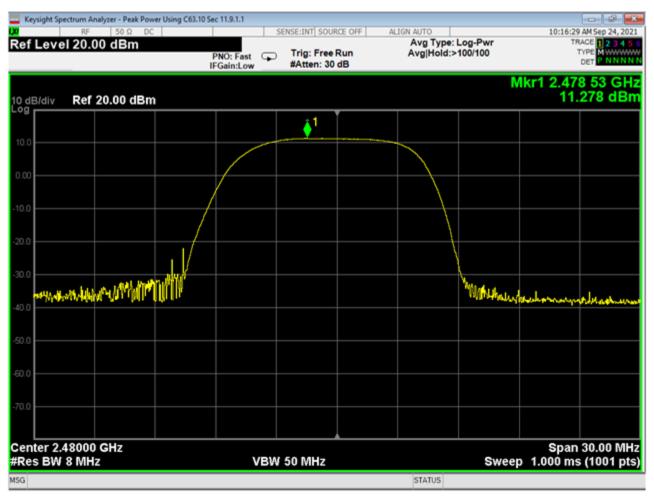
01 Pwr, Low, BTBR.png





02 Pwr, Mid, BTBR.png

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03 Pwr, High, BTBR.png

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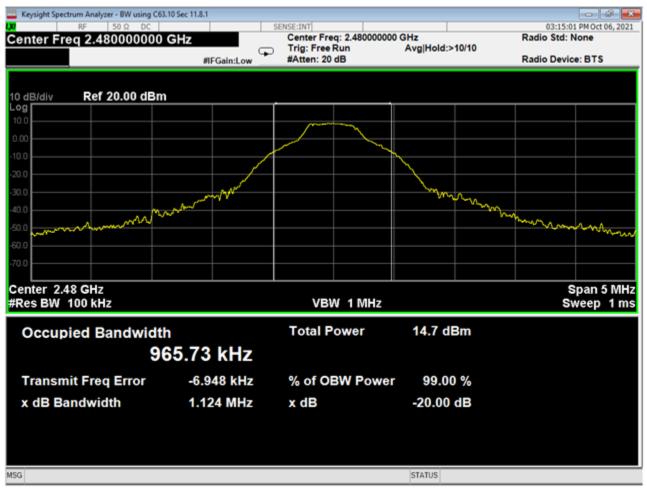
04 OBW-20dB, Low.png

ncee.	Report Number:	R20210128-20-E6	Rev	А
	Prepared for:	Garmin International, Inc.		

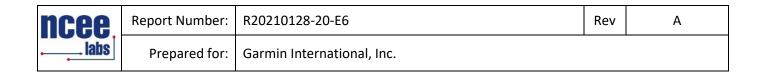


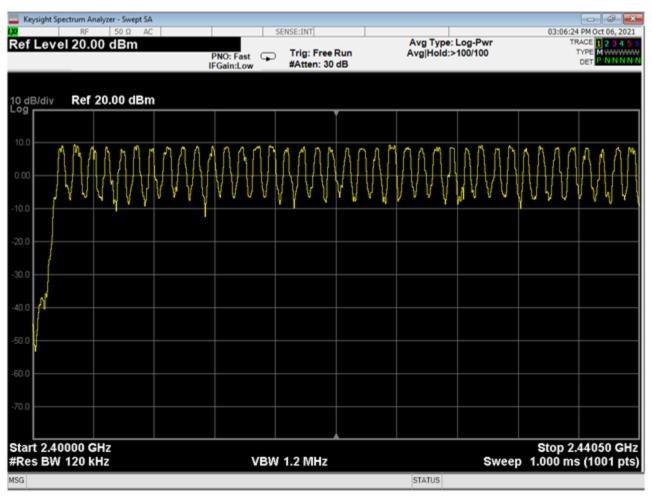
05 OBW-20dB, Mid.png

Incee	Report Number:	R20210128-20-E6	Rev	А
	Prepared for:	Garmin International, Inc.		

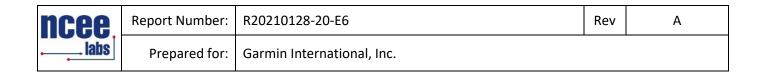


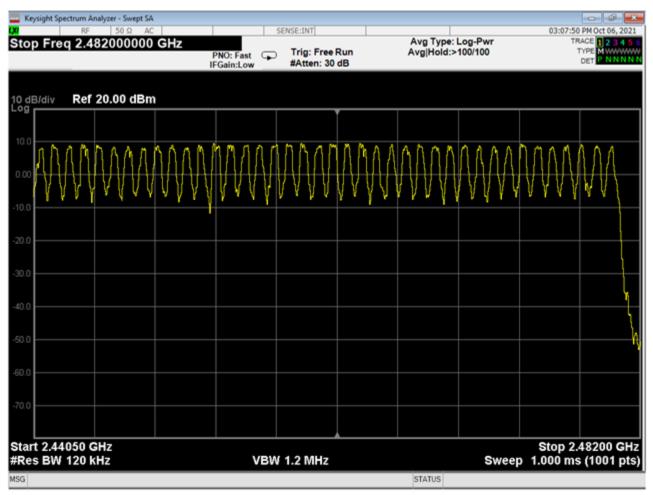
06 OBW-20dB, High.png



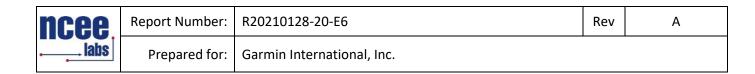


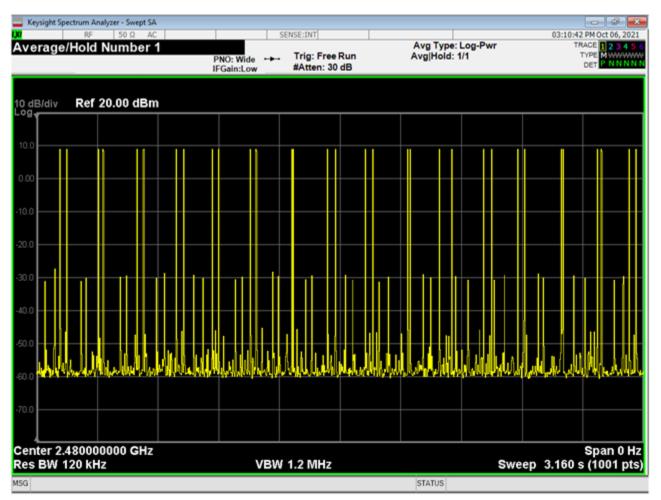
07 Channel Count, Pt1.png



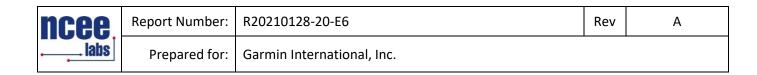


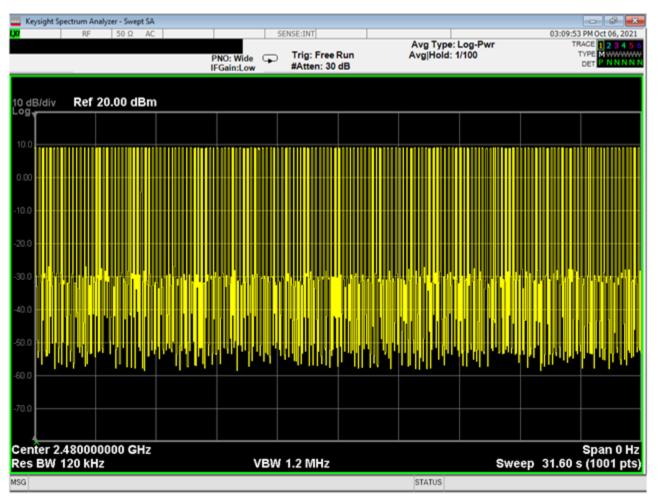
08 Channel Count, Pt2.png





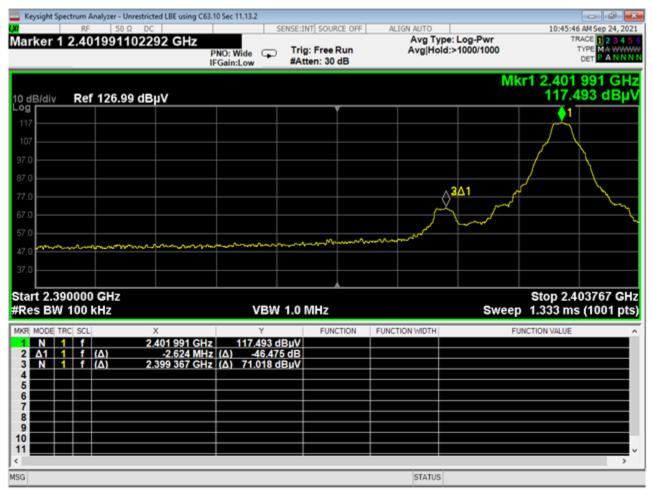
09 Dwell time, over 3.16S.png





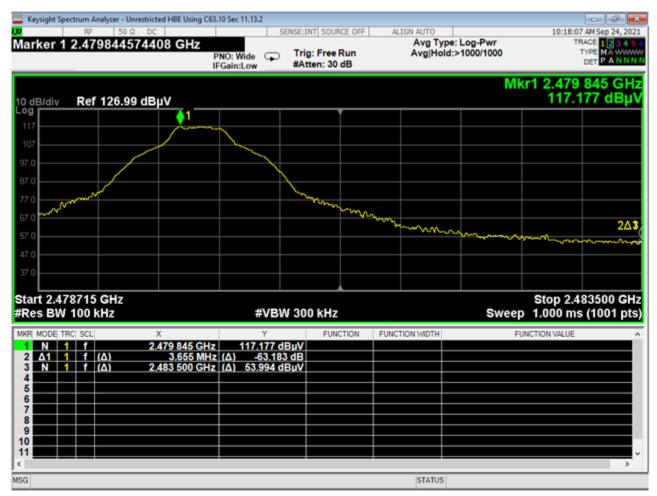
10 Dwell time, over 31.6S.png

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11 LBE Unrestricted, BTBR.png

ncee.	Report Number:	R20210128-20-E6	Rev	А
labs	Prepared for:	Garmin International, Inc.		



12 HBE Unrestricted, BTBR.png

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labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Re	stricted LBE using C63.10 Sec 6.10	.5					
	2 AC	SENSE:I	NT	ALIGN OFF		09:15:06 AM	Sep 26, 2
INTERNAL CONTRACTOR OF CONTRAC	00000 GHz PNO: F. IFGain:H		g: Free Run ten: 0 dB	Avg Type: Avg Hold:>			1234 MA PANN
Ref Offset 3					M	kr2 2.389 7	
dB/div Ref 86.60	dBµV					40.032	aB
Trace 1 Pass							
.6							
δ <b>μαρι</b>							
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6				·····			
6							
6							
0							
0							
art 2.380000 GHz						Stop 2.390	000 G
es BW 1.0 MHz		#VBW 50	MHz*		Sweep		001 p
MODE TRC SCL	х	Y	FUNCTION	FUNCTION WIDTH	FUN	ICTION VALUE	
N = 1 + f $N = 2 + f + (\Delta)$	2.380 81 GHz 2.389 78 GHz (Δ)	51.890 dBuV 40.029 dBuV					
							,
				STATUS			

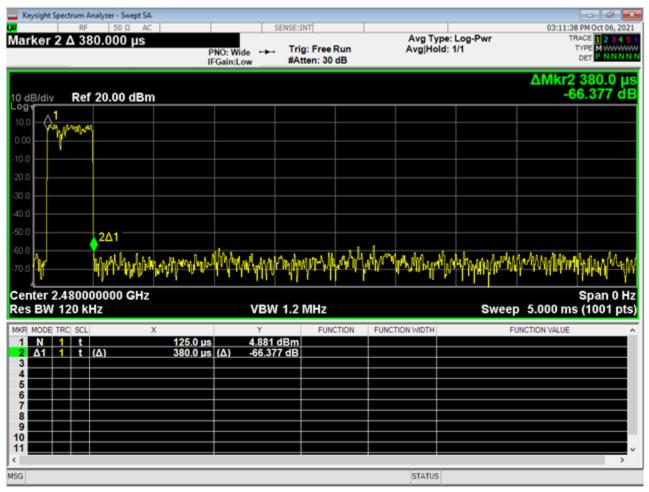
13 LBE Restricted, BTBR.png

ncee.	Report Number:	R20210128-20-E6	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spe	ectrum Analyzer -	Restricted HBE C63.10	) Sec 6.10.5							
		Ω AC		SENSE	:INT	A	LIGN OFF		09:11:33	3 AM Sep 26, 2
rker 1 SS	2.493218 PREAMP	3500000 GH2	PNO: Fast IFGain:High		ig: Free Run Atten: 0 dB		Avg Type: Avg Hold:>			TYPE MA WW DET PANN
dB/div	Ref Offset Ref 86.7							Mkr1	2.493 2 53.7	18 5 GI 12 dBj
g Trac	e 1 Pass				Ĭ					
	e 2 Pass									
.8						Â	1			
and the second s	والومر روما مرجعا	marked and the second	manante		www.man	- Annala	2 marin		And war was	and market
8	_						Y			
.8										
.8										
.8										
/6										
24				_						
art 2.48 es BW	3500 GHz 1.0 MHz		`	/BW 50	MHz*			Sweep	Stop 2.5 1.000 ms	00000 G (1001 p
NODE TR		х		Y	FUNCTION	FUNC	TION WIDTH	FU	CTION VALUE	
N 1	f f (Δ)	2.493 218 5	GHz 53. GHz (Δ) 42.	712 dBuV		_				
		2,433 445 3		240 000	<u> </u>					
			_			—				
										)

14 HBE Restricted, BTBR.png

ncee.	Report Number:	R20210128-20-E6	Rev	А
labs	Prepared for:	Garmin International, Inc.		



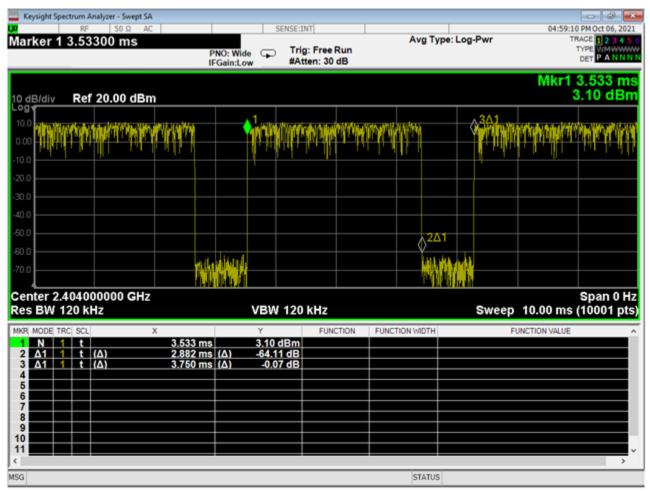
15 ON Time, BTBR.png

ncee.	Report Number:	R20210128-20-E6	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Swept SA	SENSE:	INT			03:08:41 PM Oct 06, 2021
Marker 2 Δ 1.000000000 MHz		g: Free Run tten: 30 dB	Avg Type: Avg Hold:>	Log-Pwr 100/100	TRACE 2 3 4 5 TYPE M
10 dB/div Ref 20.00 dBm				L	Mkr2 1.000 MHz 0.077 dE
-og				<mark>♦</mark> 2∆1	
	mpan	v	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		1 Mar Marine
20.0					
30.0					
40.0					
60.0					
70.0					
Start 2.478500 GHz #Res BW 120 kHz	VBW 1.2	MHz		Sweep	Stop 2.480500 GHz 1.000 ms (1001 pts
MKR MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH	FUN	ICTION VALUE
1 N 1 f 2.478 992 GH 2 Δ1 1 f (Δ) 1.000 MH 3	Iz 8.435 dBm Iz (Δ) 0.077 dB				
4 5					
6 7 8					
9 10					
					~ ~
SG			STATUS		

16 Frequency Seperation, BTBR.png

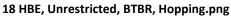
ncee.	Report Number:	R20210128-20-E6	Rev	А
ind do.	Prepared for:	Garmin International, Inc.		



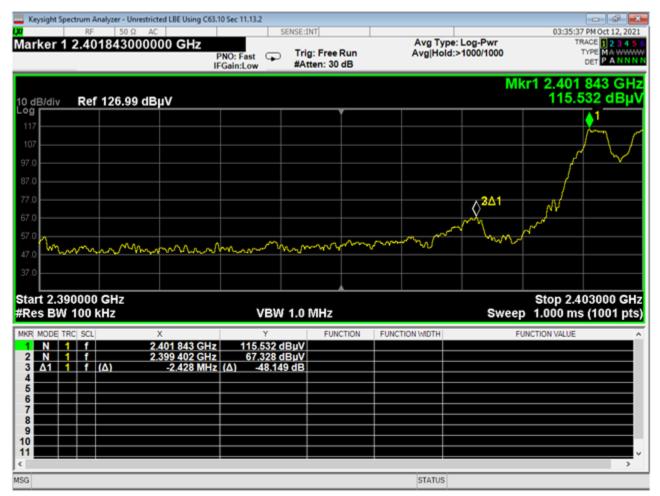
17 Duty Cycle, BTBR, Cont. Modulation.png

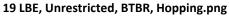
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ncee.	Report Number:	R20210128-20-E6	Rev	А
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## **REPORT END**