

FCC/ISED Test Report

Prepared for: Garmin International, Inc.

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

Product: A04556

Test Report No: R20210922-20-E3A

Approved by:



Nic S. Johnson, NCE

Technical Manager

iNARTE certified EMC Engineer EMC-003337-NE

DATE: January 14, 2022

Total Pages: 46

The Nebraska Center for Excellence in Electronics (NCEE) authorizes the above named company to reproduce this report provided it is reproduced in its entirety for use by the company's employees only. Any use that a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. NCEE accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

REVISION PAGE

Rev. No.	Date	Description
0	8 December 2021	Original – KVepuri Prepared by FLane/KVepuri
A	13 January 2022	Added remarks about intermodulation Added remarks about frequency range tested - FL



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

CONTENTS

Revision Page	2
1.0 Summary of test results	4
2.0 EUT Description	5
2.1 Equipment under test	5
2.2 Description of test modes	5
2.3 Description of support units	5
3.0 Laboratory and General Test Description	6
3.1 Laboratory description	6
3.2 Test personnel	6
3.3 Test equipment	7
3.4 General Test Procedure and Setup for Radio Measuremnts	8
4.0 Results	9
4.1 Output Power	10
4.2 Bandwidth	11
4.3 Duty Cycle	12
4.4 Radiated emissions	13
4.5 Conducted Spurious Emissions	19
4.6 Band edges	22
4.7 Power Spectral Density	23
4.8 Conducted AC Mains Emissions	24
Appendix A: Sample Calculation	29
Appendix B – Measurement Uncertainty	31
Appendix C – Graphs and Tables	32
REPORT END	46



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

1.0 SUMMARY OF TEST RESULTS

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

FCC Part 15.247

The EUT has been tested according to the following specifications:

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

APPLIED STANDARDS AND 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 5.2	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 7.1	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 7.2	Conducted Emissions	Pass



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04556
EUT Received	26 October 2021
EUT Tested	26 October 2021- 22 November 2021
Serial No.	3391975621, 3392525130
Operating Band	2400 – 2483.5 MHz
Device Type	<input checked="" type="checkbox"/> GMSK <input type="checkbox"/> GFSK <input type="checkbox"/> BT BR <input type="checkbox"/> BT EDR 2MB <input type="checkbox"/> BT EDR 3MB <input type="checkbox"/> 802.11x
Power Supply / Voltage	Internal Battery/ Charger: Garmin (Phi Hong) MN: LAC046 (worst case power supply, all the measurements presented in this report); Garmin MN: PSM10R-050; Garmin MN: PSAF10R-050Q; Garmin car charger MN:320-00239-56

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 GMSK Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY AND GENERAL TEST DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
 4740 Discovery Drive
 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	Karthik Vepuri	Test Engineer	Review/editing, testing and report
2	Fox Lane	Test Engineer	Testing and report

Notes:

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



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 21, 2021	July 21, 2023
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	May 5, 2020	May 5, 2022
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A091418	July 27, 2021	July 27, 2022
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
EMCO Horn Antenna	3116	2576	March 9, 2020	March 9, 2022
Com-Power LISN 50µH / 250µH - 50Ω	LI-220C	20070017	September 22, 2020	September 22, 2022
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	February 1, 2021	February 1, 2022
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2023
NCEE Labs-NSA on 10m Chamber	10m Semi-anechoic chamber-NSA	NCEE-001	October 25, 2019	October 25, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	April 14, 2020	April 14, 2022
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	September 24, 2021	September 24, 2023
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	September 24, 2021	September 24, 2023
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	September 24, 2021	September 24, 2023
N connector bulkhead (10m chamber)**	PE9128	NCEEBH1	September 24, 2021	September 24, 2023
N connector bulkhead (control room)**	PE9128	NCEEBH2	September 24, 2021	September 24, 2023

*Internal Characterization

Notes:

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

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

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.

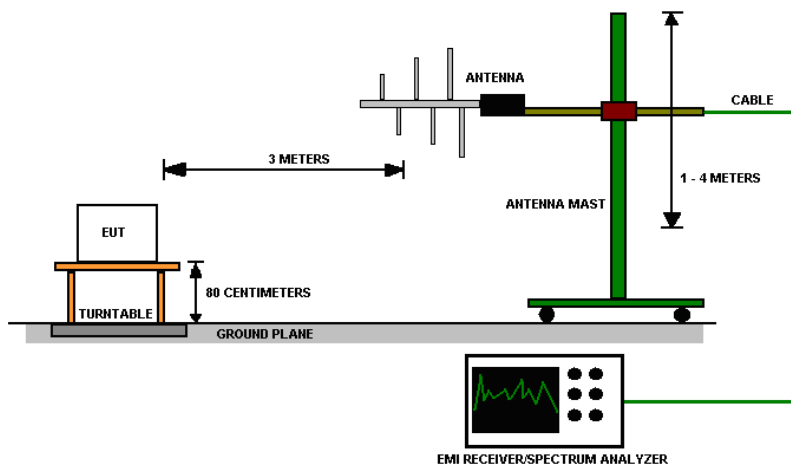


Figure 2 - Radiated Emissions Test Setup



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

4.0 RESULTS

DTS Radio Measurements

CHANNEL	Transmitter	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	PSD (dBm)	RESULT
Low	BLE	1.0729	0.7028	4.491	2.813	-13.087	PASS
Mid	BLE	1.0746	0.7001	4.441	2.780	-13.212	PASS
High	BLE	1.0752	0.7006	4.380	2.742	-13.345	PASS
Occupied Bandwidth = N/A; 6 dB Bandwidth Limit > 500 kHz				Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm			

Unrestricted 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	BLE	2400.00	62.73	111.33	48.60	20.00	PASS
High	BLE	2483.50	60.31	111.08	50.77	20.00	PASS

Peak 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	BLE	2390.00	51.58	Peak	73.98	22.40	PASS
High	BLE	2483.50	65.23	Peak	73.98	8.75	PASS

*Limit shown is the peak limit taken from FCC Part 15.209

Average Restricted Band-Edge

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)**	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	BLE	2390.00	50.63	Average	53.98	3.35	PASS
High	BLE	2483.50	52.90	Average	53.98	1.08	PASS

*Limit shown is the average limit taken from FCC Part 15.209

**Average Highest out of band level = SA Average Level + DCCF. C63.10 Sec. 11.12.2.5.2(i)(2)

See Sec 4.3 for more information on DCCF and Appendix C for SA average levels.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

4.1 OUTPUT POWER

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

Limits of power measurements:

For FCC Part 15.247 Device:

The maximum allowed peak output power is 30 dBm.

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the output power plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables below.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

4.2 BANDWIDTH

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

Limits of bandwidth measurements:

For FCC Part 15.247 Device:

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

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

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

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

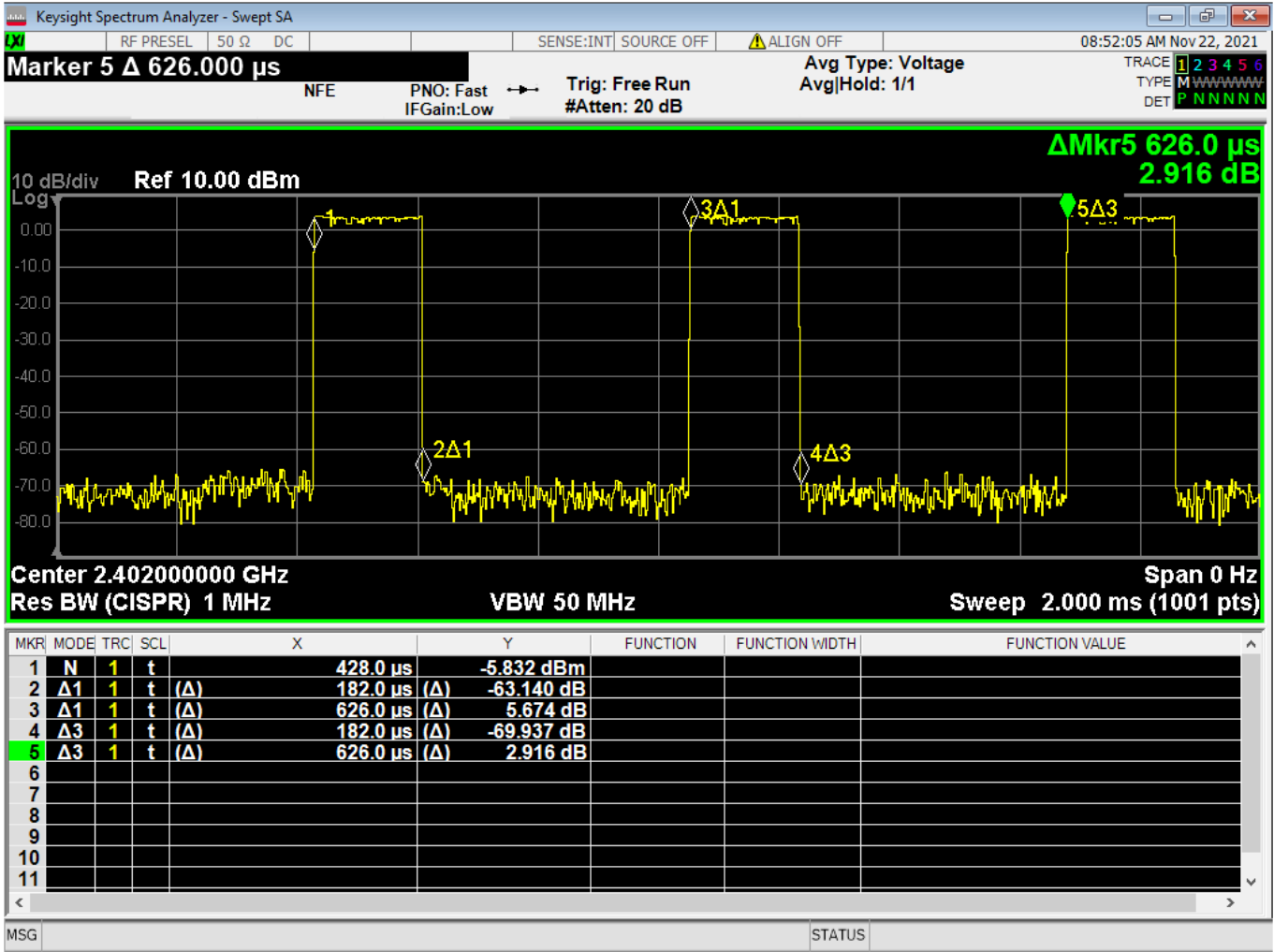
Pass

Comments:

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

4.3 DUTY CYCLE

Test Method:



C63.10 Sec. 11.12.2.5.2(i)(2)

Duty Cycle (DC) = ON Time / Period

Duty Cycle Correction Factor (DCCF) = $20 * \log(1 / DC)$

DCCF = 10.722 = $20 * \log(1 / 29.10)$

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 ($\mu\text{V/m}$)	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:

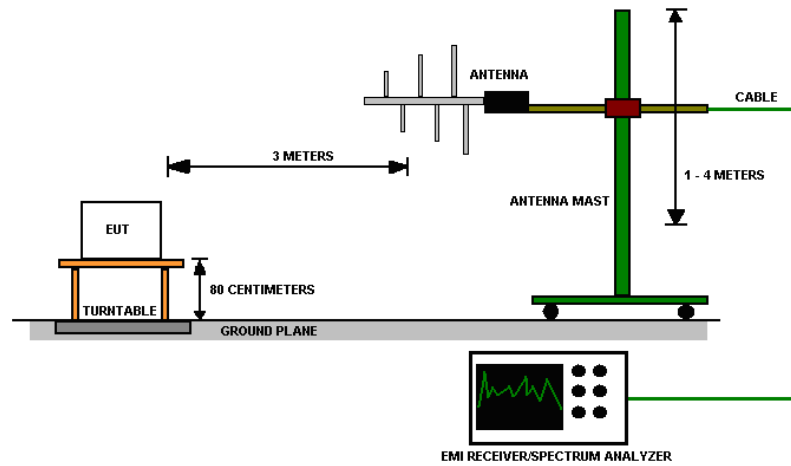
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = $20 * \log * \text{Emission level } (\mu\text{V/m})$.
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worse-case emissions were produced while running off of USB power, so results from this mode are presented.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

Test procedures:

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10-meter semi-anechoic 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:

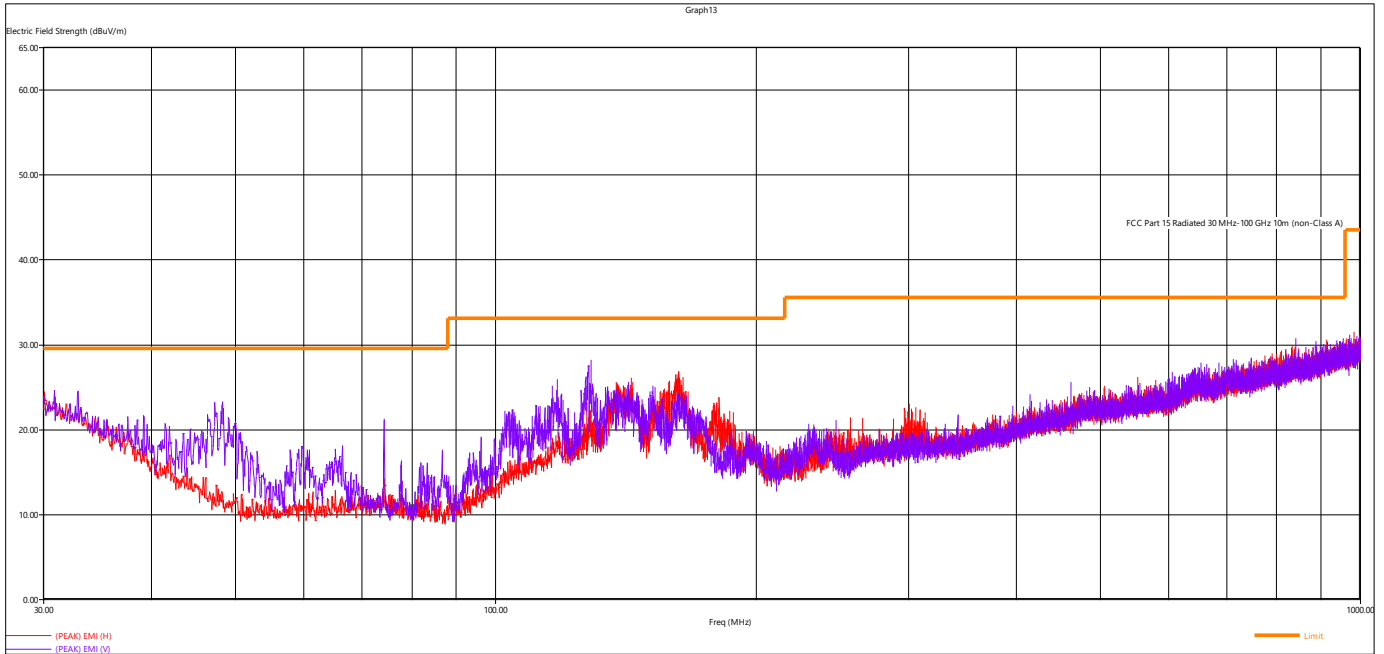


Figure 4 - Radiated Emissions Plot, Receive

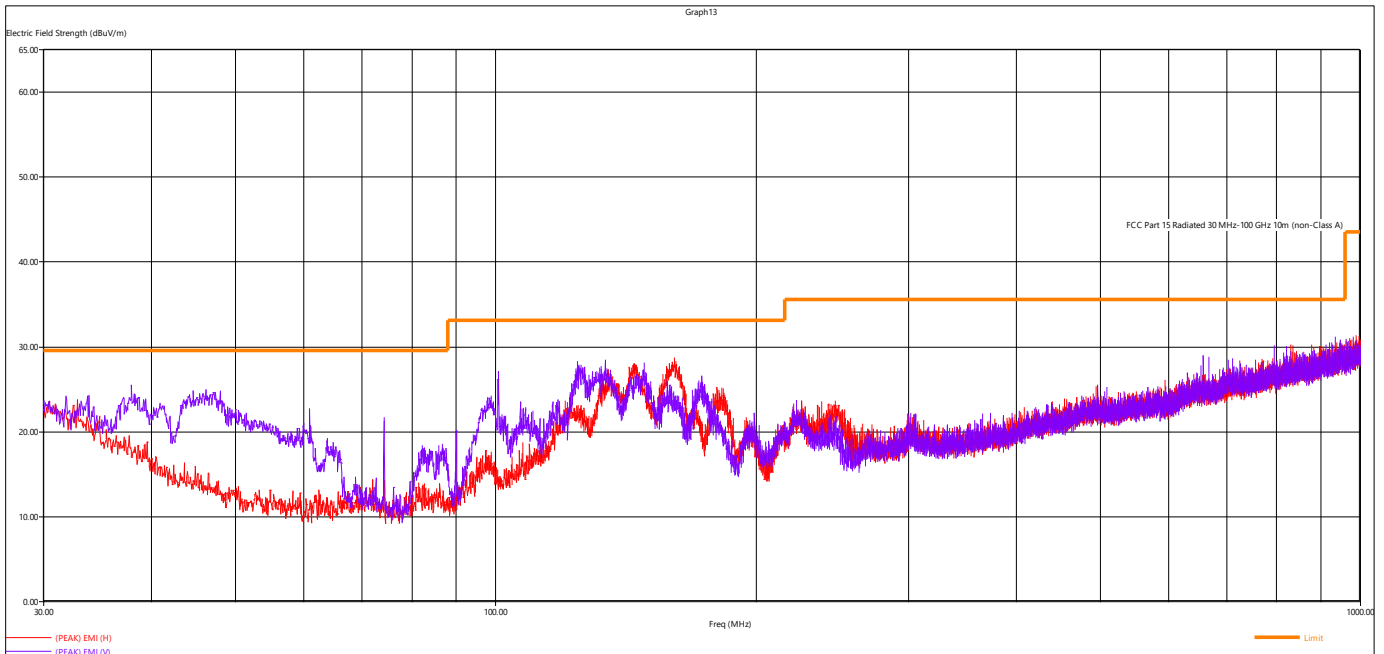


Figure 5 - Radiated Emissions Plot, BLE, Low Channel

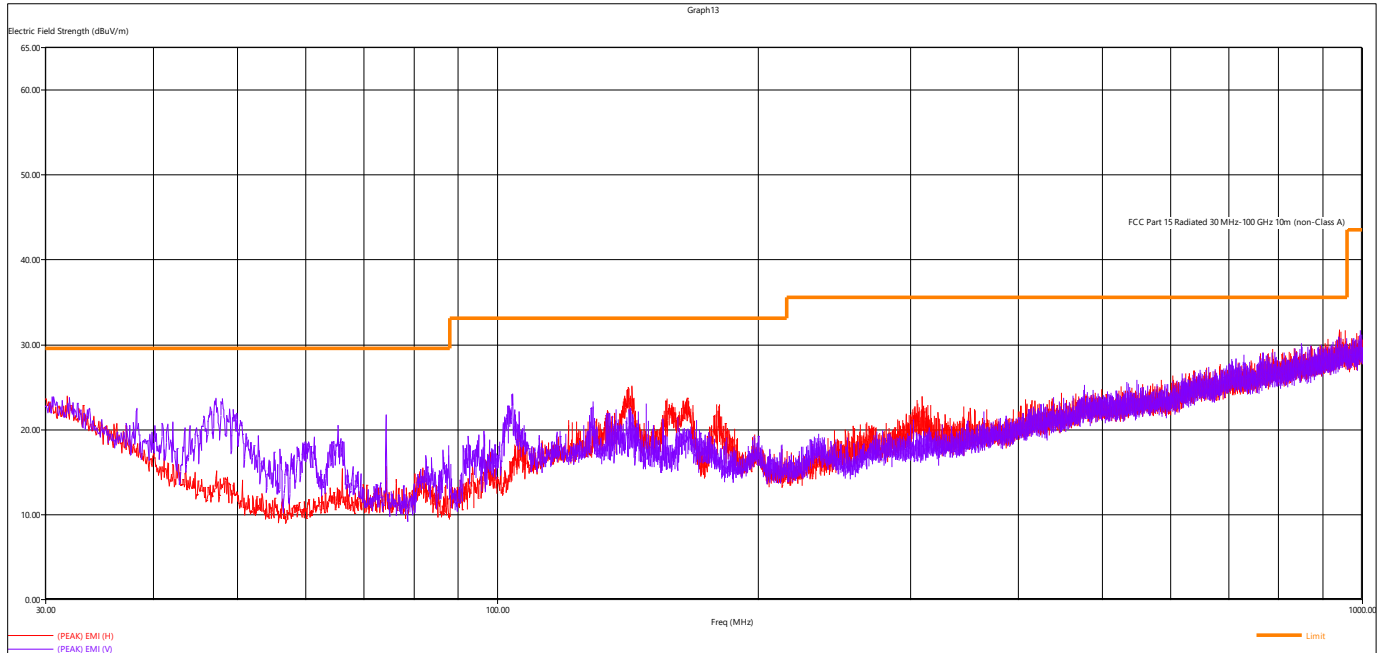


Figure 6 - Radiated Emissions Plot, BLE, Mid Channel

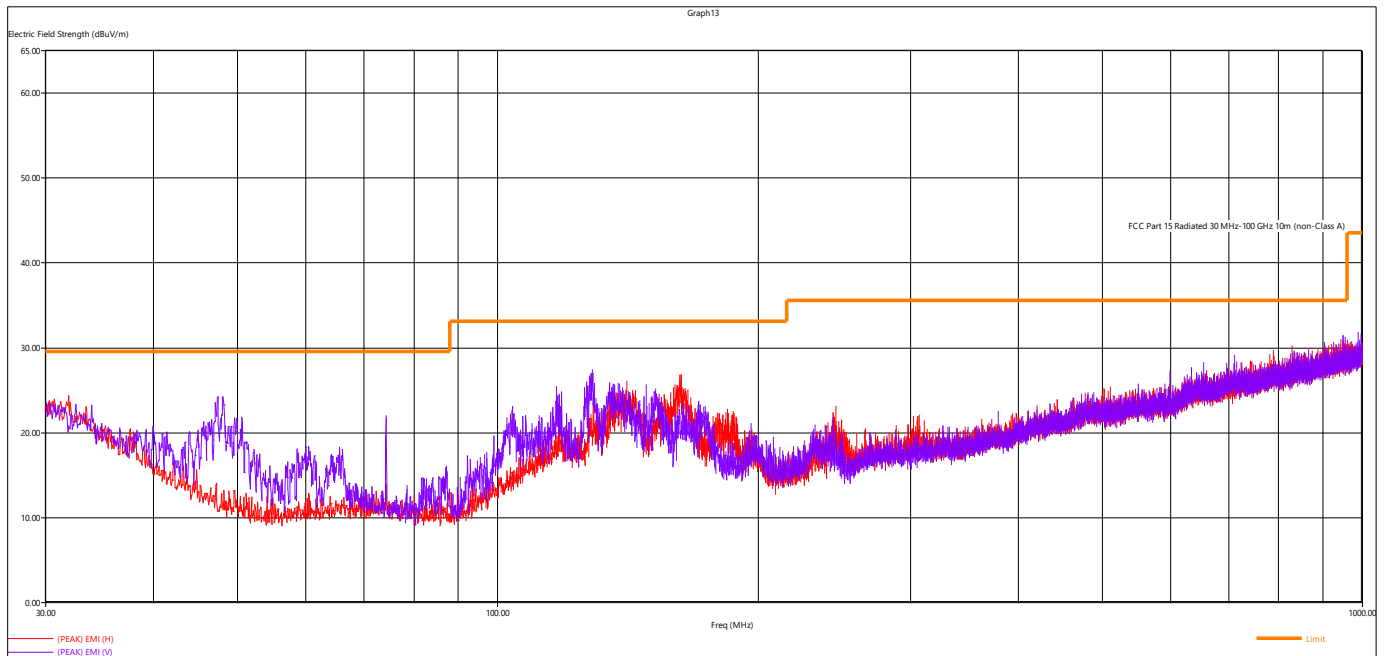


Figure 7 - Radiated Emissions Plot, BLE, High Channel



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level
5. EUT was investigated for intermodulation. No intermodulation was found above system's noise floor

Peak Measurements, BLE								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2401.772000	99.93	NA	NA	243.00	171.00	H	Low	BLE
2439.516000	99.83	NA	NA	119.00	170.00	H	Mid	BLE
2480.202000	100.18	NA	NA	266.00	156.00	H	High	BLE
7205.666000	55.80	73.98	18.18	262.00	210.00	V	Low	BLE
7319.868000	55.59	73.98	18.39	213.00	48.00	H	Mid	BLE
7439.766000	53.93	73.98	20.05	140.00	99.00	H	High	BLE

**All other emissions up to 25GHz were found to be at least 6dB below the limit line

Average Measurements, GMSK-GFSK									
Frequency	SA Avg Level	Corrected Avg Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm.	deg.			
2401.772000	87.36	98.08	NA	NA	243	171	H	Low	BLE
2439.516000	84.74	95.46	NA	NA	119	170	H	Mid	BLE
2480.202000	87.01	97.73	NA	NA	266	156	H	High	BLE
7319.868000	39.27	49.99	53.98	14.71	213	48	H	Mid	BLE
7205.666000	40.32	51.04	53.98	13.66	262	210	V	Low	BLE
7439.766000	38.43	49.15	53.98	15.55	140	99	H	High	BLE

*Corrected Avg Level = SA Avg Level + DCCF; See Sec 4.3 for more information on DCCF

**All other emissions up to 25GHz were found to be at least 6dB below the limit line



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

4.5 CONDUCTED SPURIOUS EMISSIONS

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

Limits of spurious emissions:

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

Test procedures:

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 20dB below the fundamental. More details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

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

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

The highest value measured was 2.759 dBm at the fundamental emissions. All other values were at least 20 dB below the fundamental. Worst-case values are reported.

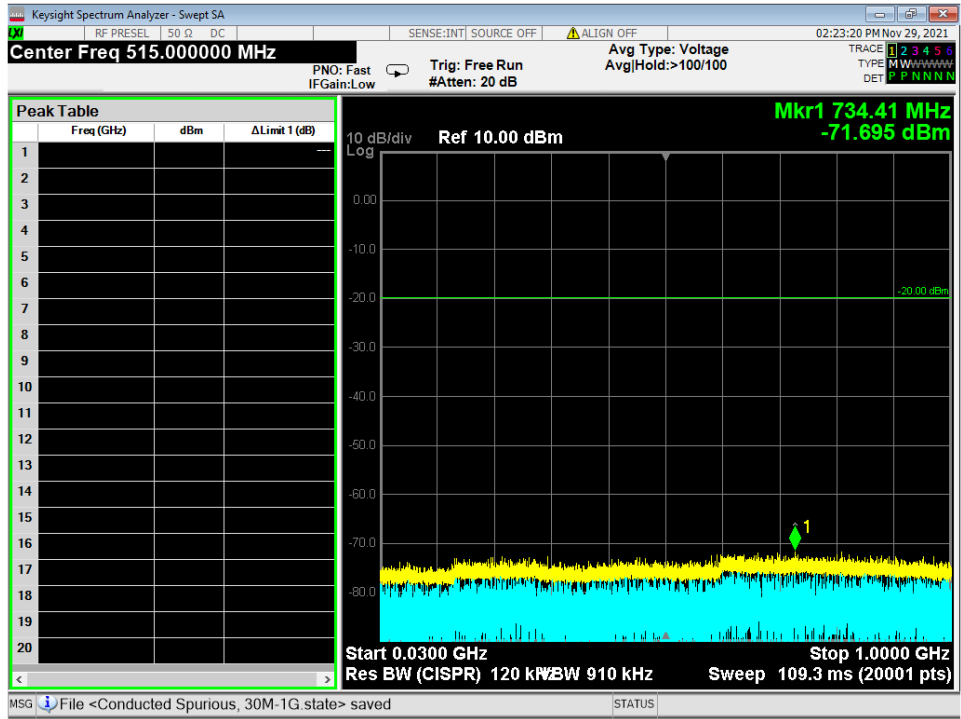


Figure 8 - Radiated Emissions Plot, BLE, 30M – 1G

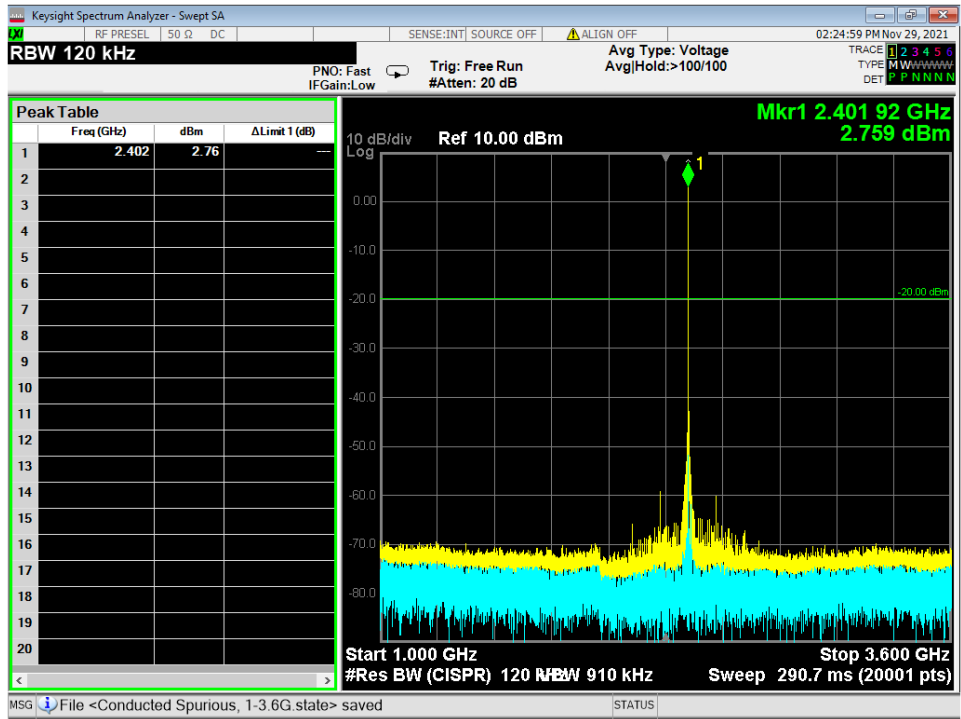


Figure 9 - Radiated Emissions Plot, BLE, 1G – 3.6G

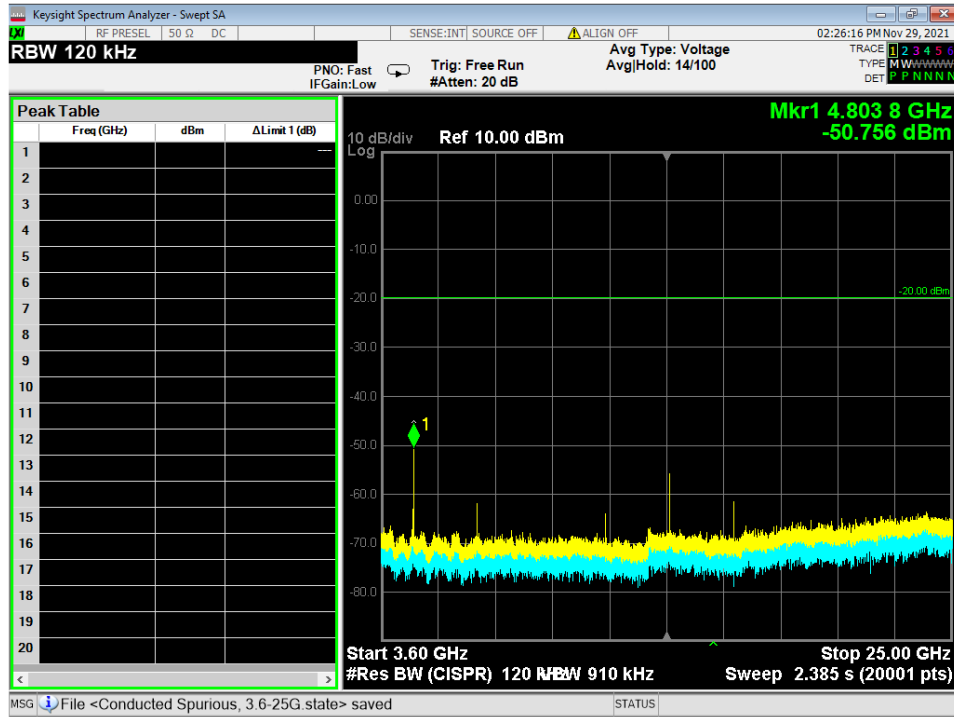


Figure 10 - Radiated Emissions Plot, BLE, 3.6G – 25G

Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

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 §15.209(a) (see §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.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

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:

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

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 (dB μ V)	
	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:

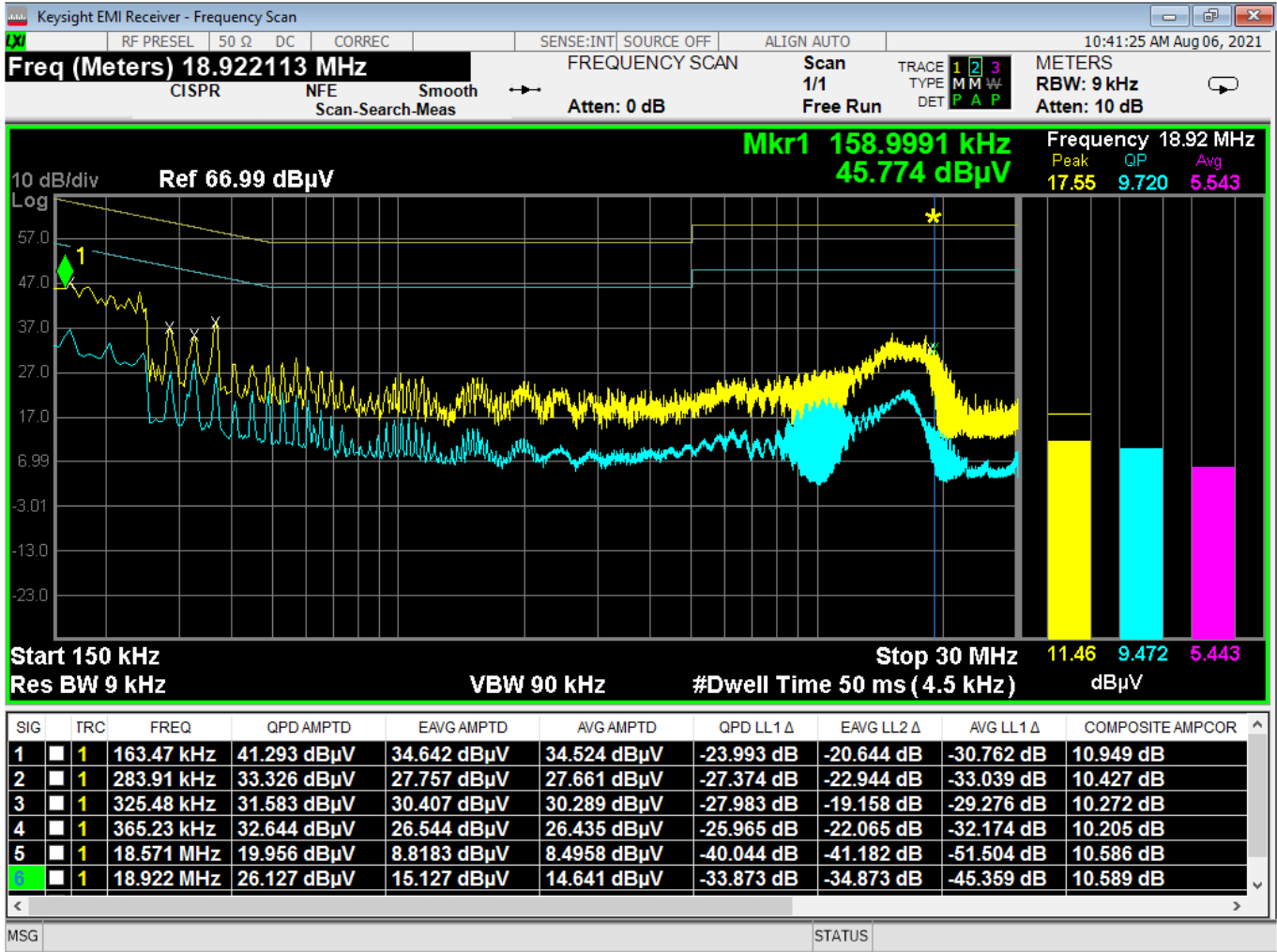


Figure 11 - Conducted Emissions Plot, Line, TX

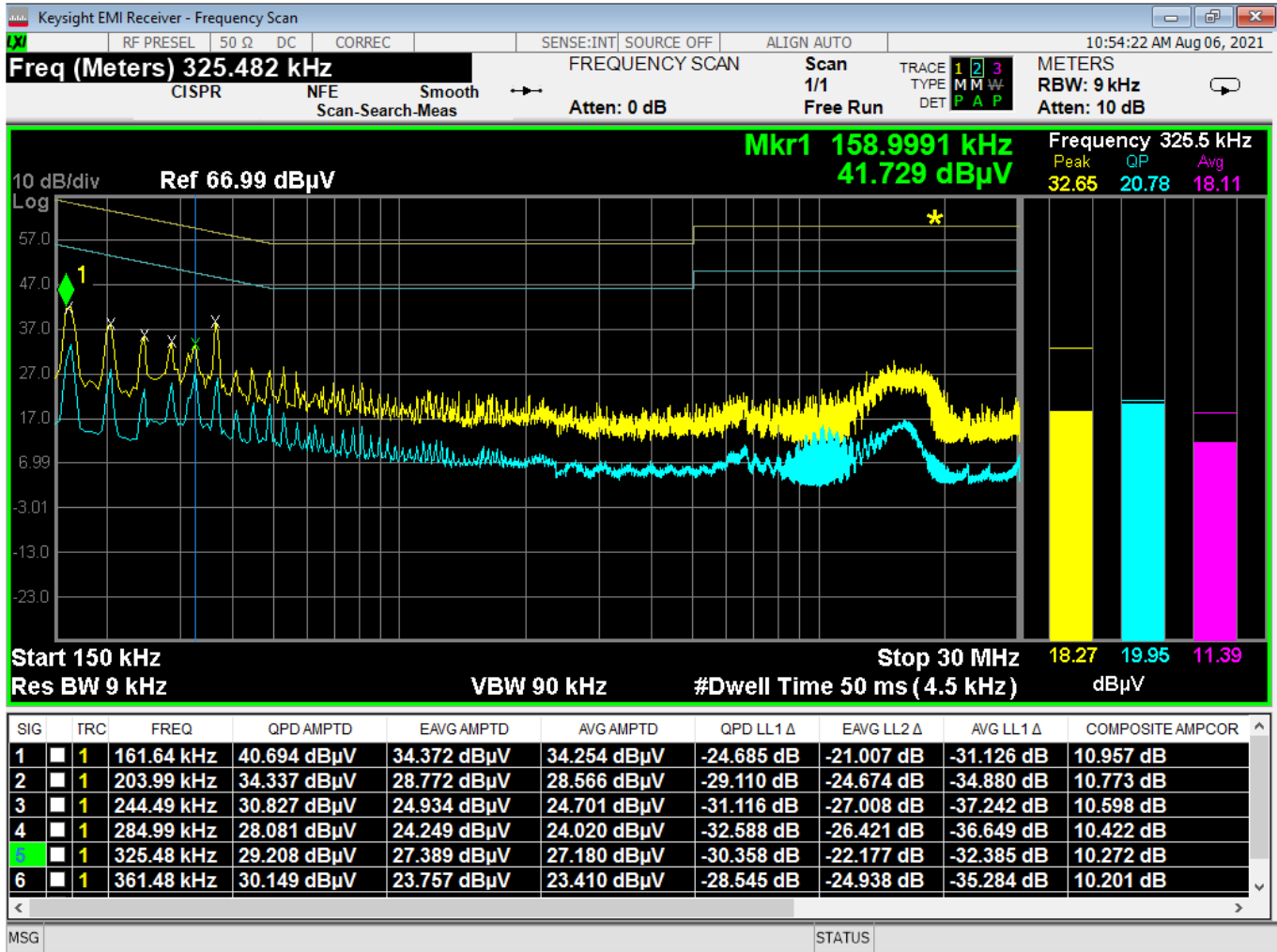


Figure 12 - Conducted Emissions Plot, Neutral, TX

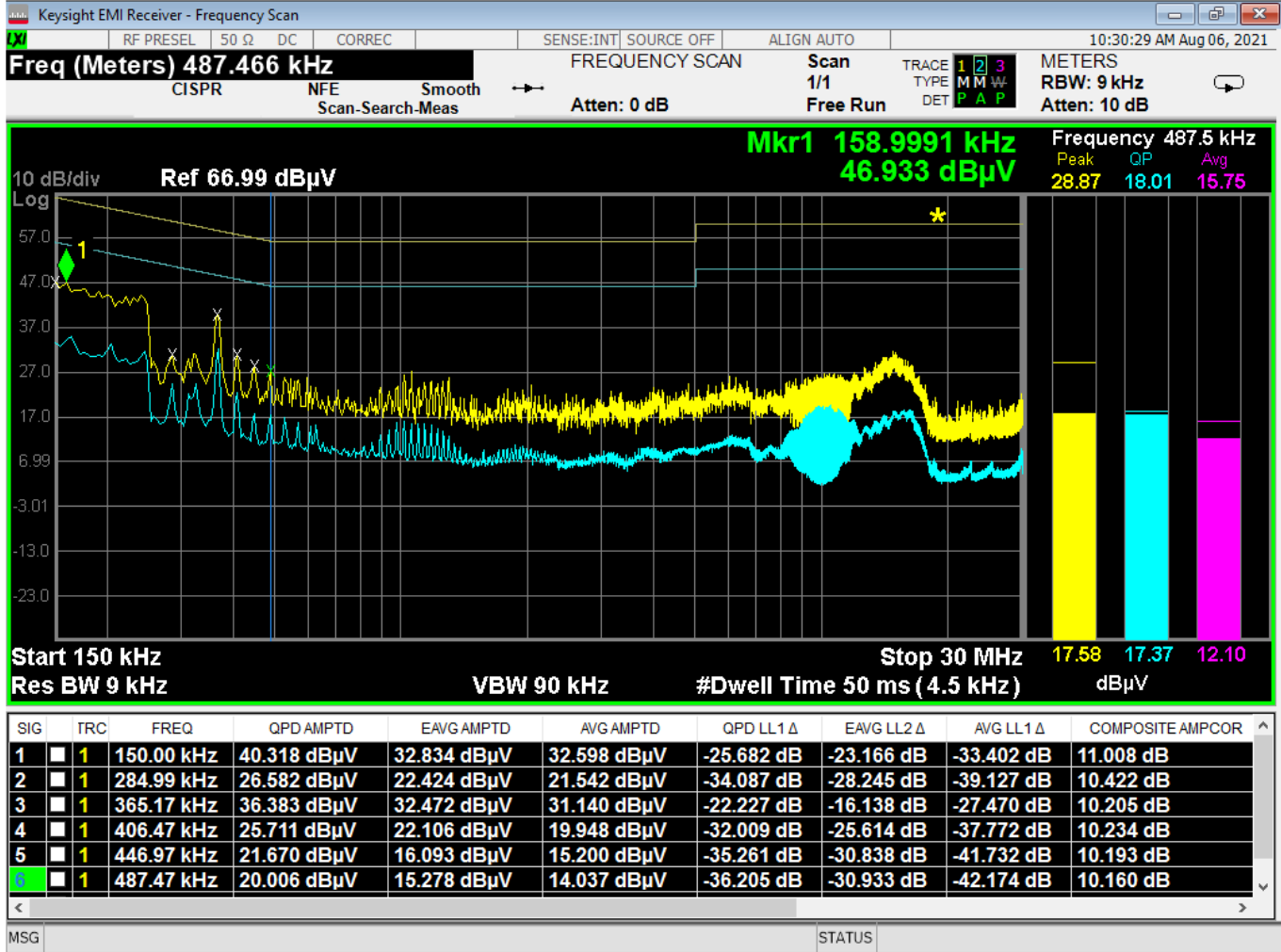


Figure 13 - Conducted Emissions Plot, Line, IDLE

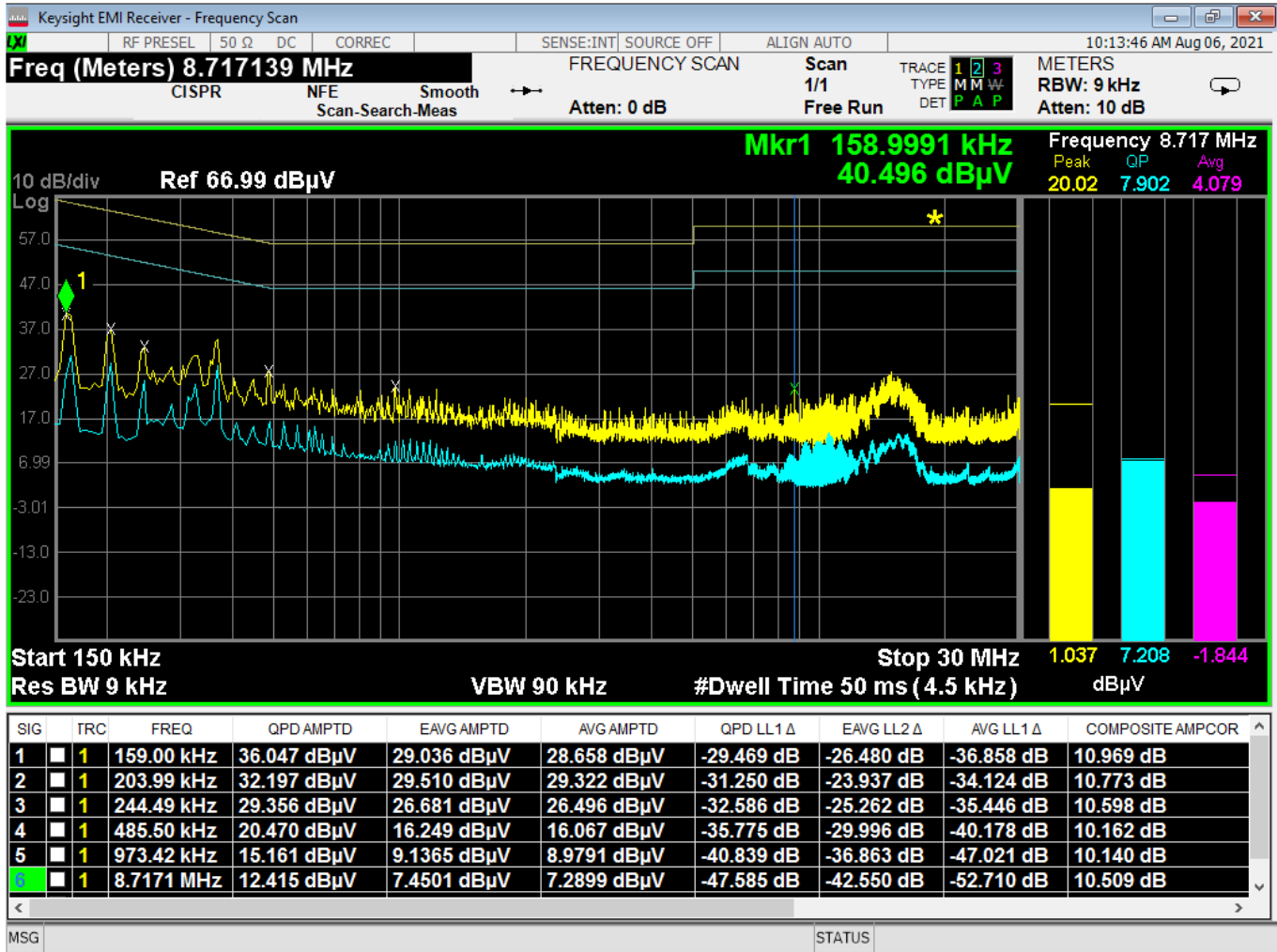


Figure 14 - Conducted Emissions Plot, Neutral, IDLE



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB μ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB μ V/m.

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

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

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

AV is calculated by taking the $20 \cdot \log(T_{on}/100)$ where T_{on} is the maximum transmission time in any 100ms window.



Report Number:	R20210922-20-E3A	Rev	A
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;

$$EIRP \text{ (Watts)} = [\text{Field Strength (V/m)} \times \text{antenna distance (m)}]^2 / 30$$

$$\text{Power (watts)} = 10^{[\text{Power (dBm)}/10]} / 1000$$

$$\text{Voltage (dB}\mu\text{V)} = \text{Power (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$\text{Field Strength (V/m)} = 10^{[\text{Field Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$\text{Gain} = 1 \text{ (numeric gain for isotropic radiator)}$$

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

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

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

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



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

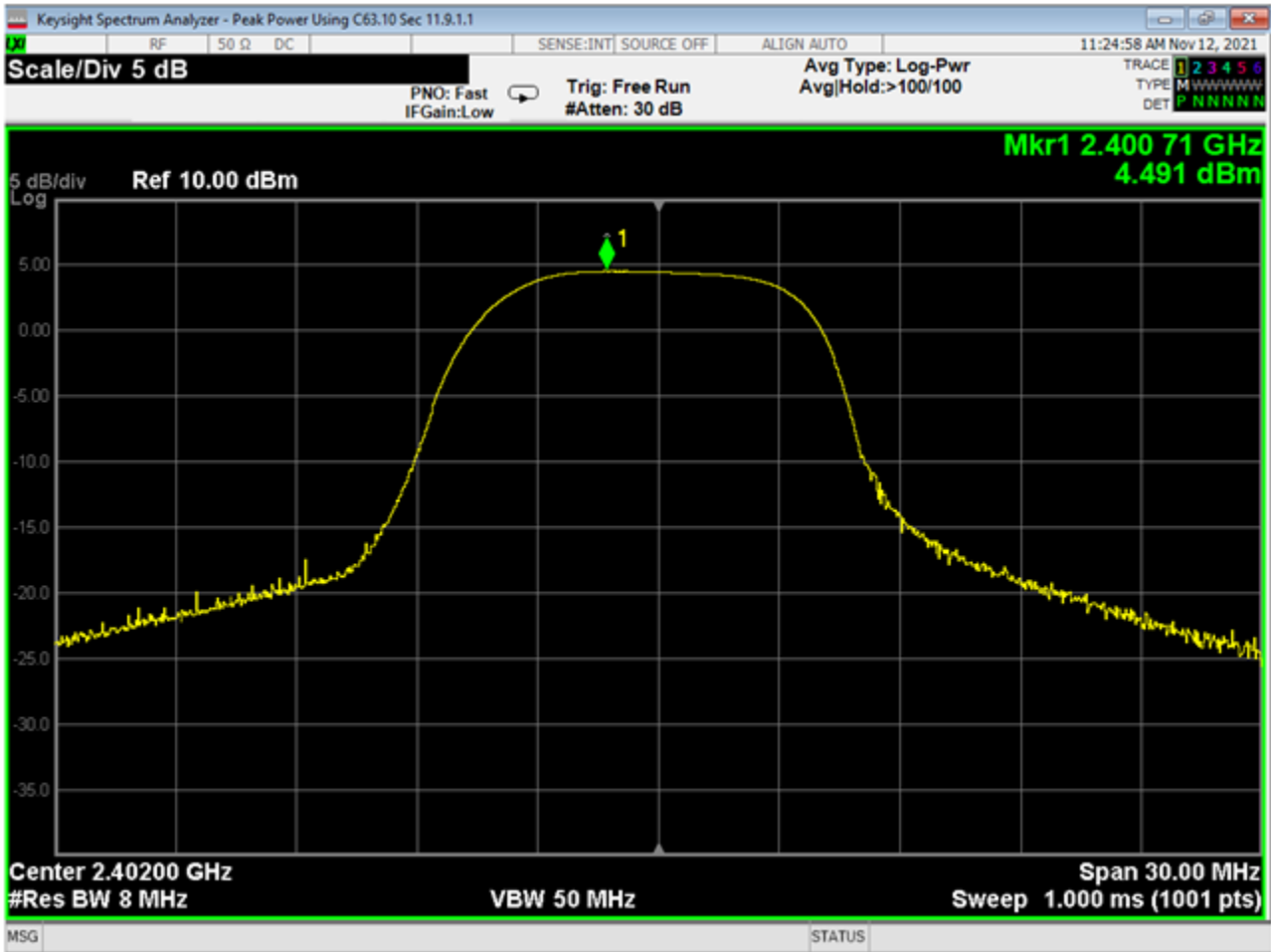
APPENDIX B – MEASUREMENT UNCERTAINTY

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

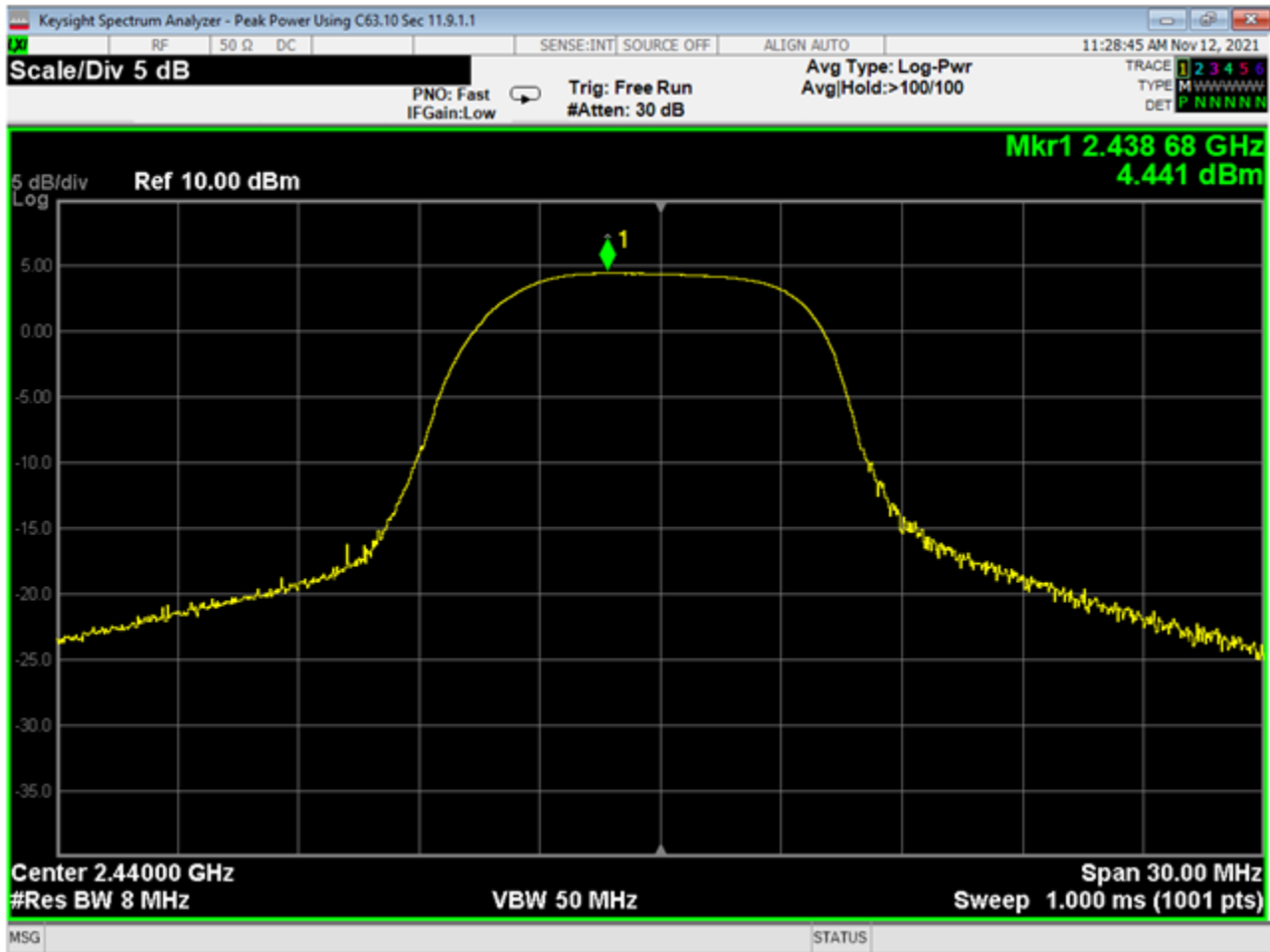
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

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

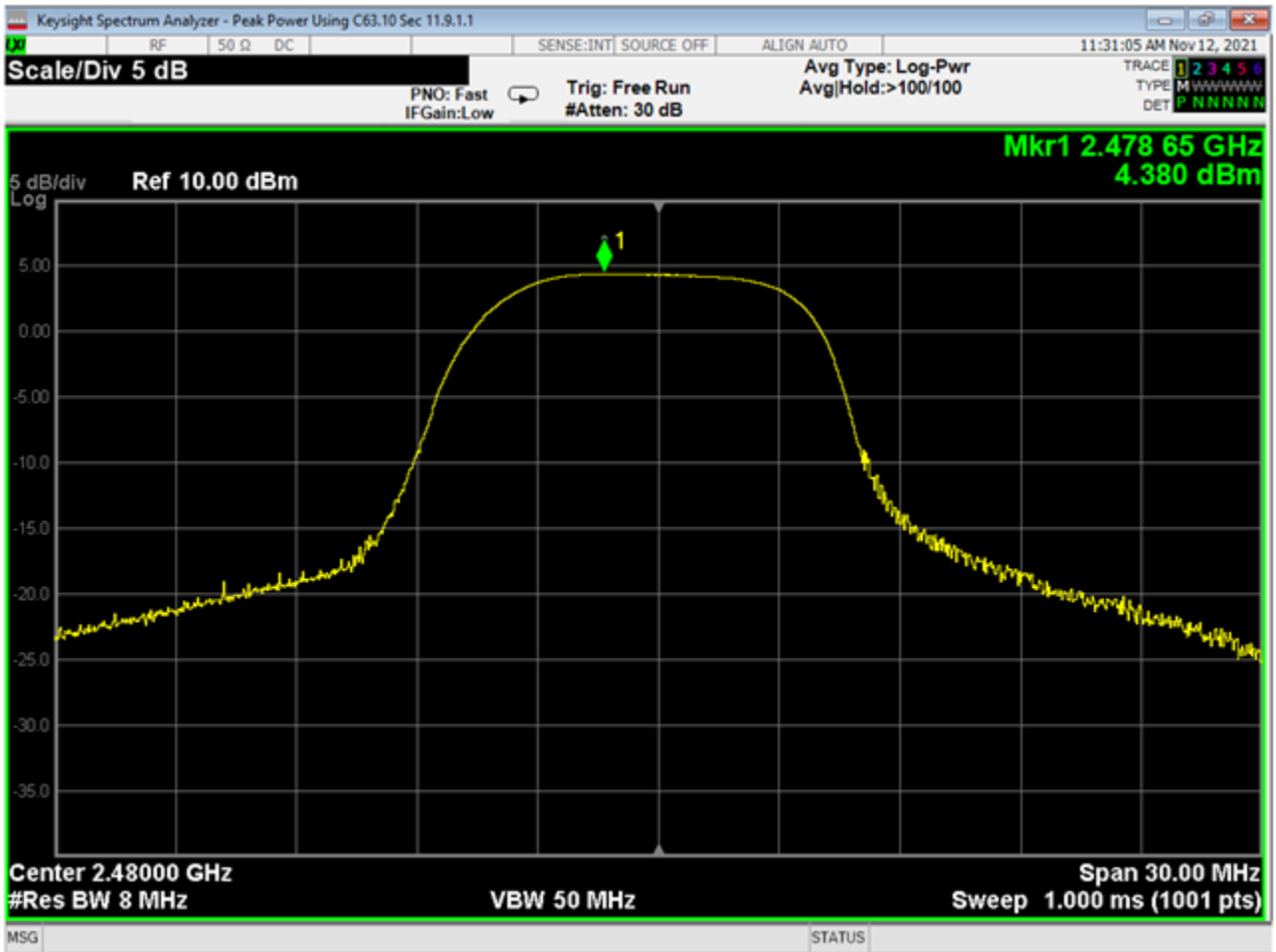
APPENDIX C – GRAPHS AND TABLES



01 Peak Power Low



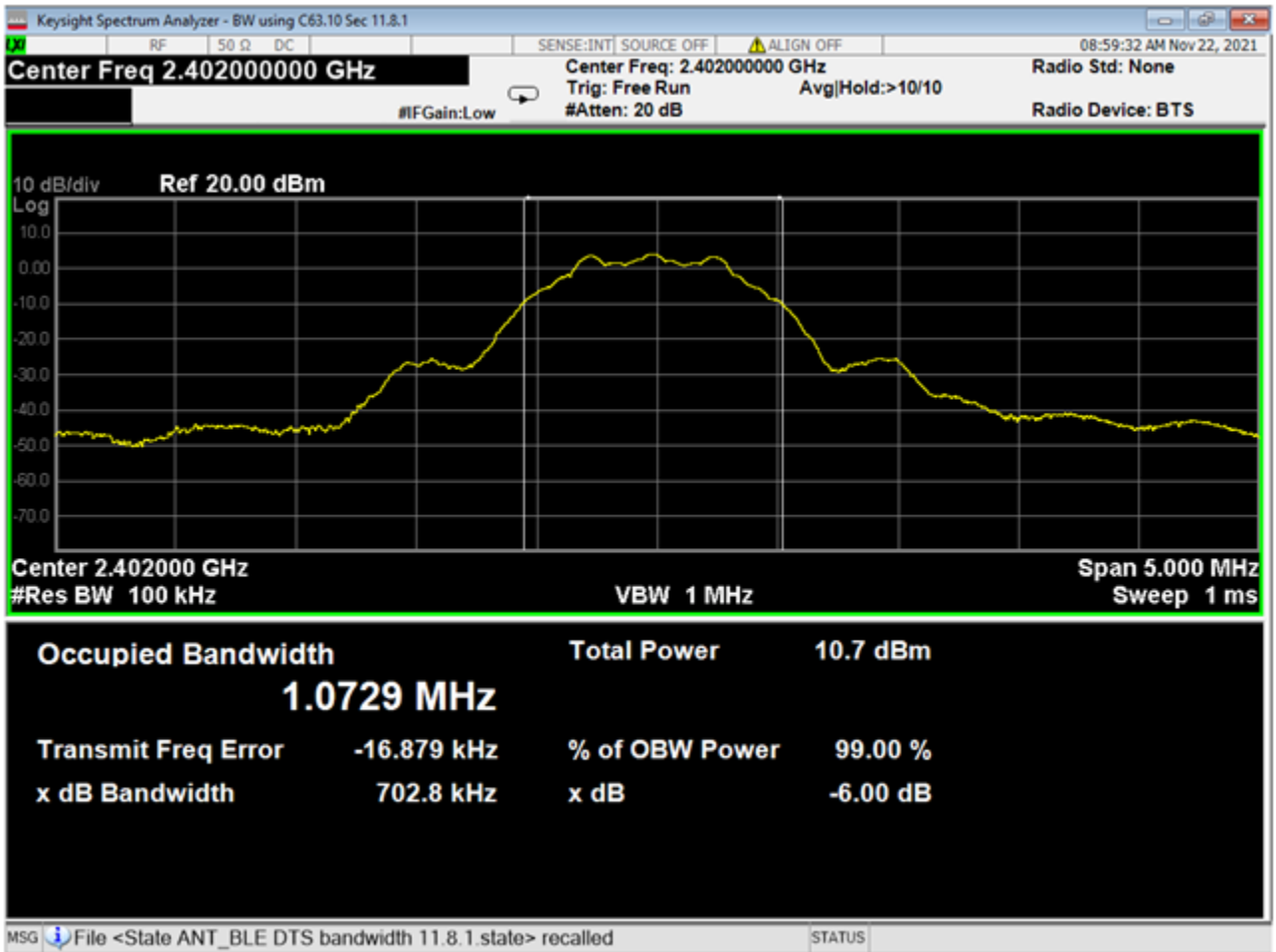
02 Peak Power Mid



03 Peak Power High



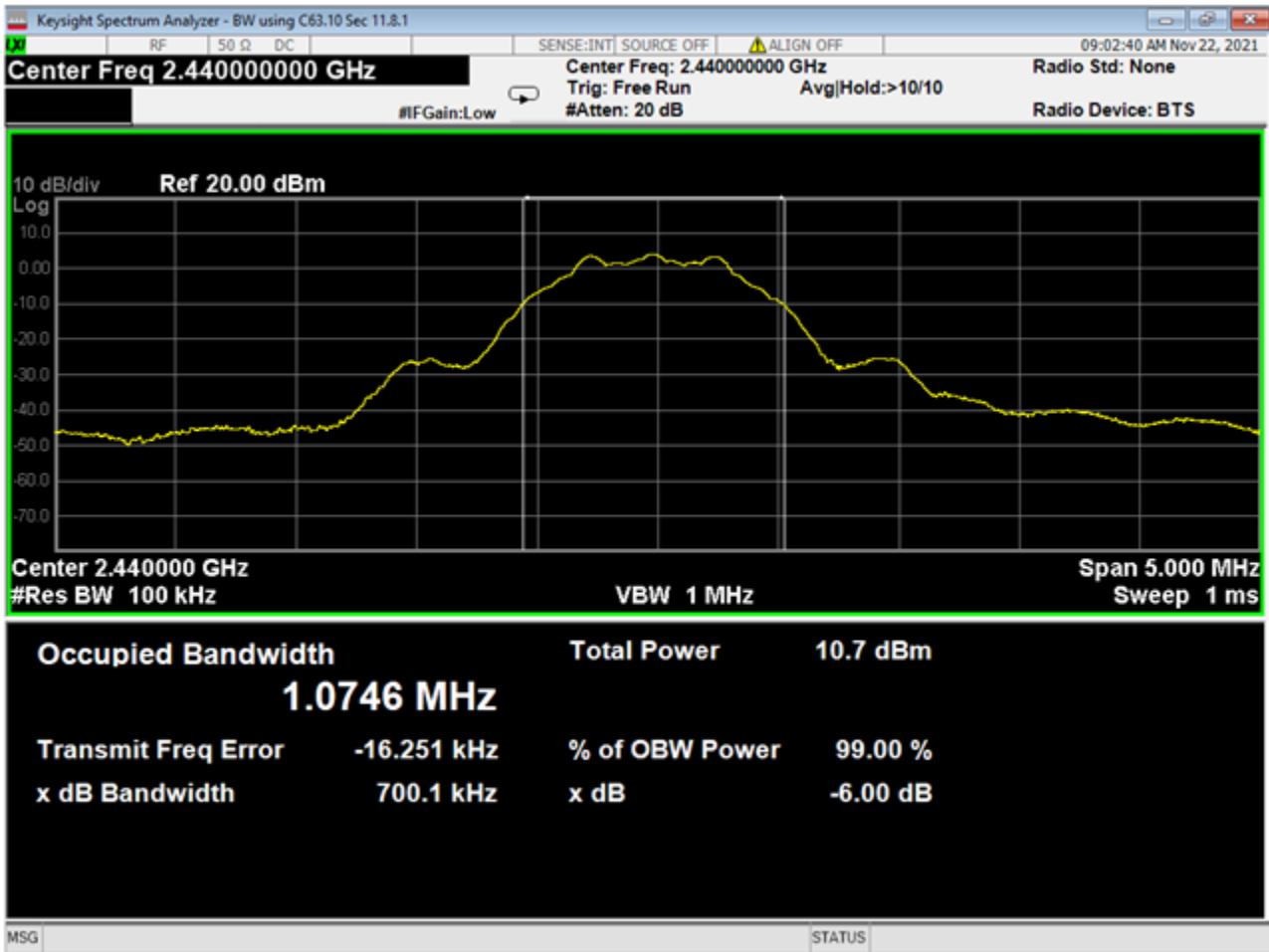
Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		



04 Bandwidth, Low



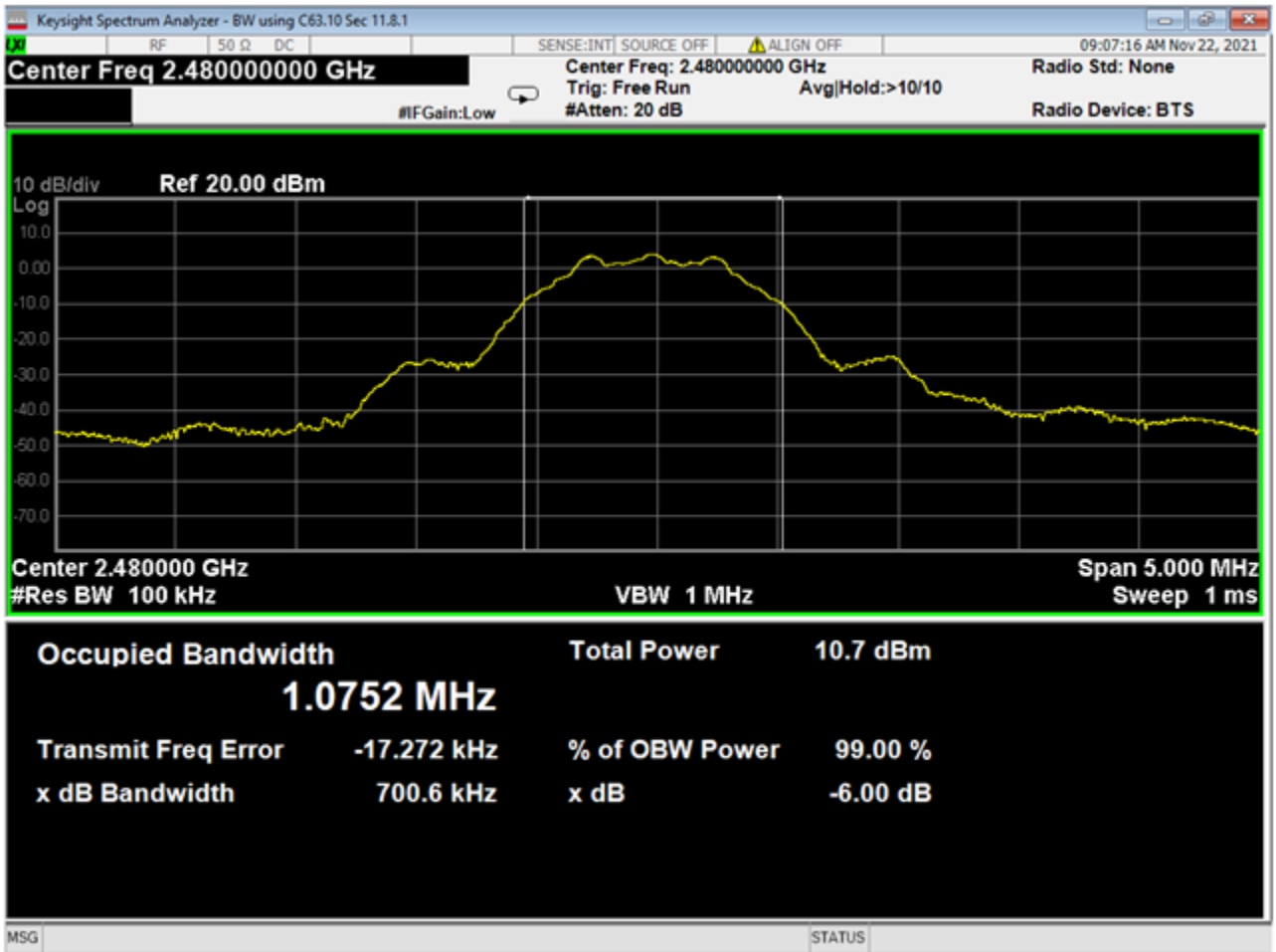
Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		



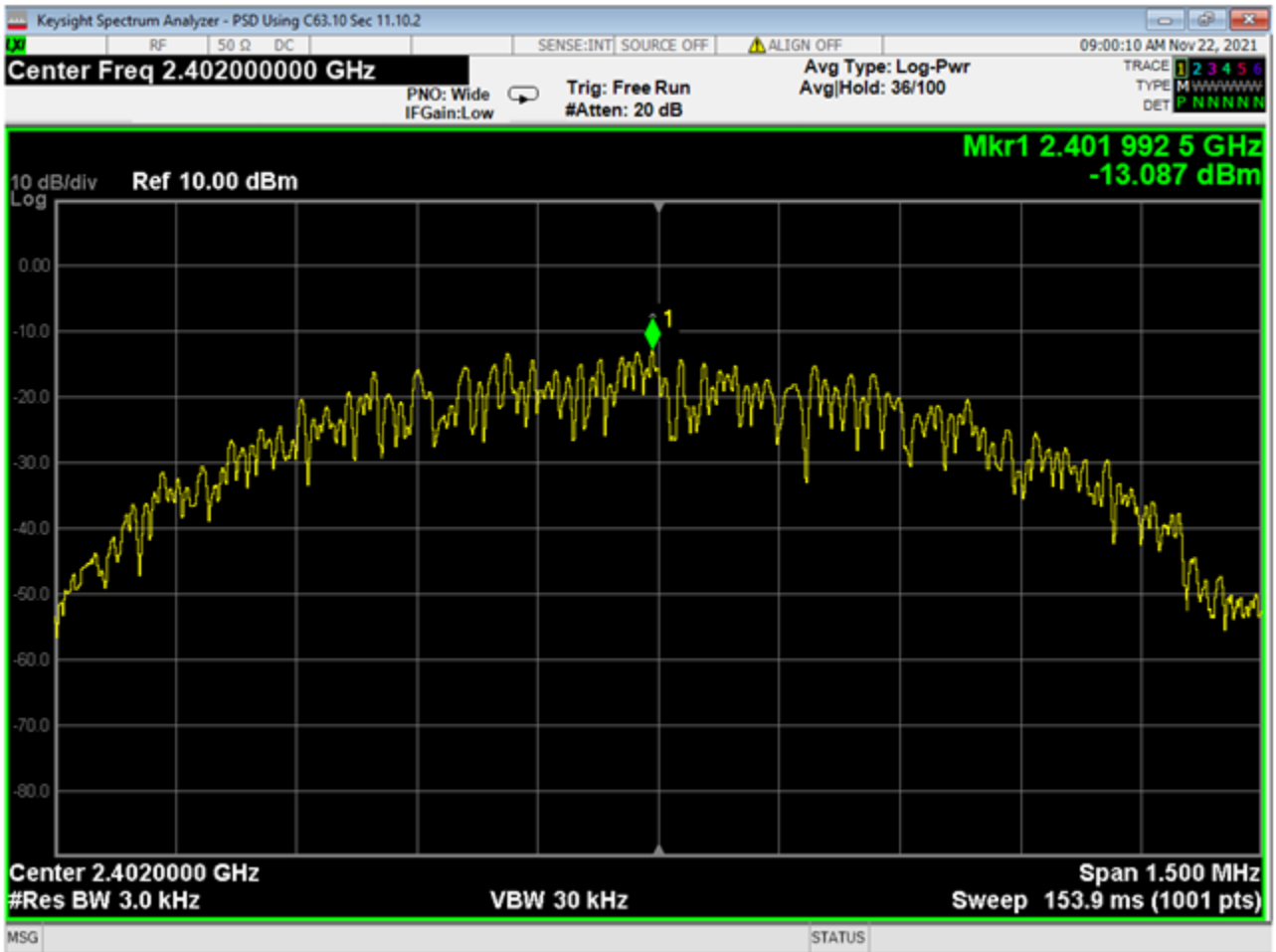
05 Bandwidth, Mid



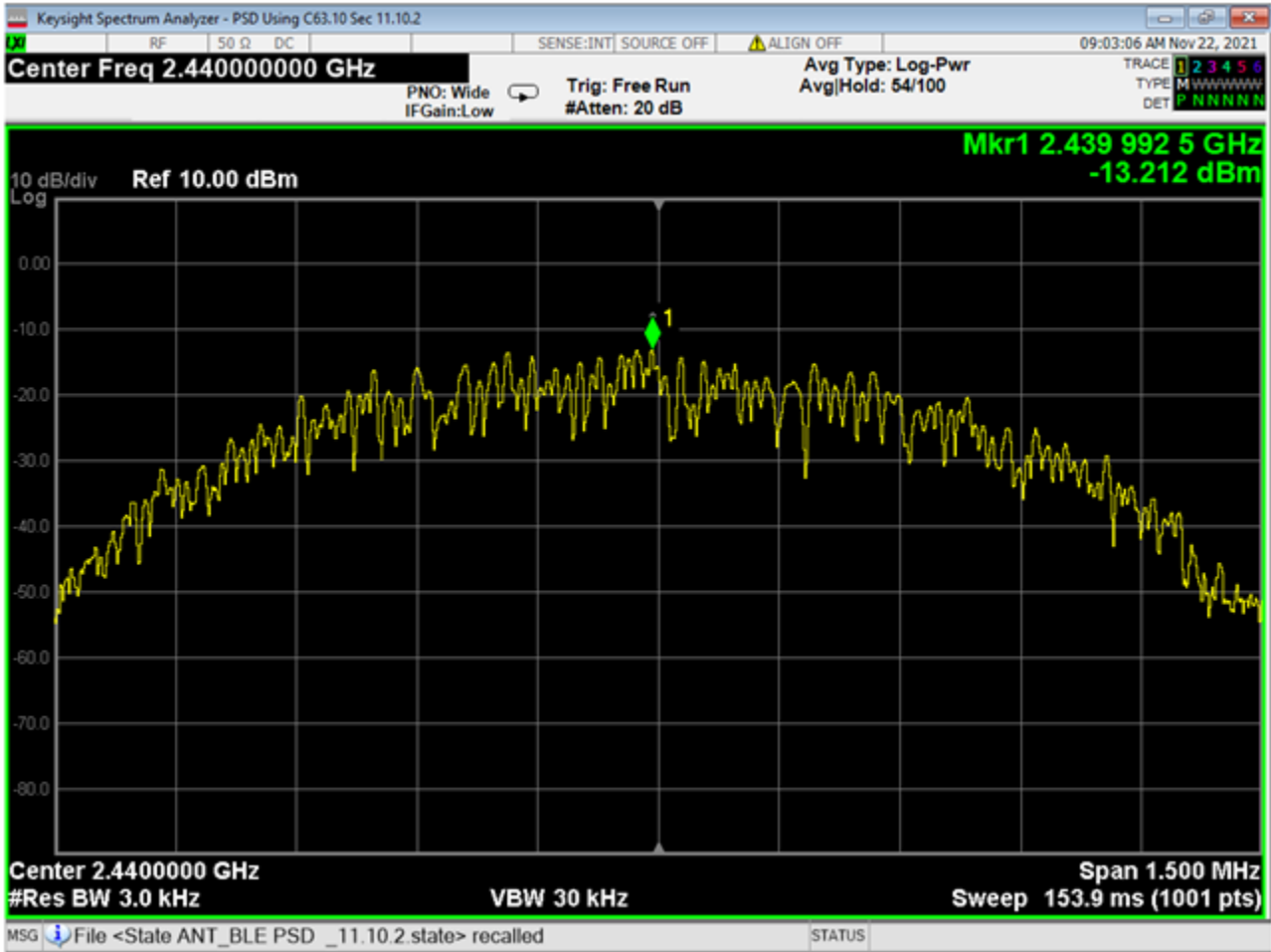
Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		



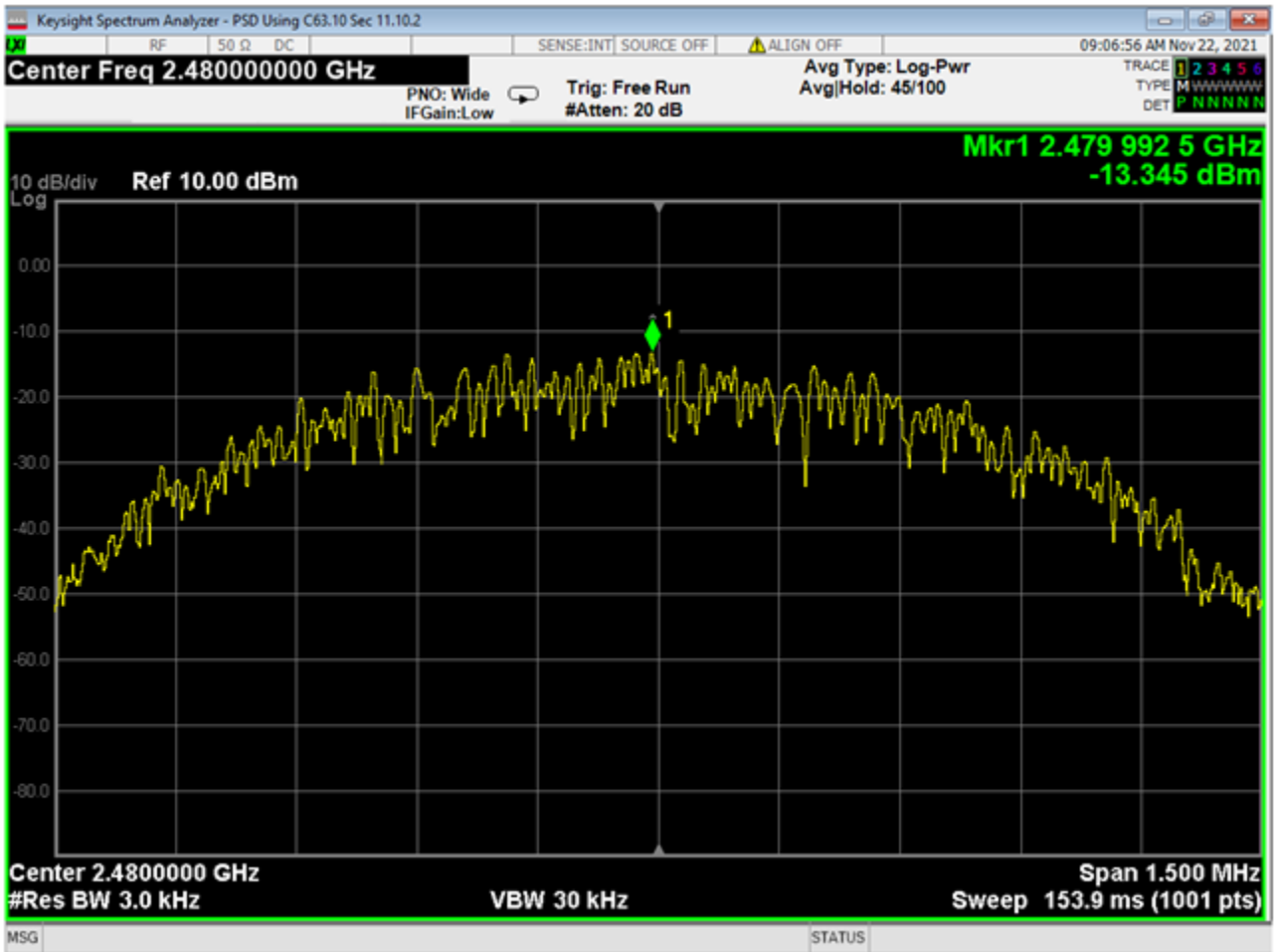
06 Bandwidth, High



07 PSD, Low



08 PSD, Mid



09 PSD, High



Report Number:

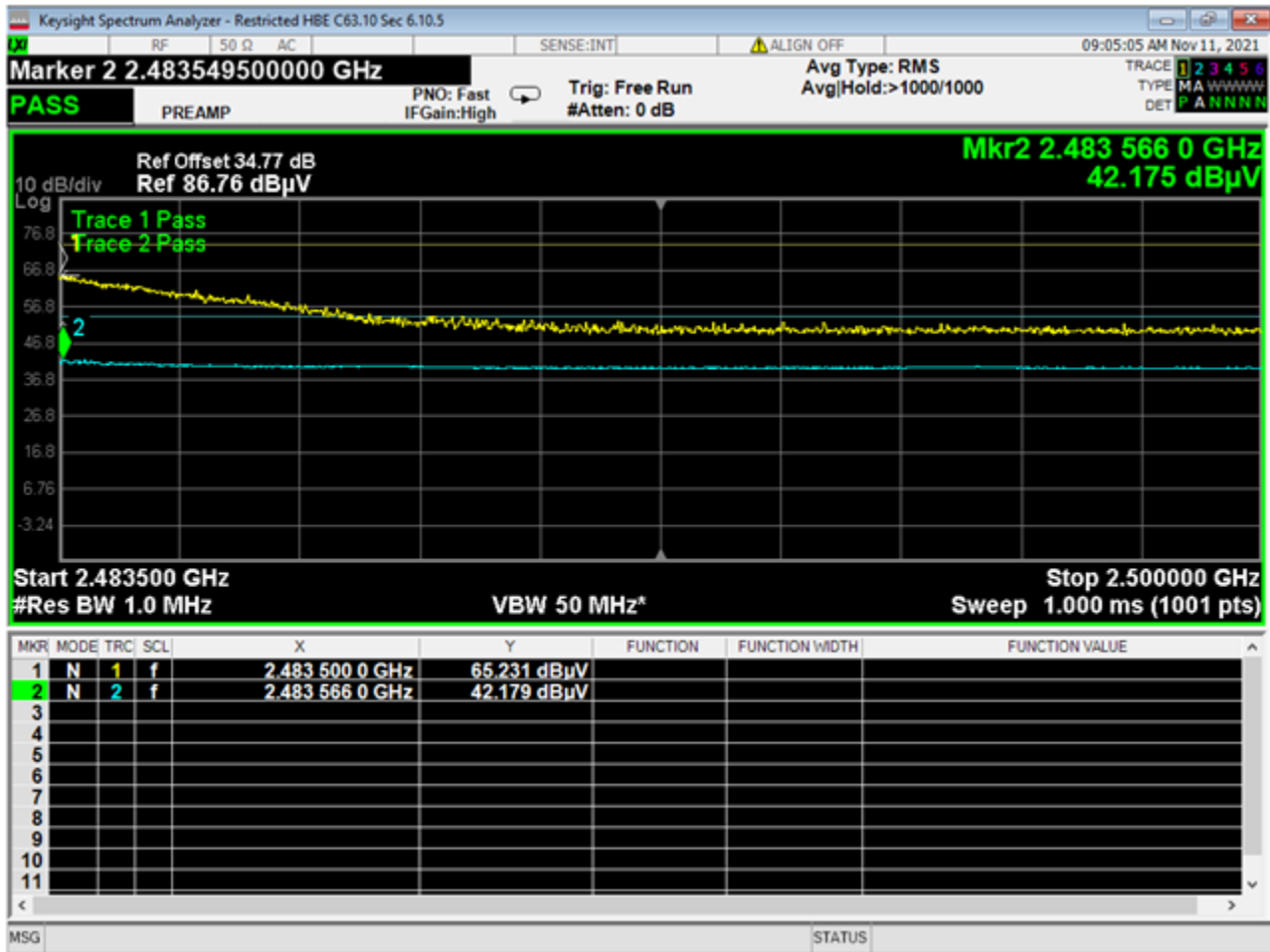
R20210922-20-E3A

Rev

A

Prepared for:

Garmin International, Inc.

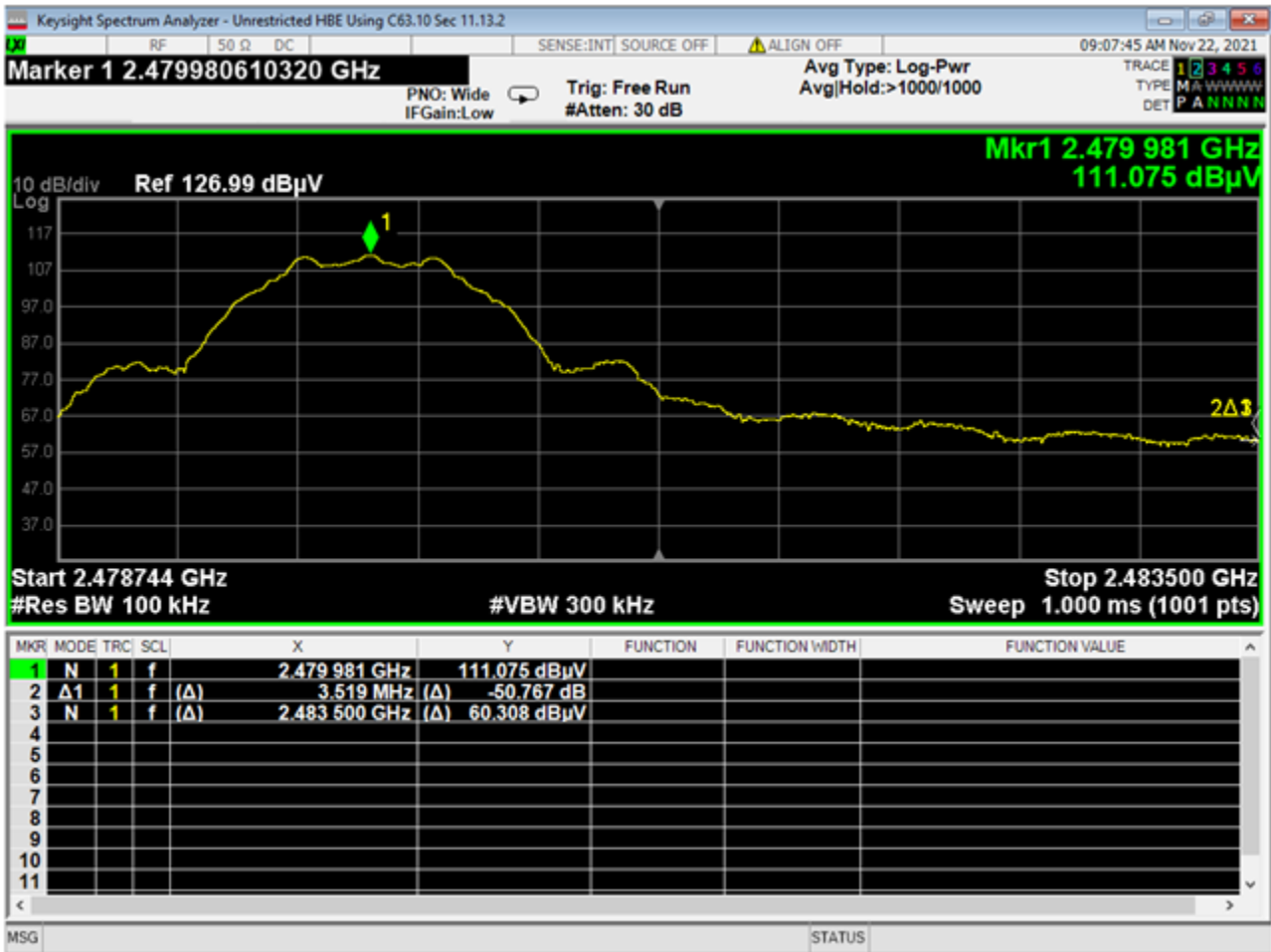


10 HBE Restricted

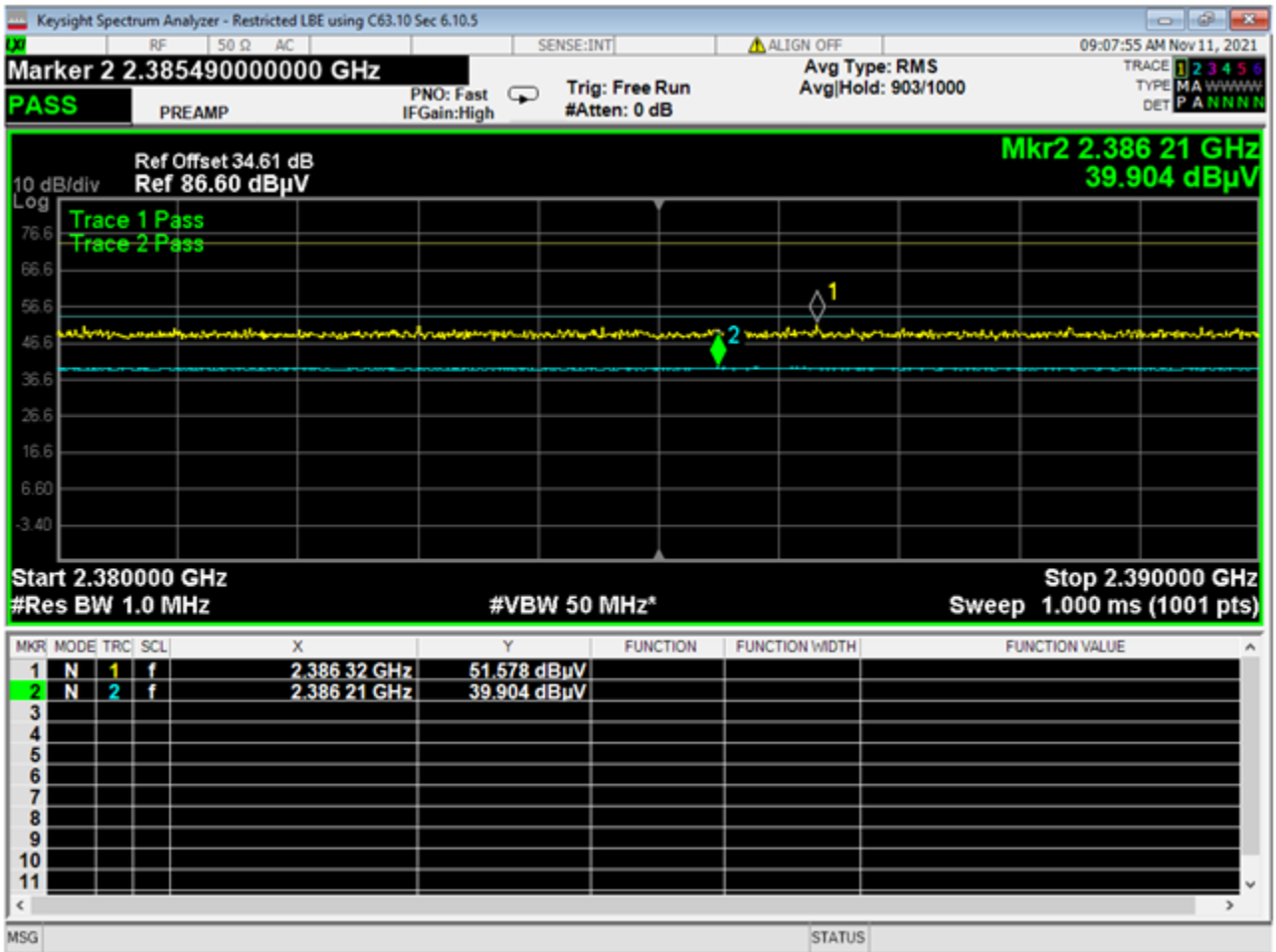
*The corrections were included in the measurement. Average measurement in the plot is an uncorrected value, as the average values are determined by adding duty cycle correction to the average value. The corrected values can be found in section 4.0 of this report.



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

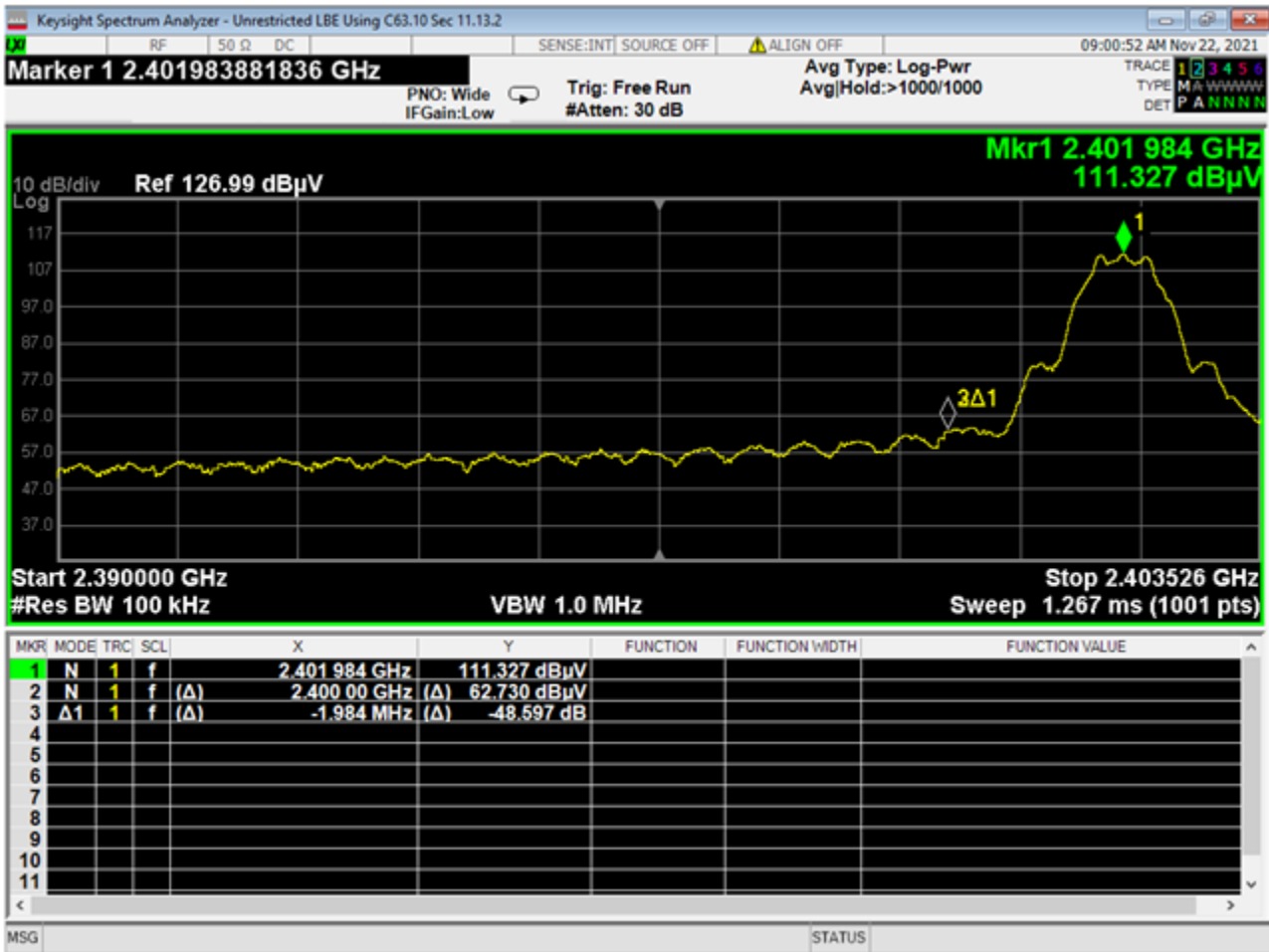


11 HBE Unrestricted Bandedge

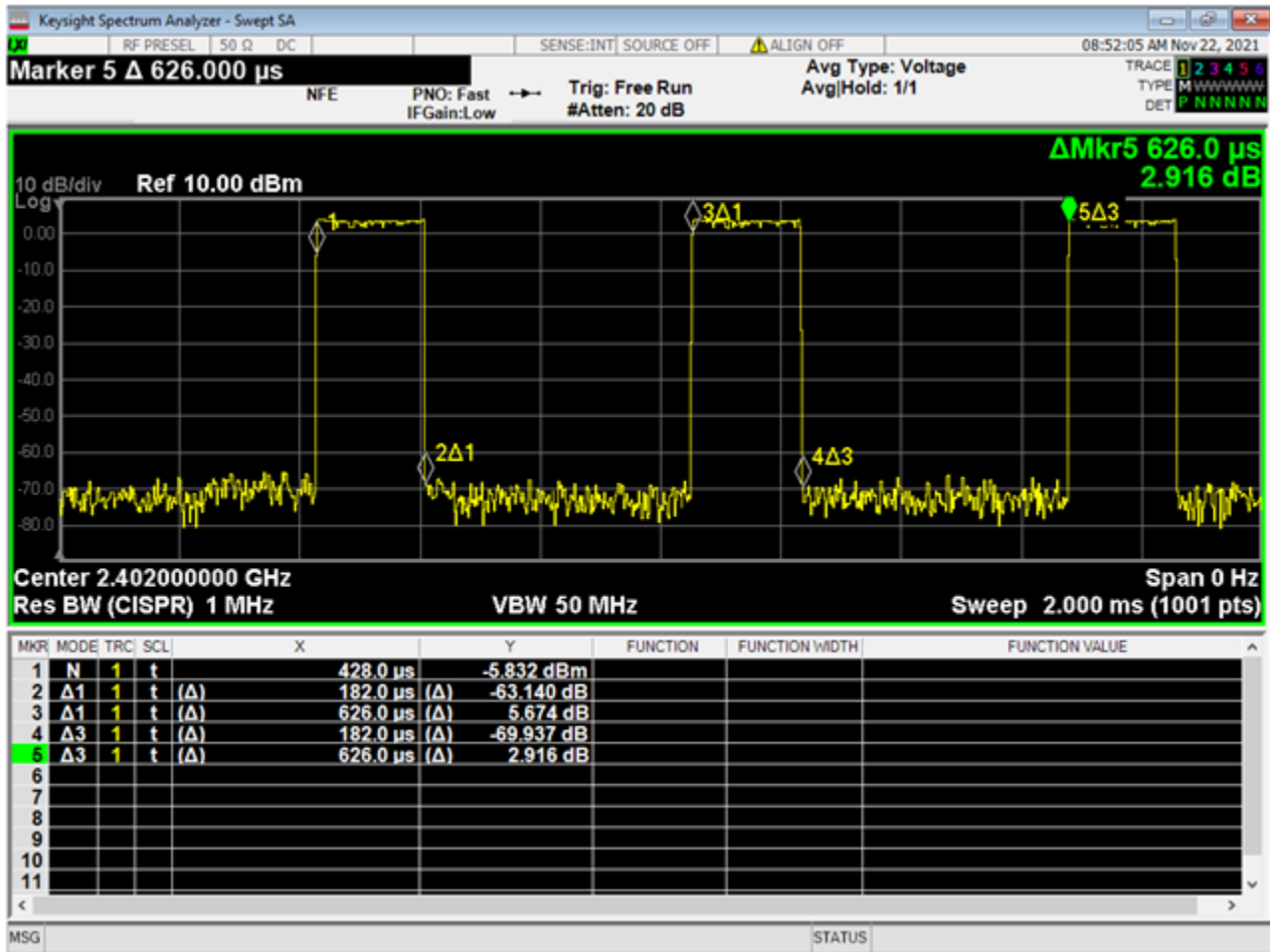


12 LBE Restricted

*The corrections were included in the measurement. Average measurement in the plot is an uncorrected value, as the average values are determined by adding duty cycle correction to the average value. The corrected values can be found in section 4.0 of this report.



13 LBE Unrestricted Bandedge



14 Duty Cycle



Report Number:	R20210922-20-E3A	Rev	A
Prepared for:	Garmin International, Inc.		

REPORT END