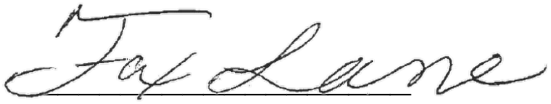
4740 Discovery Drive | Lincoln, NE 68521
tel- 402.323.6233 | tel -888.657.6860 | fax - 402.323.6238
info@nceelabs.com | http://nceelabs.com

FDS Test Report

Client:	**Garmin International Inc.**
EUT:	**1200 E. 151st Street Olathe, Kansas, 66062, USA**
Product:	**A04185**
Test Report No.:	**R20220517-22-E2A**

Approved By:



Fox Lane,
EMC Test Engineer

Date: **7 July 2023**

Total Pages: **36**

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

Revision Page

Rev. No.	Date	Description
Original	21 June 2023	Issued by FLane Prepared by FLane
A	21 June 2023	Formatting corrections - FL

Table of Contents

1 Summary of Test Results

1.1 Emissions Test Results

The EUT has been tested according to the following specifications:

(1) US Code of Federal Regulations, Title 47, Part 15
(2) ISED RSS-210, Issue 10

Testing was performance in accordance with the methods published in ANSI C63.10-2013

Table 1 - Emissions Test Results

Emissions Tests	Test Method and Limits	Result
Fundamental, Harmonics and Band Edges	FCC Part 15.209, 15.245 (b), 15.205 RSS-210, Issue 10, Annex F1	Complies

2 EUT Description

2.1 Equipment under Test (EUT)

Table 2 - Equipment under Test (EUT)

EUT	A04185
IC	1792A-04185
FCC ID	IPH-04185
EUT Received	1 December 2022
EUT Tested	1 December 2022- 9 January 2023
Serial No.	3440105262 3445628615
Operating Band	24075 MHz -24175 MHz
Device Type	Field Disturbance Sensor
Power Supply / Voltage	5VDC Representative power supply used for emissions: MN: PSAI05R-050Q PN: 362-00072-00

2.2 Description of test modes

Radar Channels	
Channel	**Frequency**
Low	24.078 GHz
Mid	24.125 MHz
High	24.172 MHz

2.3 EUT Setup

The EUT was powered by 5 VDC unless specified and set to transmit continuously on the selected frequency channel.

3 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	Testing and Report
2	Blake Winter	Test Engineer	Testing
3	Grace Larsen	Test Engineer	Testing
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
EMCO Horn Antenna	3116	2576	March 9, 2020	March 9, 2024
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	01-07-002	March 21, 2022	March 21, 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 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 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.

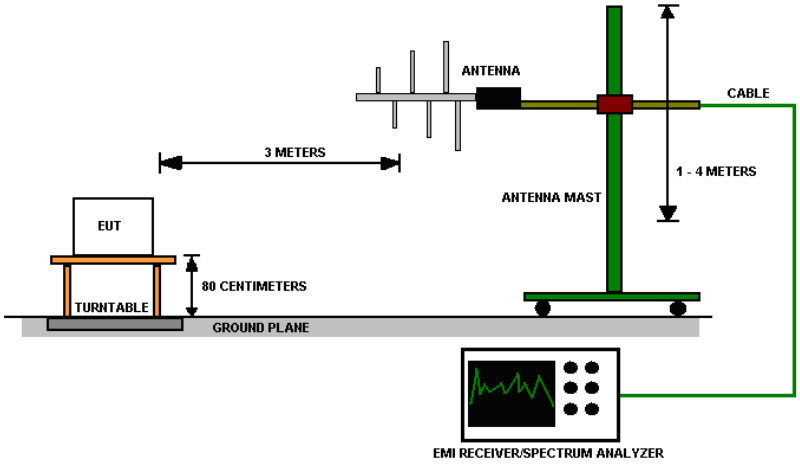


Figure 2 - Radiated Emissions Test Setup

4 Test Results

4.1 Fundamental and Harmonic Emissions

Test:	FCC Part 15.245, RSS-210, Issue 10
Test Result:	Complies

4.1.1 Test Description

Measurements distances can be seen in section 3.1.6 Table 3. The results were compared against the limits published in FCC Part 15.245.

4.1.2 Test Results

No radiated emissions measurements were found in excess of the limits. Test result data can be seen below.

4.1.3 Test Environment

Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of 33 ± 5%

Temperature of 22 ±2^{o} C

4.1.4 Test Setup

See Section 2.3 for further details.

4.1.5 Test Pictures and/or Figures

Table 3 - Fundamental Data

Fundamental, 15.245									
Ch	**Frequency**	**SA Reading (Peak) (SAR)**	**Antenna Factor (AF)**	**Cable loss (CL)**	**FS Level (Peak) (FSL)**	**Test Distance (TD)**	**FS level @ 3m (FSL 3)**	**Limit (Part 15.245)**	**Margin**
	GHz		**dB**	**dB**	**dBmV/m**	**m**	**dBmV/m**	**dBmv/m**	**dB**
Low	24.078000	14.855	45.564	2.853	**63.27**	1	**53.73**	67.96	14.23
Mid	24.125000	15.029	45.502	2.925	**63.46**	1	**53.91**	67.96	14.05
High	24.172000	14.698	45.454	2.852	**63.00**	1	**53.46**	67.96	14.50
FSL=SAR+AF+CL; FSL 3=FSL+20*log(TD/3); Margin=Limit-FSL 3									

Table 4 - Harmonic Emissions Data, Peak

Harmonics - Peak Limit FCC 15.245											
Ch	**Harmonic**	**Frequency**	**SA reading (Peak Detector) (SAR)**	**Test Distance (TD)**	**Cable loss (CL)**	**Mixer Factor (MF)**	**Antenna Factor (AF)**	**Field Strength Level (FSL)**	**FS converted to 3m (FSL 3)**	**Avg Limit (at 3m FCC Part 15.245)**	**Margin**
		GHz	**dBmV/m**	**m**	**dB**	**dB**	**dB**	**dBmV/m**	**dBmV/m**	**dBmV/m**	
Low	*2nd*	48.156000	-30.163	0.5	1.3	21.9	40.92	33.95	18.39	47.96	29.57
Mid	*2nd*	48.250000	-30.31	0.5	1.3	22	40.93	33.92	18.36	47.96	29.60
High	*2nd*	48.344000	-30.983	0.5	1.3	22.1	40.95	33.37	17.81	47.96	30.15
Low	*3rd*	72.234000	-17.157	0.5	0	0	43.42	26.26	10.70	47.96	37.26
Mid	*3rd*	72.375000	-16.757	0.5	0	0	43.46	26.70	11.14	47.96	36.82
High	*3rd*	72.516000	-17.631	0.5	0	0	43.49	25.86	10.30	47.96	37.66
Low	*4th*	96.312000	-14.288	0.25	0.32	0	45.94	31.97	10.39	47.96	37.57
Mid	*4th*	96.500000	-14.724	0.25	0.32	0	45.95	31.55	9.97	47.96	37.99
High	*4th*	96.688000	-14.772	0.25	0.32	0	45.97	31.52	9.94	47.96	38.02
FSL=SAR+MF+AF+CL; FSL 3=FSL+20*log(TD/3); Margin=Limit-FSL 3; MF=0 if it's accounted for in the plot.											

Table 5 - Harmonic Emissions Data, Average

Harmonics - Avg Limit FCC 15.245												
Ch	**Harm.**	**Frequency**	**SA reading (Peak Detector) (SAR)**	**Test Distance (TD)**	**Cable loss (CL)**	**Mixer Factor (MF)**	**Antenna Factor (AF)**	**DCCF**	**Field Strength Level (FSL)**	**FS converted to 3m (FSL 3)**	**Limit (at 3m FCC Part 15.245)**	**Margin**
		GHz	**dBmV/m**	**m**	**dB**	**dB**	**dB**	**dB**	**dBmV/m**	**dBmV/m**	**dBmV/m**	
Low	*2nd*	48.156000	-30.163	0.5	1.3	21.9	40.92	0.00	33.954	18.39	27.96	9.57
Mid	*2nd*	48.250000	-30.31	0.5	1.3	22	40.93	0.00	33.924	18.36	27.96	9.60
High	*2nd*	48.344000	-30.983	0.5	1.3	22.1	40.95	0.00	33.367	17.80	27.96	10.15
Low	*3rd*	72.234000	-17.157	0.5	0	0	43.42	0.00	26.261	10.70	27.96	17.26
Mid	*3rd*	72.375000	-16.757	0.5	0	0	43.46	0.00	26.703	11.14	27.96	16.82
High	*3rd*	72.516000	-17.631	0.5	0	0	43.49	0.00	25.857	10.29	27.96	17.66
Low	*4th*	96.312000	-14.288	0.25	0.32	0	45.94	0.00	31.969	10.39	27.96	17.57
Mid	*4th*	96.500000	-14.724	0.25	0.32	0	45.95	0.00	31.550	9.97	27.96	17.99
High	*4th*	96.688000	-14.772	0.25	0.32	0	45.97	0.00	31.519	9.94	27.96	18.02
FSL=SAR+MF+AF+CL+DCCF; FSL 3=FSL+20*log(TD/3); Margin=Limit-FSL 3; if MF=0 or CL=0 it's accounted for in the plot.												

Remarks relating to non-standard measurement distances:

Per FCC Part 15.31 (f) the distance is defined as:
To the extent practicable, the device under test shall be measured at the distance specified in the appropriate rule section. The distance specified corresponds to the horizontal distance between the measurement antenna and the closest point of the equipment under test, support equipment or interconnecting cables as determined by the boundary defined by an imaginary straight-line periphery describing a simple geometric configuration enclosing the system containing the equipment under test. The equipment under test, support equipment and any interconnecting cables shall be included within this boundary.

Per FCC Part 15.31(f)(1)
(1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

The measurements presented for 2nd, 3rd, and 4th harmonics in this report meet both criteria for allowing near-field measurements.

1. it can be shown that near field measurements are appropriate due to the characteristics of the device - (better signal to noise ratio when measuring an extremely narrow beam width.)

2. it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment.

Since the 20 dB/decade extrapolation is explicitly specified in the CFR, this takes precedence over the addition of the linear distance attenuation factor specified in C63.10, Section 9.1.

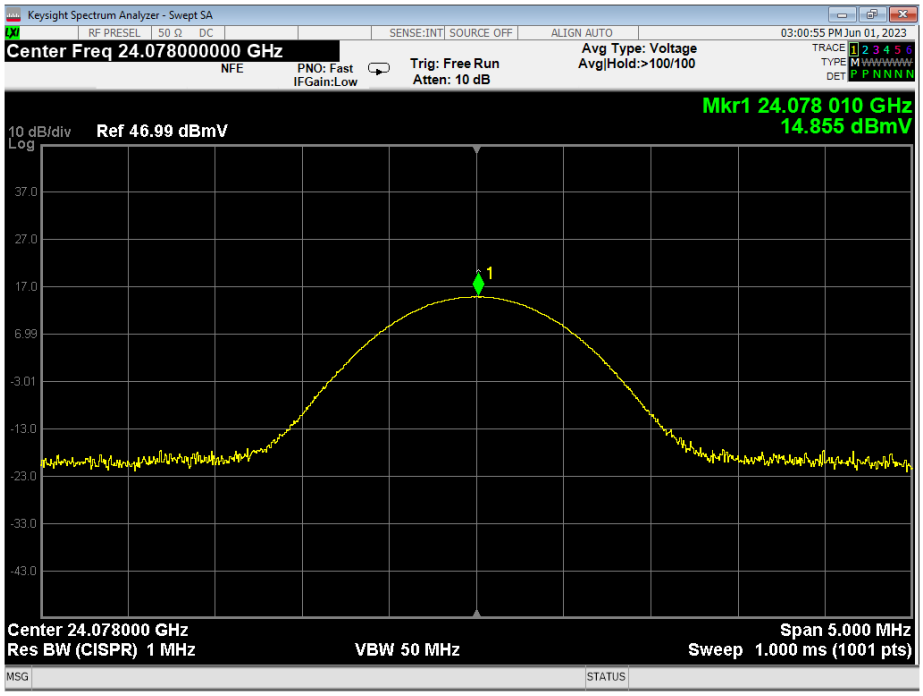


Figure 3 - Analyzer Measurement – Fundamental, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

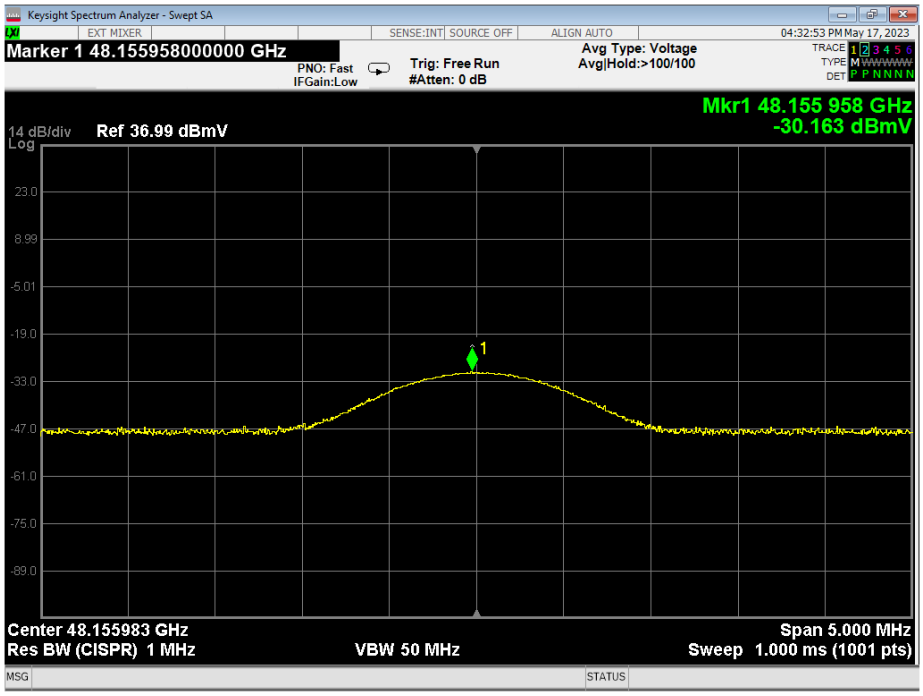


Figure 4 - Analyzer Measurement – 2nd Harmonic, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

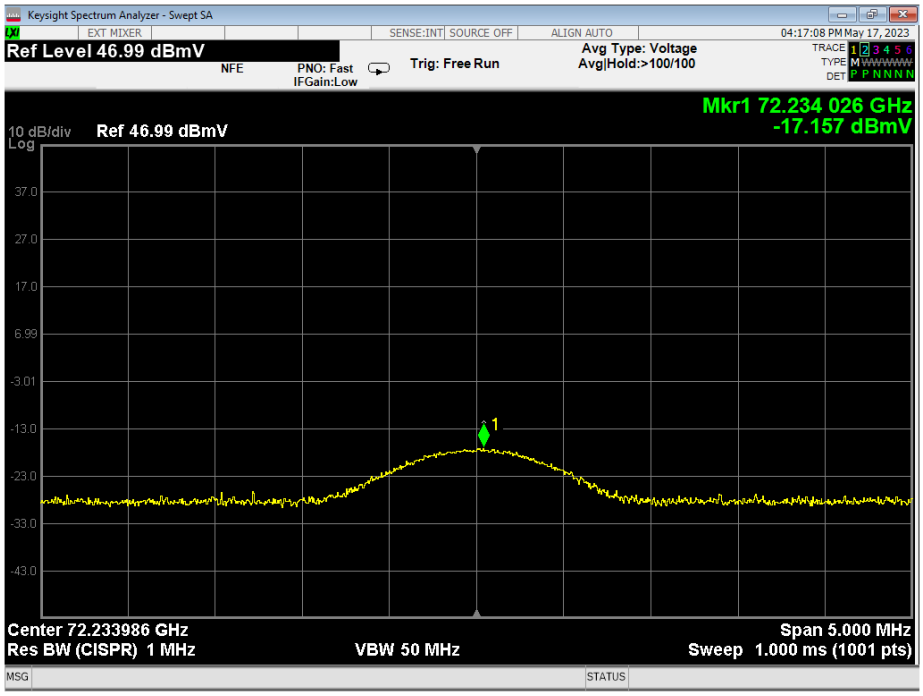


Figure 5 - Analyzer Measurement – 3rd Harmonic, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

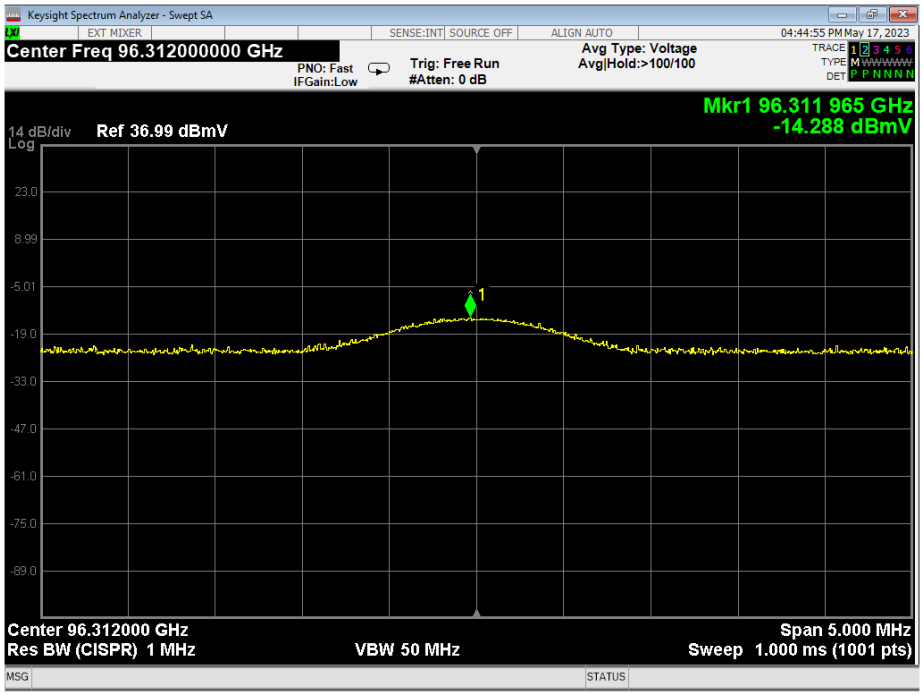


Figure 6 - Analyzer Measurement – 4th Harmonic, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

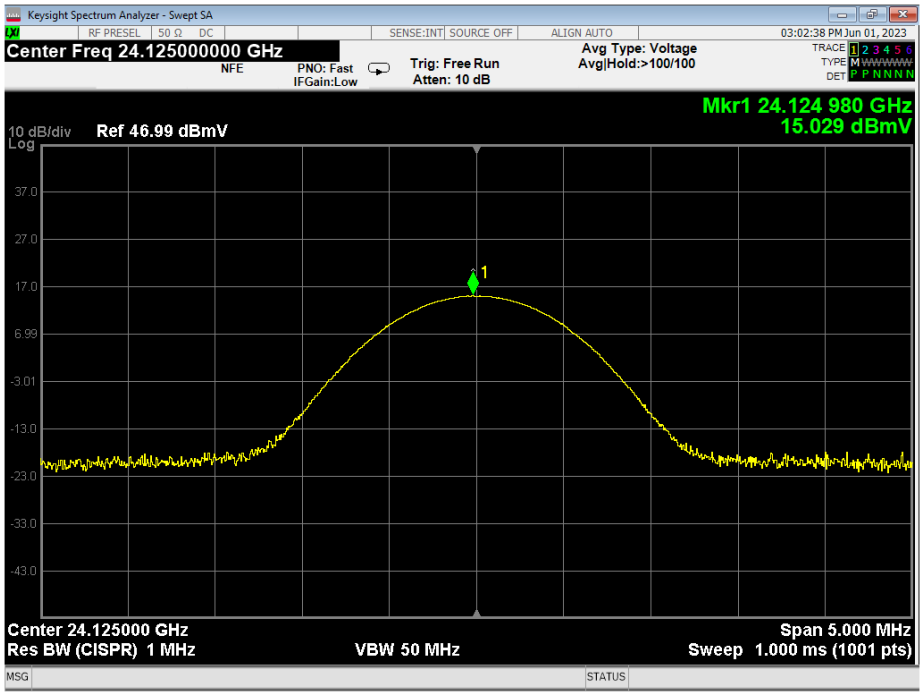


Figure 7 - Analyzer Measurement – Fundamental, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

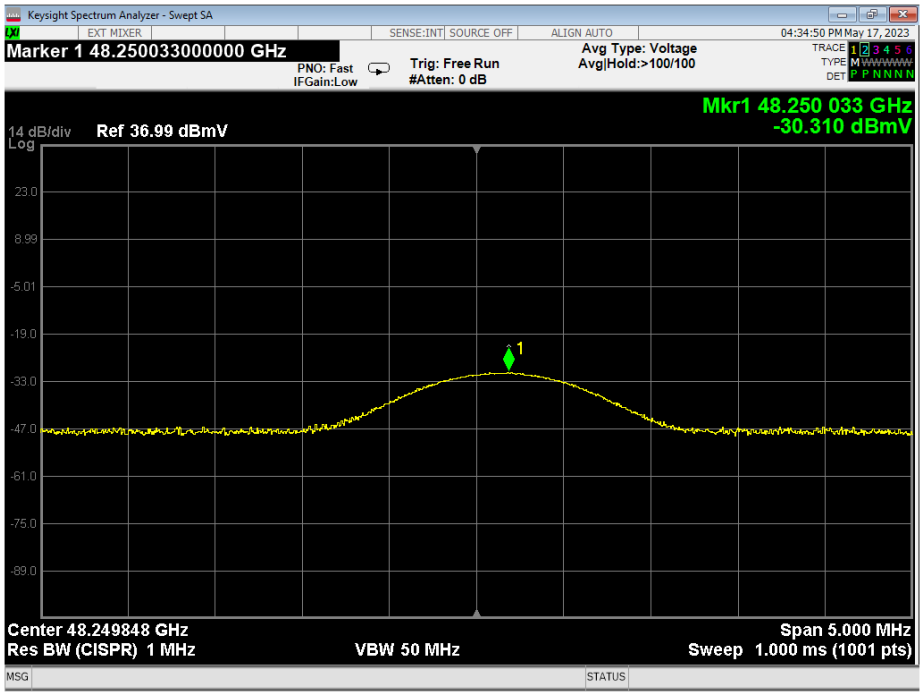


Figure 8 - Analyzer Measurement – 2nd Harmonic, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

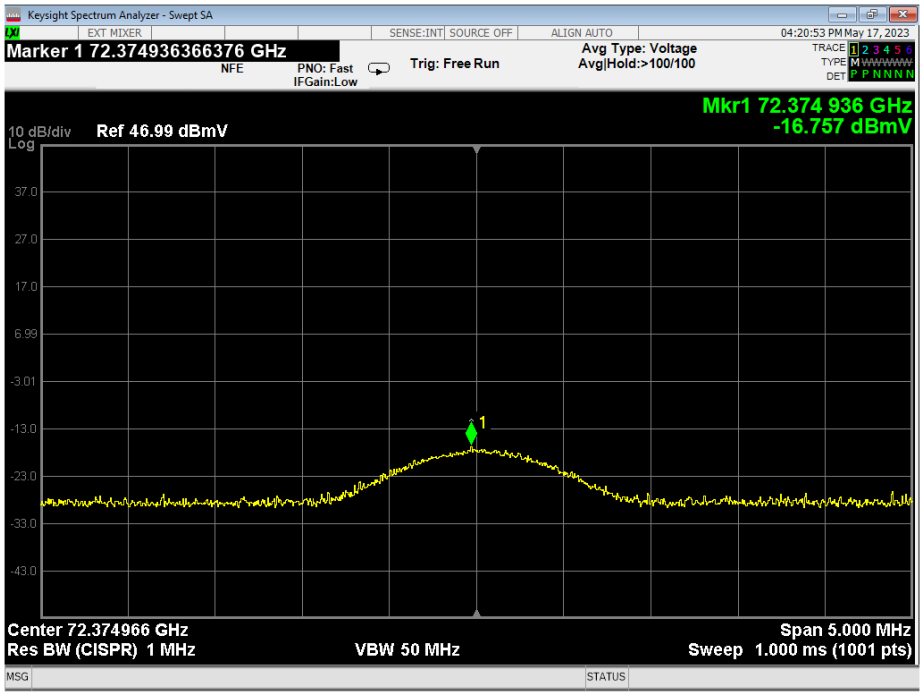


Figure 9 - Analyzer Measurement – 3rd Harmonic, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

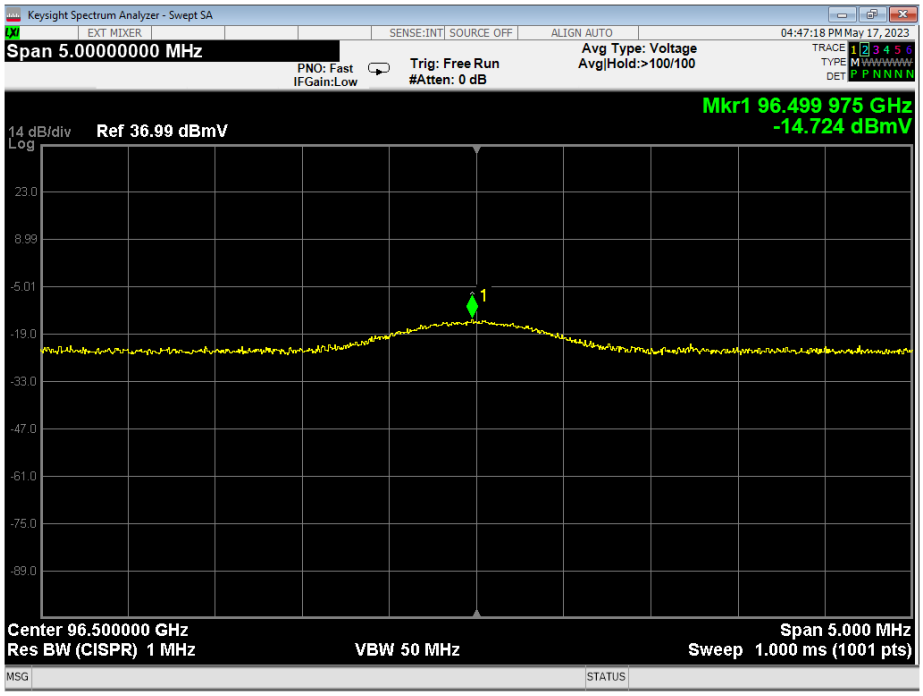


Figure 10 - Analyzer Measurement – 4th Harmonic, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

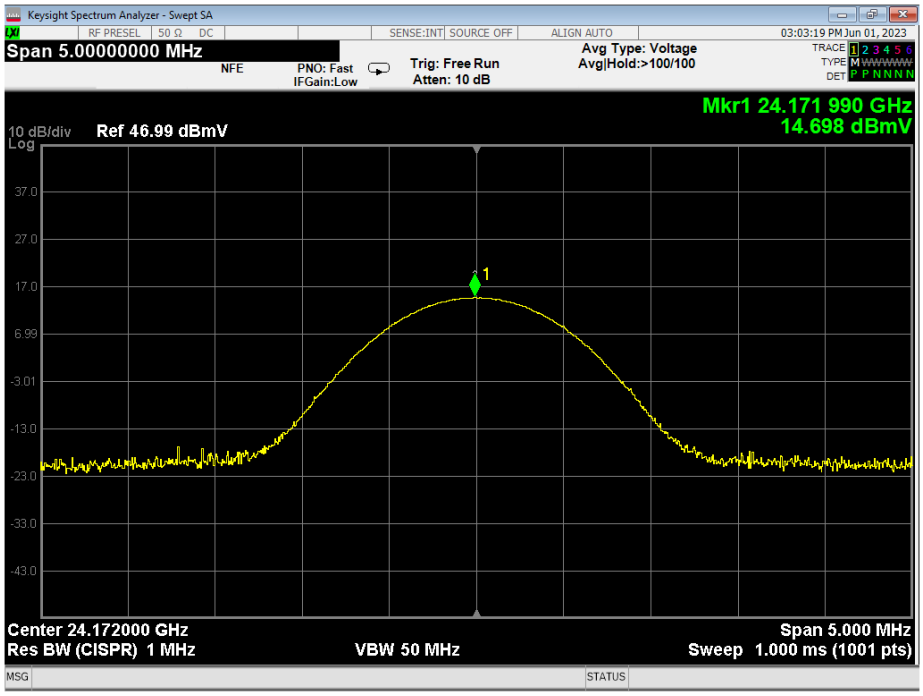


Figure 11 - Analyzer Measurement – Fundamental, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

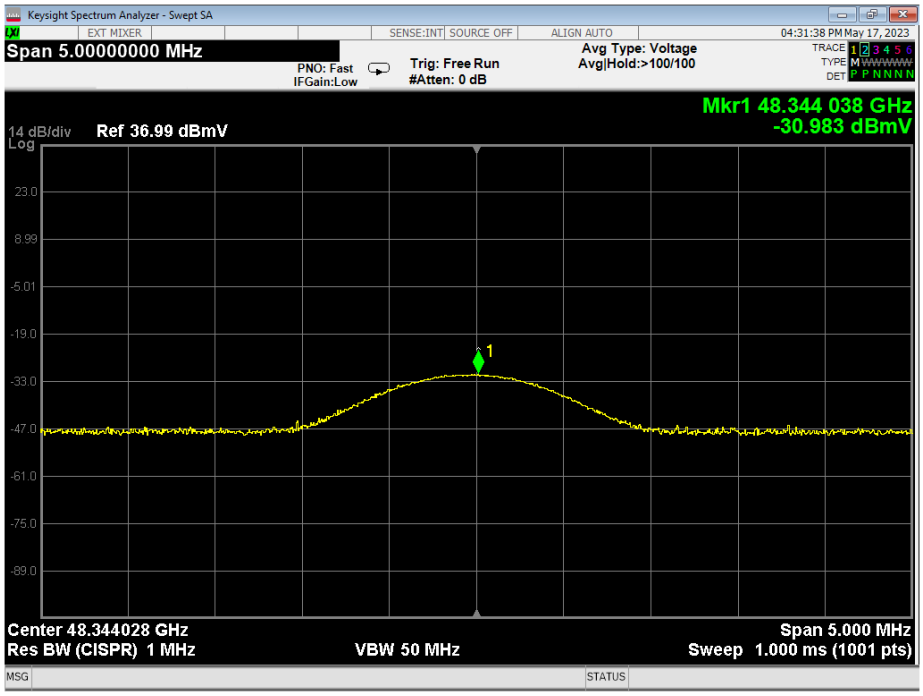


Figure 12 - Analyzer Measurement – 2nd Harmonic, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

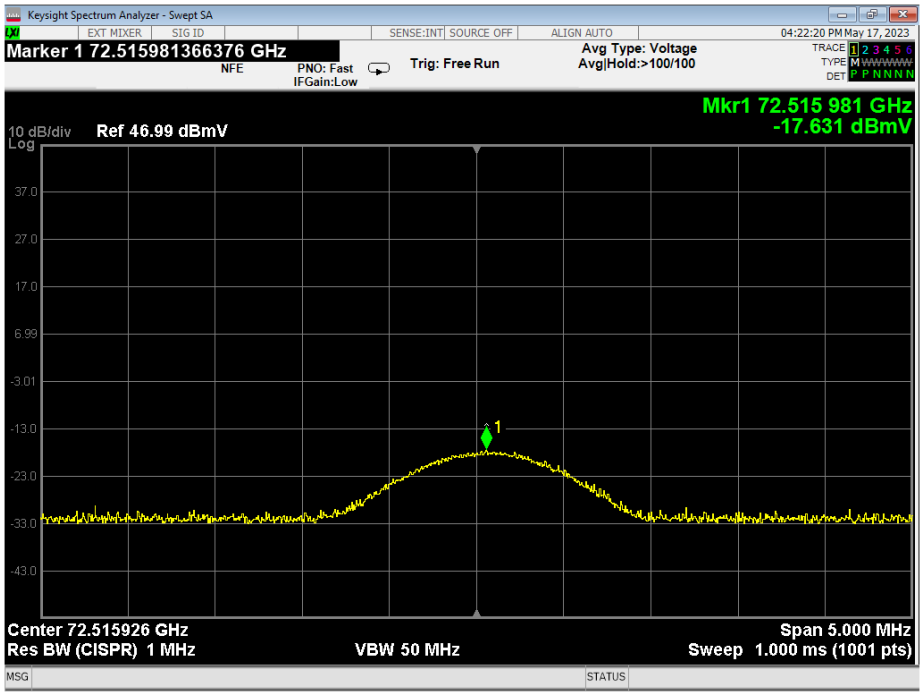


Figure 13 - Analyzer Measurement – 3rd Harmonic, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

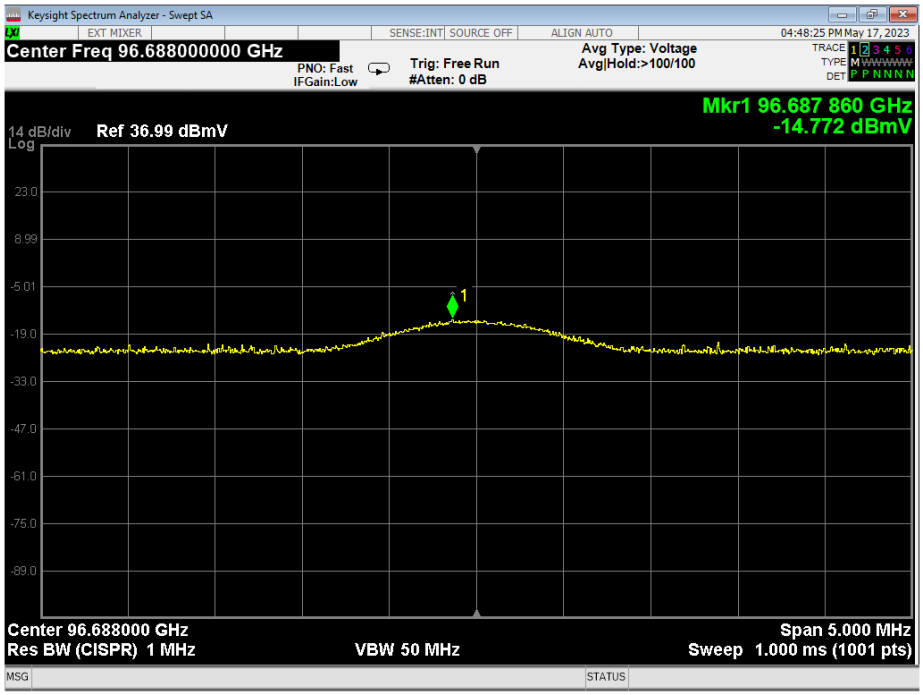


Figure 14 - Analyzer Measurement – 4th Harmonic, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

4.2 Band edges

Test:	Band Edges
Test Method:	ANSI C63.10-2013, Section(s) 6.10.5, 6.10.6
Test Result:	Complies

4.2.1 Limits of bandedge measurements:

Test Description:
For emissions outside of the allowed band of operation, the emission level needs to be 50dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

The limit from FCC Part 15.209 for all frequencies above 960 MHz is 500 µV/m at 3m.

Restricted Bands:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

4.2.2 Test procedures:

The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 1MHz. 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.

Measurements were performed as radiated measurements in the same manner as Section 3.1 of this report.

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW. The occupied bandwidth was measured using the spectrum analyzers 99% occupied bandwidth setting.

4.2.3 Deviations from test standard:

No deviation.

4.2.4 Test setup:

All the measurements were done at 1m test distance.

4.2.5 EUT operating conditions:

The EUT was set to transmit continuously on the lowest frequency channel, and the highest frequency channel.

4.2.6 Band Edges

Peak Restricted Band Edge												
Ch	**Band Edge**	**Band Frequency**	**Peak SA reading (SAR)**	**Antenna Factor (AF)**	**DCCF**	**Cable loss (CL)**	**Test Distance**	**FS level @ Test Distance**	**FS level @ 3m (FS 3 dBmV)**	**FS level @ 3m (FS 3 dBuV)**	**Peak Limit Part 15.209**	**Margin**
		GHz	**dBmV**	**dB**	**dB**	**dB**	**m**	**dBmV/m**	**dBmV/m**	**dBµv/m**	**dBµv/m**	
Low	*LBE*	24.000000	-46.08	45.56	0.00	2.85	1.00	2.34	-7.21	52.79	74	21.21
High	*HBE*	31.200000	-42.36	45.50	0.00	3.55	1.00	6.70	-2.85	57.15	74	16.85
FS = SAR 1+AF+CL; FS 3= FS TD +20*log(TD/3); SAR Detector type= Peak												
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.												

Average Restricted Band Edge												
Ch	**Band Edge**	**Band**	**SA reading (SAR)**	**Antenna Factor (AF)**	**DCCF**	**Cable loss (CL)**	**Test Distance (TD)**	**FS level @ TD**	**FS level @ 3m (FS 3 dBmV)**	**FS level @ 3m (FS 3 dBuV)**	**Avg Limit Part 15.209**	**Margin**
		GHz	**dBmV**	**dB**	**dB**	**dB**	**m**	**dBmV/m**	**dBmV/m**	**dBµv/m**	**dBµv/m**	
Low	*LBE*	24.000000	-65.05	45.56	0.00	2.85	1.00	-16.64	-26.18	33.82	54	20.18
High	*HBE*	31.200000	-56.83	45.50	0.00	3.55	1.00	-7.77	-17.32	42.68	54	11.32
FS = SAR 1+AF+CL+DCCF; FS 3= FS TD +20*log(TD/3); SAR Detector type= Average												
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.												

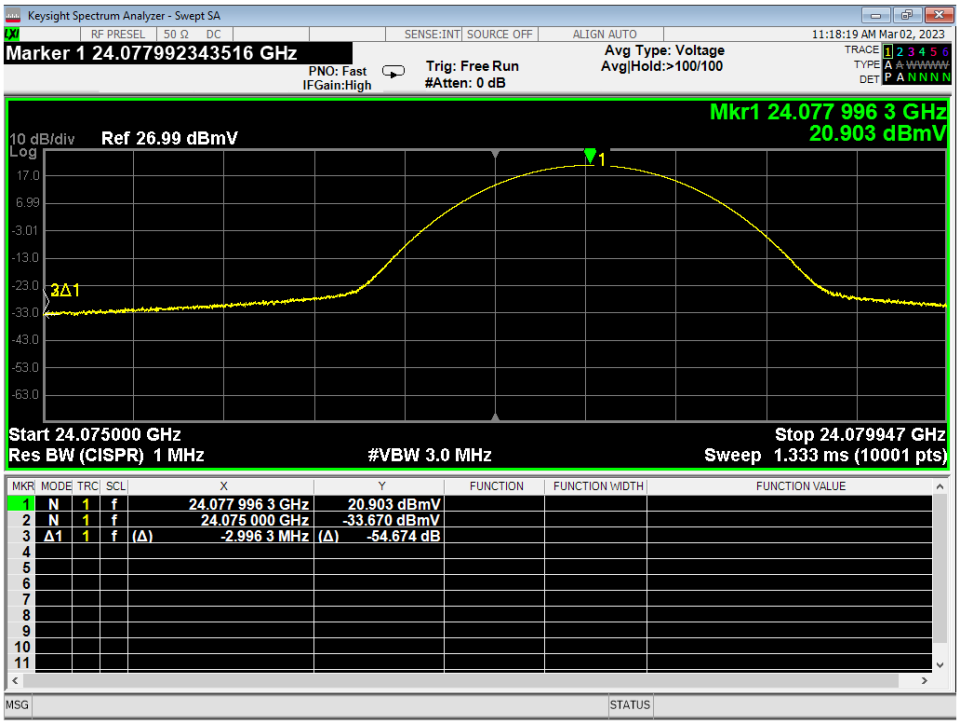


Figure 15 – Unrestricted Lower Band Edge
*Delta is greater than 50 dB as required by FCC Part 15.245 - Pass

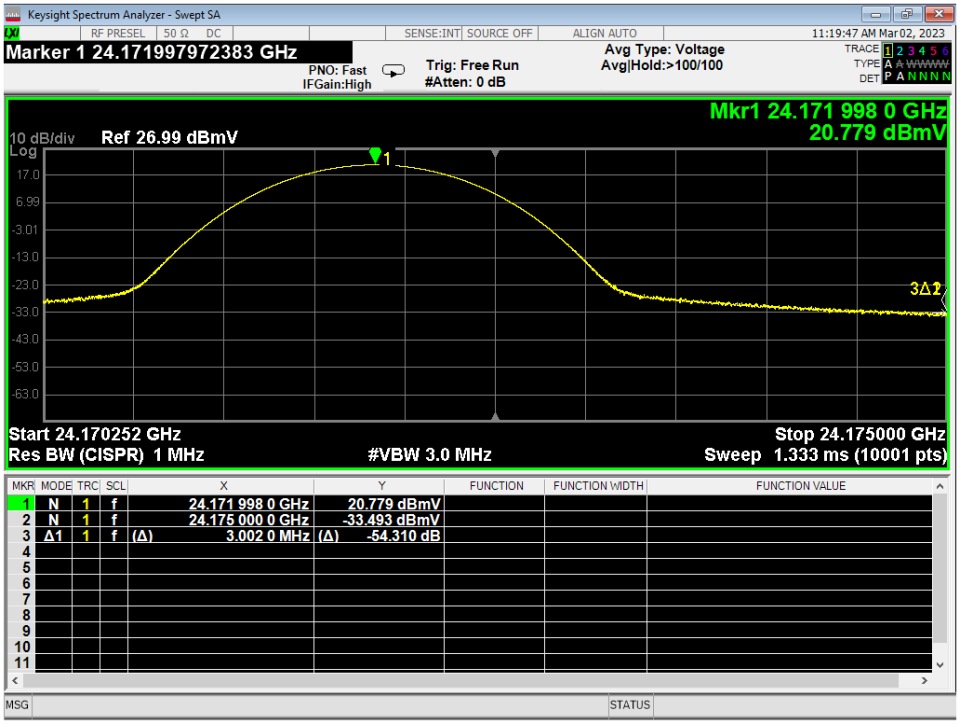


Figure 16 – Unrestricted Higher Band Edge
*Delta is greater than 50 dB as required by FCC Part 15.245 - Pass

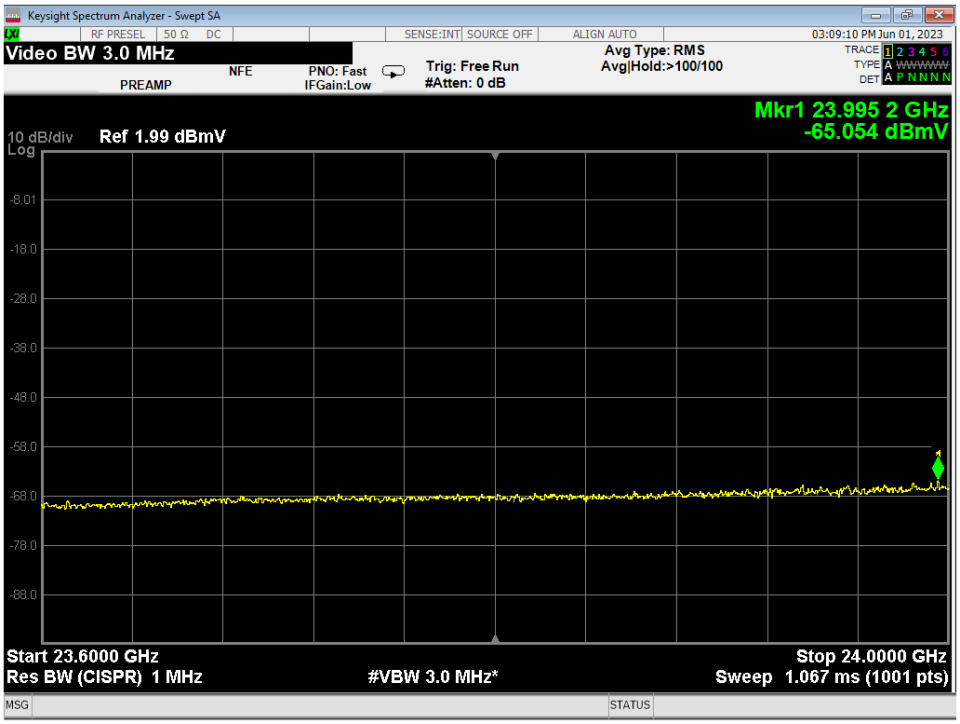


Figure 17 – Restricted Lower Band Edge, Average
Uncorrected Analyzer Measurement, see Band edge table.

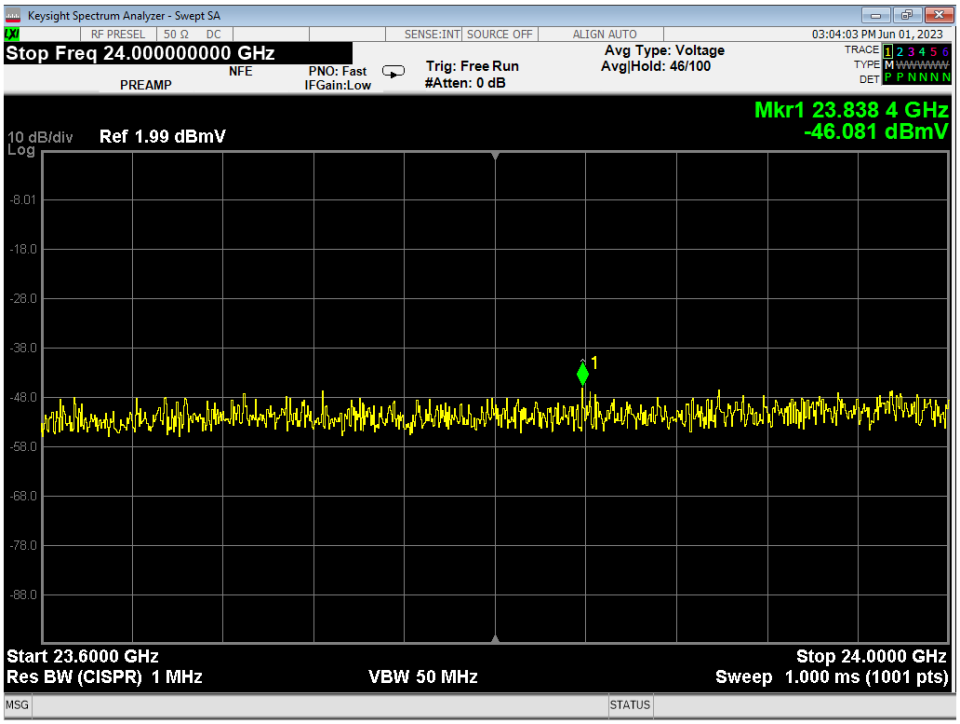


Figure 18 – Restricted Lower Band Edge, Peak
Uncorrected Analyzer Measurement, see Band edge table.

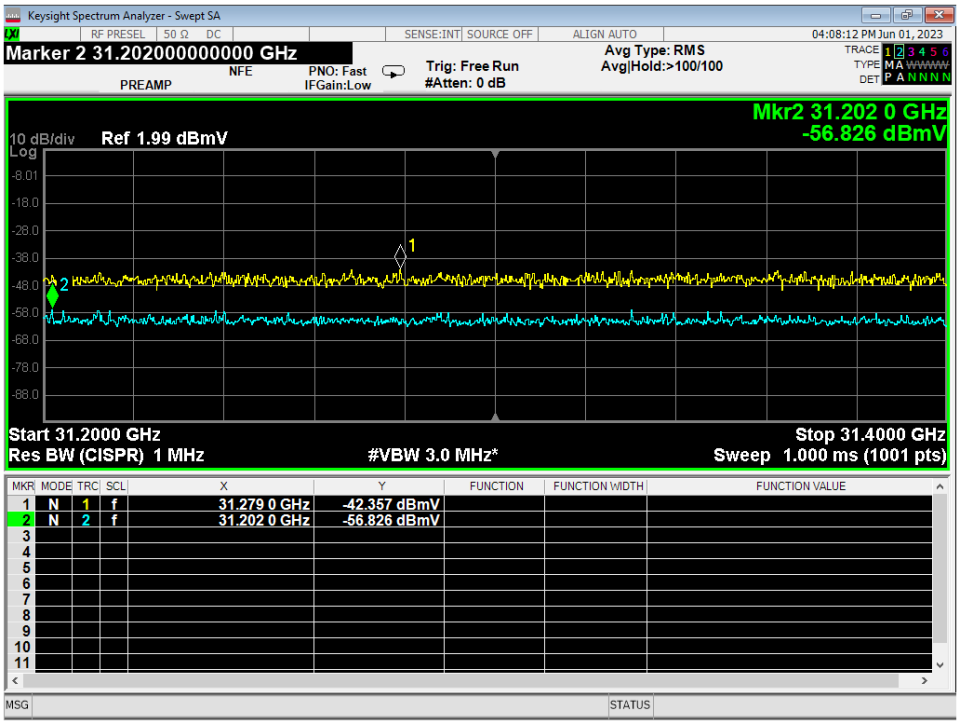


Figure 19 – Restricted Higher Band Edge, Peak and Average
Uncorrected Analyzer Measurement, see Band edge table.

4.3 Radiated Emissions

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

Limits for radiated emissions measurements:

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

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

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off battery power and external USB power. The worst-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. For emissions >18GHz device was

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.

h. For the preview scans, the EUT was tested with all radios transmitting simultaneously and independently to identify the highest peaks.

Test setup:

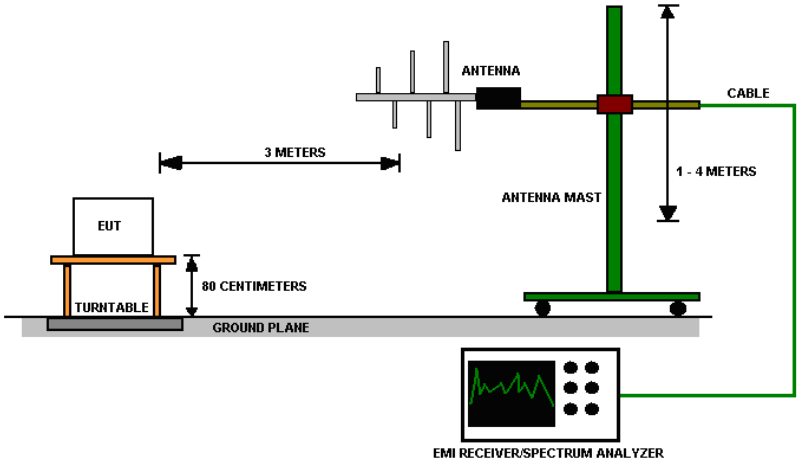


Figure 20 - Radiated Emissions Test Setup

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:

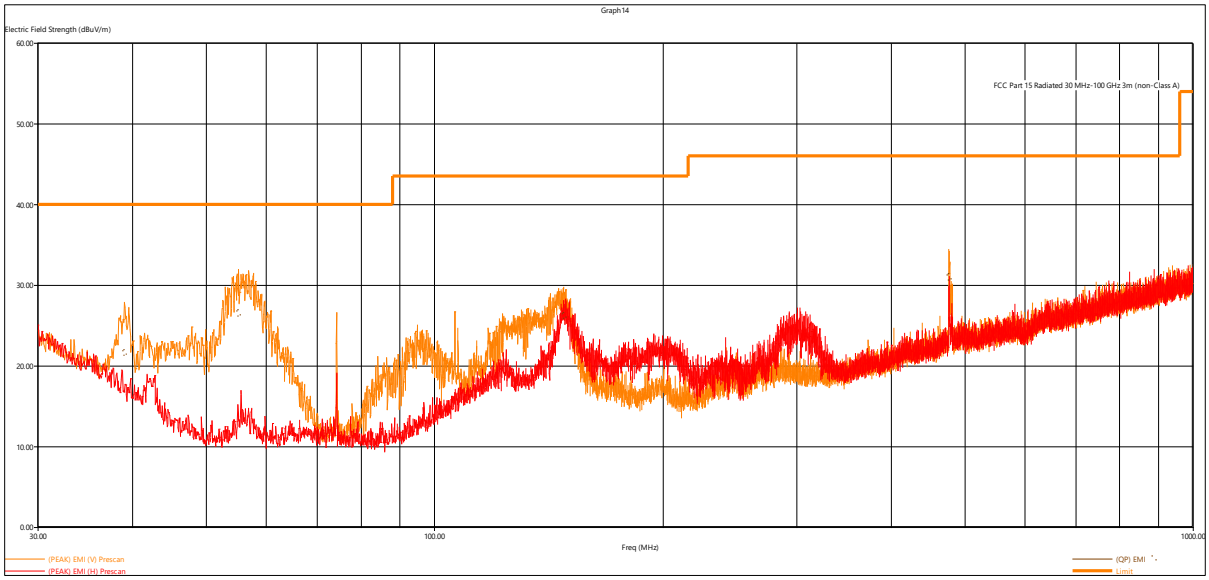


Figure 21 - Radiated Emissions Plot, Low Channel

REMARKS:

1. Emission level (dBµV/m) = Raw Value (dBµV) + 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

Quasi-Peak Measurements, 30MHz – 1GHz, Radar, Low							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol.**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**		
38.983920	21.53	40.00	18.47	161.00	170.00	V	Low
55.015680	26.46	40.00	13.54	106.00	2.00	V	Low
147.822480	26.15	43.52	17.37	122.00	90.00	V	Low
476.351040	30.96	46.02	15.06	290.00	359.00	V	Low

The EUT was maximized in all 3 orthogonal axes. The worst-case axis and channel are shown in the plot and table above.

Harmonics, band edges, and fundamental emissions are shown in Section 3.1 and 3.2.

Peak Measurements, 1GHz – 100 GHz							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol.**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**		
5204.154000	42.75	73.98	31.23	231.00	28.00	V	Low
5757.488000	44.53	73.98	29.45	356.00	3.00	V	Low

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

Average Measurements, 1GHz – 100 GHz							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol.**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**		
5204.154000	28.96	53.98	25.02	231.00	28.00	V	Low
5757.488000	29.91	53.98	24.07	356.00	3.00	V	Low

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

4.4 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 0.5-5 5-30	66 to 56 56 60	56 to 46 46 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:
The EUT was set to transmit continuously on the middle channel. Device was charging using the following PSU:

MN: PSAF10R-050Q 5VDC USB Power Supply

Test Results: PASS

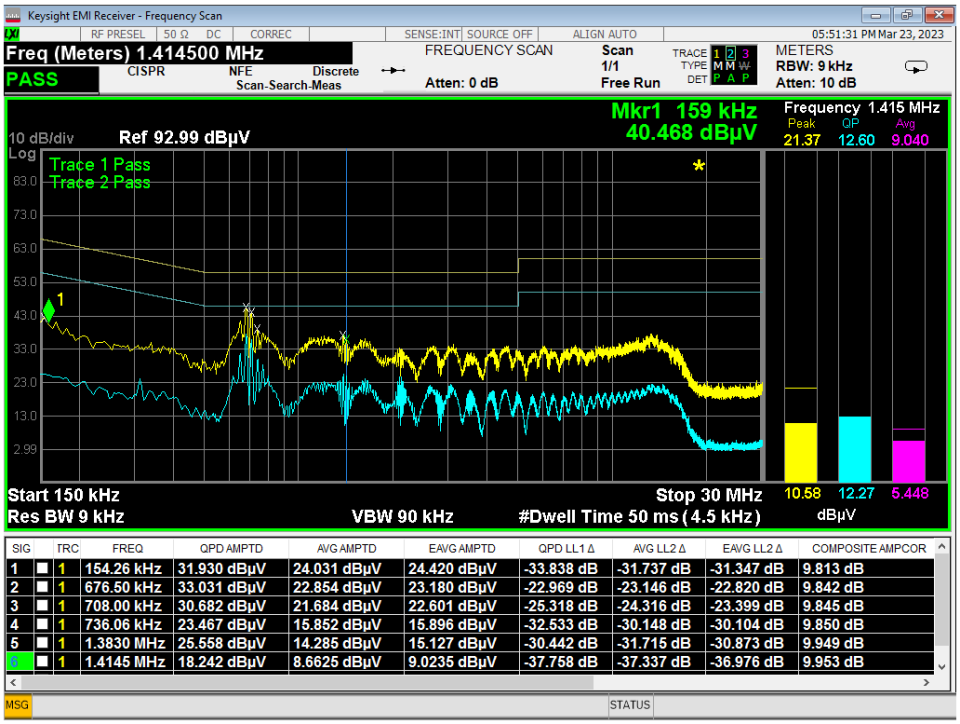


Figure 22 - Conducted Emissions Plot, Tx, Line

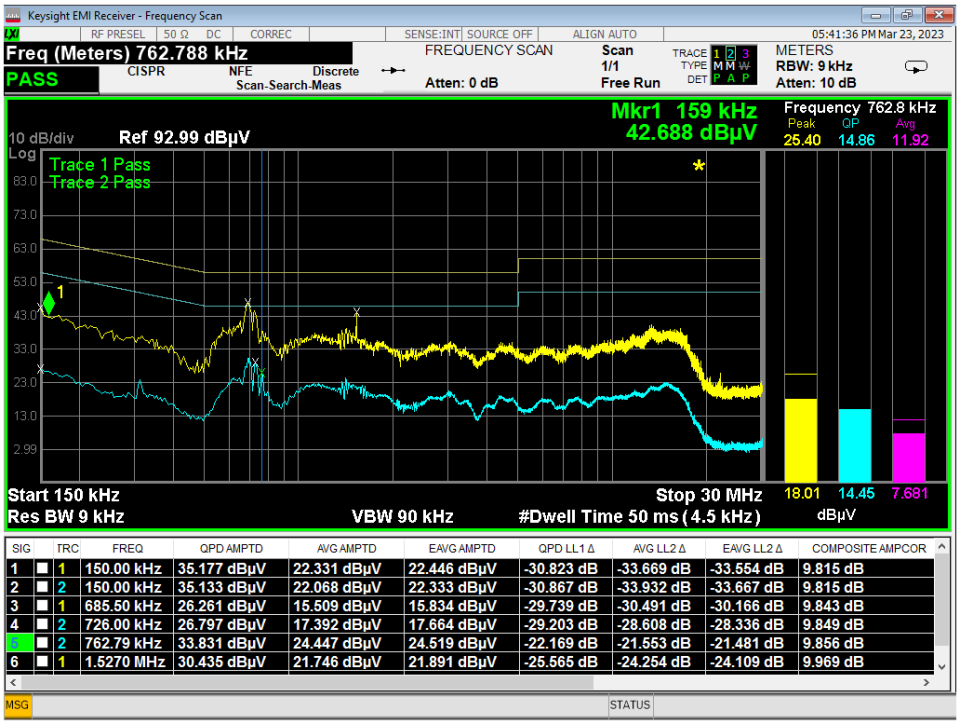
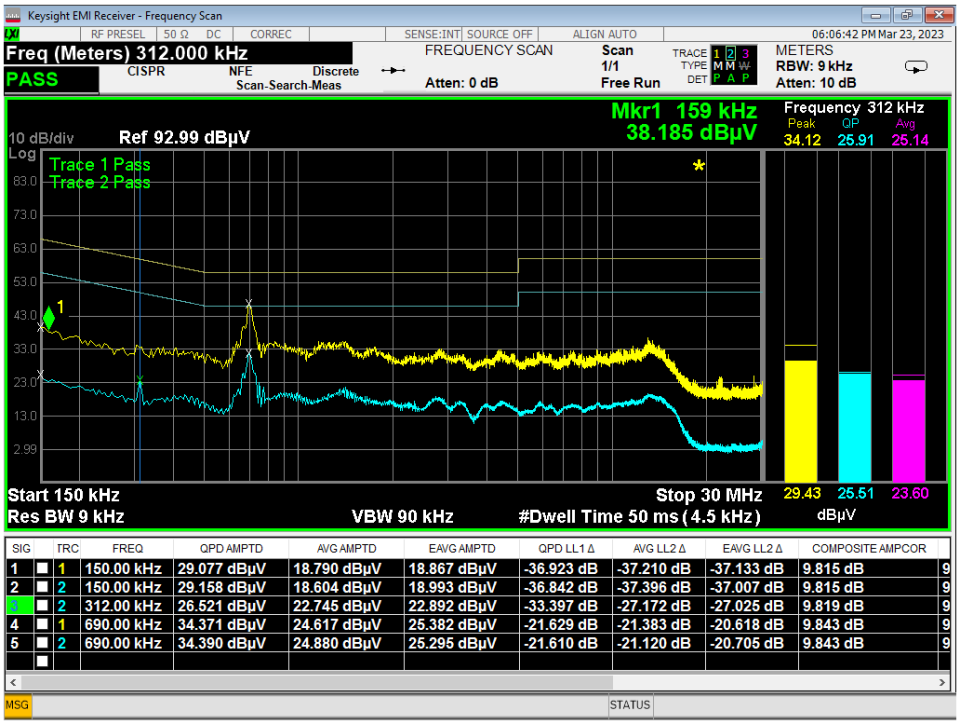
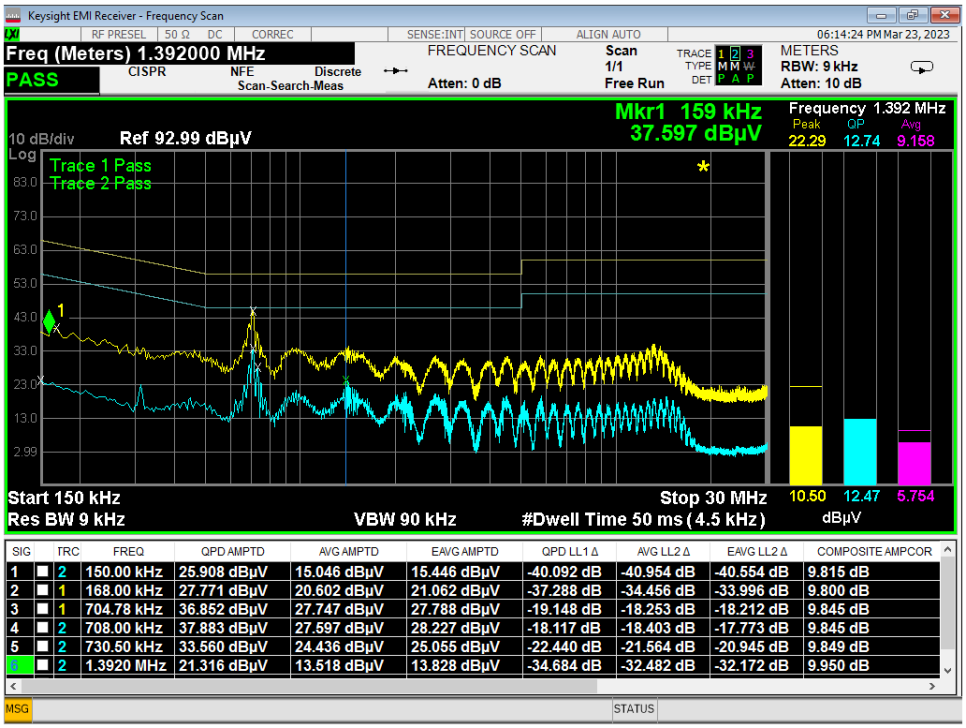


Figure 23 - Conducted Emissions Plot, Tx, Neutral



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	29.077 dBµV	18.790 dBµV	18.867 dBµV	-36.923 dB	-37.210 dB	-37.133 dB	9.815 dB	9
2	2	150.00 kHz	29.158 dBµV	18.604 dBµV	18.993 dBµV	-36.842 dB	-37.396 dB	-37.007 dB	9.815 dB	9
3	2	312.00 kHz	26.521 dBµV	22.745 dBµV	22.892 dBµV	-33.397 dB	-27.172 dB	-27.025 dB	9.819 dB	9
4	1	690.00 kHz	34.371 dBµV	24.617 dBµV	25.382 dBµV	-21.629 dB	-21.383 dB	-20.618 dB	9.843 dB	9
5	2	690.00 kHz	34.390 dBµV	24.880 dBµV	25.295 dBµV	-21.610 dB	-21.120 dB	-20.705 dB	9.843 dB	9

Figure 24 - Conducted Emissions Plot, Rx, Line



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	EAVG AMPTD	QPD LL1 Δ	AVG LL2 Δ	EAVG LL2 Δ	COMPOSITE AMPCOR
1	2	150.00 kHz	25.908 dBµV	15.046 dBµV	15.446 dBµV	-40.092 dB	-40.954 dB	-40.554 dB	9.815 dB
2	1	168.00 kHz	27.771 dBµV	20.602 dBµV	21.062 dBµV	-37.288 dB	-34.456 dB	-33.996 dB	9.800 dB
3	1	704.78 kHz	36.852 dBµV	27.747 dBµV	27.788 dBµV	-19.148 dB	-18.253 dB	-18.212 dB	9.845 dB
4	2	708.00 kHz	37.883 dBµV	27.597 dBµV	28.227 dBµV	-18.117 dB	-18.403 dB	-17.773 dB	9.845 dB
5	2	730.50 kHz	33.560 dBµV	24.436 dBµV	25.055 dBµV	-22.440 dB	-21.564 dB	-20.945 dB	9.849 dB
6	2	1.3920 MHz	21.316 dBµV	13.518 dBµV	13.828 dBµV	-34.684 dB	-32.482 dB	-32.172 dB	9.950 dB

Figure 25 - Conducted Emissions Plot, Rx, Neutral

4.5 Duty Cycle

4.5.1 Test Results:

No duty cycle is reported for this report.

Annex A - Sample Calculations

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 (if applicable)
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 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 x Gain (numeric)]
Power (watts) = 10^[Power (dBm)/10] x 1000
Field Strength (dBμV/m) = Field Strength (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 x d^2)/30 = FS [(d^2)/30] = FS [0.3}
EIRP(dBm) = FS(dBμV/m) – 10(log 10^9) + 10log[0.3] = -95.23

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

Annex 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 – 18GHz	±3.03

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

CISPR 16-4-2:2011 was used to calculate the above values.

REPORT END