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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address:

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

Product:

A04543

Test Report No:

R20230109-20-E6B

Approved by:

Lane

Fox Lane, EMC Test Engineer

DATE:

April 13, 2023

Total Pages:

85

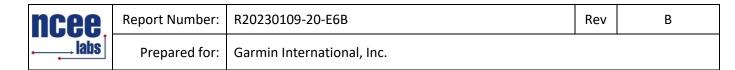
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REVISION PAGE

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



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1.0 SUMMARY OF TEST RESULTS

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The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

FCC Part 15.247

The EUT has been tested according to the following specifications:

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

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



2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04543
FCC ID	IPH-04543
IC ID	1792A-04543
EUT Received	13 February 2023
EUT Tested	15 February 2023- 23 March 2023
Serial No.	3436743098 (Radiated Measurements) 3436743374 (Conducted Measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	GMSK I GFSK I BT BR I BT EDR 2MB I BT EDR 3MB 802.11x
Power Supply / Voltage	Internal Battery / 5VDC Charger: Garmin (Phi Hong) Model: AQ27A-59CFA GPN: 362-00118-00 (Representative Power Supply)
Antenna Type / Gain (dBi)	-3.02dBi Trace Antenna Antenna Gain value based off Customer provided AUT Report. Results may differ.

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

2.2 DESCRIPTION OF TEST MODES

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

GFSK and GMSK 1MB Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

GMSK 2MB Transmissions:			
Channel	Frequency		
Low	2404 MHz		
Mid	2440 MHz		
High	2478 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 Electron	ronics (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
NCC CAB Identification No:	US0177

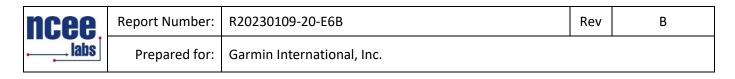
Environmental conditions varied slightly throughout the tests: Relative humidity of 35 \pm 4%

Temperature of $22 \pm 3^{\circ}$ Celsius

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Fox Lane	Test Engineer	Review/Testing and Report
2	Blake Winter	Test Engineer	Testing
3	Grace Larsen	Test Engineer	Testing and Report
4	Ethan Schmidt	Test Technician	Testing

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



3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)**	N9038A	MY59050109	July 19, 2022	July 19, 2024
Keysight MXE Signal Analyzer (26.5GHz)**	N9038A	MY56400083	July 19, 2022	July 19, 2024
Keysight EXA Signal Analyzer**	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A082918-1	July 26, 2022	July 26, 2023
ETS EMCO Red Horn Antenna	3115	00218655	July 21, 2022	July 21, 2023
Com-Power LISN, Single Phase**	LI-220C	20070017	July 18, 2022	July 18, 2024
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	March 21, 2022	March 21, 2024
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	August 22, 2022	August 22, 2024
Trilithic High Pass Filter*	6HC330	23042	March 21, 2022	March 21, 2024
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi- anechoic chamber- VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2023
NCEE Labs-NSA on 10m Chamber*	10m Semi- anechoic chamber-NSA	NCEE-001	May 25, 2022	May 25, 2024
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	90-195-040	August 22, 2022	August 22, 2024
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	September 24, 2021	September 24, 2023
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	September 24, 2021	September 24, 2023
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	September 24, 2021	September 24, 2023
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	September 24, 2021	September 24, 2023
N connector bulkhead (control room)*	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 ⊠

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.

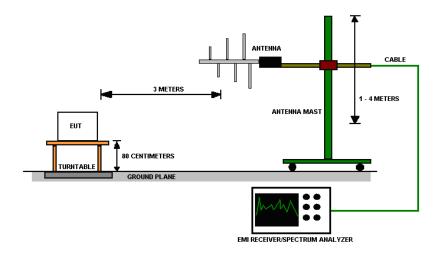


Figure 2 - Radiated Emissions Test Setup

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4.0 RESULTS

			DTS Radio Mea	asurements					
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	AVERAGE OUTPUT POWER (dBm)	AVERAGE OUTPUT POWER (mW)	PSD (dBm)	RESULT		
Low	GFSK	943.79	512.70	1.200	1.318	-10.848	PASS		
Mid	GFSK	950.89	514.90	1.480	1.406	-10.514	PASS		
High	GFSK	945.10	512.20	0.220	1.052	-11.766	PASS		
Low	GMSK 1Mb	1094.00	769.70	NA*	NA*	-17.188	PASS		
Mid	GMSK 1Mb	1103.20	767.70	NA*	NA*	-16.406	PASS		
High	GMSK 1Mb	1111.90	771.20	NA*	NA*	-16.983	PASS		
Low	GMSK 2Mb	2080.40	1131.00	NA*	NA*	-19.591	PASS		
Mid	GMSK 2Mb	2081.00	1127.00	NA*	NA*	-19.68	PASS		
High	GMSK 2Mb	2086.30	1134.00	NA*	NA*	-19.514	PASS		
		6 dB Bandwidth Li BLE2MB" table for		Peak Output Por	wer Limit = 30	dBm; PSD Li	mit = 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	GMSK 1Mb	2400.00	52.83	105.72	52.89	30.00	PASS		
Low	GMSK 2Mb	2400.00	42.83	106.13	63.30	30.00	PASS		
Low	GFSK	2400.00	55.62	107.95	52.34	30.00	PASS		
High	GMSK 1Mb	2483.50	42.77	105.90	63.13	30.00	PASS		
High	GMSK 2Mb	2483.50	40.82	106.12	65.30	30.00	PASS		
High	GFSK	2483.50	42.72	106.88	64.16	30.00	PASS		
		P	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	GMSK 1Mb	2390.00	54.75	Peak	73.98	19.24	PASS		
Low	GMSK 2Mb	2390.00	52.70	Peak	73.98	21.28	PASS		
Low	GFSK	2390.00	52.51	Peak	73.98	21.47	PASS		
High	GMSK 1Mb	2483.50	53.42	Peak	73.98	20.56	PASS		
High	GMSK 2Mb	2483.50	54.26	Peak	73.98	19.72	PASS		
	GFSK								
	High GFSK 2483.50 53.28 Peak 73.98 20.70 PASS								



	Average Restricted Band-Edge											
CHANNELModeBand edge /Measurement Frequency (MHz)Raw Peak out of band level (dBuV/m @ 3m)Corrected Highest out of band level (dBuV/m @ 3m)DCCFCorrected Highest out of band level (dBuV/m @ 3m)Limit (dBuV/m @ 3m)								Margin (dB)	Result			
Low	GMSK 1Mb	2390.00	54.75	7.33	47.42	Average	53.98	6.56	PASS			
Low	GMSK 2Mb	2390.00	52.70	12.4	40.30	Average	53.98	13.68	PASS			
Low	GFSK	2390.00	NA	NA	41.06	Average	53.98	12.92	PASS			
High	GMSK 1Mb	2483.50	53.42	7.33	46.09	Average	53.98	7.89	PASS			
High	GMSK 2Mb	2483.50	54.26	12.4	41.86	Average	53.98	12.12	PASS			
High	GFSK	2483.50	NA FOO Duit 45	NA	41.93	Average	53.98	12.06	PASS			

*Limit shown is the average limit taken from FCC Part 15.209 Highest out of band level = Raw peak out of band level - DCCF (as per C63.10 Sec. 11.12.2.5.2)

		DTS Powe	r GMSK1MB/GN	ISK2MB					
CHANNEL	Transmitter	AVERAGE RAW OUTPUT POWER (dBm)	DCCF (For Power)	AVERAGE CORRECTED OUTPUT POWER* (dBm)	AVERAGE Corrected OUTPUT POWER (mW)	RESULT			
Low	GMSK 1Mb	-4.98	3.67	-1.31	0.74	PASS			
Mid	GMSK 1Mb	-4.23	3.67	-0.56	0.88	PASS			
High	GMSK 1Mb	-4.54	3.67	-0.87	0.82	PASS			
Low	GMSK 2Mb	-7.32	6.20	-1.12	0.77	PASS			
Mid	GMSK 2Mb	-7.33	6.20	-1.13	0.77	PASS			
High									
See section	4.3 for more info	ormation on DCCF							
*Average co	rrected power =	average raw output	ut power + DCCF	(For Power)					



4.1 OUTPUT POWER

Test Method: All measurements were performed using the section 11.9.2.2.2 from ANSI C63.10.

Limits of power measurements: For FCC Part 15.247 Device: The maximum allowed output power is 30 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the output power plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.



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4.2 BANDWIDTH

Prepared for:

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

Limits of bandwidth measurements:

For FCC Part 15.247 Device:

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

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

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

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the bandwidth plots can be found in the Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.



4.3 DUTY CYCLE

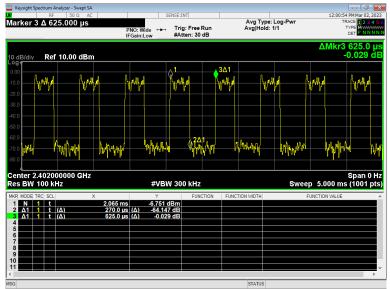


Figure 3 – Duty Cycle, GMSK 1MB

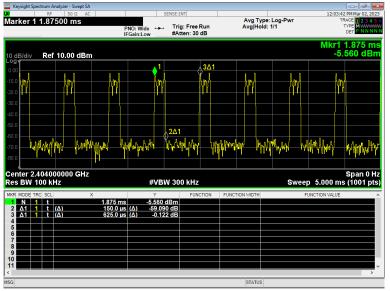


Figure 4 – Duty Cycle, GMSK 2MB

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The following duty cycle and duty cycle correction factors (DCCF) were used where applicable.

Duty Cycle correction factor (for emissions) = $20 * \log(1 / \text{Duty cycle})$ Duty Cycle correction factor (for power) = $10*\log(1 / \text{Duty Cycle})$

Duty cycle for GMSK 1MB: Duty cycle correction factor (for e Duty Cycle correction factor (for p	,	7.33dB 3.67dB
Duty cycle for GMSK 2MB: Duty cycle correction factor (for e Duty Cycle correction factor (for p		12.40dB 6.20dB

The GFSK Modulation has a duty cycle of >98%.



4.4 RADIATED EMISSIONS

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

Limits for radiated emissions measurements:

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

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

NOTE:

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

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



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.

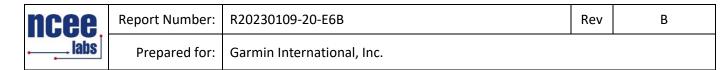
c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

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:

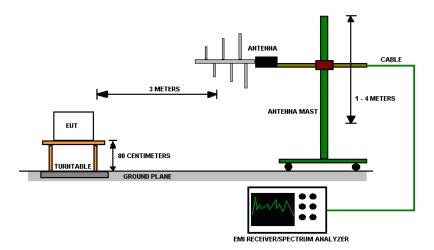


Figure 5 - Radiated Emissions Test Setup

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:

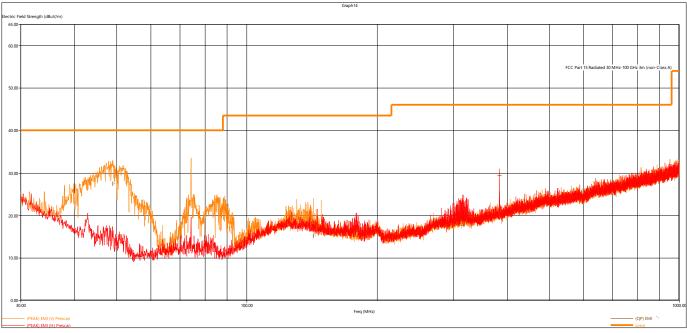
No deviation.

EUT operating conditions

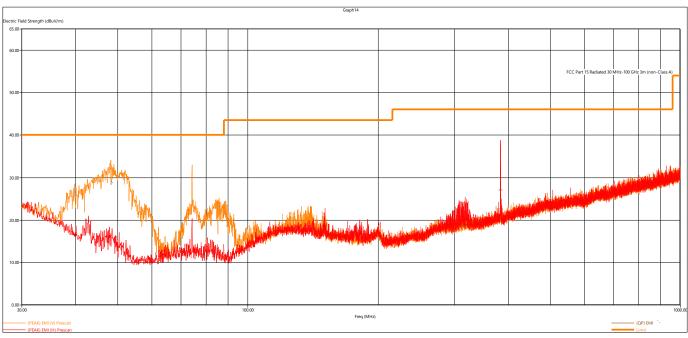
Details can be found in section 2.1 of this report.

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Test results:

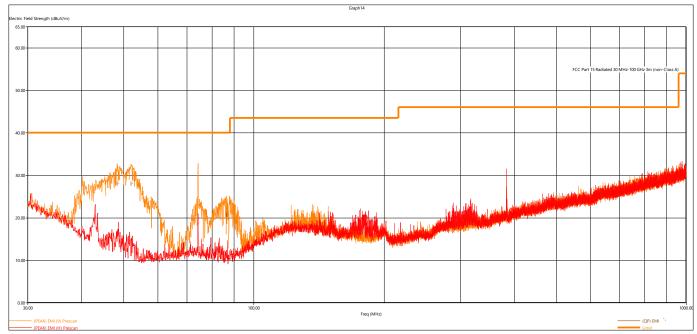














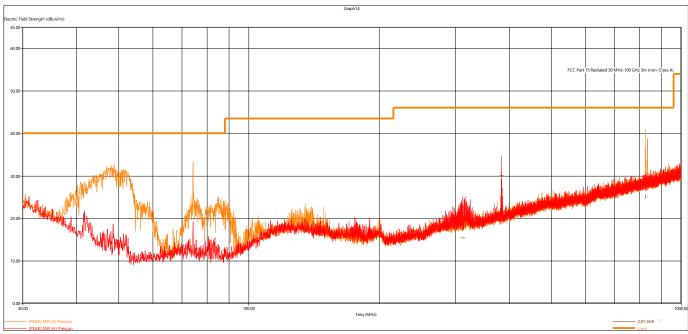


Figure 9 - Radiated Emissions Plot, GMSK 2MB

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 = Limit value Emission level

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	Quasi-Peak Measurements, GMSK-GFSK									
Frequency Level Limit Margin Height Angle Pol Channel Modulati										
MHz	dBµV/m	dBµV/m	dB	cm.	deg.					
48.348960	27.91	40.00	12.09	104.00	3.00	V	Low	GMSK 1MB		
383.627280	29.94	46.02	16.08	111.00	303.00	Н	Low	GMSK 2MB		
48.228960	28.72	40.00	11.28	109.00	317.00	V	Low	GFSK		
48.877920	27.41	40.00	12.59	116.00	210.00	V	I	RX		

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



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	Peak Measurements, GMSK-GFSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation	
MHz	dBµV/m	dBµV/m	dB	cm.	deg.				
2402.342000	88.08	NA	NA	447	147	Н	Low	GMSK 1MB	
2439.780000	87.17	NA	NA	384	115	Н	Mid	GMSK 1MB	
2480.288000	87.19	NA	NA	374	114	Н	High	GMSK 1MB	
2404.036000	87.13	NA	NA	158	145	Н	Low	GMSK 1MB	
2440.062000	86.84	NA	NA	148	148	Н	Mid	GMSK 1MB	
2477.616000	87.45	NA	NA	482	150	Н	High	GMSK 1MB	
2401.870000	89.37	NA	NA	153	149	Н	Low	GFSK	
2440.150000	88.63	NA	NA	148	146	Н	Mid	GFSK	
2480.304000	89.47	NA	NA	482	148	Н	High	GFSK	

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

	Average Measurements, GMSK-GFSK									
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation		
MHz	dBµV/m	dBµV/m	dB	cm.	deg.					
2402.342000	80.75*	NA	NA	447	147	Н	Low	GMSK 1MB		
2439.780000	79.84*	NA	NA	384	115	Н	Mid	GMSK 1MB		
2480.288000	79.86*	NA	NA	374	114	Н	High	GMSK 1MB		
2404.036000	79.8*	NA	NA	158	145	Н	Low	GMSK 1MB		
2440.062000	79.51*	NA	NA	148	148	Н	Mid	GMSK 1MB		
2477.616000	80.12*	NA	NA	482	150	Н	High	GMSK 1MB		
2401.870000	87.62	NA	NA	153	149	Н	Low	GFSK		
2440.150000	86.65	NA	NA	148	146	Н	Mid	GFSK		
2480.304000	86.19	NA	NA	482	148	Н	High	GFSK		
	– Poak Lo		(For Emiss	sione)	•	•	•	•		

*Average Level = Peak Level – DCCF (For Emissions)

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



Test Method: ANSI C63.10-2013, Section 6.7 Limits of spurious emissions:

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

Test procedures:

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 30dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:

None.

Test setup:

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

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Note that the limit shown on the plots does not apply. It is a line for reference

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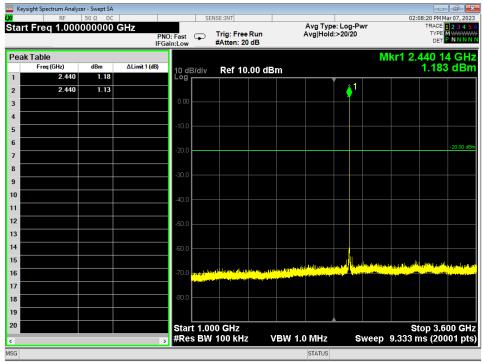


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Keysight Spectrum An RF	50 Ω DC		5	SENSE:INT					🕞 💣 🛃
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Peak Table								Mkr1 90	6.64 MH
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Figure 10 - Radiated Emissions Plot, GFSK, 30MHz – 1GHz, Mid







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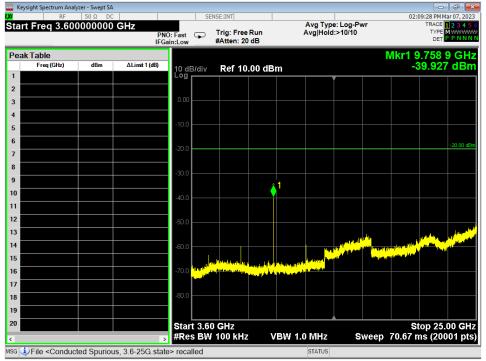
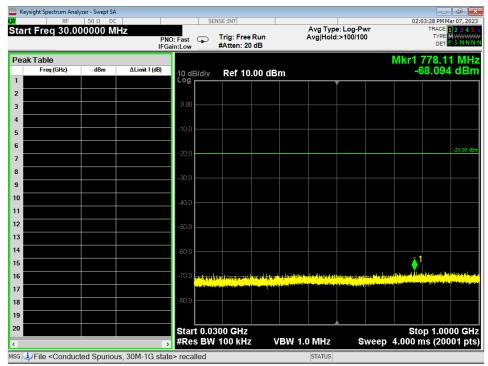


Figure 12 - Radiated Emissions Plot, GFSK, 3.6GHz – 25GHz, Mid







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u i i	t Spectrum Analyze RF	50 Ω DC	1		SEI	NSE:INT						02	:04:38 PM M	
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Figure 14 - Radiated Emissions Plot, GMSK 1MB, 1GHz – 3.6GHz, Mid

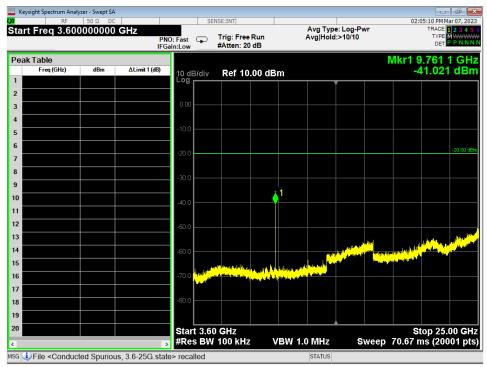


Figure 15 - Radiated Emissions Plot, GMSK 1MB, 3.6GHz – 25GHz, Mid

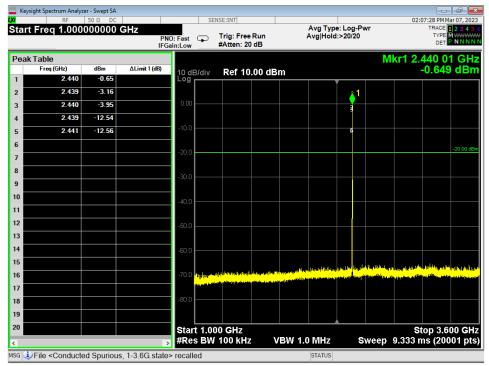


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	Analyzer - Swept SA F 50 Ω DC		SE	NSE:INT				02:07:04	PM Mar 07, 202
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Peak Table								Mkr1 93	5.69 MH
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3			0.00						
4									
5			-10.0						
6									
7			-20.0						-20.00 dE
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9			-30.0						
0			-40.0						
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Figure 16 - Radiated Emissions Plot, GMSK 2MB, 30MHz – 1GHz, Mid







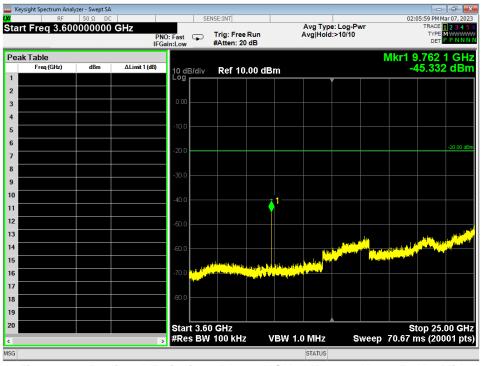


Figure 18 - Radiated Emissions Plot, GMSK 2MB, 3.6GHz – 25GHz, Mid



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4.6 BAND EDGES

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

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

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

Test procedures:

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

Deviations from test standard:

No deviation.

Test setup:

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

EUT operating conditions:

Details can be found in section 2.1 of this report.



Test results:

Pass

Comments:

- 1. All the band edge plots can be found in the Appendix C.
- 2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
- 3. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209.
- 4. Tabulated data is listed in section 4.0.



4.7 **POWER SPECTRAL DENSITY**

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

Limits of power measurements:

For FCC Part 15.247 Device:

The maximum PSD allowed is 8 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

- 1. All the Power Spectral Density (PSD) plots can be found in Appendix C.
- 2. All the measurements were found to be compliant.
- 3. Tabulated data is listed in section 4.0.



4.8 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 MHz

3. 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.



Test Results:



Figure 19 - Conducted Emissions Plot, Line, TX



Figure 20 - Conducted Emissions Plot, Neutral, TX



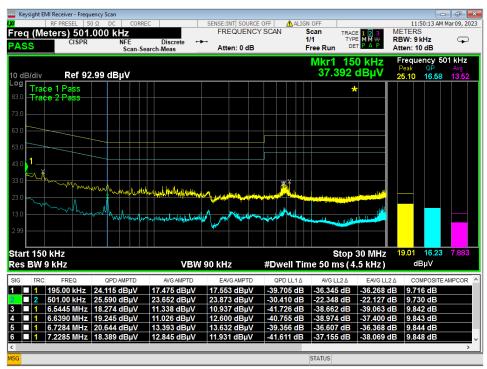


Figure 21 - Conducted Emissions Plot, Line, IDLE

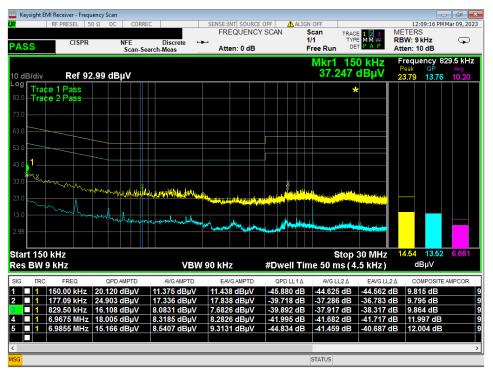


Figure 22 - Conducted Emissions Plot, Neutral, IDLE

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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labs	Prepared for:	Garmin International, Inc.		

EIRP Calculations

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

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

Power (watts) = 10^[Power (dBm)/10] / 1000

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

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

Gain = 1 (numeric gain for isotropic radiator)

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

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

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

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



APPENDIX B - MEASUREMENT UNCERTAINTY

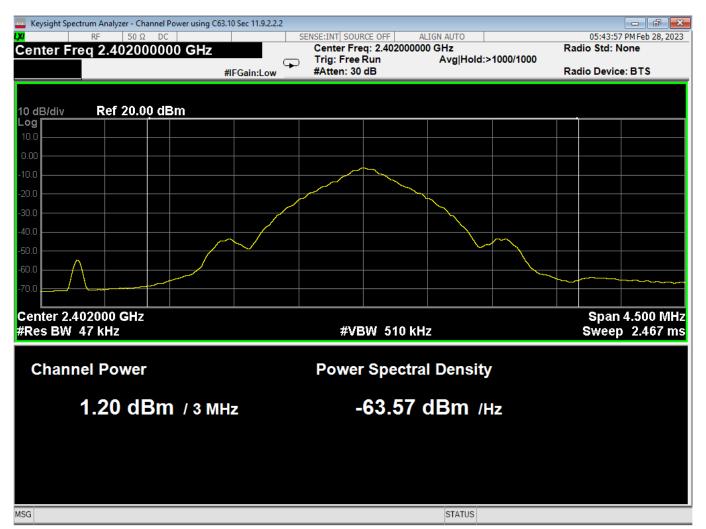
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

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

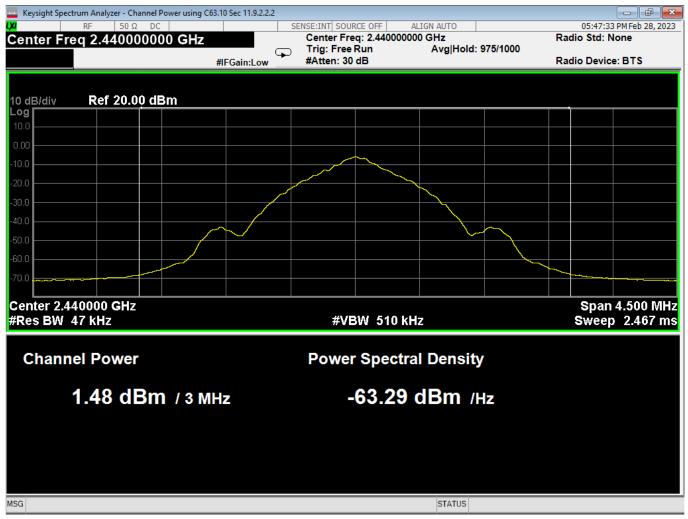
ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

APPENDIX C – GRAPHS AND TABLES



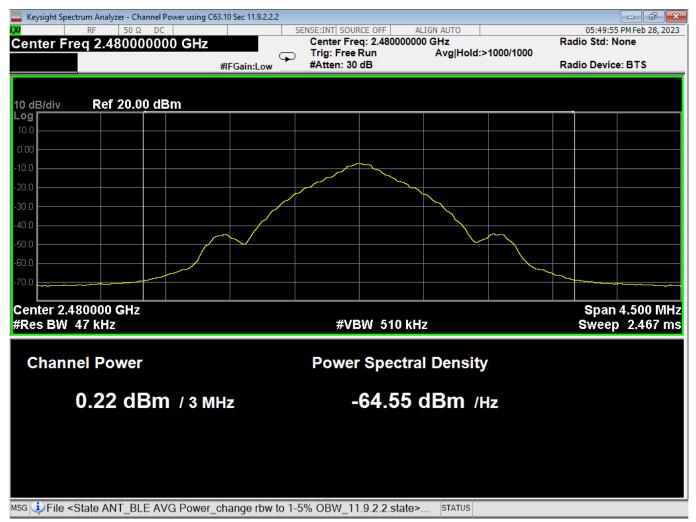
01 Average Power, Low Channel, GFSK

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02 Average Power, Mid Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		



03 Average Power, High Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63.	10 Sec 11.8.1			
		SENSE:INT SOURCE OFF ALL Center Freg: 2.40200000		05:43:08 PM Feb 28, 2023 Radio Std: None
Center Freq 2.40200000	GHZ	🗋 Trig: Free Run	Avg Hold:>10/10	Radio Stu. None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm				
Log 10.0				
0.00				
-10.0				
-20.0				
-30.0				
-40.0				
-50.0	ver Varia			man man and a
-60.0				
-70.0				
Center 2.402000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidth		Total Power	7.04 dBm	
35	3.68 kHz			
Transmit Freq Error	16.001 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	512.7 kHz	x dB	-6.00 dB	
MSG JFile <state 6<="" ant_ble="" dts="" td=""><td>dR bandwidth 11 9 1 c</td><td>tatas recalled</td><td>STATUS</td><td></td></state>	dR bandwidth 11 9 1 c	tatas recalled	STATUS	
	ub banuwidth 11.8.1.9	ale> lecalleu	314103	

04 6dB Bandwidth, Low Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

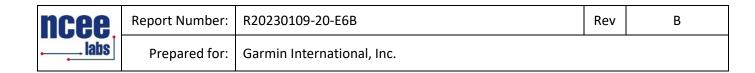
Keysight Spectrum Analyzer - BW using C6:	3.10 Sec 11.8.1			
R F 50 Ω DC			LIGN AUTO	05:47:09 PM Feb 28, 2023
Center Freq 2.44000000	GHz	Center Freq: 2.44000000		Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBn	<u>ا</u>			
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0.00				
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60.0				man and and a second se
70.0				
10.0				
Center 2.440000 GHz				Span 5.000 MH:
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidt	h	Total Power	7.43 dBm	
9	98.26 kHz			
Transmit Freq Error	12.912 kHz	% of OBW Power	r 99.00 %	
x dB Bandwidth	514.9 kHz	x dB	-6.00 dB	
SG			STATUS	

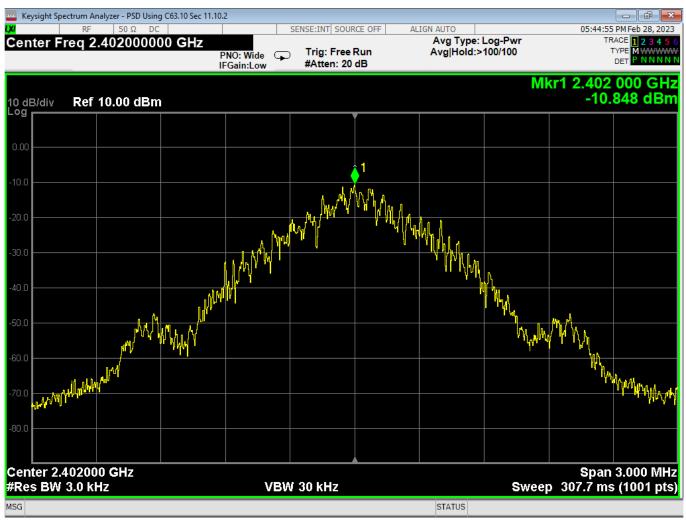
05 6dB Bandwidth, Mid Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

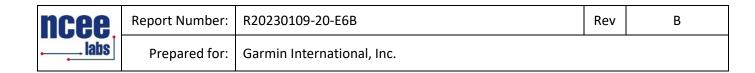
Keysight Spectrum Analyzer - BW using C63	STO SECTION			
RF 50 Ω DC			IGN AUTO	05:49:29 PM Feb 28, 2023
Center Freq 2.48000000	GHz	Center Freq: 2.48000000		Radio Std: None
	#IFGain:Low	☐ Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm	<u> </u>	_		
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50.0 60.0	- marine and the		Juny	
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-70.0 Center 2.480000 GHz				Span 5.000 MHz
70.0 Center 2.480000 GHz		VBW 1 MHz		Span 5.000 MHz Sweep 1 ms
-70.0 Center 2.480000 GHz #Res BW 100 kHz		VBW 1 MHz Total Power	6.10 dBm	Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt			6.10 dBm	Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt	95.59 kHz	Total Power		Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt				Span 5.000 MHz Sweep 1 ms
70.0 Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt 99 Transmit Freq Error	95.59 kHz 12.442 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt	95.59 kHz	Total Power		Span 5.000 MHz Sweep 1 ms
70.0 Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt 99 Transmit Freq Error	95.59 kHz 12.442 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MHz Sweep 1 ms
70.0 Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt 99 Transmit Freq Error	95.59 kHz 12.442 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt 99 Transmit Freq Error	95.59 kHz 12.442 kHz	Total Power % of OBW Power	99.00 %	Span 5.000 MHz Sweep 1 ms

06 6dB Bandwidth, High Channel, GFSK



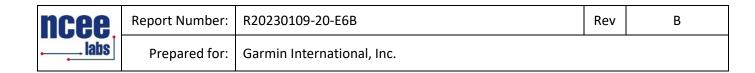


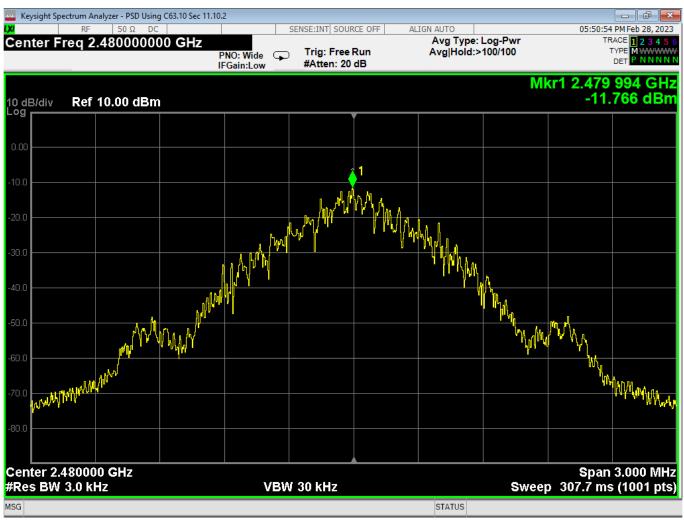
07 PSD, Low Channel, GFSK





08 PSD, Mid Channel, GFSK





09 PSD, High Channel, GFSK

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

🔤 Keysight Sp	ectrum An	alyzer - Unrestrict	ed LBE using C63.	10 Sec 11.13.2								
L <mark>XI</mark>	RF	50 Ω DC			SENSE:	INT SOUR	CE OFF	ALIGN				8 PM Feb 28, 2023
Marker 3	2.399	99841922	F	PNO: Wide ↔ FGain:Low		g: Free F tten: 20			Avg Type vg Hold:	: Log-Pwr 750/750	1	RACE 1 2 3 4 5 (TYPE MA WWW DET PANNN
										M	kr3 2.399	984 GHz
10 dB/div	Ref	116.99 dB	μV								55.6	617 dBµV
Log 107									FL1 2.4000	^{о 6Нz} 1		
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27.0												
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#Res BW				VB	W 1.0	MHz				Swee	p 1.467 m	s (1001 pts)
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6												
8												
9												
11												~
<									074740			>
MSG									STATUS			

10 Lower Bandedge, Unrestricted, GFSK

ncee.	Report Number:	R20230109-20-E6B	Rev	В
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www.www.www.www.www.www.www.www.www.ww	3.10 Sec 11.13.2					- 6 ×
LX RF 50 Ω DC	SENSE:	INT SOURCE OFF	ALIGN AUTO			M Feb 28, 2023
Marker 1 2.480012522080 GHz		g: Free Run tten: 20 dB	Avg Type: Avg Hold:>		TY	CE 1 2 3 4 5 6 PE MA WWW ET P A N N N N
				Mki	1 2.480 0	
10 dB/div Ref 116.99 dBµV					106.88	i1 dBµV
107						
97.0			<u> </u>			
87.0						
77.0						
67.0		A	\rightarrow			
57.0	<u>An</u>			h h h h h h h h h h h h h h h h h h h		010
47.0 mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	hard			- when the second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	3∆ 2
37.0						
27.0						
Start 2.475645 GHz					Stop 2.48	3500 GHz
#Res BW 100 kHz	VBW 1.0	MHz		Sweep	1.000 ms ((1001 pts)
	Y	FUNCTION F		FUN	ICTION VALUE	^
1 N 1 f 2.480 013 GH 2 N 1 f (Δ) 2.483 500 GH						
$\frac{3}{4} \Delta 1 \frac{1}{1} f (\Delta) \frac{3.487}{3.487} MH$						
5						
8						
10						
<						> [*]
MSG			STATUS			

11 Higher Bandedge, Unrestricted, GFSK

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

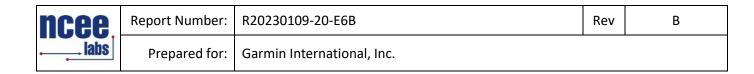
Keysight Sp		alyzer - Restricted L	3E using C63.10 S					1			
<mark>X</mark> Marker 2	RF	50 Ω AC	0 GHz		SENSE:IN	Т	<u> </u> <u>∧</u> A	LIGN OFF Avg Type	RMS		7 AM Feb 28, 2023 RACE <mark>1 2 3 4 5</mark> (
PASS		EAMP	Р	NO: Fast 🖵 Gain:High		: Free Run en: 0 dB		Avg Hold:	>1000/1000		
)ffset 36.12 dB							Ν	1kr2 2.38	7 77 GHz
10 dB/div Log 🗖	Ref	88.11 dBµV							_	41.0)63 dBµV
Trac	e 1 Pa	SS									
68.1	e 2 Pa	SS									
58.1				1							
	لوريون روريان الم	Hellinger University	المربية المربية المربية	moundant	∙washartan	رحمهامار المراجع	-	- Astrony	Annu Harlanna 2	of survey of the	๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛ ๛
38.1											
28.1											
18.1											
8.11											
-1.89											
Start 2.38	80000	GH7				k				Ston 2 3	90000 GHz
#Res BW				#VB	W 50 I	MHz*			Swee	p 1.000 ms	s (1001 pts)
MKR MODE T	RC SCL	Х		Y		FUNCTION	FUNCT	TION WIDTH	F	UNCTION VALUE	^
1 N 2	1 f		383 67 GHz 387 77 GHz	52.507 o 41.064 o							
3	2 1	2.3		41.004 0	ивич						
4 5											
6											
7 8											
9											
11											v
<											>
ISG								STATUS			

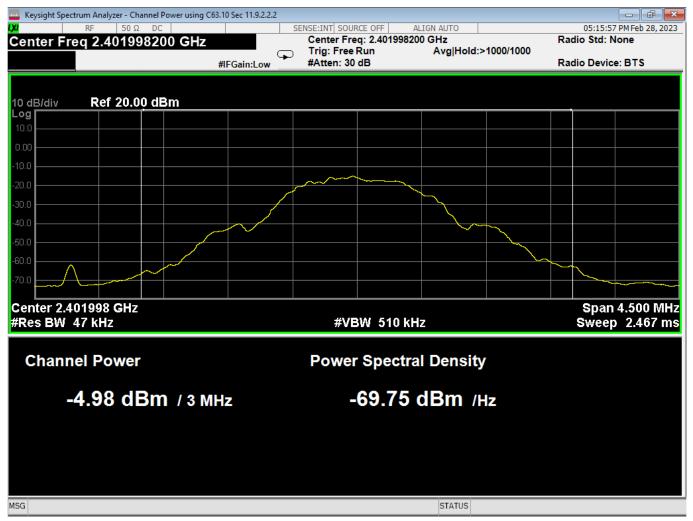
12 Lower Bandedge, Restricted, GFSK

ncee.	Report Number:	R20230109-20-E6B	Rev	В
	Prepared for:	Garmin International, Inc.		

Keysight Sp	ectrum Analyzer - Restric	ted HBE C63.10 Sec (5.10.5							
0	RF 50 Ω	AC		SENSE:	INT	<u>∧</u> ∧	LIGN OFF		10:45:2	26 AM Feb 28, 20
Aarker 2	2.498878000	000 GHz					Avg Type	RMS	٦	RACE 1 2 3 4
	2.100010000		PNO: Fast	n Tri	g: Free Run			:>1000/1000		TYPE MA WW
PASS	PREAMP		FGain:High		tten: 0 dB		0.			DET PANN
	TREFAM		rounningh							
	D-608-428.8							Mkr	2 2.498 8	178 0 G⊦
	Ref Offset 36.6								/11	927 dBµ
IO dB/div	Ref 88.64 dB	ρμν		_						
	e 1 Pass				Ť					
	e 2 Pass									
	e 2 F 455									
68.6										
58.6										
48.6	1en-en-	helesta helesta and the second	and a second three and the second	and the second	from a second a secon	hoy fact to see	alar the state of the second	and some first states and the	Malind New York	when 2 were
38.6										
28.6										
18.6										
10.0										
8.64										
1.36										
start 2 48	3500 GHz								Stop 2 !	500000 GH
	1.0 MHz		\/B\	N 50 I	1 41 -*			Curso	5 1.000 m	o /4004 pt
Res DW			VD	N 30 I	VINZ			Swee	J 1.000 III	s(iouipi
KR MODE TH		х	Y		FUNCTION	EUNC	TION WIDTH	F	UNCTION VALUE	
		.495 479 0 GHz		dDV		TONC	THOIR WIDTH	1	DIVETION VALUE	
2 N 2		.493 479 0 GH2 .498 878 0 GH2								
3		.496 676 U GH2	41.925	авµу						
4										
5										
6										
7										
8										
9										
10										
11										
										>
G							STATUS			

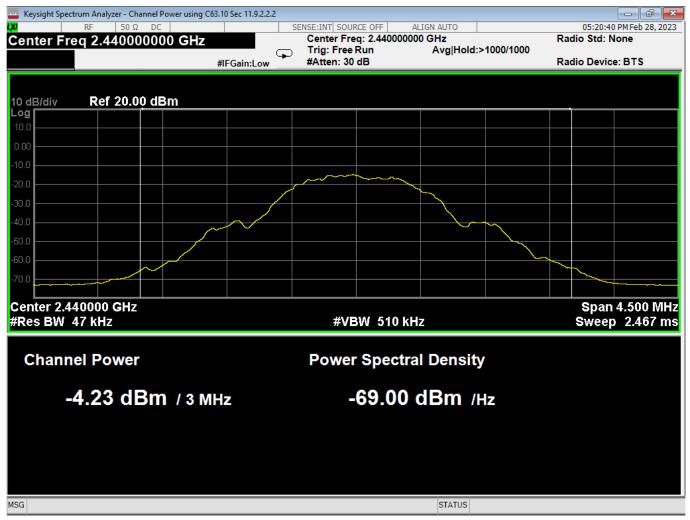
13 Higher Bandedge, Restricted, GFSK





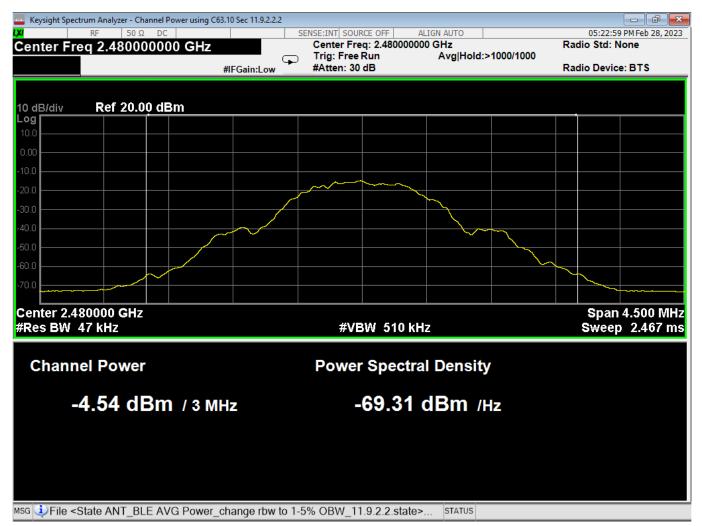
14 Average Power, Low Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		



15 Average Power, Mid Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		



16 Average Power, High Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63.1	0 Sec 11.8.1			
XI RF 50 Ω DC			GN AUTO	05:12:19 PM Feb 28, 2023
Center Freq 2.402000000 (GHz	Center Freq: 2.402000000		Radio Std: None
		 Trig: Free Run #Atten: 20 dB 	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm			-	
10.0				
0.00				
-10.0				
-20.0	/			
-30.0				
-40.0				
-50.0	<u></u>			~~
60.0				Munning a part
70.0				
-70.0				
Center 2.402000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidth		Total Power	5.48 dBm	
1.1	291 MHz			
Transmit Freq Error	9.465 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	769.7 kHz	x dB	-6.00 dB	
ISG File <state 6<="" ant_ble="" dts="" td=""><td>dB bandwidth 11.8.1.</td><td>state> recalled</td><td>STATUS</td><td></td></state>	dB bandwidth 11.8.1.	state> recalled	STATUS	

17 6dB Bandwidth, Low Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

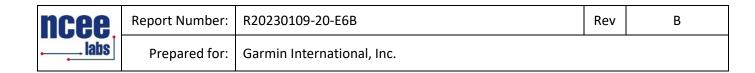
Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1			
XI RF 50 Ω DC			GN AUTO	05:20:00 PM Feb 28, 2023
Center Freq 2.440000000	GHz	Center Freq: 2.44000000		Radio Std: None
		Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm			-	
Log				
0.00				
10.0				
-20.0				
-30.0				
-40.0				
-50.0	<u></u>			~~~~ <u>~</u>
-60.0				
a local and a second second				and have non
-70.0				
Center 2.440000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
Occupied Bandwidt	'n	Total Power	6.42 dBm	
1.′	1276 MHz			
Transmit Freq Error	12.929 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	767.7 kHz	x dB	-6.00 dB	
SG			STATUS	

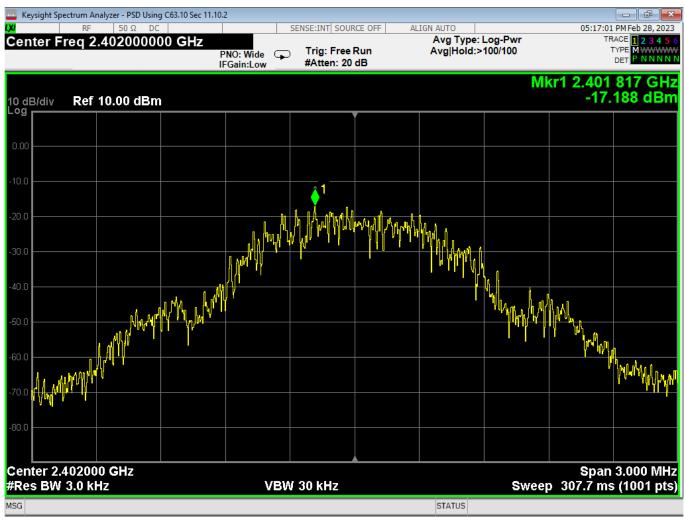
18 6dB Bandwidth, Mid Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

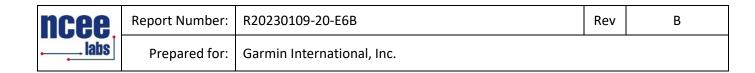
RF 50 Ω DC		SENSE:INT SOURCE OFF AL	IGN AUTO	05:22:35 PM Feb 28, 2023
Center Freq 2.48000000	GHz	Center Freq: 2.48000000		Radio Std: None
		 Trig: Free Run #Atten: 20 dB 	Avg Hold:>10/10	Radio Device: BTS
	-			
10 dB/div Ref 20.00 dBm	<u>1</u>			
10.0				
0.00				
10.0				
20.0				
30.0			- man -	
40.0				
50.0	~~		<u> </u>	<u>~</u>
60.0				- www.
-60.0 mm_mm_mm_mm_mm_mm_mm_mm_mm_mm_mm_mm_mm_				moult was allowed the
70.0				
Center 2.480000 GHz				Span 5.000 MHz
		VBW 1 MHz		Span 5.000 MHz Sweep 1 ms
Center 2.480000 GHz #Res BW 100 kHz Occupied Bandwidt	 h	VBW 1 MHz Total Power	5.88 dBm	
Res BW 100 kHz Occupied Bandwidt	^h 1381 MHz		5.88 dBm	
Res BW 100 kHz Occupied Bandwidt				
Res BW 100 kHz Occupied Bandwidt 1.	1381 MHz	Total Power		
Res BW 100 kHz Occupied Bandwidt 1. Transmit Freq Error	1381 MHz 10.908 kHz	Total Power % of OBW Power	99.00 %	
Res BW 100 kHz Occupied Bandwidt 1. Transmit Freq Error	1381 MHz 10.908 kHz	Total Power % of OBW Power	99.00 %	
Res BW 100 kHz Occupied Bandwidt 1. Transmit Freq Error	1381 MHz 10.908 kHz	Total Power % of OBW Power	99.00 %	
Res BW 100 kHz Occupied Bandwidt 1. Transmit Freq Error	1381 MHz 10.908 kHz	Total Power % of OBW Power	99.00 %	

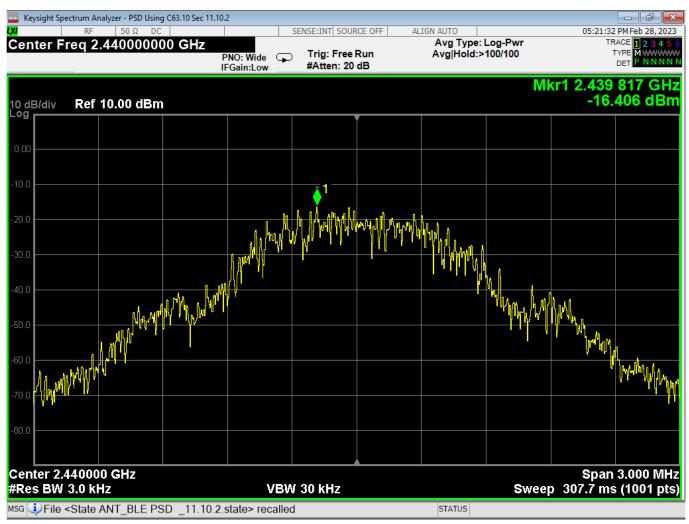
19 6dB Bandwidth, High Channel, GMSK 1MB



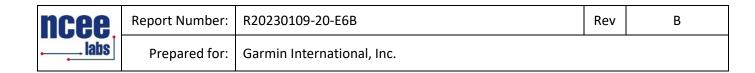


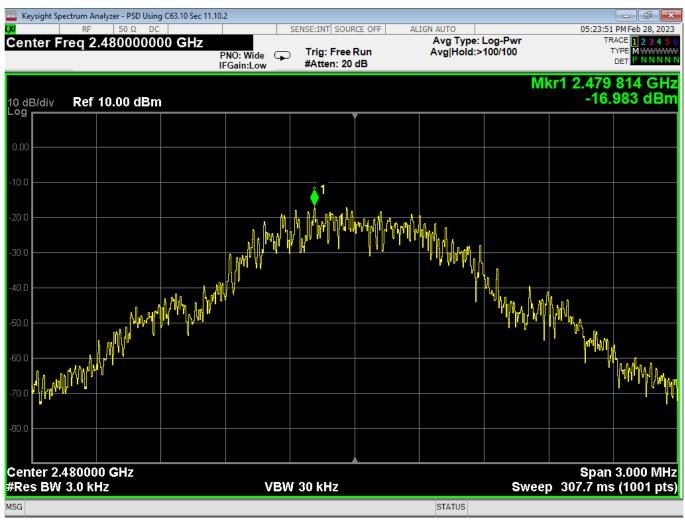
20 PSD, Low Channel, GMSK 1MB





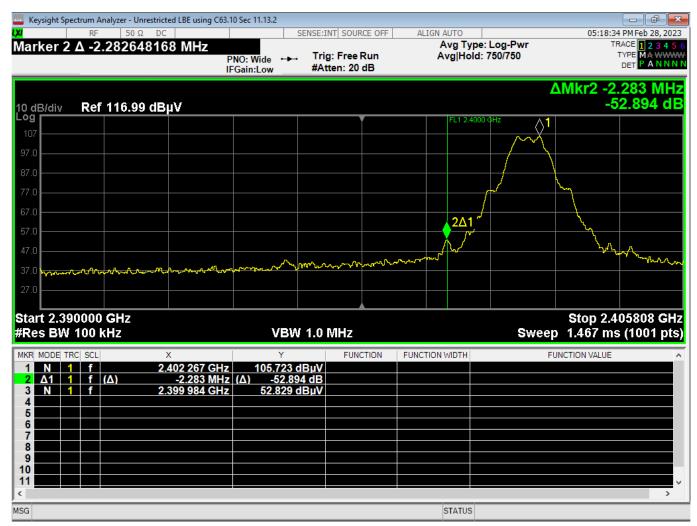
21 PSD, Mid Channel, GMSK 1MB





22 PSD, High Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B		В
labs	Prepared for:	Garmin International, Inc.		



23 LBE, unrestricted GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B		В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Unrestricted LBE using C63	.10 Sec 11.13.2		
RF 50 Ω DC	SENSE:INT SOURCE OFF	ALIGN AUTO	05:24:20 PM Feb 28, 2023
	PNO: Wide 😱 Trig: Free Run IFGain:Low #Atten: 20 dB	Avg Type: Log-Pwr Avg Hold:>1000/1000	TRACE 12345 TYPE MAWWW DET PANNN
10 dB/div Ref 116.99 dBµV		Mk	r1 2.479 738 GHz 105.901 dBµV
107			
97.0			
77.0			
67.0			
47.0	Surface		3 <u></u>
27.0			
Start 2.475645 GHz #Res BW 100 kHz	VBW 1.0 MHz	Sweep	Stop 2.483500 GHz 1.000 ms (1001 pts)
MKR MODE TRC SCL X 1 N 1 f 2.479 738 GH2	105.901 dBµV	FUNCTION WIDTH FU	NCTION VALUE
2 N 1 f (Δ) 2.483 500 GHz 3 Δ1 1 f (Δ) 3.762 MHz 4	z (Δ) 42.769 dBμV z (Δ) -63.132 dB		
5 6 7			
8			
10 11			> ×
ISG		STATUS	

24 HBE, unrestricted GMSK 1MB

ncee.	Report Number:	R20230109-20-E6B		В
labs	Prepared for:	Garmin International, Inc.		

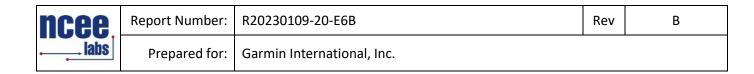
🔤 Keysight Spe	ctrum Analyzer - Restricted LBE using C6	3.10 Sec 6.10.5			
L <mark>XI</mark>	RF 50 Ω AC	SENS	E:INT	ALIGN OFF	10:39:15 AM Feb 28, 2023
Marker 2 PASS	2.385610000000 GHz PREAMP		Trig: Free Run Atten: 0 dB	Avg Type: RMS Avg Hold:>1000/100	TRACE 1 2 3 4 5 DO TYPE DET P A N N N
10 dB/div	Ref Offset 36.12 dB Ref 88.11 dBµV				Mkr2 2.385 61 GHz 41.034 dBµV
	e 1 Pass e 2 Pass				
58.1	A. Proget - Art at 11-1-1-1-10-10-10-10-10-10-10-10-10-10-1	al and part of the second	with with a straight to an day of		Assand Land and marked and a straight of the second straight of the
48.1				¢²	
28.1					
18.1					
8.11 -1.89					
Start 2.38 #Res BW	0000 GHz 1.0 MHz	#VBW 5	50 MHz*	s	Stop 2.390000 GHz weep 1.000 ms (1001 pts
MKR MODE TR	f 2.386 17 G			FUNCTION WIDTH	FUNCTION VALUE
2 N 2 3 4	f 2.385 61 G	Hz 41.034 dBµ	V		
5 6 7 8					
9 10					
11 < sg					>
				STATUS	

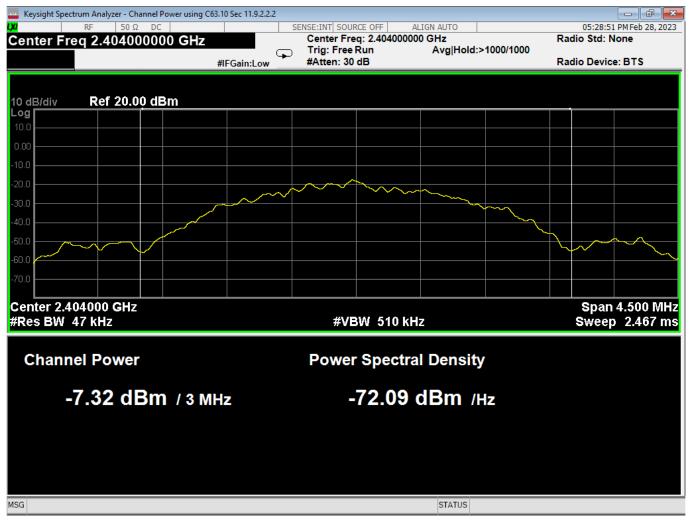
25 LBE, Restricted GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B		В
labs	Prepared for:	Garmin International, Inc.		

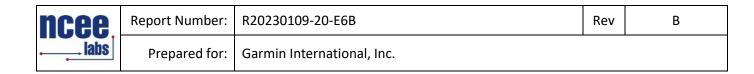
Keysight Spectrum Analyz	er - Restricted HBE C63.10 Sec	6.10.5				
RF	50 Ω AC	SE	NSE:INT	ALIGN OFF		10:40:39 AM Feb 28, 20
arker 2 2.4846 ASS PREA		PNO: Fast 😱 IFGain:High	Trig: Free Run #Atten: 0 dB	Avg Type Avg Hold	e: RMS :>1000/1000	TRACE 12345 TYPE MA DET PANN
	et 36.65 dB .64 dBµV				Mkr2	2.484 605 5 GH 41.908 dBµ
78.6 Trace 1 Pass 78.6 Trace 2 Pass 78.6						
8.6	uter Man Internet agenetic and a second		Line gran of the bary of	"hanti persional for a general star agen	waa daaraya ayaa ahaayaa ahaa ahaa ahaa ahaa	
8.6			<u> </u>		·····················	
3.6 64						
						24
tart 2.483500 GH Res BW 1.0 MHz		VBW :	50 MHz*		Sweep	Stop 2.500000 Gl 1.000 ms (1001 pt
KR MODE TRC SCL	× 2.489 291 5 GH	z 53.422 dB		FUNCTION WIDTH	FU	NCTION VALUE
2 N 2 f 3 4 5	2.484 605 5 GH	z 41.905 dE	BuV			
6 7 8 9						
9						
9 0 1 1						>

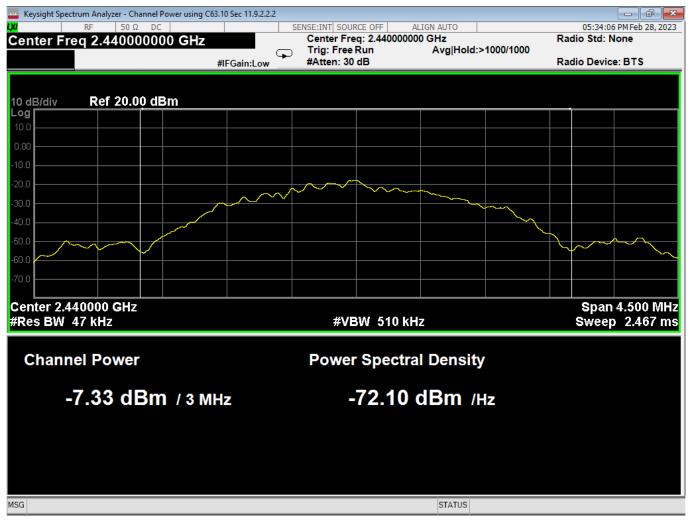
26 HBE, Restricted GMSK 1MB



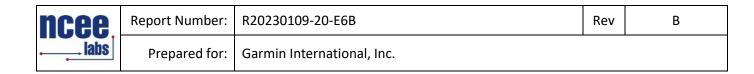


27 Average Power, Low Channel, GMSK 2MB





28 Average Power, Mid Channel, GMSK 2MB





29 Average Power, High Channel, GMSK 2MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs		Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63.10 Sec 11				
₩ RF 50 Ω DC Center Freq 2.404000000 GHz	SI SI	ENSE:INT SOURCE OFF	ALIGN AUTO	05:27:37 PM Feb 28, 2023 Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm				
Log				
10.0				
-10.0		~~~~	<u> </u>	
-10.0				
-30.0				
-40.0				
-50.0				
-60.0				`
-70.0				
Center 2.404000 GHz #Res BW 100 kHz		VBW 1 MHz	2	Span 5.000 MHz Sweep 1 ms
Occupied Bandwidth		Total Power	6.12 dBm	
	5 MHz			
Transmit Freq Error 24	.556 kHz	% of OBW Pow	ver 99.00 %	
x dB Bandwidth 1	.131 MHz	x dB	-6.00 dB	
MSG			STATUS	

30 6dB Bandwidth, Low Channel, GMSK 2MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs		Garmin International, Inc.		

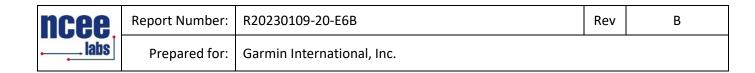
Keysight Spectrum Analyzer - BW using C63.10 Sec 1	1.8.1			
R F 50 Ω DC			IGN AUTO	05:33:33 PM Feb 28, 2023 Radio Std: None
Center Freq 2.440000000 GHz		Center Freq: 2.44000000 Trig: Free Run	Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm				
Log				
10.0				
0.00				
-10.0				
-20.0	\bigwedge		\longrightarrow	
-30.0				
-40.0				
-50.0				
-60.0				
-70.0				
Center 2.440000 GHz				Span 5.000 MHz
#Res BW 100 kHz		VBW 1 MHz		Sweep 1 ms
		T (1 D	8.04 ID	
Occupied Bandwidth		Total Power	6.01 dBm	
2.101	4 MHz			
Transmit Freq Error 2	4.555 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	.127 MHz	x dB	-6.00 dB	
MSG			STATUS	

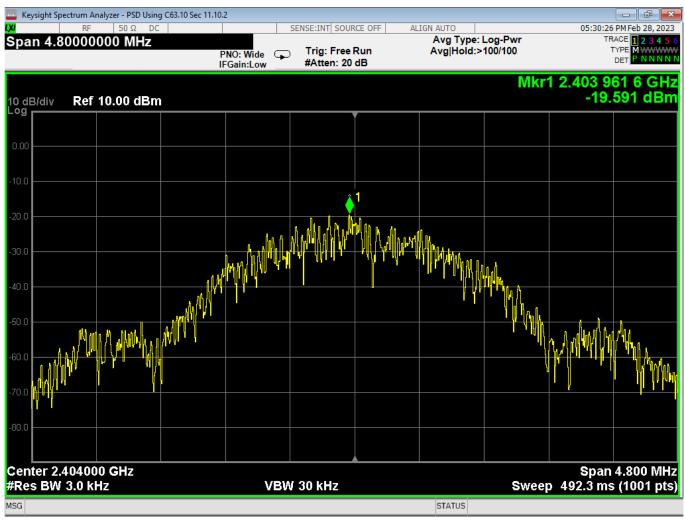
31 6dB Bandwidth, Mid Channel, GMSK 2MB

Incee labs	Report Number:	R20230109-20-E6B		В
	Prepared for:	Garmin International, Inc.		

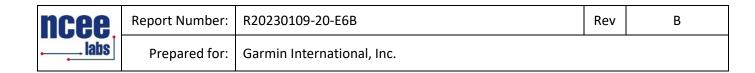
Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1							
Center Freq 2.478000000	GHz	SENSE:INT SOURCE OFF ALI Center Freq: 2.478000000 Trig: Free Run	IGN AUTO	05:37:45 PM Feb 28, 2023 Radio Std: None				
	#IFGain:Low		Avg Hold:>10/10	Radio Device: BTS				
10 dB/div Ref 20.00 dBm								
Log								
0.00								
-10.0	~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
-20.0								
-30.0								
-40.0								
-50.0								
-60.0								
-70.0								
Center 2.478000 GHz #Res BW 100 kHz		VBW 1 MHz		Span 5.000 MHz Sweep 1 ms				
Occupied Bandwidt	า	Total Power	6.31 dBm					
	2.1087 MHz							
Transmit Freq Error	19.387 kHz	% of OBW Power	99.00 %					
x dB Bandwidth	1.134 MHz	x dB	-6.00 dB					
ISG			STATUS					

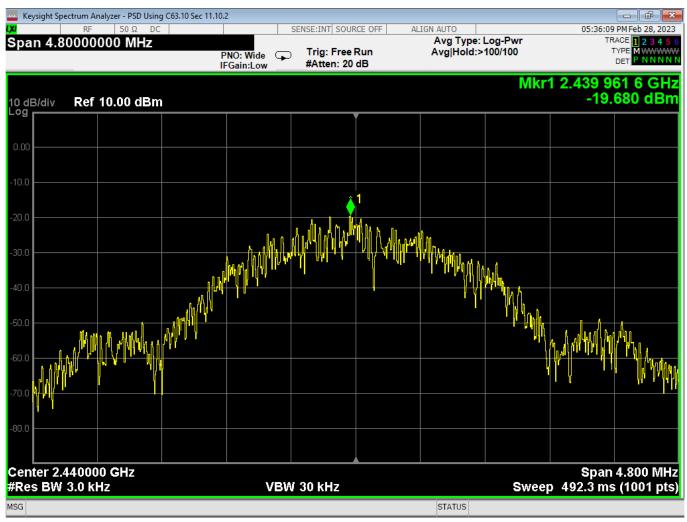
32 6dB Bandwidth, High Channel, GMSK 2MB



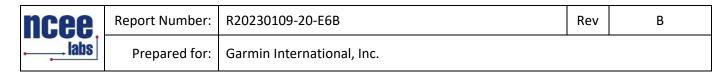


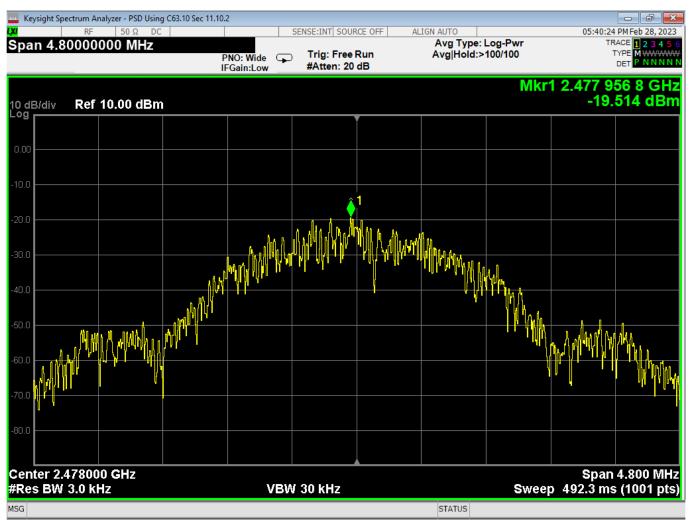
33 PSD, Low Channel, GMSK 2MB





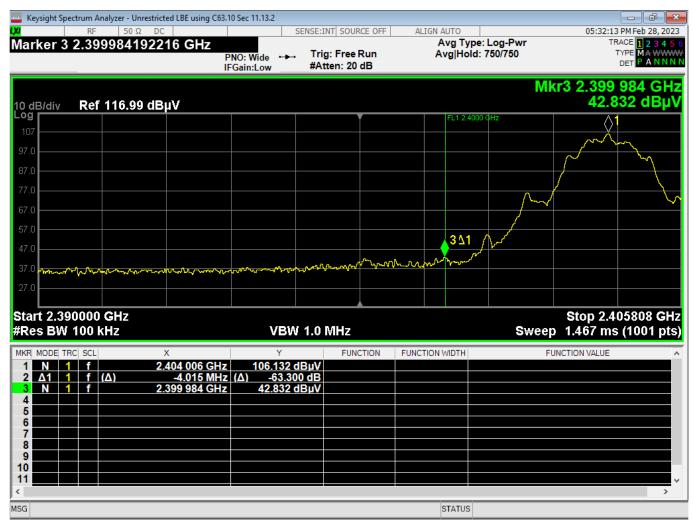
34 PSD, Mid Channel, GMSK 2MB





35 PSD, High Channel, GMSK 2MB

Incee	Report Number:	R20230109-20-E6B	Rev	В
	Prepared for:	Garmin International, Inc.		



36 Lower Bandedge, Unrestricted, GMSK 2MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Unrestricted LBE us	ing C63.10 Sec 11.13.2			
		IT SOURCE OFF	ALIGN AUTO Avg Type: Log-Pwr	05:41:05 PM Feb 28, 202 TRACE 1 2 3 4 5
larker 1 2.478001724000 G	PNO: Wide	: Free Run ten: 20 dB	Avg Hold:>1000/100	
0 dB/div Ref 116.99 dBµV				Mkr1 2.478 002 GH 106.115 dBµ
107	<u> </u>			
97.0				
87.0				
77.0				
57.0		Land L		
57.0				
47.0			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	3Δ
			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	hourse have have and
37.0				
27.0				
start 2.475645 GHz				Stop 2.483500 GH
Res BW 100 kHz	VBW 1.0 M	MHz	SI	veep 1.000 ms (1001 pt
IKR MODE TRC SCL X	Y	FUNCTION FUI	NCTION WIDTH	FUNCTION VALUE
1 N 1 f 2.478 00 2 N 1 f (Δ) 2.483 50	2 GHz 106.115 dBμV 0 GHz (Δ) 40.815 dBμV			
	8 MHz (Δ) -65.300 dB			
4				
6				
7 8				
9				
				>
G			STATUS	

37 Higher Bandedge, Unrestricted, GMSK 2MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - Restricted LBE using C						
Marker 2 2.388450000000 GHz	PNO: Fast 🕞 Trig	g: Free Run ten: 0 dB	ALIGN OFF Avg Type: RM Avg Hold:>10	AS 00/1000	TR	AM Feb 28, 2023 ACE 1 2 3 4 5 YPE MA WWW DET P A N N N
Ref Offset 36.12 dB 10 dB/div Ref 88.11 dBµV				M	(r2 2.38) 41.0	3 45 GHz 54 dBμV
Log       78.1       78.1       68.1						
58.1 48.1	Un Un Spanipher and the second states of the second	(************************************	ngr≜dagati garan selahar∎dah arahan sebagai	mge-nafen/lanny,rezila	1 ~~~~~2 ~~~~~~	furt-all-aligners
38.1						
18.1       8.11       -1.89						
Start 2.380000 GHz #Res BW 1.0 MHz	#VBW 50	MHz*		Sweep	Stop 2.3 1.000 ms	90000 GH: (1001 pts
MKR MODE TRC SCL X 1 N 1 f 2.388 53 ( 2 N 2 f 2.388 45 (		FUNCTION	FUNCTION WIDTH	-	CTION VALUE	
3 4 5 6						
7 8 9 10						
sg			STATUS			>

38 Lower Bandedge, Restricted, GMSK 2MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

RF     50 Ω     AC     SENSE:INT     ALIGN OFF       Iarker 2 2.499835000000 GHz     Avg Type: RMS       ASS     PREAMP     IFGain:High     Trig: Free Run     Avg Hold:>1000/1000       Ref Offset 36.65 dB     Mkr	10:43:59 AM Feb 28, 2 TRACE 1 2 3 4 TYPE MA WA DET P A N N
ASS PREAMP IFGain:High Trig: Free Run Avg Hold:>1000/1000 #Atten: 0 dB	TYPE MA WW
ASS PREAMP IFGain:High Trig: Free Run Avg Hold:>1000/1000 #Atten: 0 dB	TYPE MA WW
ASS PREAMP IFGain:High #Atten: 0 dB	
Mkr	DET
Ref Offset 36.65 dB MKr	
	2 2.499 835 0 GI
0 dB/div Ref 88.64 dBµV	41.817 dBj
og Trace 1 Pass	
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.36	
tart 2.483500 GHz	Stop 2.500000 G
Res BW 1.0 MHz VBW 50 MHz* Swee	p 1.000 ms (1001 p
	UNCTION VALUE
N 1 f 2.484 341 5 GHz 54.263 dBµV	
2 N 2 f 2.499 835 0 GHz 41.814 dBµV	
3	
8	
9	
0	
	2
STATUS	2

39 Higher Bandedge, Restricted, GMSK 2MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

0 Sec 11.8.1			- 6 2
			05:42:13 PM Feb 28, 202
GHz			Radio Std: None
#IFGain:Low	#Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
		<u></u>	
www.mr		July - Carlo	man management
			Span 5.000 MH
	VBW 470 KHZ		Sweep 2.733 m
	Total Power	7.76 dBm	
3.79 kHz			
16.015 kHz	% of OBW Powe	r 99.00 %	
476.2 kHz	x dB	-6.00 dB	
	#IFGain:Low	SENSE:INT SOURCE OFF A Center Freq: 2.40200000 Trig: Free Run #Atten: 20 dB VBW 470 kHz VBW 470 kHz Total Power 3.79 kHz 16.015 kHz % of OBW Powe	SENSE:INT SOURCE OFF ALIGN AUTO Center Freq: 2.402000000 GHz Trig: Free Run Avg Hold:>10/10 #Atten: 20 dB

40 Occupied Bandwidth, Low Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1			
LXI RF 50 Ω DC		SENSE:INT SOURCE OFF A	LIGN AUTO	05:46:48 PM Feb 28, 2023
Center Freq 2.440000000	GHz	Center Freq: 2.44000000		Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm		_		
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-70.0				
Center 2.440000 GHz				Span 5.000 MHz
#Res BW 47 kHz		VBW 470 kHz		Sweep 2.733 ms
Occupied Bandwidt	h	Total Power	8.14 dBm	
	50.89 kHz			
Transmit Freq Error	12.205 kHz	% of OBW Powe	r 99.00 %	
x dB Bandwidth	478.5 kHz	x dB	-6.00 dB	
MSG			STATUS	

41 Occupied Bandwidth, Mid Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C6	3.10 Sec 11.8.1			
RF 50 Ω DC			ALIGN AUTO	05:49:04 PM Feb 28, 202
enter Freq 2.48000000	GHz	Center Freq: 2.4800000		Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
0 dB/div Ref 20.00 dBn	n			
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enter 2.480000 GHz Res BW 47 kHz		VBW 470 kHz	,	Span 5.000 MH Sweep 2.733 m
		VOVV 470 KH2		Sweep 2.755 m
Occupied Bandwidt	h	Total Power	6.82 dBm	
9	45.10 kHz			
Transmit Freq Error	11.177 kHz	% of OBW Powe	r 99.00 %	
x dB Bandwidth	475.4 kHz	x dB	-6.00 dB	
a			STATUS	

42 Occupied Bandwidth, High Channel, GFSK

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63.1	10 Sec 11.8.1			
LXI RF 50 Ω DC		SENSE:INT SOURCE OFF ALI Center Freq: 2.402000000	GN AUTO	05:09:59 PM Feb 28, 2023 Radio Std: None
Center Freq 2.402000000		Trig: Free Run	Avg Hold:>10/10	Radio Std. None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm				
10.0				
0.00				
-10.0				
-20.0				
-30.0				
-40.0				
-50.0	Martin Contraction of the second seco			~
-60.0				Marsh and and the second
-70.0				
				0
Center 2.402000 GHz #Res BW 47 kHz		VBW 470 kHz		Span 5.000 MHz Sweep 2.733 ms
The sources of the second seco		VDW 470 KHZ		5weep 2.755 ms
Occupied Bandwidth		Total Power	5.24 dBm	
	940 MHz			
1.0				
Transmit Freq Error	8.462 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	722.2 kHz	x dB	-6.00 dB	
		1.0.1 states receiled		
^{MSG} ↓ File <state ant_ble="" c<="" dts="" td=""><td>ccupied Bandwidth 1</td><td>1.8.1.state> recalled</td><td>STATUS</td><td></td></state>	ccupied Bandwidth 1	1.8.1.state> recalled	STATUS	

43 Occupied Bandwidth, Low Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1			
₩ RF 50 Ω DC Center Freq 2.440000000	GHz	SENSE:INT SOURCE OFF ALI Center Freq: 2.440000000	IGN AUTO	05:19:28 PM Feb 28, 2023 Radio Std: None
	#IFGain:Low	☐ Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm				
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Center 2.440000 GHz #Res BW 47 kHz		VBW 470 kHz		Span 5.000 MHz Sweep   2.733 ms
Occupied Bandwidtl	h	Total Power	6.34 dBm	
1.′	1032 MHz			
Transmit Freq Error	13.710 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	723.5 kHz	x dB	-6.00 dB	

44 Occupied Bandwidth, Mid Channel, GMSK 1MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

Keysight Spectrum Analyzer - BW using C63	.10 Sec 11.8.1			- 6 -
XI RF 50 Ω DC		SENSE:INT SOURCE OFF ALI Center Freq: 2.480000000		05:22:12 PM Feb 28, 2023 Radio Std: None
Center Freq 2.48000000		🗩 Trig: Free Run	Avg Hold:>10/10	Radio Stu. None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm			_	
Log 10.0				
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-40.0			- North	
-50.0	Arrow and a second s			√\ <u>.</u>
-60.0				Vir Marken Marken
-70.0				"Marthan Marthan
Center 2.480000 GHz				Span 5.000 MHz
#Res BW 47 kHz		VBW 470 kHz		Sweep 2.733 ms
Occupied Bandwidt	h	Total Power	5.83 dBm	
1.1	1119 MHz			
Transmit Freq Error	11.569 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	723.0 kHz	x dB	-6.00 dB	
ISG			STATUS	

45 Occupied Bandwidth, High Channel, GMSK 1MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

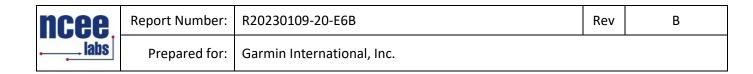
www.www.www.www.www.www.www.www.www.ww	Sec 11.8.1			
LXI RF 50 Ω DC			GN AUTO	05:25:30 PM Feb 28, 2023 Radio Std: None
Center Freq 2.404000000 G	HZ	Center Freq: 2.404000000 Trig: Free Run	Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm				
Log				
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-20.0	$-\rho$			
-30.0			\	
-40.0				
-50.0				
-60.0 7				
-70.0				
Center 2.404000 GHz				Span 5.000 MHz
#Res BW 47 kHz		VBW 470 kHz		Sweep 2.733 ms
		T-4-1 D		
Occupied Bandwidth		Total Power	5.01 dBm	
2.08	804 MHz			
Transmit Freq Error	30.841 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	1.175 MHz	x dB	-6.00 dB	
MSG			STATUS	

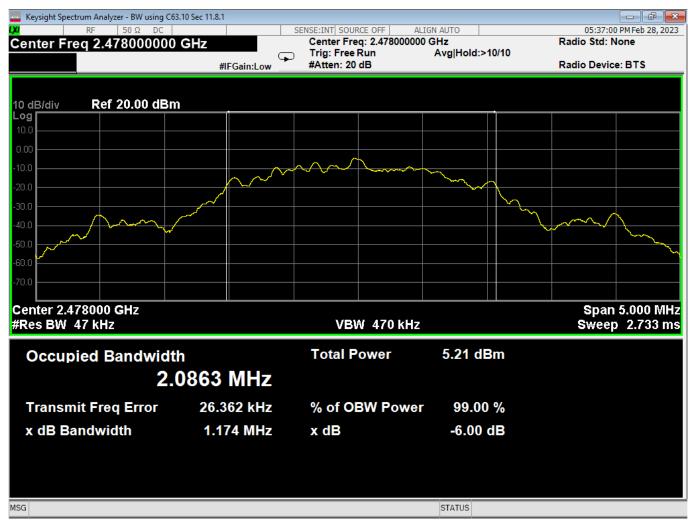
46 Occupied Bandwidth, Low Channel, GMSK 2MB

ncee,	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

www. Keysight Spectrum Analyzer - BW using C	63.10 Sec 11.8.1			
<b>Γ</b> RF 50 Ω DC		SENSE:INT SOURCE OFF ALI Center Freg: 2.440000000	GN AUTO	05:33:03 PM Feb 28, 2023 Radio Std: None
Center Freq 2.44000000	0 GHZ	Trian Eres Dur	Avg Hold:>10/10	Radio Sta: None
	#IFGain:Low	#Atten: 20 dB		Radio Device: BTS
10 dB/div Ref 20.00 dB	m			
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-30.0				
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-40.0				wa w
-50.0				
-60.0				
-70.0				
Center 2.440000 GHz #Res BW 47 kHz		VBW 470 kHz		Span 5.000 MHz
#Res BW 47 KHZ				Sweep 2.733 ms
Occupied Bandwid	th	Total Power	5.03 dBm	
2.	.0810 MHz			
Transmit Freq Error	30.945 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	1.177 MHz	x dB	-6.00 dB	
MSG			STATUS	

47 Occupied Bandwidth, Mid Channel, GMSK 2MB





48 Occupied Bandwidth, High Channel, GMSK 2MB

ncee.	Report Number:	R20230109-20-E6B	Rev	В
labs	Prepared for:	Garmin International, Inc.		

## REPORT END