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FCC/ISED Test Report

Prepared for: Garmin International, Inc.

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

Product: A04452

Test Report No: R20220901-21-E2B

Approved by:

Fox Lane,
EMC Test Engineer

DATE: December 6, 2022

Total Pages: 38

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ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

REVISION PAGE

Rev. No.	Date	Description
0	18 November 2022	Issued by – FLane Reviewed by KVepuri Prepared by GLarsen, FLane
A	2 December 2022	Corrected Antenna Gain - FL
B	6 December 2022	Removed Antenna Gain - FL

CONTENTS

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)(1) RSS-247 Issue 2 Section 5.1(b)	Peak output power	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.1 (b)	Bandwidth	Pass
FCC Part 15.247(a)(1)(iii) RSS-247 Issue 2 Section 5.1(d)	Frequency Hopping System	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 5.5	Band Edge Measurement	Pass
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	A04452
IC	1792A-04452
FCC ID	IPH-04452
EUT Received	3 October 2022
EUT Tested	3 October 2022- 7 November 2022
Serial No.	3426283485 (Radiated Measurements) 3426283465 (Conducted Measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	☐ GMSK ☐ GFSK ☒ BT BR ☐ BT EDR 2MB ☐ BT EDR 3MB ☐ 802.11x
Power Supply / Voltage	Internal Battery / 5VDC Charger: Garmin (Phi Hong) Model: AQ27A-59CFA GPN: 362-00118-00 (Representative Power Supply)

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

2.2 DESCRIPTION OF TEST MODES

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

For BTBR 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 ± 4%
Temperature of 22 ± 3° 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

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.

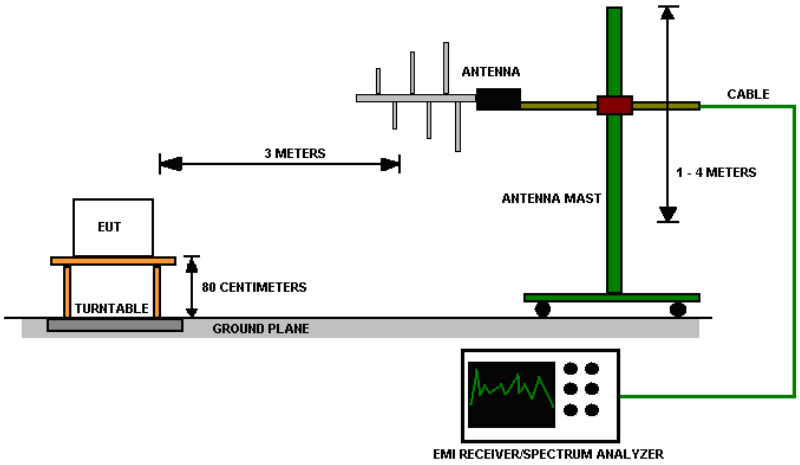


Figure 2 - Radiated Emissions Test Setup

4.0 RESULTS

DSS Radio Measurements								
CHANNEL	**Transmitter**	**Occupied Bandwidth (kHz)**	**20 dB Bandwidth (kHz)**	**AVERAGE OUTPUT POWER (dBm)**	**AVERAGE OUTPUT POWER (mW)**	**RESULT**	**No. of Hopping Channels**	**ON Time (µs)**
							79	377
Low	Continuous	947.82	1117.0	9.86	9.68	PASS	**Channel Separation (MHz)**	**Time of Occupancy (ms)**
Mid	Continuous	935.81	1118.0	10.19	10.45	PASS		
High	Continuous	955.18	1117.0	9.98	9.95	PASS	1.00	120.64
Occupied Bandwidth = N/A; Channel Separation Limit: > 2/3 * 20 dB Bandwidth.			Peak Output Power Limit = 125mW; Time of Occupancy Limit < 0.4s; Time of Occupancy = ON Time * # of transmissions over, period of time of occupancy= 0.000377*32*10 (See Figure 11 in appendix C) =0.1264 s Period of Time of Occupancy = 0.4 * # of Channels = 0.4 * 79 = 31.6s					

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	Continuous	2400.00	70.617	116.706	46.089	30.0	PASS
Low	Hopping	2400.00	69.431	117.598	48.167	30.0	PASS
High	Continuous	2483.50	55.819	117.435	61.616	30.0	PASS
High	Hopping	2483.50	52.510	116.119	63.609	30.0	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	Continuous	2390.00	54.220	Peak	73.98	19.76	PASS
High	Continuous	2483.50	56.236	Peak	73.98	17.744	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	Continuous	2390.00	42.169	Average	53.98	11.81	PASS
High	Continuous	2483.50	45.904	Average	53.98	8.076	PASS
*Limit shown is the average limit taken from FCC Part 15.209 See Sec 4.3 for more information on DCCF							

4.1 OUTPUT POWER

Test Method: All the radio measurements were performed using the section 11.9.2.2.4 from ANSI C63.10.

Limits of power measurements:
For FCC Part 15.247 Device:
The maximum allowed peak output power is 125mW.

Test procedures:
Details can be found in section 3.4 of this report. See section 4.3 for Duty cycle used.

Deviations from test standard:
No deviation.

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

EUT operating conditions:
Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the output power plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables below.
4. Compiled values can be found in the Results section, 4.0.

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:
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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:

All transmitter(s)/modulation(s) in this report are >98%, no duty cycle corrections were added

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 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:

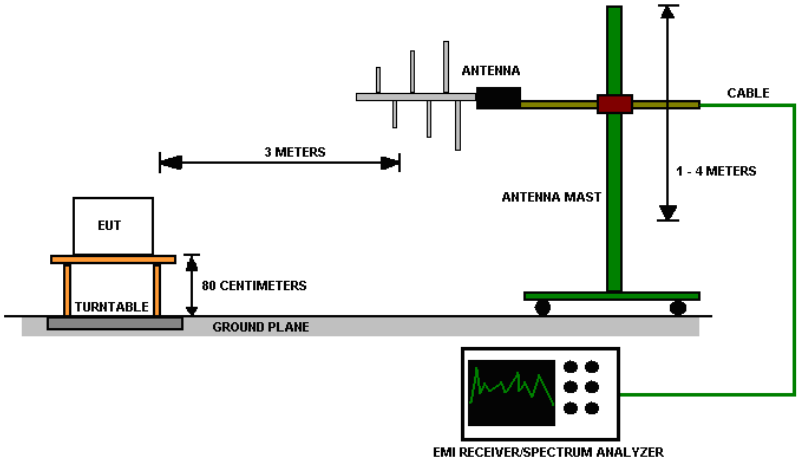


Figure 3 - Radiated Emissions Test Setup

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:

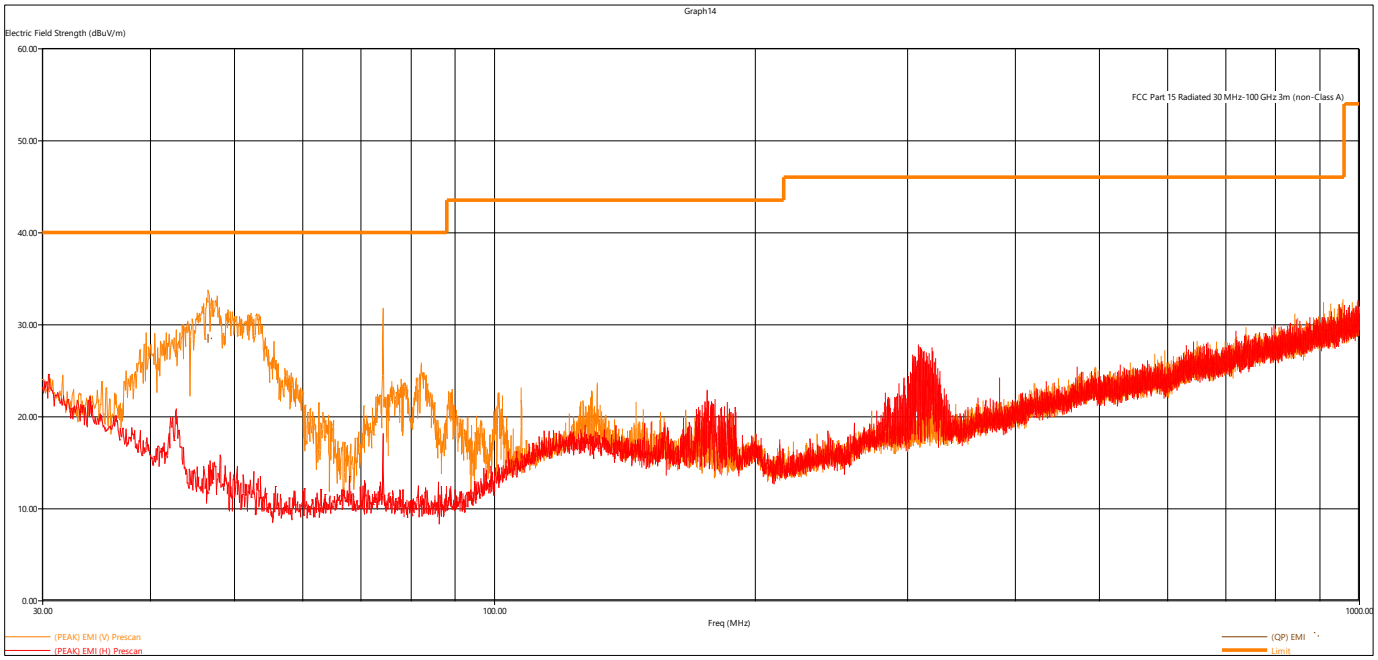


Figure 4 - Radiated Emissions Plot, Receive

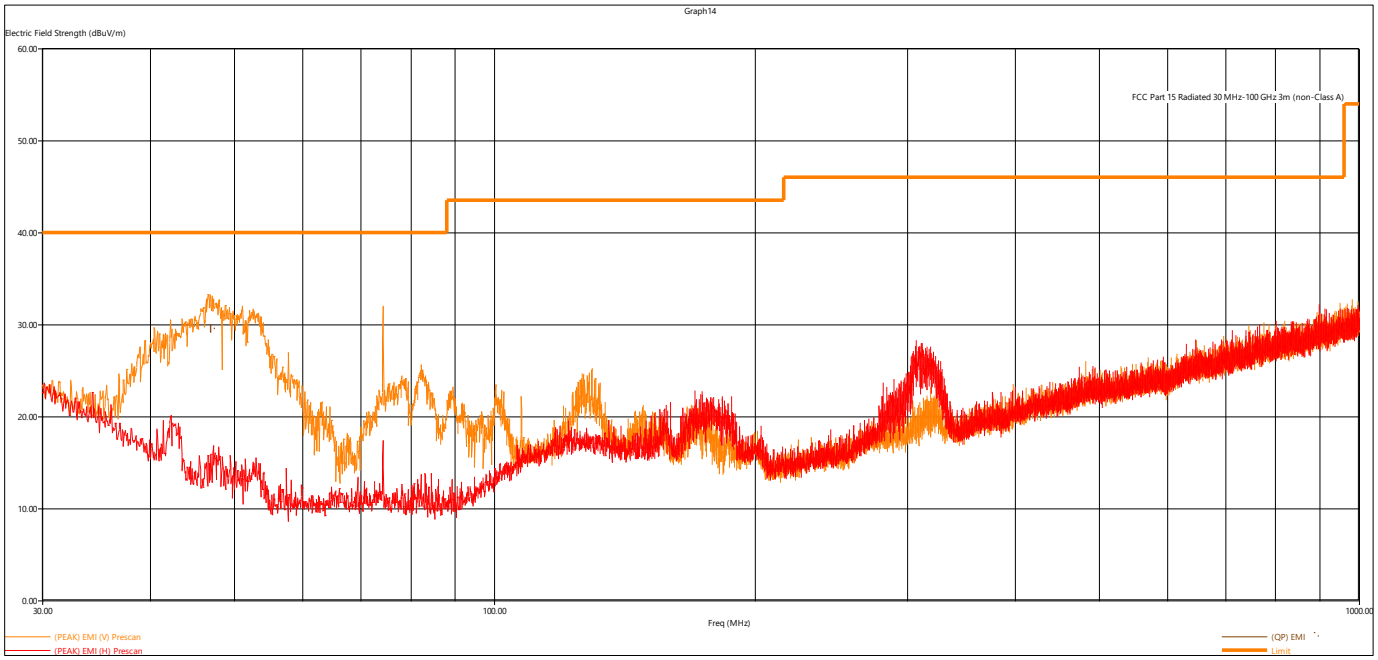


Figure 5 - Radiated Emissions Plot, BTBR, Low Channel

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. Emissions found to be at least 10dB below limit line and were not reported.

Quasi-Peak Measurements, BTBR								
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**	**Modulation**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**			
46.880640	29.56	40.00	10.44	106.00	227.00	V	Low	BTBR
46.431840	28.41	40.00	11.59	106.00	235.00	V	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.

Peak Measurements, BTBR								
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**	**Modulation**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**			
2402.064000	105.81	NA	NA	162.00	5.00	V	Low	BT BR
2440.082000	105.79	NA	NA	187.00	360.00	V	Mid	BT BR
2480.114000	106.20	NA	NA	172.00	3.00	V	High	BT BR
4803.862000	46.68	73.98	27.30	200.00	215.00	V	Low	BT BR
7206.342000	54.43	73.98	19.55	516.00	115.00	V	Low	BT BR
4880.268000	48.97	73.98	25.01	177.00	162.00	V	Mid	BT BR
7320.040000	55.37	73.98	18.61	473.00	150.00	V	Mid	BT BR
4960.100000	48.47	73.98	25.51	204.00	209.00	H	High	BT BR
7440.102000	53.17	73.98	20.81	498.00	154.00	V	High	BT BR
All other emissions found to be at least 6dB below limit line								

Average Measurements, BTBR								
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**	**Modulation**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**			
2402.064000	104.97	NA	NA	162.00	5.00	V	Low	BT BR
2440.082000	104.83	NA	NA	187.00	360.00	V	Mid	BT BR
2480.114000	105.09	NA	NA	172.00	3.00	V	High	BT BR
4803.862000	38.35	53.98	15.63	200.00	215.00	V	Low	BT BR
7206.342000	45.72	53.98	8.26	516.00	115.00	V	Low	BT BR
4880.268000	40.83	53.98	13.15	177.00	162.00	V	Mid	BT BR
7320.040000	**48.19**	**53.98**	**5.79**	**473.00**	**150.00**	**V**	**Mid**	**BT BR**
4960.100000	40.24	53.98	13.74	204.00	209.00	H	High	BT BR
7440.102000	44.98	53.98	9.00	498.00	154.00	V	High	BT BR
*Average Levels Obtained from; Average Level = Peak Level + DCCF (For Emissions), for more information on DCCF see Sec 4.3 All other emissions found to be below measurement sensitivity.								

4.5 CONDUCTED SPURIOUS EMISSIONS

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 § 15.209(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:

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:

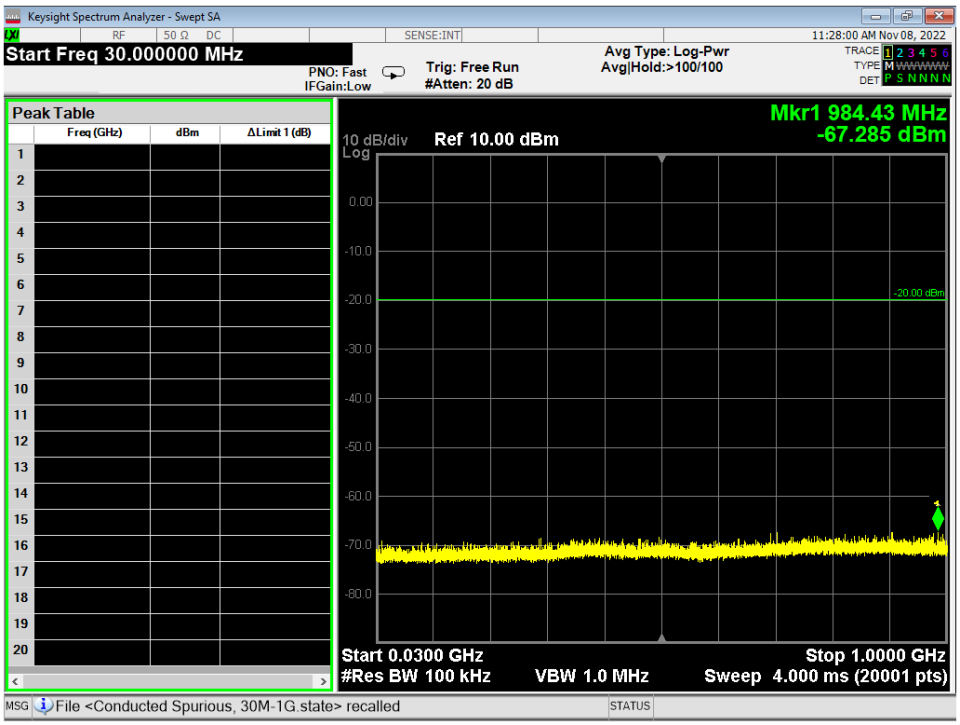


Figure 6 - Radiated Emissions Plot, BTBR, 30M – 1G

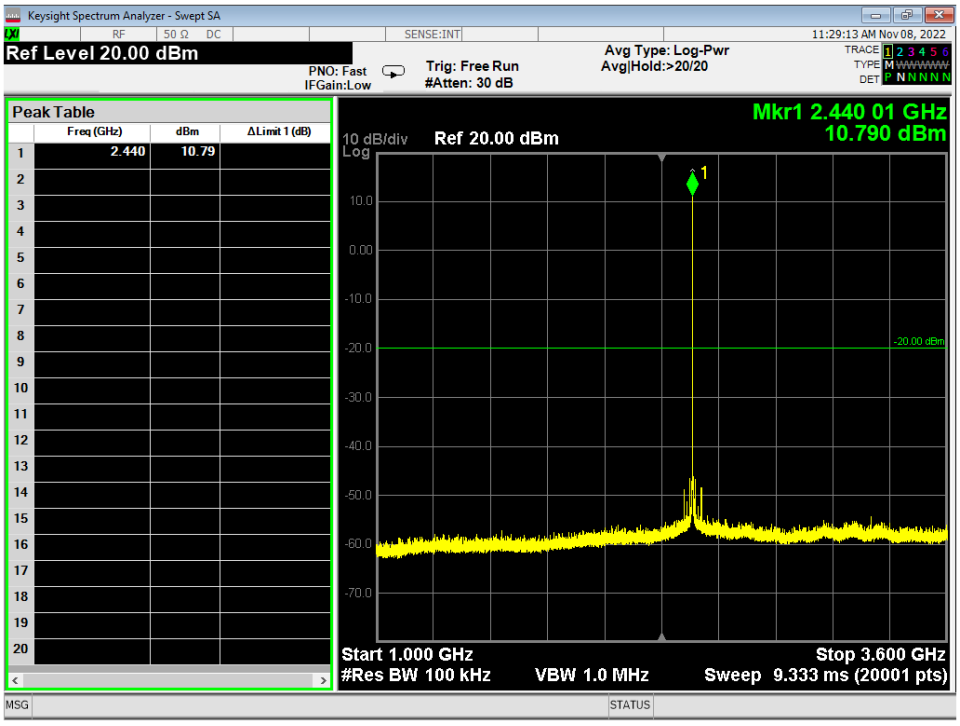


Figure 7 - Radiated Emissions Plot, BTBR, 1G – 3.6G

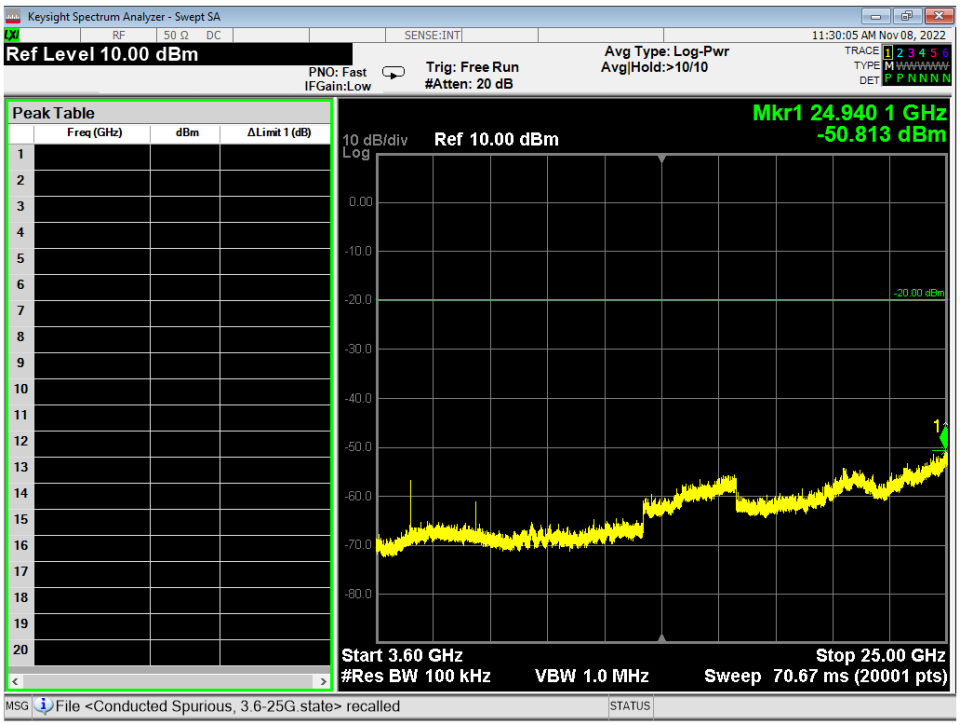


Figure 8 - Radiated Emissions Plot, BTBR, 3.6G – 25G

4.6 BAND EDGES

Test Method: All the radio measurements were performed using the sections from ANSI C63.10. Restricted band edges are using Sec 6.10.5.

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.

4.7 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, Section(s) 6.2

Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

Notes:
1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 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.

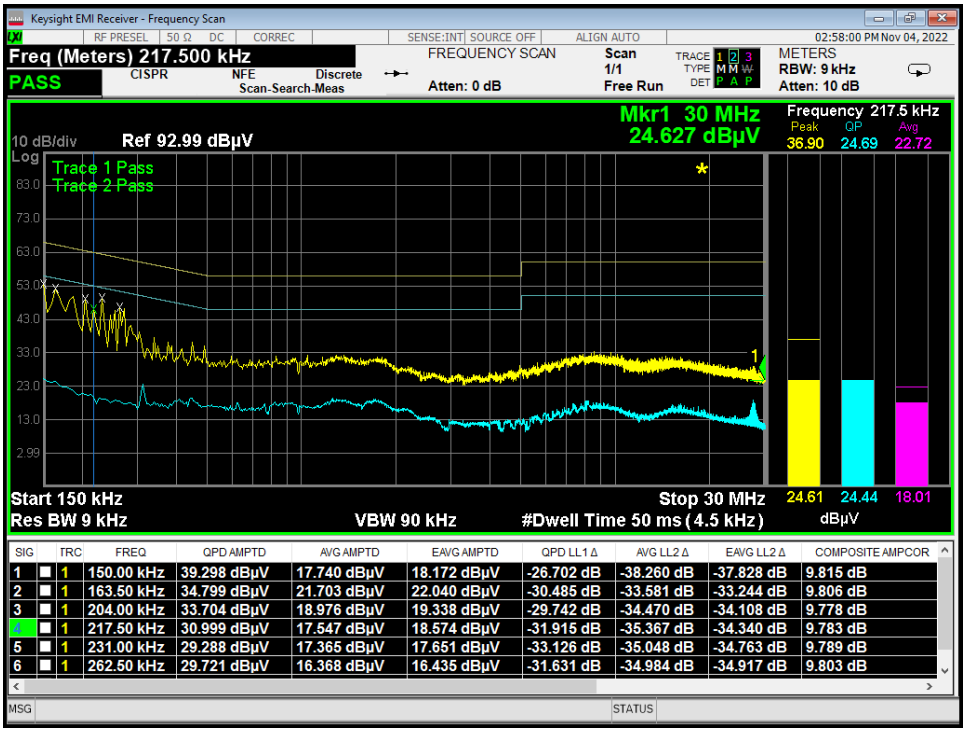
Test Procedures:

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

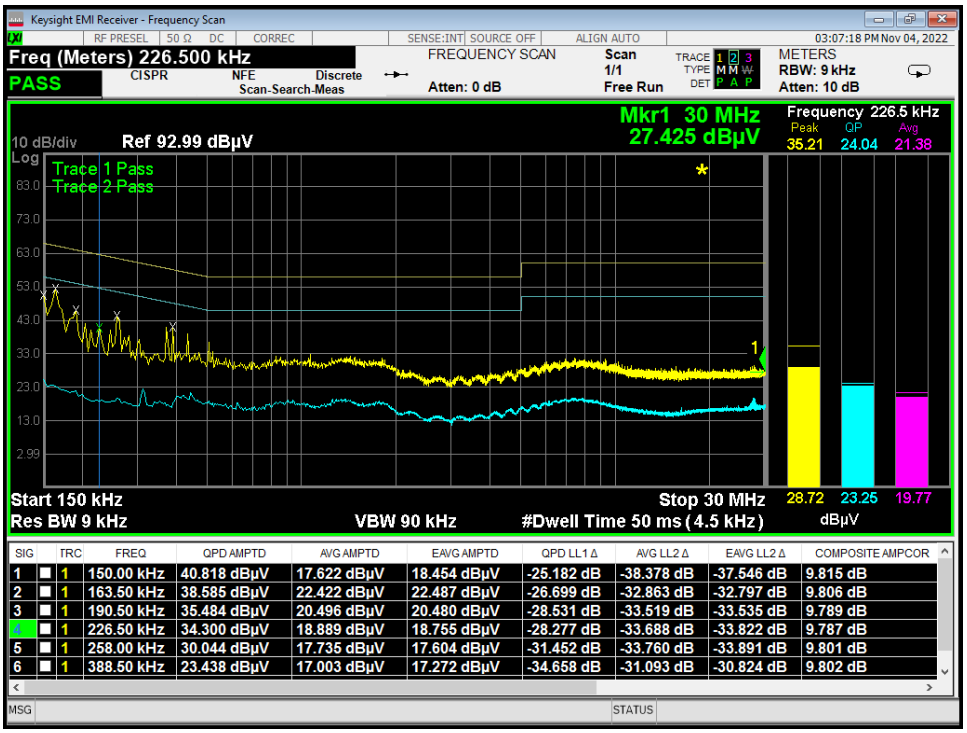
EUT operating conditions:
Details can be found in section 2.1 of this report.
.

Test Results:



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	EAVG AMPTD	QPD LL1 Δ	AVG LL2 Δ	EAVG LL2 Δ	COMPOSITE AMPCOR
1	1	150.00 kHz	39.298 dBµV	17.740 dBµV	18.172 dBµV	-26.702 dB	-38.260 dB	-37.828 dB	9.815 dB
2	1	163.50 kHz	34.799 dBµV	21.703 dBµV	22.040 dBµV	-30.485 dB	-33.581 dB	-33.244 dB	9.806 dB
3	1	204.00 kHz	33.704 dBµV	18.976 dBµV	19.338 dBµV	-29.742 dB	-34.470 dB	-34.108 dB	9.778 dB
4	1	217.50 kHz	30.999 dBµV	17.547 dBµV	18.574 dBµV	-31.915 dB	-35.367 dB	-34.340 dB	9.783 dB
5	1	231.00 kHz	29.288 dBµV	17.365 dBµV	17.651 dBµV	-33.126 dB	-35.048 dB	-34.763 dB	9.789 dB
6	1	262.50 kHz	29.721 dBµV	16.368 dBµV	16.435 dBµV	-31.631 dB	-34.984 dB	-34.917 dB	9.803 dB

Figure 9 - Conducted Emissions Plot, Line, TX



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	EAVG AMPTD	QPD LL1 Δ	AVG LL2 Δ	EAVG LL2 Δ	COMPOSITE AMPCOR
1	1	150.00 kHz	40.818 dBµV	17.622 dBµV	18.454 dBµV	-25.182 dB	-38.378 dB	-37.546 dB	9.815 dB
2	1	163.50 kHz	38.585 dBµV	22.422 dBµV	22.487 dBµV	-26.699 dB	-32.863 dB	-32.797 dB	9.806 dB
3	1	190.50 kHz	35.484 dBµV	20.496 dBµV	20.480 dBµV	-28.531 dB	-33.519 dB	-33.535 dB	9.789 dB
4	1	226.50 kHz	34.300 dBµV	18.889 dBµV	18.755 dBµV	-28.277 dB	-33.688 dB	-33.822 dB	9.787 dB
5	1	258.00 kHz	30.044 dBµV	17.735 dBµV	17.604 dBµV	-31.452 dB	-33.760 dB	-33.891 dB	9.801 dB
6	1	388.50 kHz	23.438 dBµV	17.003 dBµV	17.272 dBµV	-34.658 dB	-31.093 dB	-30.824 dB	9.802 dB

Figure 10 - Conducted Emissions Plot, Neutral, TX

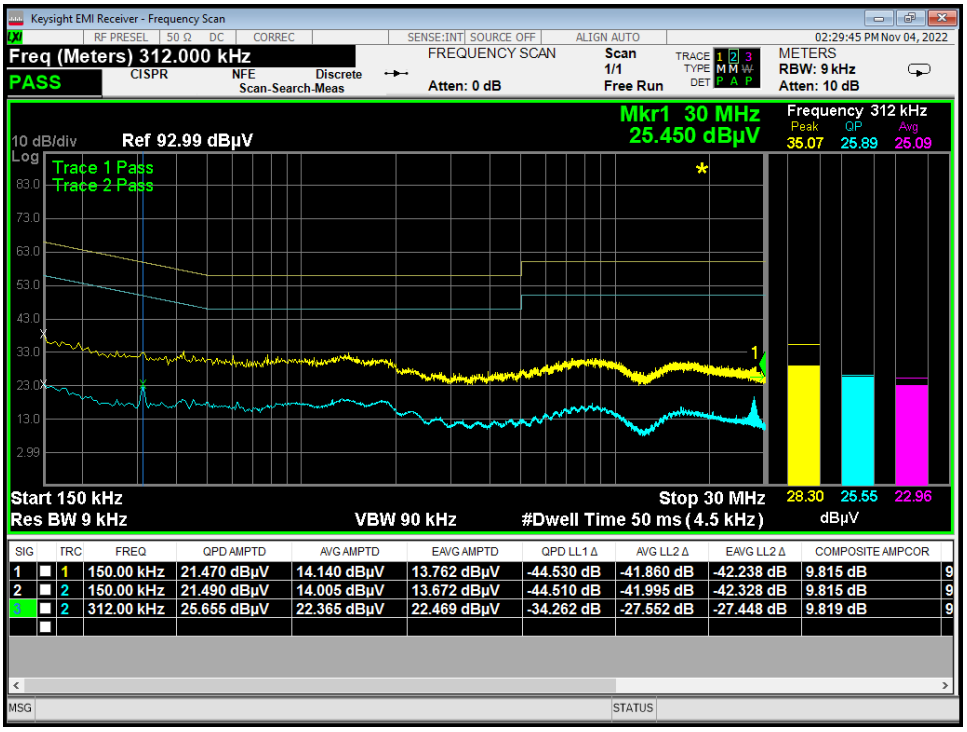


Figure 11 - Conducted Emissions Plot, Line, IDLE

Figure 12 - 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 dBμV 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 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

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

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 (dBµV) = Power (dBm) + 107 (for 50Ω measurement systems)

Field Strength (V/m) = 10^[Field Strength (dBµV/m) / 20] / 10^6

Gain = 1 (numeric gain for isotropic radiator)

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

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

EIRP(dBm) = FS(dBµV/m) – 10(log 10^9)+ 10log[0.3] = FS(dBµV/m) - 95.23

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

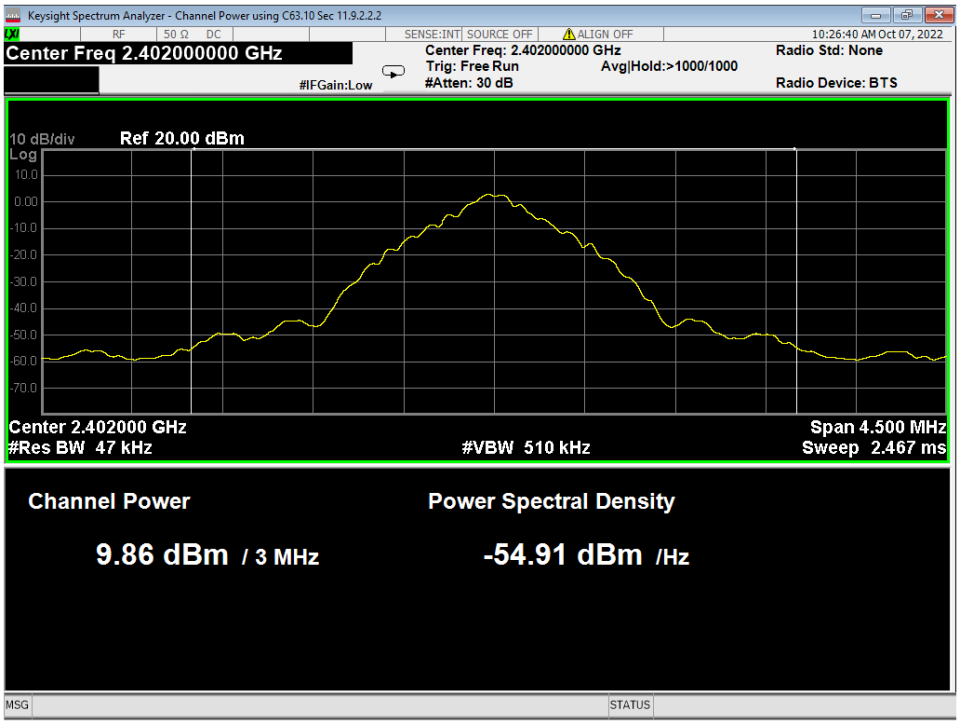
APPENDIX B – MEASUREMENT UNCERTAINTY

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

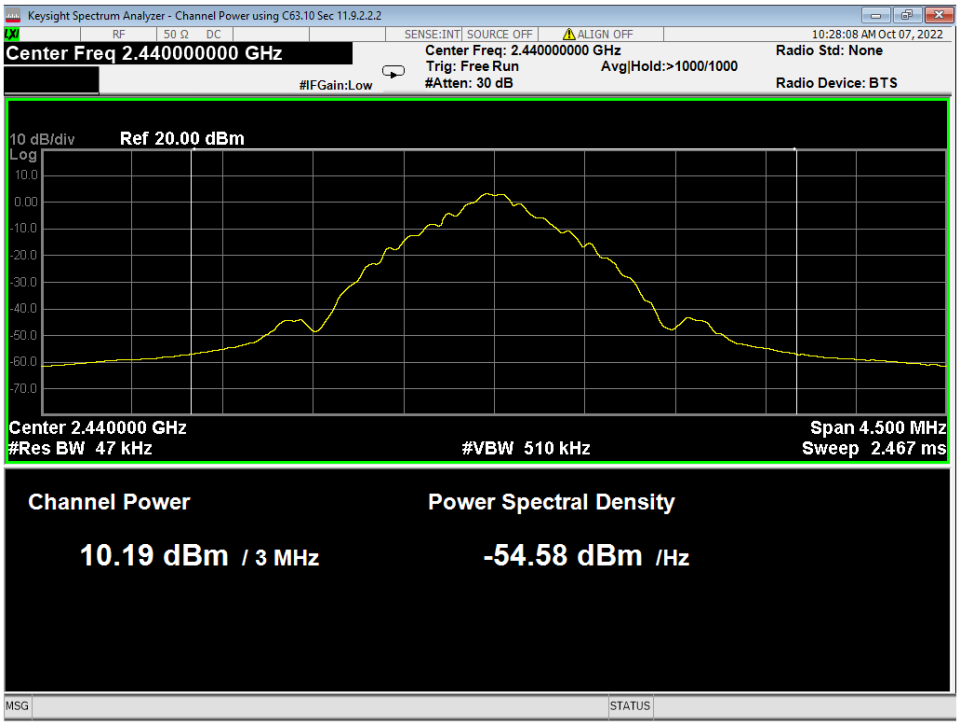
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	±4.31
Radiated Emissions, 3m	1GHz - 18GHz	±5.08
Emissions limits, conducted	150kHz – 30MHz	±3.03

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

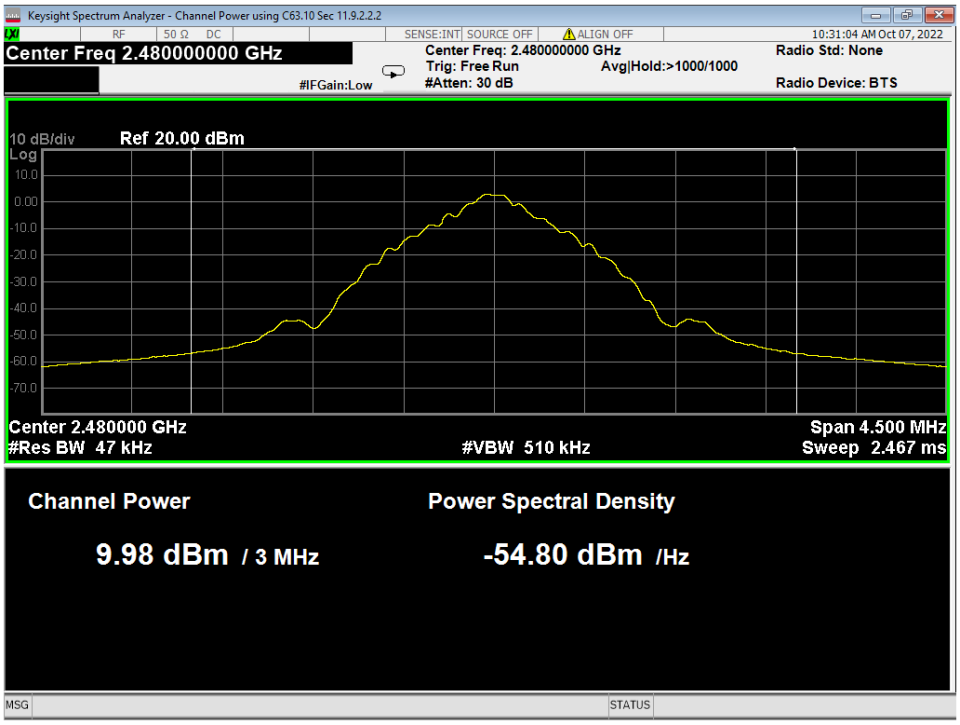
APPENDIX C – GRAPHS AND TABLES



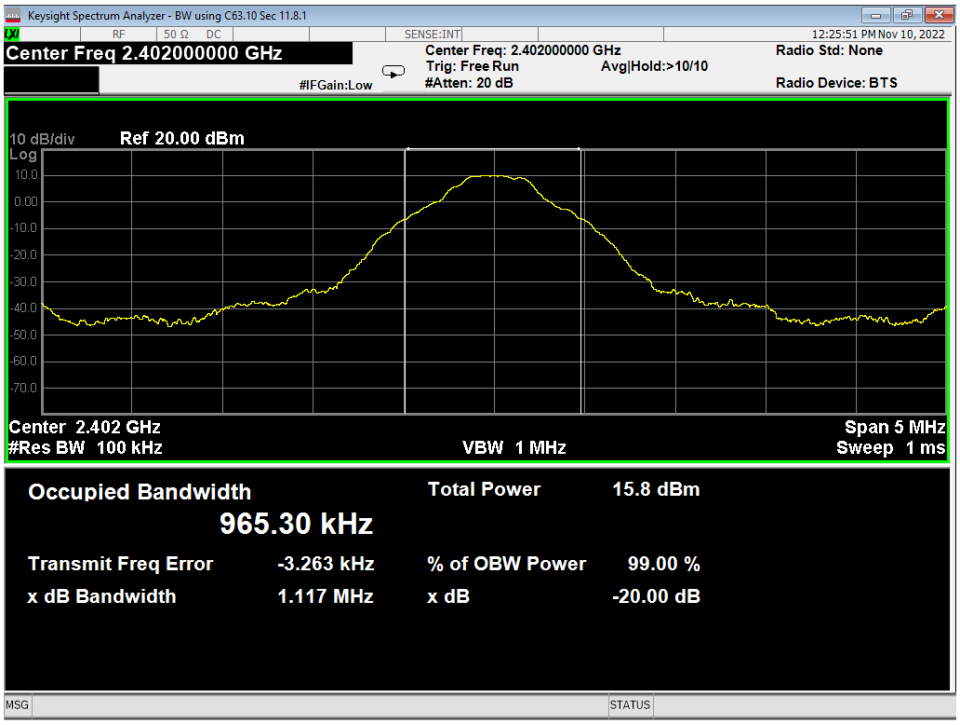
01 Average Power, Low Channel, BTBR



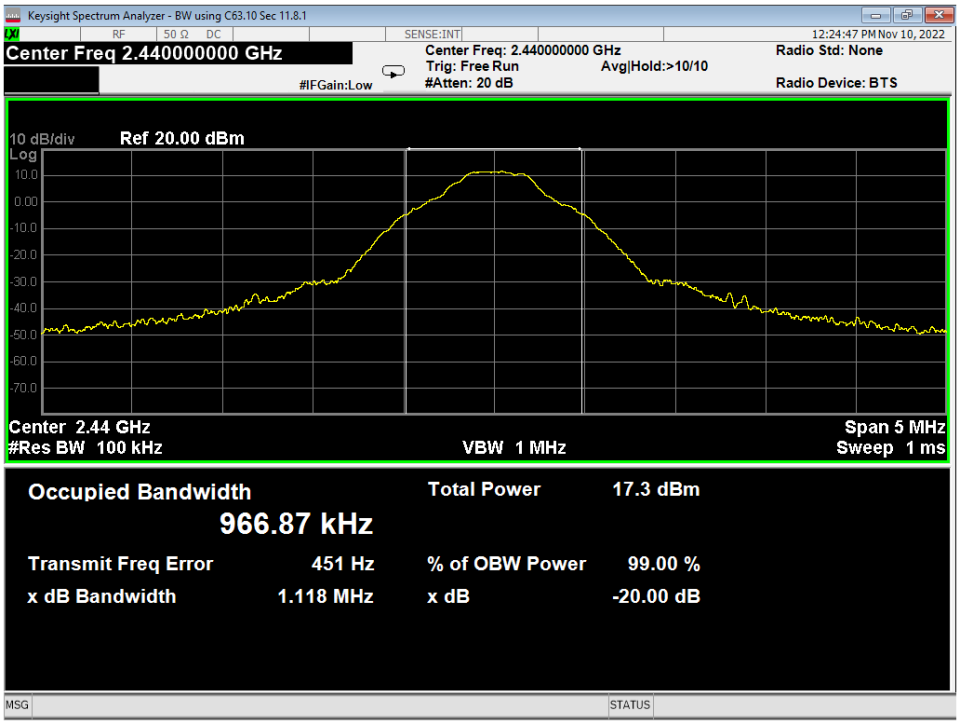
02 Average Power, Mid Channel, BTBR



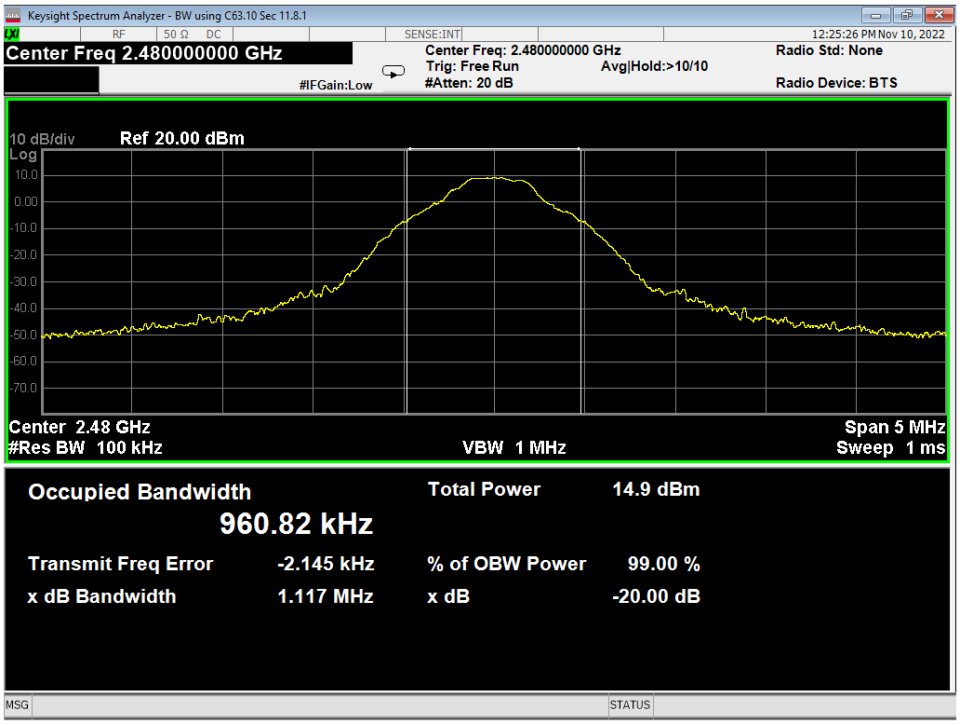
03 Average Power, High Channel, BTBR



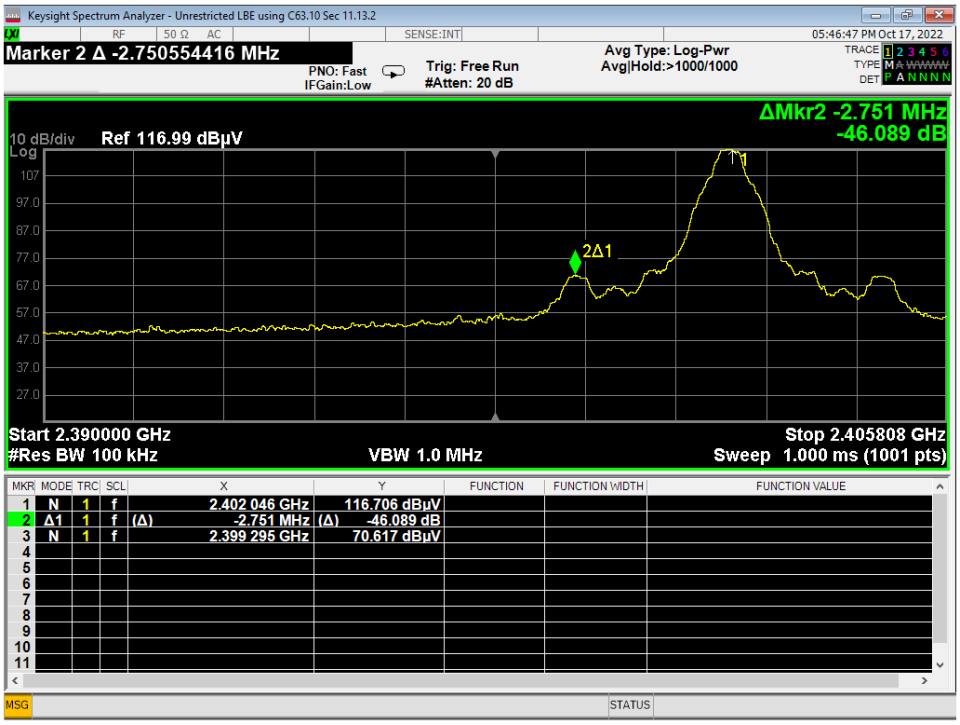
04 OBW-20dB, Low Channel, BTBR



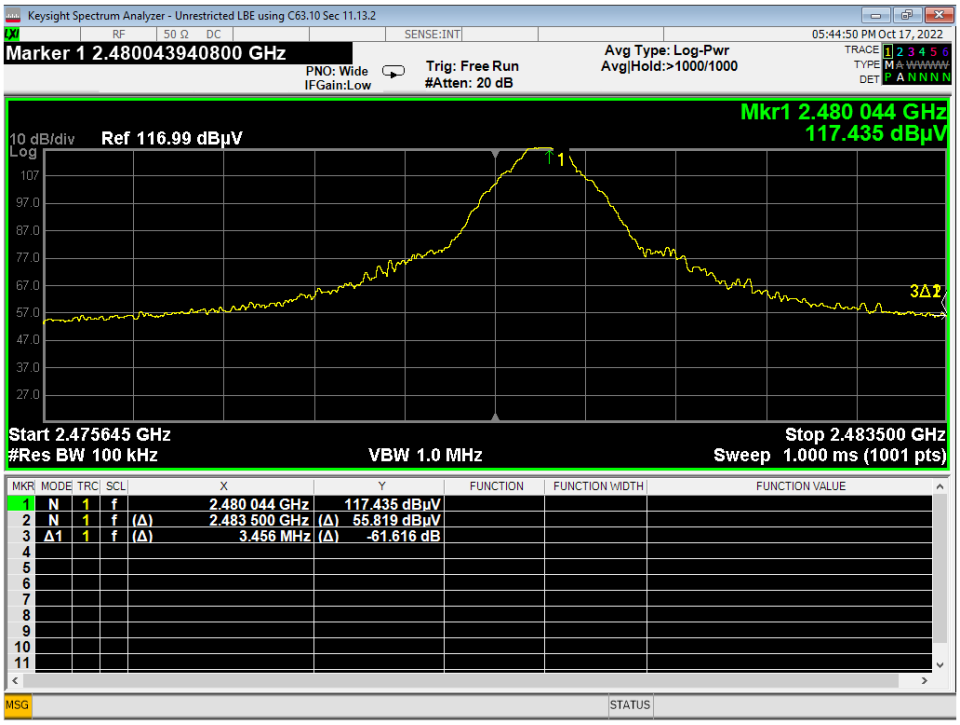
05 OBW-20dB, Mid Channel, BTBR



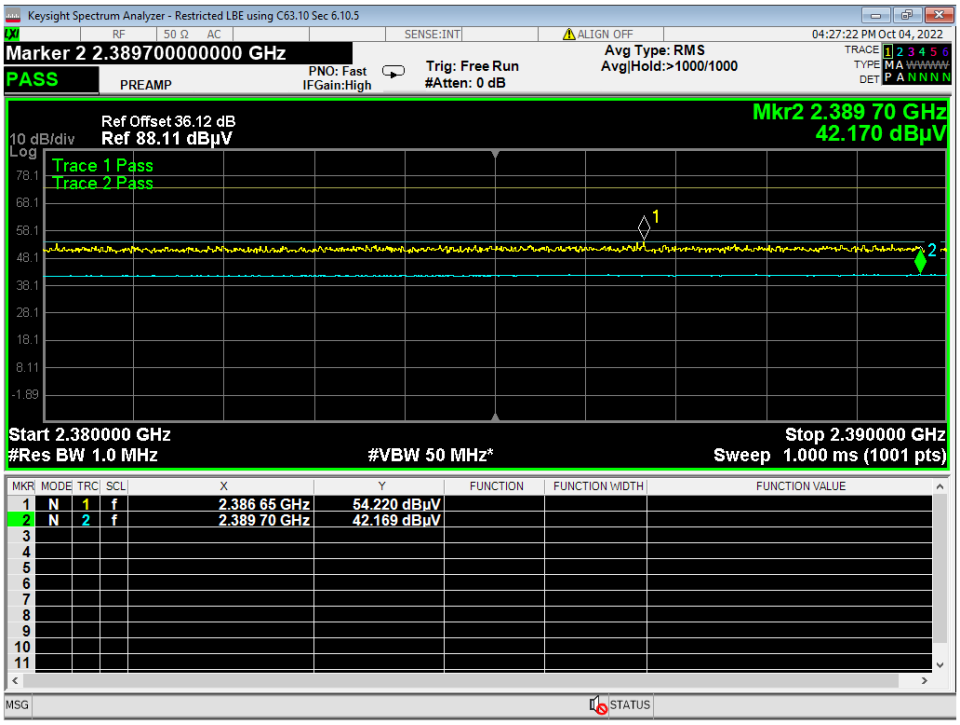
06 OBW-20dB, High Channel, BTBR



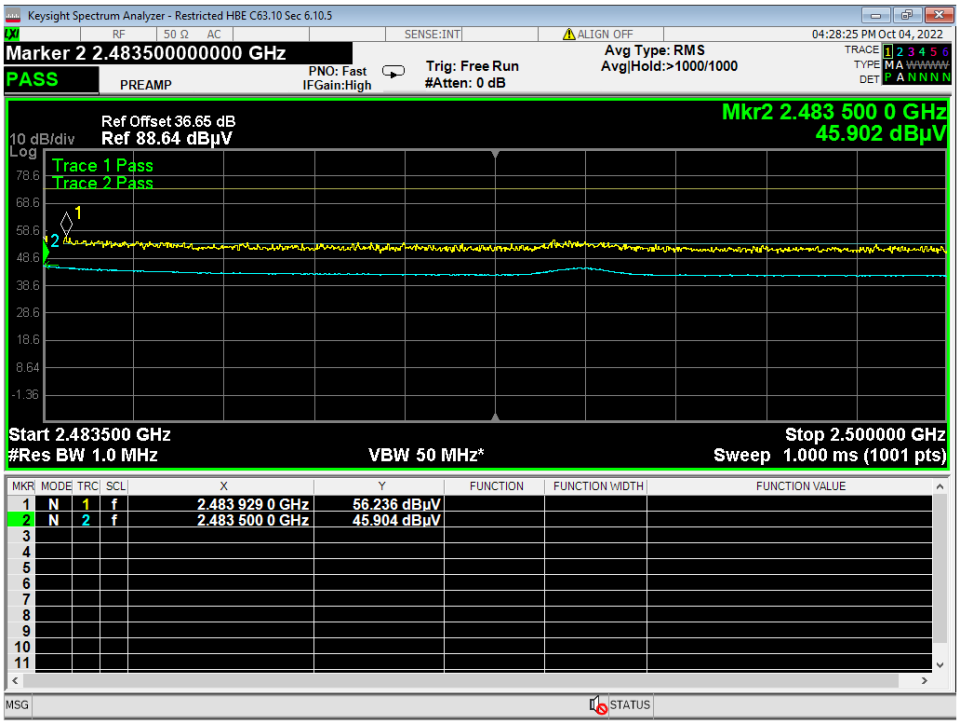
07 Lower Bandedge, Unrestricted, BTBR



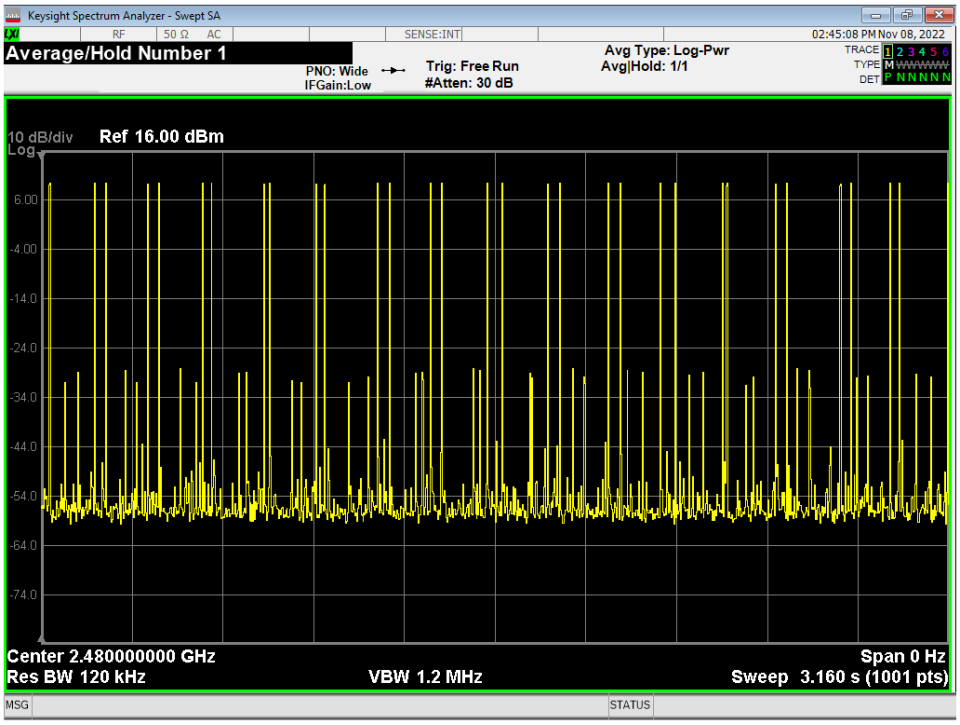
08 Higher Bandedge, Unrestricted, BTBR



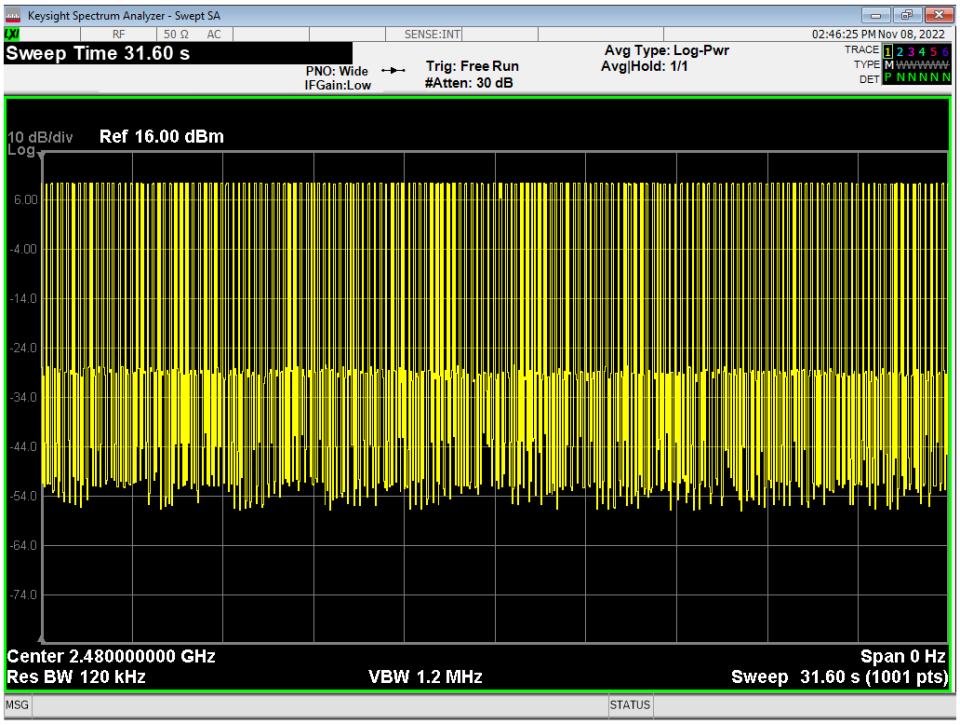
09 Lower Bandedge, Restricted, BTBR



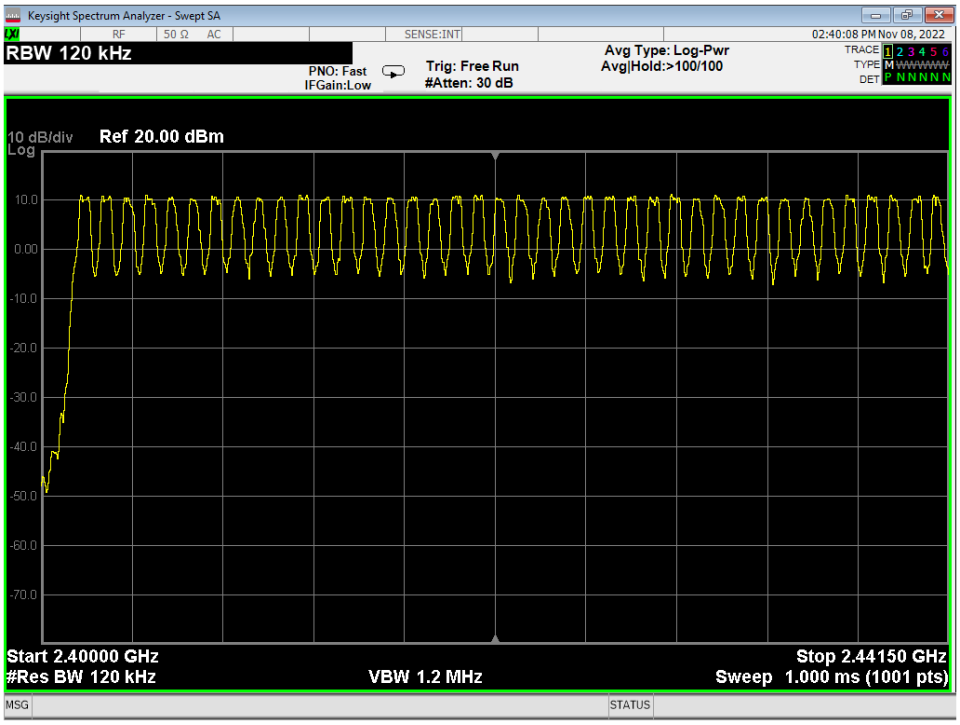
10 Higher Bandedge, Restricted, BTBR



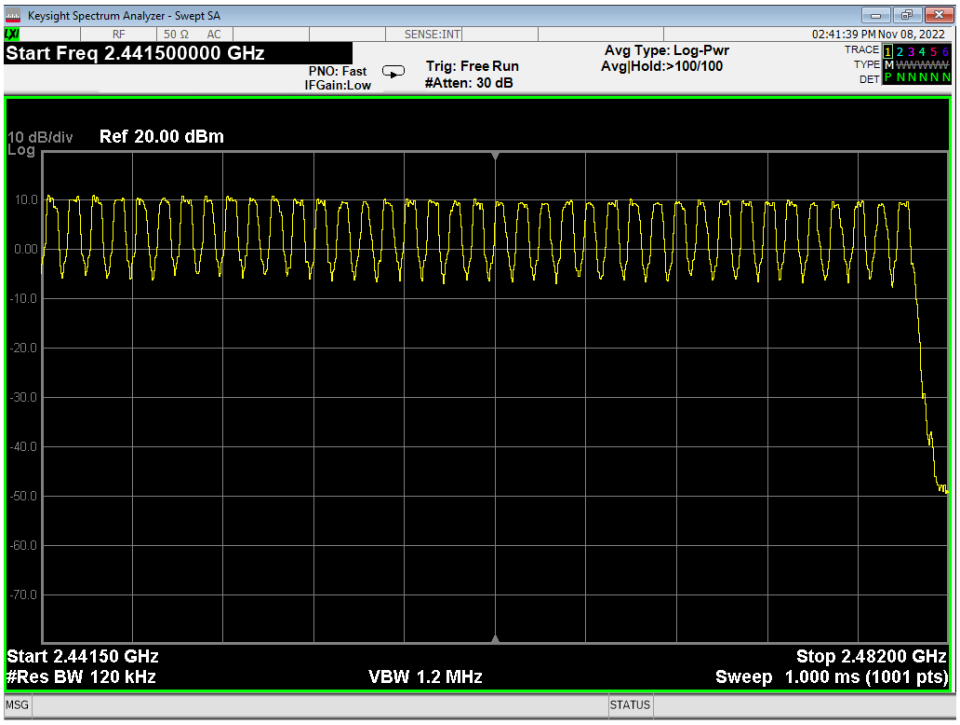
11 Dwell Time, 3.16S (reported for better resolution)



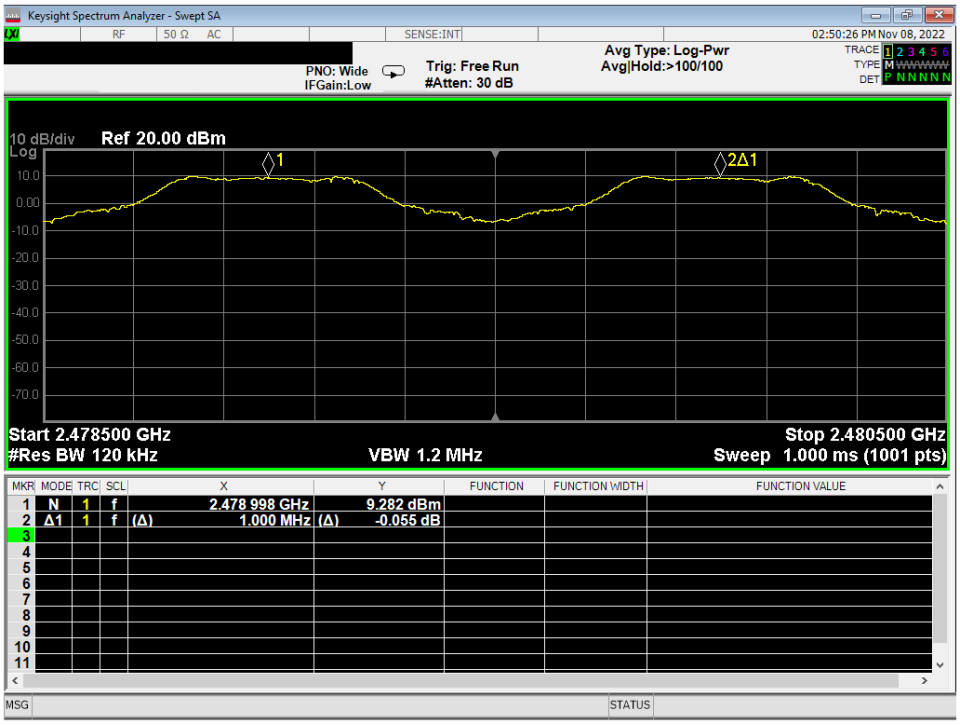
12 Dwell Time, 31.6S



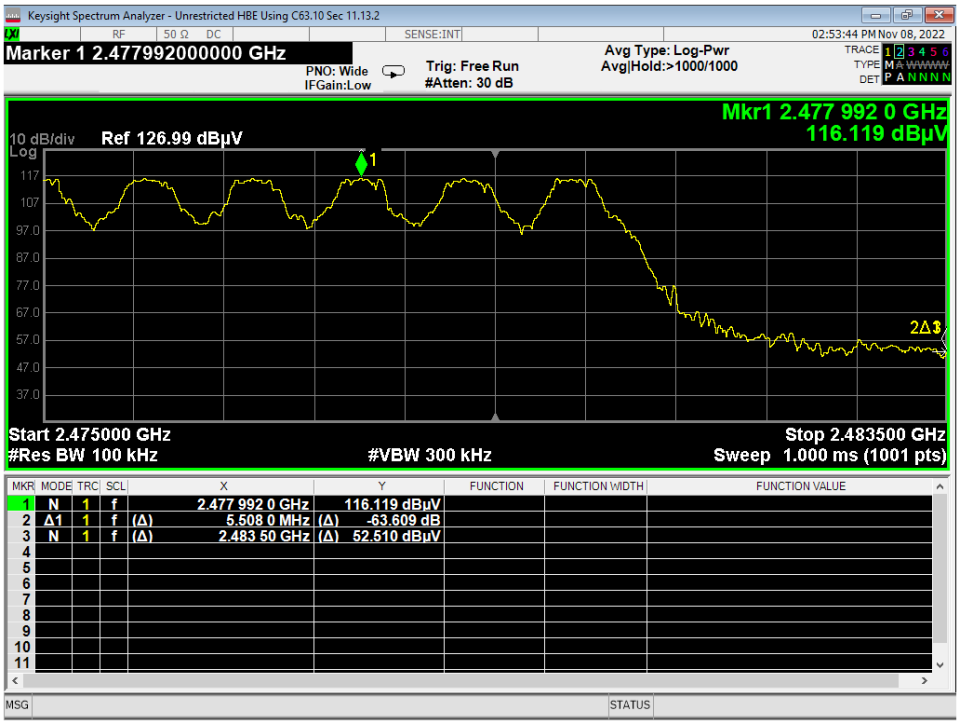
13 Channel Count, 2400-2441.5M



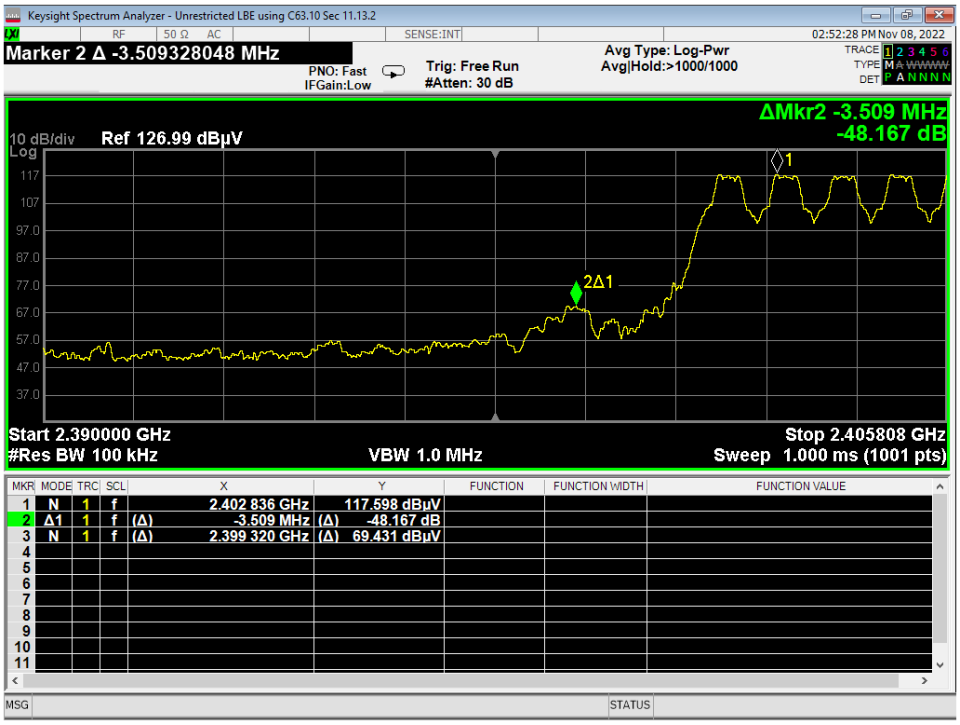
14 Channel Count, 2441.5-2482M



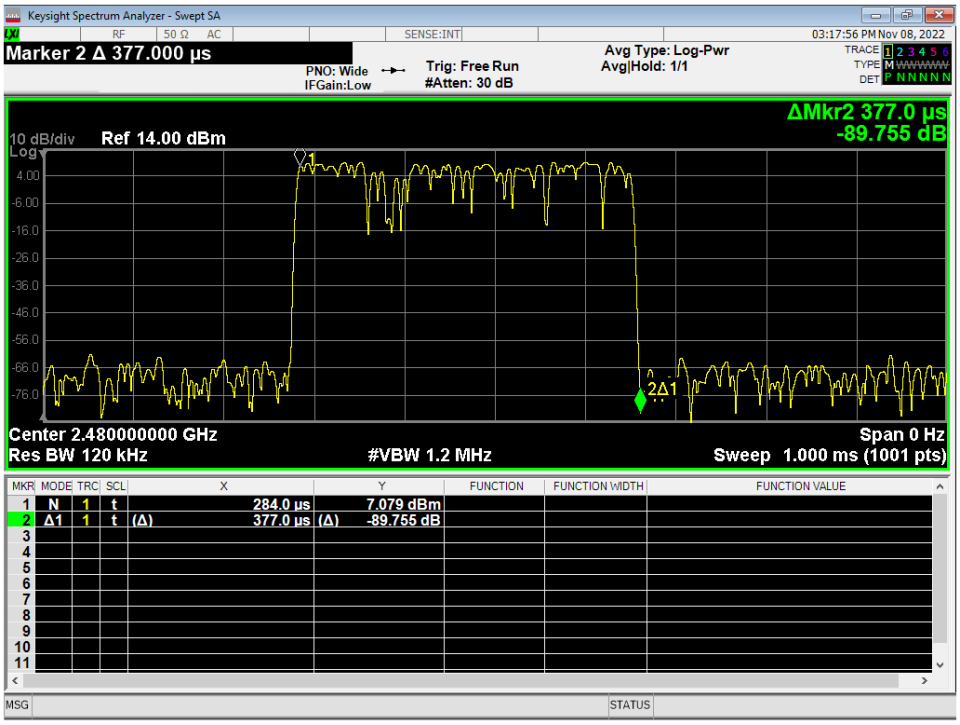
15 Frequency Separation



16 Higher Bandedge, Unrestricted, Hopping



17 Lower Bandedge, Unrestricted, Hopping



18 ON Time BTBR Hopping

REPORT END