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# **FCC/ISED** Test Report

Prepared for: Garmin International, Inc.

Address:

1200 E. 151<sup>st</sup> Street Olathe, Kansas, 66062, USA

Product: C04112

Test Report No: R20220122-21-E5A

Approved by:

Mahendra Karthik Vepuri, NCE EMC Test Engineer, iNARTE Certified EMC Engineer #EMC-041453-E

DATE: June 23, 2022

Total Pages: 57

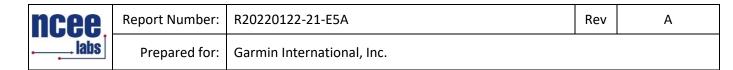
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# REVISION PAGE

Rev. No.	Date	Description		
0 6 June 2022		Original – KVepuri		
		Prepared by FLane, KVepuri		
А	23 June 2022	Added comment to Sec 4.0 and 4.1 - FL		



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# 1.0 SUMMARY OF TEST RESULTS

The intention of this report is to determine, if the EUT can be qualified as Class II permissive change (FCC ID: IPH-A04112). The manufacturer made modifications to the EUT that qualify for a C2PC. Manufacturer has declared that the changes would not change conducted measurements. So, only the measurements that would be affected due to these changes are investigated in this report. The measurements that can be done in conducted manner are ignored as they won't be affected due to these changes. The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section(s):

# FCC Part 15.247 🖂

The EUT has been tested according to the following specifications:

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

APPLIED STANDARDS AND REGULATIONS					
Standard Section	Test Type	Result			
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass			
FCC Part 15.247(b)(3) RSS-247 Issue 2 Section 5.4(d)	Peak output power	Pass			
FCC Part 15.209 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			

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## 2.0 EUT DESCRIPTION

# 2.1 EQUIPMENT UNDER TEST

**Summary and Operating Condition:** 

EUT	C04112
EUT Received	25 February 2022
EUT Tested	1 March 2022- 26 May 2022
Serial No.	3400415111 (Conducted Unit) 3412218493 (Radiated Unit)
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 802.11x Transmissions:				
Channel Frequency				
Low	2412 MHz			
Mid	2437 MHz			
High	2462 MHz			

Data Rate					
Modulation Low High					
802.11b	1Mb	11Mb			
802.11g	6Mb	54Mb			
802.11n	MCS0	MCS7			

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	Review / Testing
4	Blake Winter	Test Engineer	Testing
5	Grace Larsen	Test Engineer	Testing

## Notes:

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



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## 3.3 TEST EQUIPMENT

DESCRIPTION AND	MODEL NO.	SERIAL NO.	LAST CALIBRATION	
MANUFACTURER			DATE	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, 2023
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, 2023
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	March 21, 2022	March 21, 2024
Agilent Preamp*	87405A	3950M00669	March 21, 2022	March 21, 2024
Trilithic High Pass Filter*	6HC330	23042	March 21, 2022	March 21, 2024
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

\*\*2 Year Cal Cycle

\*\*\*3 Year Cal Cycle

#### Notes:

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



# 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

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

# Conducted $\boxtimes$

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.

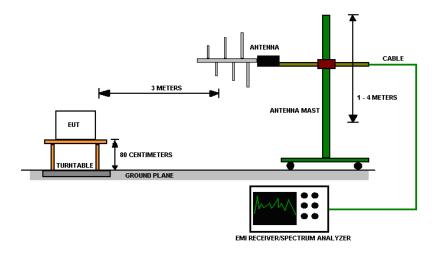


Figure 2 - Radiated Emissions Test Setup

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# 4.0 RESULTS

	DTS Radio Measurements								
CHANNEL	Modulation	Data Rate	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	RESULT				
Low	802.11b	1MB	16.12	40.93	PASS				
Mid	802.11b	1MB	17.90	61.66	PASS				
High	802.11b	1MB	17.89	61.52	PASS				
Low	802.11g	6MB	16.20	41.69	PASS				
Mid	802.11g	6MB	22.29	169.43	PASS				
High	802.11g	6MB	15.68	36.98	PASS				
Low	802.11n	MCS0	15.20	33.11	PASS				
Mid	802.11n	MCS0	21.71	148.25	PASS				
High	802.11n	MCS0	15.29	33.81	PASS				
Low	802.11b	11MB	19.51	89.33	PASS				
Mid	802.11b	11MB	21.38	137.40	PASS				
High	802.11b	11MB	21.27	133.97	PASS				
Low	802.11g	54MB	17.03	50.47	PASS				
Mid	802.11g	54MB	19.95	98.86	PASS				
High	802.11g	54MB	16.62	45.92	PASS				
Low	802.11n	MCS7	16.30	42.66	PASS				
Mid	802.11n	MCS7	16.48	44.46	PASS				
High	802.11n	MCS7	16.86	48.53	PASS				
		0dBm / 1000mW; urement tolerance		with IPH-A04	112.				



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		Peak Res	tricted Band-Edge,	Low Data Rate							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result				
Low	802.11 b	2390.00	62.92	Peak	73.98	11.07	PASS				
Low	802.11 g	2390.00	66.87	Peak	73.98	7.11	PASS				
Low	802.11 n	2390.00	68.78	Peak	73.98	5.20	PASS				
High	802.11 b	2483.50	61.91	Peak	73.98	12.07	PASS				
High	802.11 g	2483.50	60.87	Peak	73.98	13.11	PASS				
High	802.11 n	2483.50	61.90	Peak	73.98	12.08	PASS				
*Limit shown	is the peak l	imit taken from FC	C Part 15.209								
		Average Re	estricted Band-Edge	e, Low Data Rate							
CHANNEL	Band edge /Measurement Highest out of Measurement Limit										
Low	802.11 b	2390.00	52.49	Average	53.98	1.49	PASS				
Low	802.11 g	2390.00	52.06	Average	53.98	1.92	PASS				
Low	802.11 n	2390.00	52.57	Average	53.98	1.41	PASS				
High	802.11 b	2483.50	50.22	Average	53.98	3.76	PASS				
riigii				•	F0.00	6.01	DACC				
High	802.11 g	2483.50	47.77	Average	53.98	6.21	PASS				
-	802.11 g 802.11 n	2483.50 2483.50	47.77 47.57	Average Average	53.98 53.98	6.41	PASS				



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		Peak Rest	ricted Band-Ec	lge, High Data R	ate		
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	802.11 b	2390.00	62.03	Peak	73.98	11.95	PASS
Low	802.11 g	2390.00	69.42	Peak	73.98	4.57	PASS
Low	802.11 n	2390.00	70.59	Peak	73.98	3.39	PASS
High	802.11 b	2483.50	61.91	Peak	73.98	12.07	PASS
High	802.11 g	2483.50	71.21	Peak	73.98	2.77	PASS
High	802.11 n	2483.50	72.28	Peak	73.98	1.70	PASS
*Limit shown is	the peak lin	nit taken from FCC	C Part 15.209				
		Average Re	stricted Band-	Edge, High Data	Rate		
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	802.11 b	2390.00	51.84	Average	53.98	2.14	PASS
Low	802.11 g	2390.00	53.48	Average	53.98	0.50	PASS
Low	802.11 n	2390.00	53.69	Average	53.98	0.29	PASS
High	802.11 b	2483.50	50.24	Average	53.98	3.74	PASS
High	802.11 g	2483.50	51.46	Average	53.98	2.52	PASS
High	802.11 n	2483.50	51.15	Average	53.98	2.83	PASS
*Limit shown is	the average	e limit taken from I	-CC Part 15.209	9			



## 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. Results were all within measurement tolerance.



# 4.2 DUTY CYCLE

# Test Method:

All Modulations/Transmitters in this report had a duty cycle of >98%



# 4.3 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 (µV/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.



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# Test procedures:

Prepared for:

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.

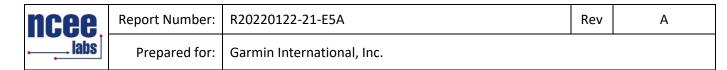
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

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:

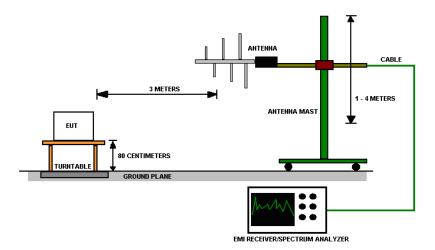


Figure 3 - Radiated Emissions Test Setup

# 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:

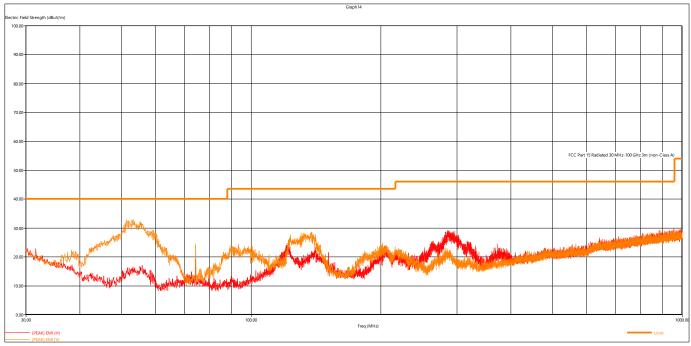
No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.



**Test results:** 





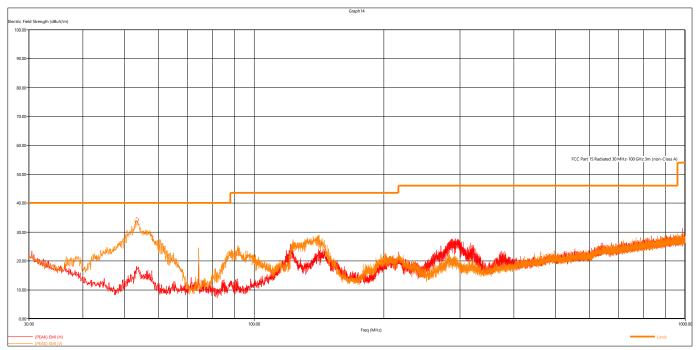


Figure 5 - Radiated Emissions Plot, 802.11b, Low Data Rate



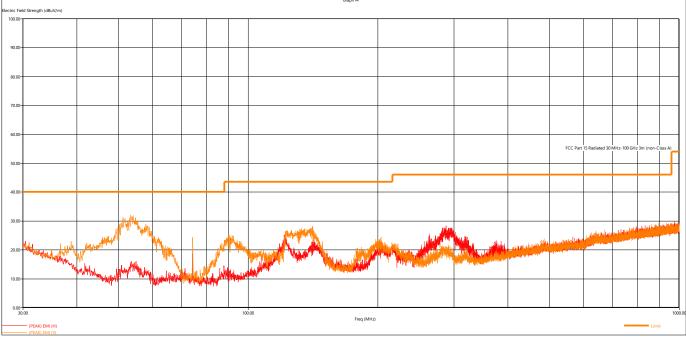


Figure 6 - Radiated Emissions Plot, 802.11g, Low Data Rate, Low Ch

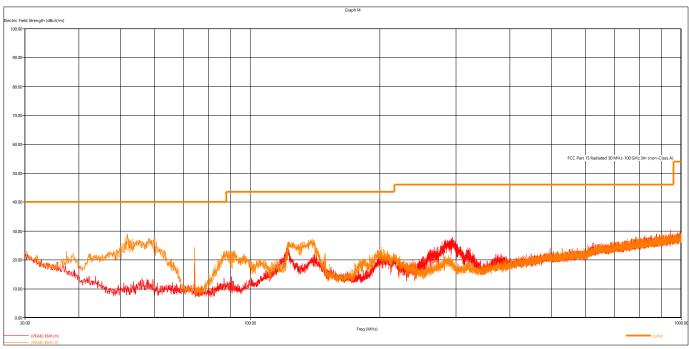


Figure 7 - Radiated Emissions Plot, 802.11n, Low Data Rate, Low Ch



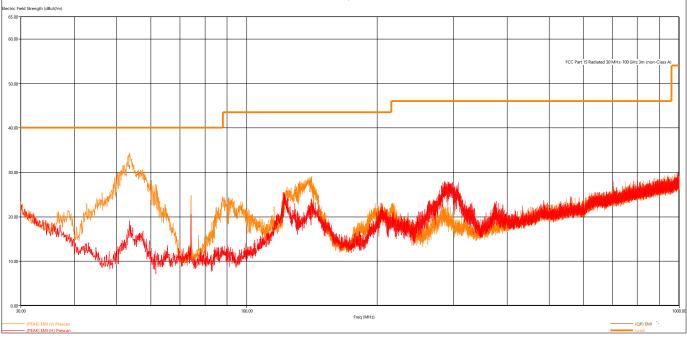


Figure 8 - Radiated Emissions Plot, 802.11b, High Data Rate, Low Ch

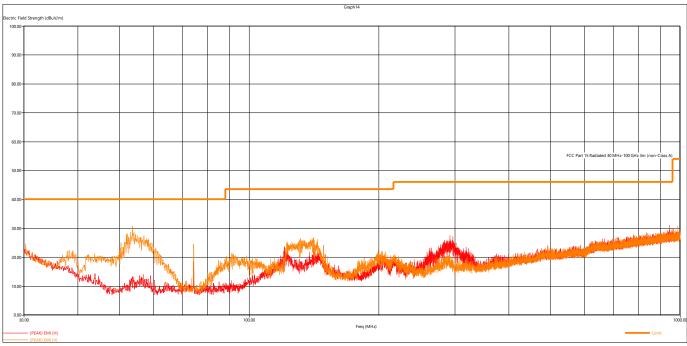


Figure 9 - Radiated Emissions Plot, 802.11g, High Data Rate, Low Ch

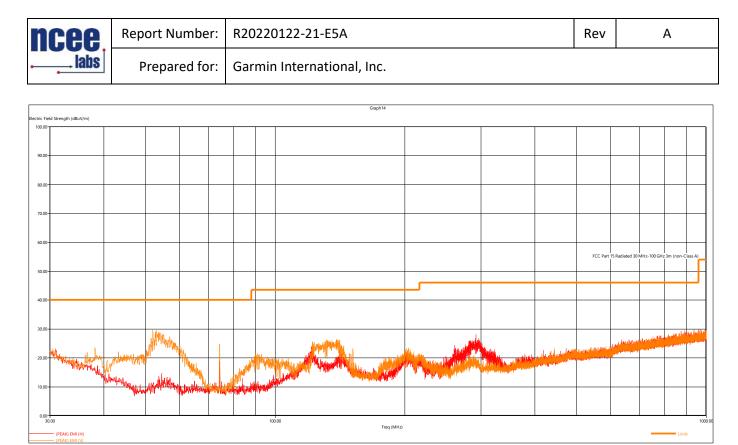


Figure 10 - Radiated Emissions Plot, 802.11n, High Data Rate, Low Ch

# 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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			Peak Me	asureme	ents, 802	.11x			
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation	Data Rate
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2411.074	103.72	NA	NA	133	183	Н	Low	802.11b	1MHz
2436.108	105.62	NA	NA	116	197	Н	Mid	802.11b	1MHz
2461.164	103.37	NA	NA	164	180	Н	High	802.11b	1MHz
7309.52	58.53	73.98	15.45	110	360	V	Mid	802.11b	1MHz
2411.156	108.08	NA	NA	129	183	Н	Low	802.11b	11MHz
2436.414	109.43	NA	NA	115	197	Н	Mid	802.11b	11MHz
2460.984	107.16	NA	NA	126	181	Н	High	802.11b	11MHz
7309.132	59.48	73.98	14.5	177	16	V	Mid	802.11b	11MHz
2413.626	100.18	NA	NA	130	182	Н	Low	802.11g	6MHz
2434.88	108.08	NA	NA	114	197	Н	Mid	802.11g	6MHz
2463.002	99.33	NA	NA	132	178	Н	High	802.11g	6MHz
7314.71	63.13	73.98	10.85	100	360	V	Mid	802.11g	6MHz
2415.468	101.6	NA	NA	133	181	Н	Low	802.11g	54MHz
2438.388	104.22	NA	NA	255	195	Н	Mid	802.11g	54MHz
2463.44	98.73	NA	NA	256	97	V	High	802.11g	54MHz
7313.638	58.45	73.98	15.53	212	8	V	Mid	802.11g	54MHz
2419.286	98.48	NA	NA	125	183	Н	Low	802.11n	MCS0
2439.514	108.37	NA	NA	112	192	Н	Mid	802.11n	MCS0
2462.23	99.36	NA	NA	119	179	Н	High	802.11n	MCS0
7310.732	59.59	73.98	14.39	263	25	V	Mid	802.11n	MCS0
2419.798	101.06	NA	NA	139	181	Н	Low	802.11n	MCS7
2438.432	104.47	NA	NA	117	200	Н	Mid	802.11n	MCS7
2458.484	90.78	NA	NA	124	179	Н	High	802.11n	MCS7

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above. All other emissions found to be at least 6dB below the limit line. System Noise floor was at least 6 dB below the limit line throughout the test range.



		ŀ	verage N	leasuren	nents, 80	)2.11x			
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation	Data Rate
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2411.074	100.87	NA	NA	133	183	Н	Low	802.11b	1MHz
2436.108	102.9	NA	NA	116	197	Н	Mid	802.11b	1MHz
2461.164	100.65	NA	NA	164	180	Н	High	802.11b	1MHz
7309.52	53.18	53.98	0.80	110	360	V	Mid	802.11b	1MHz
2411.156	100.11	NA	NA	129	183	Н	Low	802.11b	11MHz
2436.414	101.94	NA	NA	115	197	Н	Mid	802.11b	11MHz
2460.984	99.77	NA	NA	126	181	Н	High	802.11b	11MHz
7309.132	47.73	53.98	6.25	177	16	V	Mid	802.11b	11MHz
2413.626	90.98	NA	NA	130	182	Н	Low	802.11g	6MHz
2434.88	98.67	NA	NA	114	197	Н	Mid	802.11g	6MHz
2463.002	90.43	NA	NA	132	178	Н	High	802.11g	6MHz
7314.71	48.73	53.98	5.25	100	360	V	Mid	802.11g	6MHz
2415.468	91.35	NA	NA	133	181	Н	Low	802.11g	54MHz
2438.388	94.35	NA	NA	255	195	Н	Mid	802.11g	54MHz
2463.44	88.94	NA	NA	256	97	V	High	802.11g	54MHz
7313.638	44.07	53.98	9.91	212	8	V	Mid	802.11g	54MHz
2419.286	89.22	NA	NA	125	183	Н	Low	802.11n	MCS0
2439.514	97.92	NA	NA	112	192	Н	Mid	802.11n	MCS0
2462.23	88.94	NA	NA	119	179	Н	High	802.11n	MCS0
7310.732	46.03	53.98	7.95	263	25	V	Mid	802.11n	MCS0
2419.798	90.28	NA	NA	139	181	Н	Low	802.11n	MCS7
2438.432	93.61	NA	NA	117	200	Н	Mid	802.11n	MCS7
2458.484	101.51	NA	NA	124	179	Н	High	802.11n	MCS7

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above. All other emissions found to be at least 6dB below the limit line. System Noise floor was at least 6 dB below the limit line throughout the test range.



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## 4.4 BAND EDGES

Prepared for:

**Test Method**: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

## Limits of 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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# 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)]<sup>2</sup> / 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

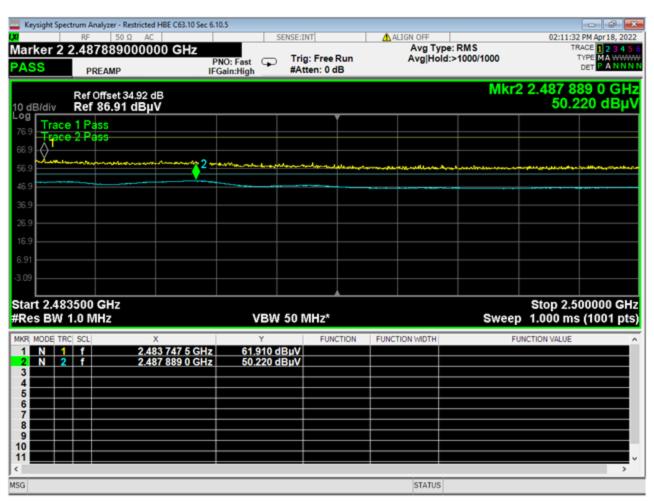
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

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

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

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# APPENDIX C – GRAPHS AND TABLES



HBE Restricted, Wifi B 1 Mbps

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Ar	nalyzer - Restricted HBE C63.10 S	ec 6.10.5				- 4
RF	50 Ω AC	S	ENSE:INT	ALIGN OFF		02:09:07 PM Apr 18, 20
100	3747500000 GHz REAMP	PNO: Fast 😱 IFGain:High	Trig: Free Run #Atten: 0 dB	Avg Type: Avg Hold:>		TRACE 1 2 3 4 TYPE MA WW DET P A N N
dB/div Ref	Offset 34.92 dB 86.91 dBµV				Mkr1	2.483 747 5 GH 61.910 dBµ
<b>29 Trace 1 Pa</b> 6.9 <b>Trace 2 Pa</b> 6.9 6.9 6.9 6.9 6.9 6.9 6.9 6.9 6.9 6.9						
tart 2.483500 Res BW 1.0 M		VBW	50 MHz*		Sweep	Stop 2.500000 GI 1.000 ms (1001 pt
R         MDDE         TRC         SCL           1         1         1         1           2         N         2         1           3         3         3         5           5         5         5         5           6         7         7         7           8         9         9         0           1         1         1         1	X 2.483 747 5 G 2.483 533 0 G	Hz 61.910 d Hz 50.239 d		FUNCTION WIDTH	FU	ICTION VALUE

HBE Restricted, Wifi B 11 Mbps

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

RF 5	0 Ω AC	SENSE	EINT	ALIGN OFF		12:25:04 PM Apr 18, 2
nter Freq 2.491			rig: Free Run Atten: 0 dB	Avg Type Avg Hold:	: RMS >1000/1000	TRACE 2 3 4 TYPE MAWY DET P A N
Ref Offse IB/div Ref 86.9					Mkr1	2.483 500 0 G 71.207 dB
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Trace 2 Pass						
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2			and the state of a second	````\``\``\``\``\`````````````````````	n ala anna ann an ann an an an an an an an a	and the second
3						
,						
2						
rt 2.483500 GHz s BW 1.0 MHz		VBW 50	MHz*		Sweep	Stop 2.500000 G 1.000 ms (1001 p
MODE TRC SCL	x	Y	FUNCTION	FUNCTION WIDTH	FUN	ICTION VALUE
N 1 1 N 2 f	2.483 500 0 GHz 2.483 500 0 GHz	71.207 dBu 51.456 dBu				

HBE Restricted, Wifi G 54Mb

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	RF 50 \$	2 AC		SENSE:INT	ALIGN OFF		12:25:53 PM Apr 18,
ter Fr	reg 2.4917	50000 GHz				e: RMS	TRACE 23
ss	PREAMP		PNO: Fast 😱	Trig: Free Run #Atten: 0 dB	Avg Hol	d:>1000/1000	DET P A N
	TREPART		n ouningn			Mkr4	2.483 599 0 G
B/div	Ref Offset 3 Ref 86.91					WIKI	60.870 dE
Trace	e 1 Pass						
-Trace	e 2 Pass						
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<u> </u>							
—							
<u> </u>							
	3500 GHz 1.0 MHz		VBM	50 MHz*		Sweep	Stop 2.500000 1.000 ms (1001
MODE TR	C SCL	× 2.483 599 0 GH	z 60.870 d	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
N 2	f	2.483 500 0 GH					

HBE Restricted, Wifi G 6Mb

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spec	trum Analyzer - Restricted HBE C63.10 RF 50 Ω AC		NT	ALIGN OFF		12:47:42 PM Apr 18, 202
enter Fre ASS	eq 2.491750000 GHz		g: Free Run ten: 0 dB	Avg Type: F Avg Hold:>1		TRACE 2 3 4 5 TYPE MA WWW DET P A N N
0 dB/div	Ref Offset 34.92 dB Ref 86.91 dBµV				Mkr1	2.485 546 0 GH 61.896 dBµ
og 76.9 76.9 76.9 77ace 56.9	2 Pass					
6.9 6.9						
6.9 6.9 .91						
tart 2.483 Res BW 1	3500 GHz 1.0 MHz	VBW 50 P	MHz*		Sweep	Stop 2.500000 GH 1.000 ms (1001 pt
R MODE TRO	C SCL X	Y	FUNCTION	FUNCTION WIDTH		ICTION VALUE
1         1           2         N         2           3         -         -           4         -         -           5         -         -           6         -         -           7         -         -           9         -         -           0         -         -           1         -         -	f 2.485 546 0 0 f 2.483 500 0 0					
	HBE Wifi N MCS7, Power se	etting 21.png> saved		STATUS		>

HBE Restricted, Wifi N MCS0

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	- Restricted HBE C63.10 Sec 6.					
enter Freq 2.49	F		ig: Free Run itten: 0 dB	ALIGN OFF Avg Type Avg Hold:	:RMS >1000/1000	12:46:20 PM Apr 18, 20 TRACE 2 3 4 TYPE MA WWW DET P A N N
dB/div Ref 86.	et 34.92 dB 91 dBμV				Mkr1	2.483 516 5 GH 72.283 dBµ
1 race 1 Pass						
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i.9						
.9						
91						
art 2.483500 GH	z					Stop 2.500000 GI
tes BW 1.0 MHz		VBW 50	MHz*		Sweep	1.000 ms (1001 pt
R MODE TRC SCL N 1 f N 2 f	X 2,483 516 5 GHz 2,483 500 0 GHz	Ү 72,283 dBµV 51,148 dBµV		FUNCTION WIDTH	FUN	ICTION VALUE
						,
	MCS0, Power setting					

HBE Restricted, Wifi N MCS7

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectru	um Analyzer - Restricted LBI	E using C63.10 Sec 6.	10.5				
	RF 50 Ω AC		SEN	SE:INT	ALIGN OFF		03:05:18 PM Apr 18, 2
rker 2 2. <mark>SS</mark>	389960000000 PREAMP	GHz PNO: IFGain		Trig: Free Run #Atten: 0 dB	Avg Type Avg Hold:	: RMS >1000/1000	TRACE 1 2 3 4 TYPE MA
	Ref Offset 34.81 dB Ref 86.80 dBµV					Μ	kr2 2.389 96 GI 51.845 dBj
g Trace 1 Trace 2	Pass						
8 <b></b>	againmenter be Miller and	and the second second					·L
8							
8							
art 2.3800 es BW 1.0			#VBW :	50 MHz*		Sweep	Stop 2.390000 G 1.000 ms (1001 p
R MODE TRC :		89 84 GHz	۲ 62.031 dBj	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
N 2		89 96 GHz	51.844 dB				
							1

LBE Restricted, Wifi B 11MHz

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Ana	lyzer - Restricted LBE using C63	.10 Sec 6.10.5				- 6
RF	50 Ω AC	SE	NSE:INT	ALIGN OFF		03:19:08 PM Apr 18
0.0	840000000 GHz	PNO: Fast 😱 IFGain:High	Trig: Free Run #Atten: 0 dB	Avg Type: F Avg Hold:>1		TRACE 1 2 TYPE MA DET P A
dB/div Ref 8	ffset 34.81 dB 86.80 dBµV				M	kr2 2.385 84 ( 52.490 dl
9 17 Trace 1 Pas 17 Trace 2 Pas 18 18 18 18 18 18 18 19 19 19 19 19 19 19 19 19 19				2		
20 art 2.380000 C Res BW 1.0 MH		#VBW	50 MHz*		Sweep	Stop 2.390000 1.000 ms (1001
R MODE TRC SCL N 1 1 N 2 1	X 2,389 99 G 2.385 84 G			FUNCTION WIDTH	FU	ICTION VALUE

LBE Restricted, Wifi B 1MHz

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	Ω AC	SENSE:	INT	ALIGN OFF		12:11:47 PM Apr 18,
ter Freq 2.3850	PNC		g: Free Run tten: 0 dB	Avg Type: Avg Hold:		TRACE 2 3 TYPE MA H DET P A
Ref Offset 3 B/div Ref 86.80					М	kr1 2.388 68 G 69.415 dE
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ter 2.385000 GHz s BW 1.0 MHz	2	#VBW 50	MHz*		Sweep	Span 10.00 f 1.000 ms (1001
MODE TRC SCL	× 2.388 68 GHz	Y 60.445.4D:0/	FUNCTION	FUNCTION WIDTH	FUI	ICTION VALUE
N 2 f	2.389 93 GHz	69.415 dBµV 53.475 dBµV				

LBE Restricted, Wifi G 54Mb

ncee.	Report Number:	R20220122-21-E5A	Rev	А
labs	Prepared for:	Garmin International, Inc.		

	AC	SENSE	:INT	ALIGN OFF		12:13:00 PM Apr 18,
ser Freq 2.38500	PNC		ig: Free Run Atten: 0 dB	Avg Type: Avg Hold:		TRACE 2 3 TYPE MAW DET PAN
Ref Offset 34 Bidiv Ref 86.80					Mk	r1 2.389 40 G 66.873 dB
Trace 1 Pass						
Trace 2 Pass						
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and the state of t						·····
ter 2.385000 GHz s BW 1.0 MHz		#VBW 5	0 MHz*		Sweep	Span 10.00 M 1.000 ms (1001
MODE TRC SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUN	TION VALUE
N 1 f N 2 f	2.389 40 GHz 2.389 93 GHz	66.873 dBµV 52.061 dBµV				

LBE Restricted, Wifi G 6Mb

ncee labs	Report Number:	R20220122-21-E5A	Rev	А
	Prepared for:	Garmin International, Inc.		

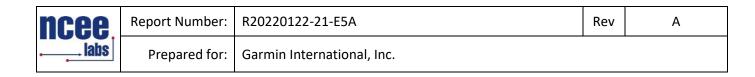
Keysight Spectrum Analyzer - Rest	ricted LBE using C63.10 Sec 6.10.5			- 6
enter Freq 2.38500		SENSE:INT	ALIGN OFF Avg Type: RMS	01:07:41 PM Apr 18, 20 TRACE 22 8 4
SS PREAMP	PNO: Fasi IFGain:Hig		Avg Hold:>1000/1	000 TYPE MA WWW DET PANN
Ref Offset 34. dB/div Ref 86.80 d				Mkr1 2.388 50 GH 68.780 dBµ
g Trace 1 Pass Trace 2 Pass				
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art 2.380000 GHz tes BW 1.0 MHz		#VBW 50 MHz*		Stop 2.390000 GI Sweep 1.000 ms (1001 pt
R MODE TRC SCL	X	Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
N 1 T N 2 f		3.780 dBµV 2.570 dBµV		
				>
	S7, Power setting 19.png		STATUS	

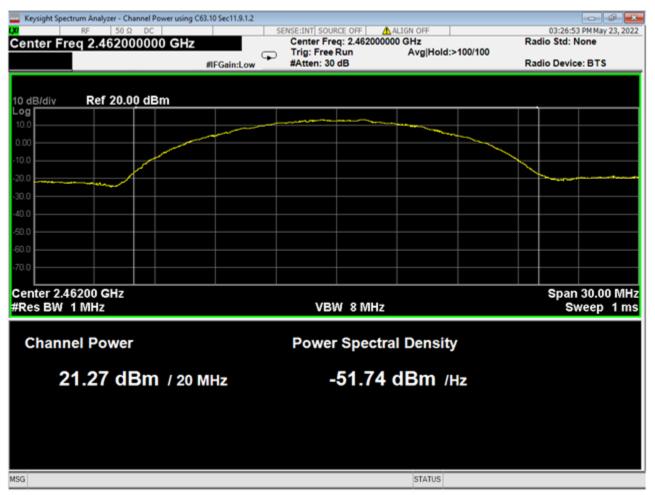
LBE Restricted, Wifi N MCS0

ncee labs	Report Number:	R20220122-21-E5A	Rev	А
	Prepared for:	Garmin International, Inc.		

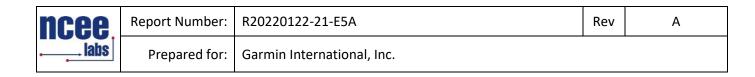
50 Ω AC 5000000 GHz AP et 34.81 dB 80 dBμV	IFGain:High #At	g: Free Run ten: 0 dB	ALIGN OFF Avg Type: RMS Avg Hold:>1000	Mkr1 2	1:06:20 PM Apr18, 20 TRACE 1 2 3 4 TYPE MA WHY DET PA NN 2.389 94 GH 70.588 dBµ
		ميەسلىراندىرە	alliner antiger with the		70.588 dBµ
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and failed and a star of the	and the second	م مهر المرود و الم	addines and the wither advance	keyberta findeliket direkter	and a start back
					wyr1, 44, 44, 44, 74, 74, 74, 74, 74, 74, 74
Iz	#VBW 50	MHz*		Stop Sweep 1.00	p 2.390000 GI 0 ms (1001 pt
× 2.389 94 GH	۲ 70.588 dBµV	FUNCTION	FUNCTION WIDTH	FUNCTION V	ALUE
2.389 93 GH					

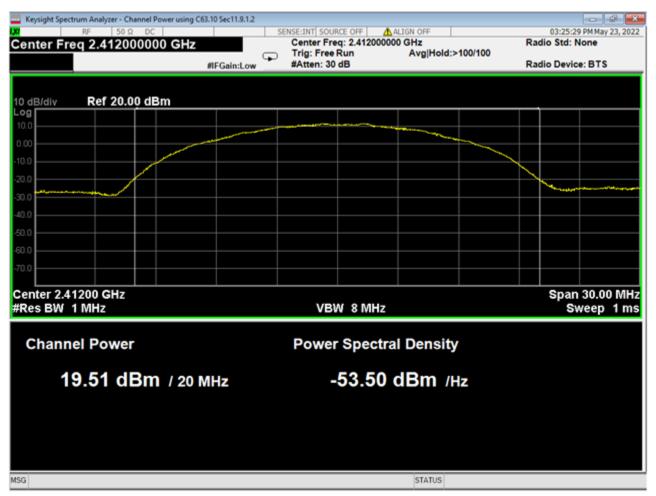
LBE Restricted, Wifi N MCS7





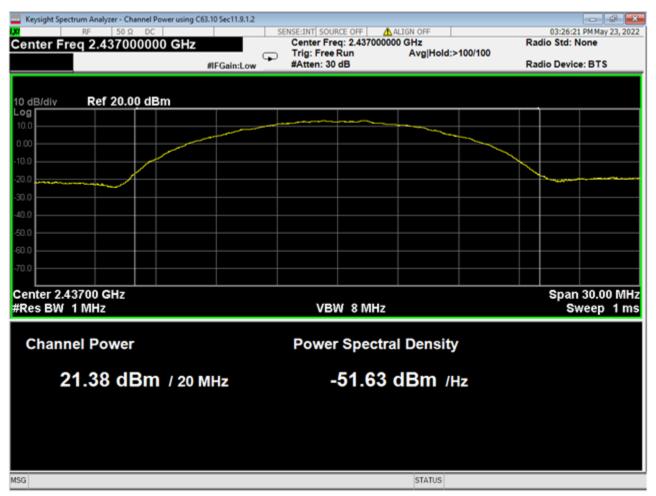
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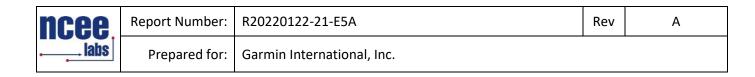


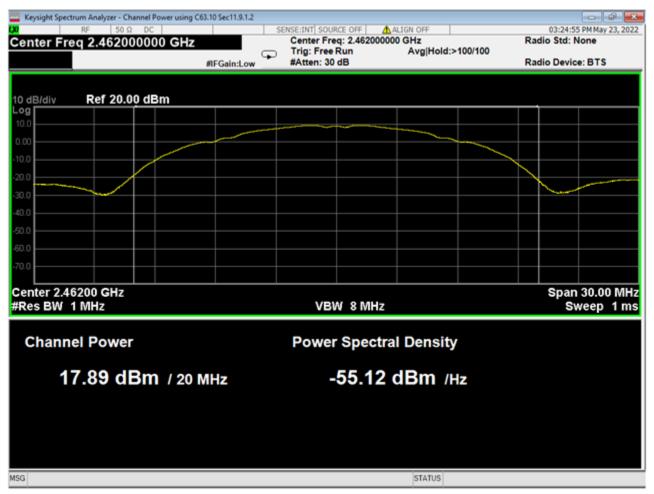
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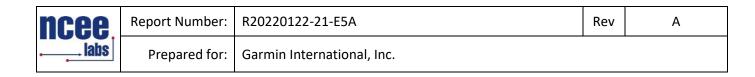


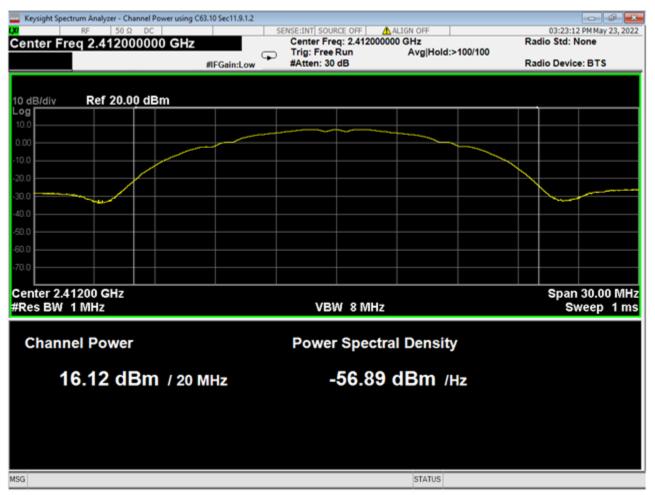
Wifi B 11MB, Mid



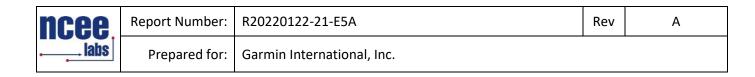


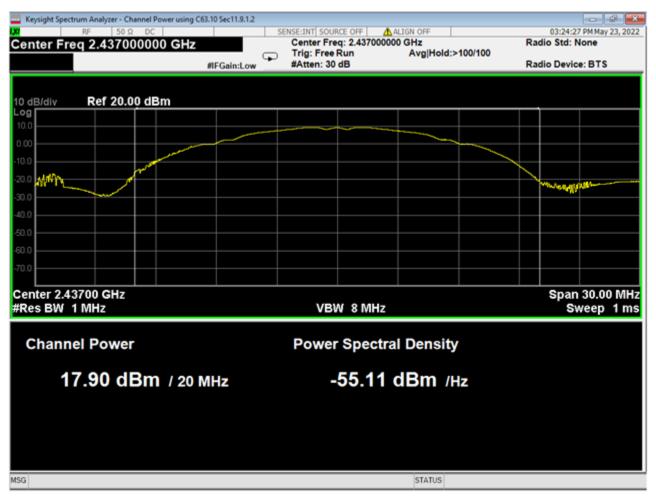
Wifi B 1MB, High



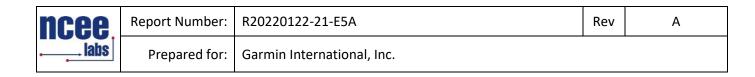


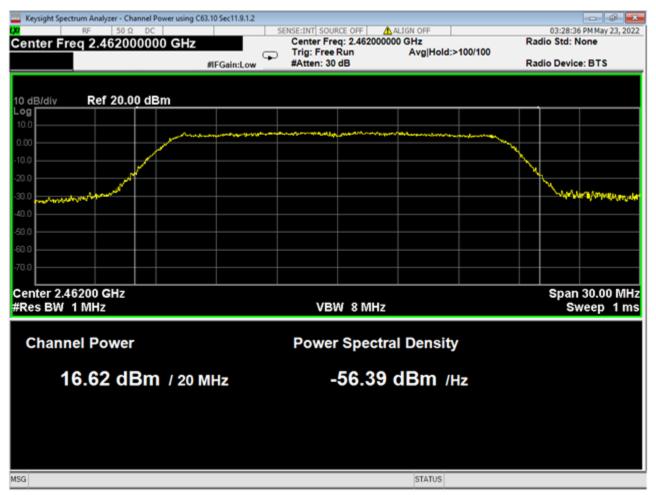
Wifi B 1MB, Low



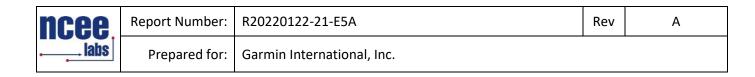


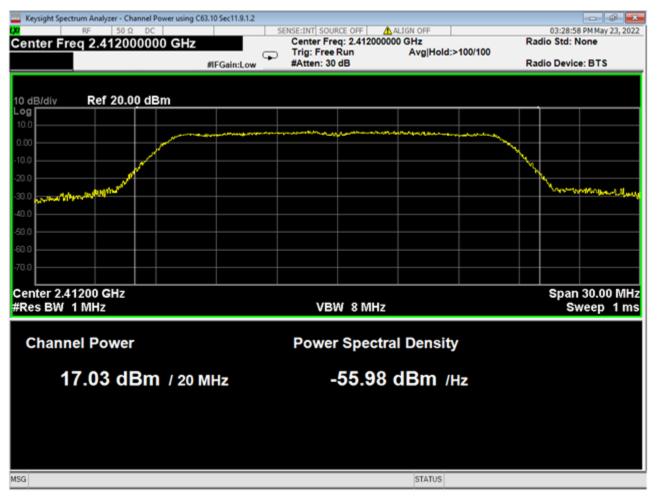
Wifi B 1MB, Mid



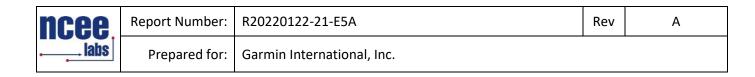


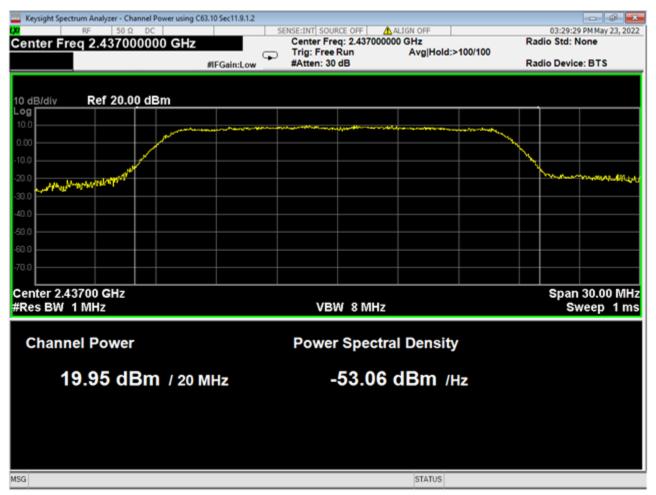
Wifi G 54MB, High



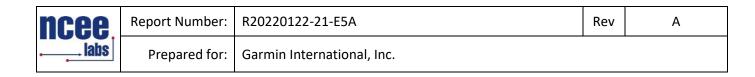


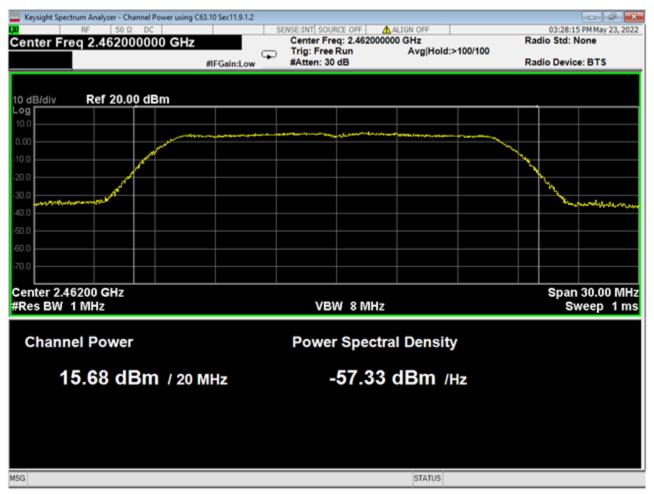
Wifi G 54MB, Low



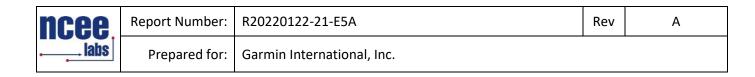


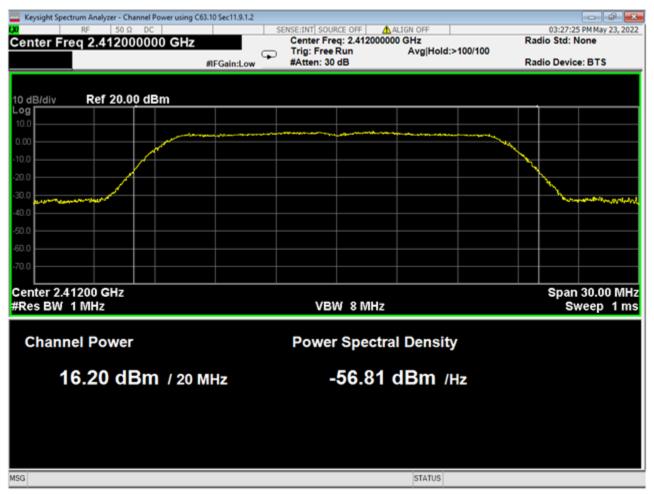
Wifi G 54MB, Mid



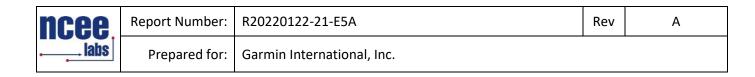


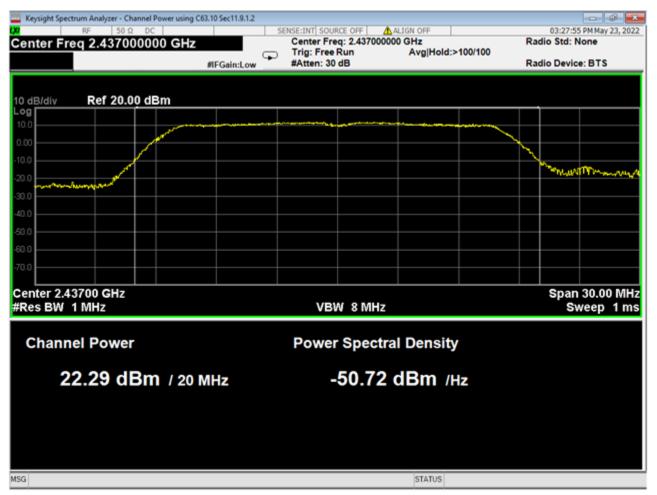
Wifi G 6MB, High



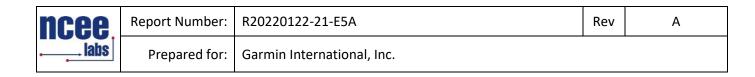


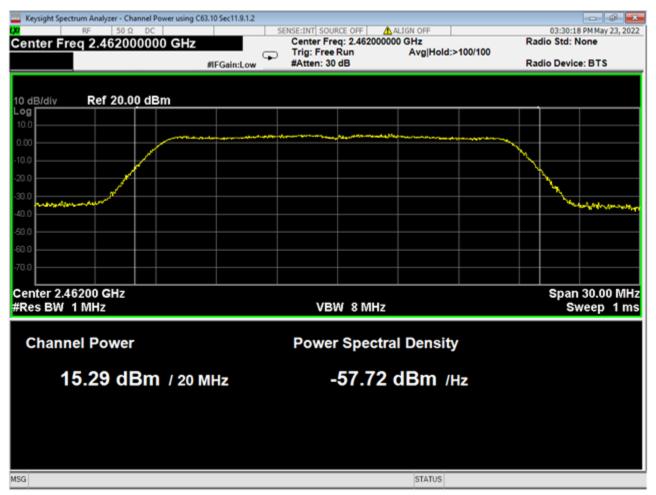
Wifi G 6MB, Low



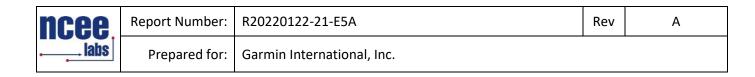


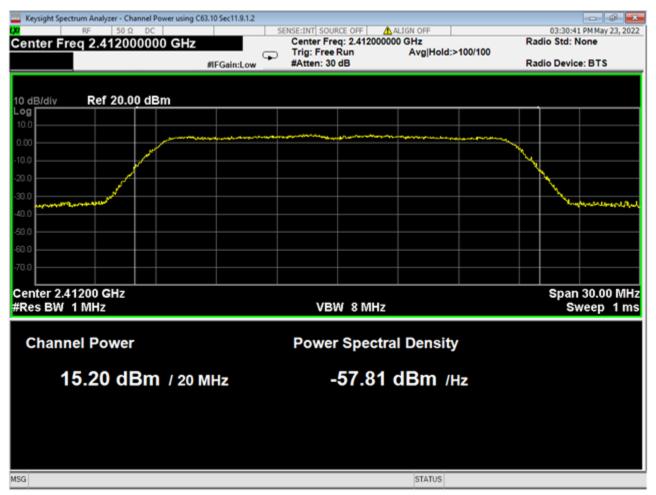
Wifi G 6MB, Mid



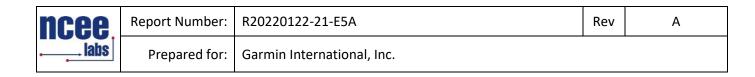


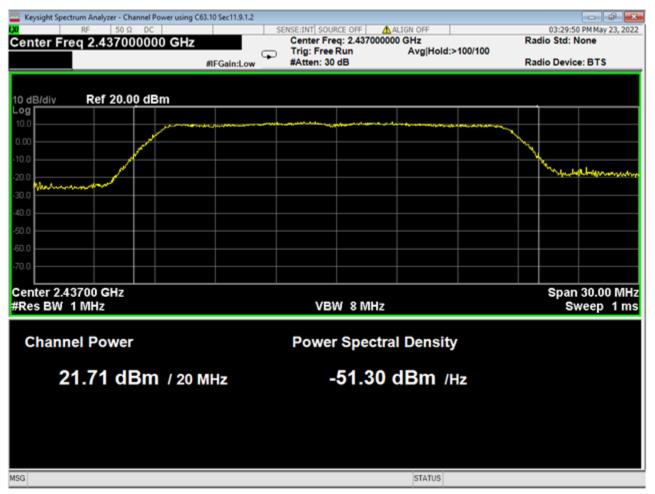
Wifi N MCSO, High



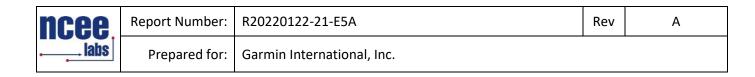


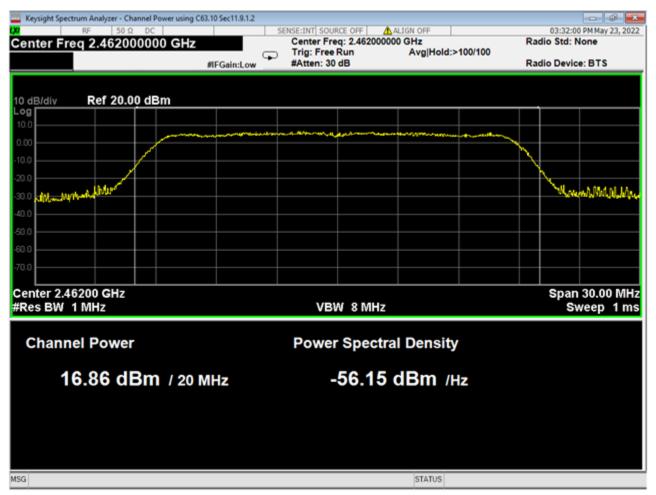
Wifi N MCS0, Low



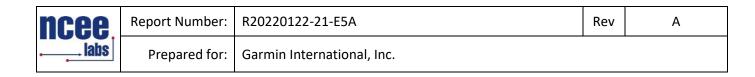


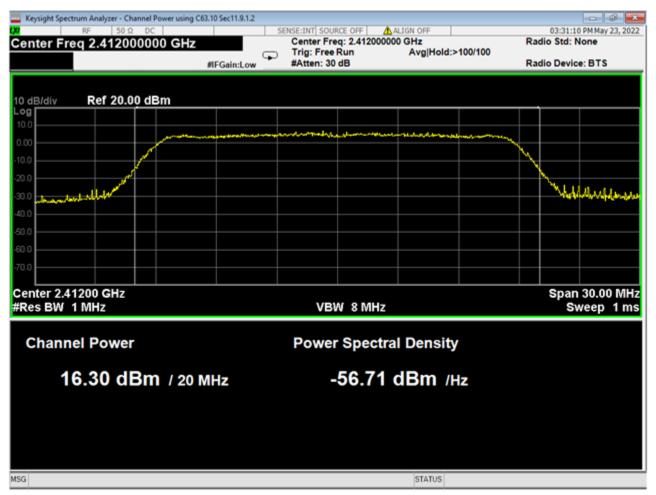
Wifi N MCS0, Mid



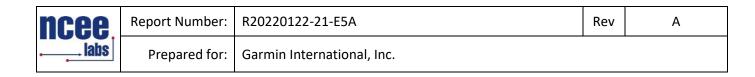


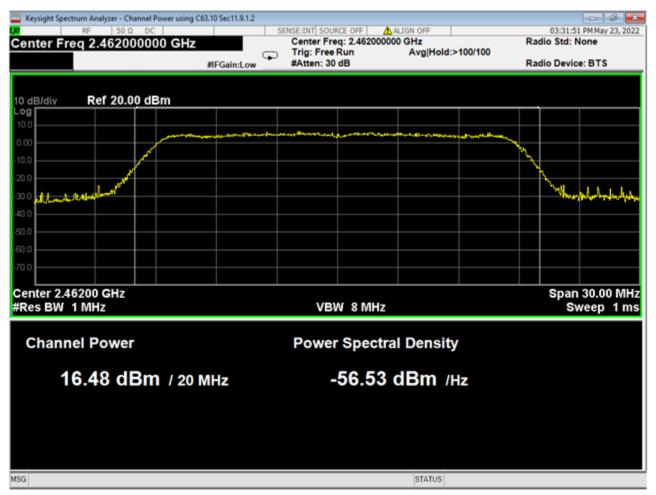
Wifi N MCS7, High





Wifi N MCS7, Low





Wifi N MCS7, Mid

Incee	Report Number:	R20220122-21-E5A	Rev	А
	Prepared for:	Garmin International, Inc.		

## REPORT END