ncee labs
Product Compliance Solutions
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: **A03985**

Test Report No.: **R20200722-20-E2A**

Approved By:

Nic S. Johnson, NCE
Technical Manager
iNARTE Certified EMC Engineer #EMC-003337-NE

Date: **1 June 2021**

Total Pages: **40**

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TESTING LABORATORY
CERTIFICATE NO. 1953.01

Revision Page

Rev. No.	Date	Description
Original	5/7/2021	Original – Njohnson Prepared by KVepuri/FLane
A	6/01/2021	Peak fundamental and Harmonic data were added in section 3.1 -KV/NJ

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 15.245 RSS-210, Issue 10, Section F.2	Complies

2 EUT Description

2.1 Equipment under Test (EUT)

Table 2 - Equipment under Test (EUT)

EUT	A03985
Manufacturers Identification	PR, 2TDK,2X470PF, GDS
EUT Received	2/22/2021
EUT Tested	2/22/2021 - 4/20/2021
Serial No.	00199 (Assigned by the test lab; EUT receive date:2/22/2021)
Operating Band	24075 MHz -24175 MHz
Device Type	Radar transceiver
Power Supply	Internal Battery/ Charger: Garmin (Phi Hong) MN: PSAF10R-050Q (Representative Power Supply); SN: P161400162A1

2.2 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 32 ± 4%
Temperature of 22 ± 3° Celsius

2.3 EUT Setup

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

3 Test Results

3.1 Fundamental Emissions

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

Test Result: Complies

3.1.1 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.

3.1.2 Test Results

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

3.1.3 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° C

3.1.4 Test Setup

See Section 2.3 for further details.

3.1.5 Test Pictures and/or Figures

Table 3 - Fundamental and Harmonic Emissions Data

Measurements made at 1m for fundamental; 0.05m & 0.5m for 2nd and 3rd Harmonics respectively.
Measurements were extrapolated to 3m.

PR, 2TDK,2X470PF, GDS – Fundamental, peak									
Channel	**Frequency**	**SA reading @ 1m (SA1)**	**Antenna Factor (AF)**	**Cable Loss (CL)**	**Test Distance (D)**	**Corrected Field Strength level @ 1m (FS1)**	**Extrapolated Field Strength level @ 3m (FS3)**	**3m 15.245 Limit**	**Margin**
	GHz	**dBmV**	**dB**	**dB**	**m**	**dBmV/m**	**dBmV/m**	**dBmv/m**	
Low	24.084989	18.01	45.564	1.89	1	65.464	55.92157	67.9588	12.03723
Mid	24.124908	18.24	45.502	1.89	1	65.632	56.08957	67.9588	11.86923
High	24.164967	18.47	45.502	1.89	1	65.862	56.31957	67.9588	11.63923
FS1= SA1+AF+CL; FS3 = FS1 +20*log (D/3); Margin=Limit-FS3; Detector Type= Peak; Limit=20*log (2500 (mV/m))									Passing

PR, 2TDK,2X470PF, GDS – Peak Harmonics compared to average limit										
Channel	**Harmonic**	**Frequency**	**SA reading @ 1m (SA1)**	**Test Distance (D)**	**Mixer Factor (MF)**	**Antenna Factor (AF)**	**Corrected Field Strength Level @ test Distance (FSD)**	**Extrapolated Field Strength Level @ 3m (FS3)**	**Limit at 3m FCC Part 15.245**	**Margin**
		GHz	**dBmV/m**	**m**	**dB**	**dB**	**dBmV/m**		**dBmV/m**	
Low	2nd	48.170000	-50.411	0.05	21.9	40.92	12.40	-23.16	27.95880017	51.12
Mid	2nd	48.250000	-50.979	0.05	22.1	40.93	12.05	-23.51	27.95880017	51.47
High	2nd	48.330000	-50.084	0.05	22.1	40.95	12.97	-22.60	27.95880017	50.56
Low	3rd	72.255000	-6.865	0.5	0	43.44	36.57	21.01	27.95880017	6.95
Mid	3rd	72.375000	-6.344	0.5	0	43.46	37.12	21.55	27.95880017	6.41
High	3rd	72.495000	-6.963	0.5	0	43.47	36.51	20.94	27.95880017	7.01
FSD= SA1+AF+MF; FS3 = CFSL 1 +20*log(D/3); SA1 Detector type= Peak					0 if SA reading includes mixer correction	Margin=Limit-CFSL 3; Limit=20*log (25 (mV/m))				Passing

Remarks relating to 5 cm and 50 cm measurements of 2nd and 3rd harmonics:

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 a distance of 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 and 3rd harmonics in this report meet both of the 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. (yes it can)

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.

Plots:

Note:

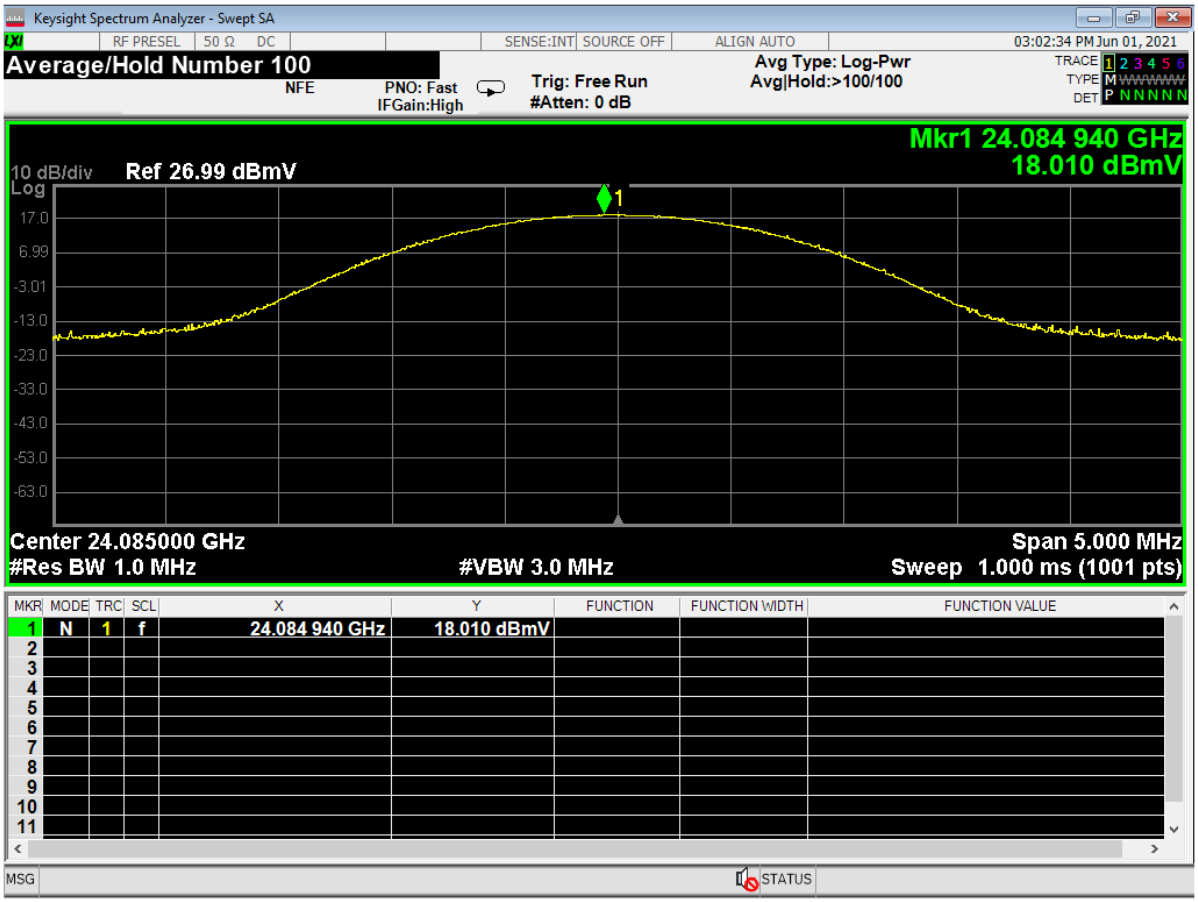

Figure 1 - Analyzer Measurement – Fundamental, Low Channel

Uncorrected measurement as recorded on spectrum analyzer

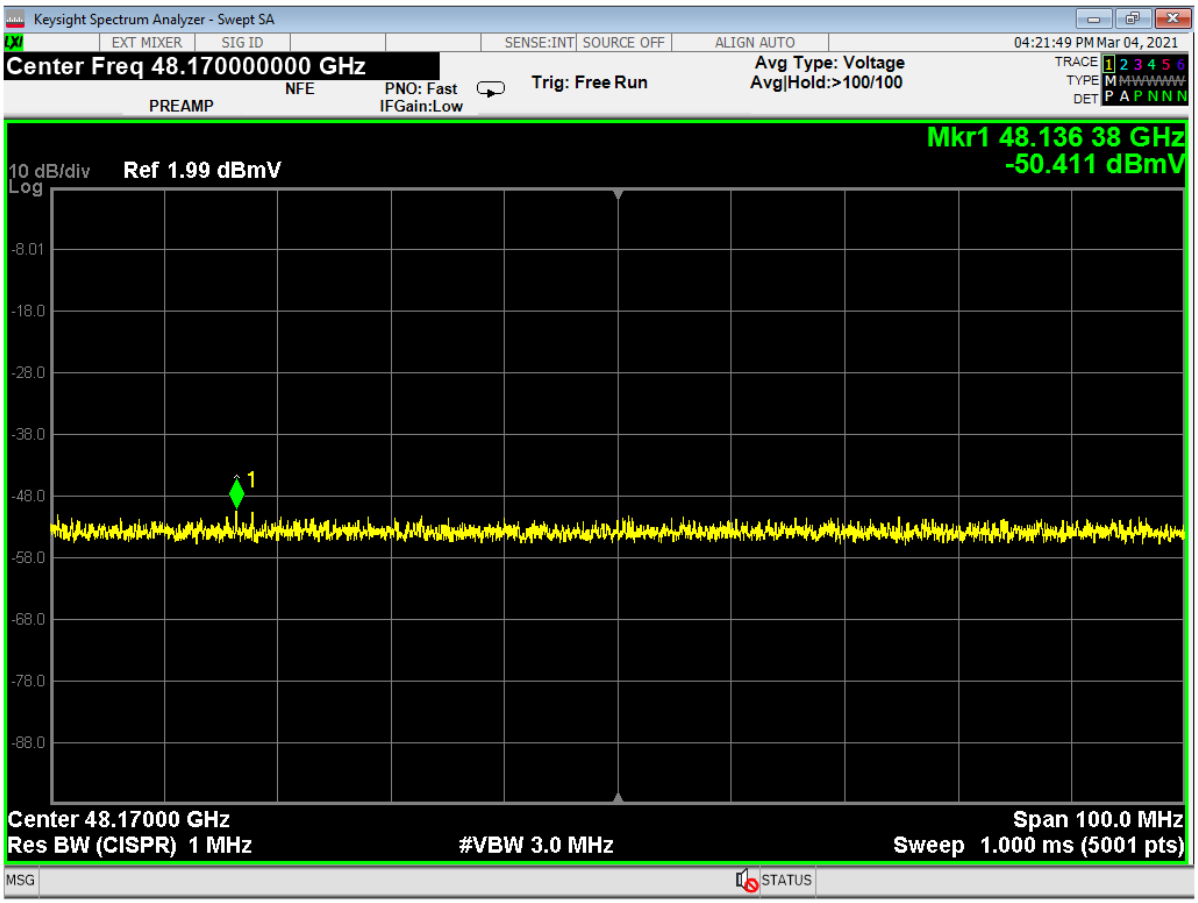

Figure 2 - Analyzer Measurement – 2nd Harmonic, Low Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

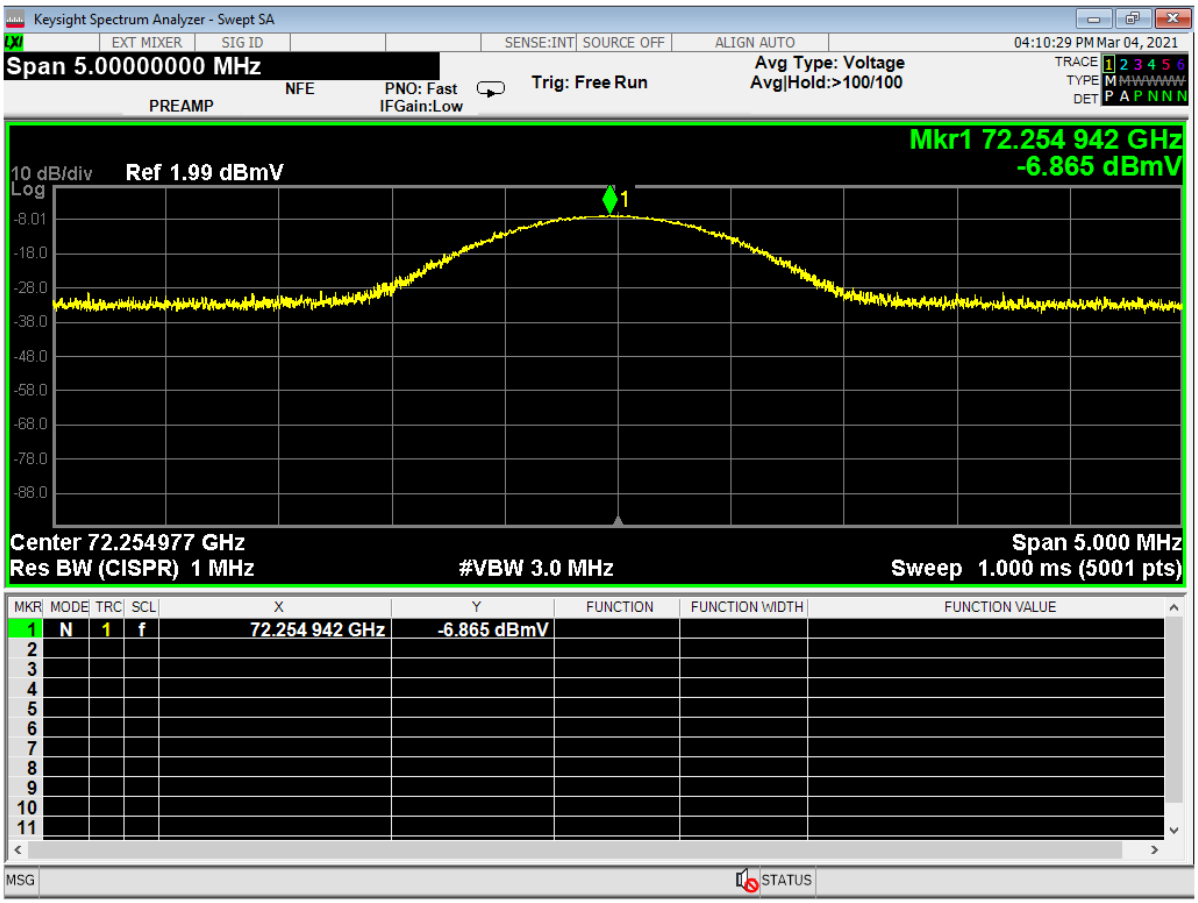

Figure 3 - Analyzer Measurement – 3rd Harmonic, Low Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

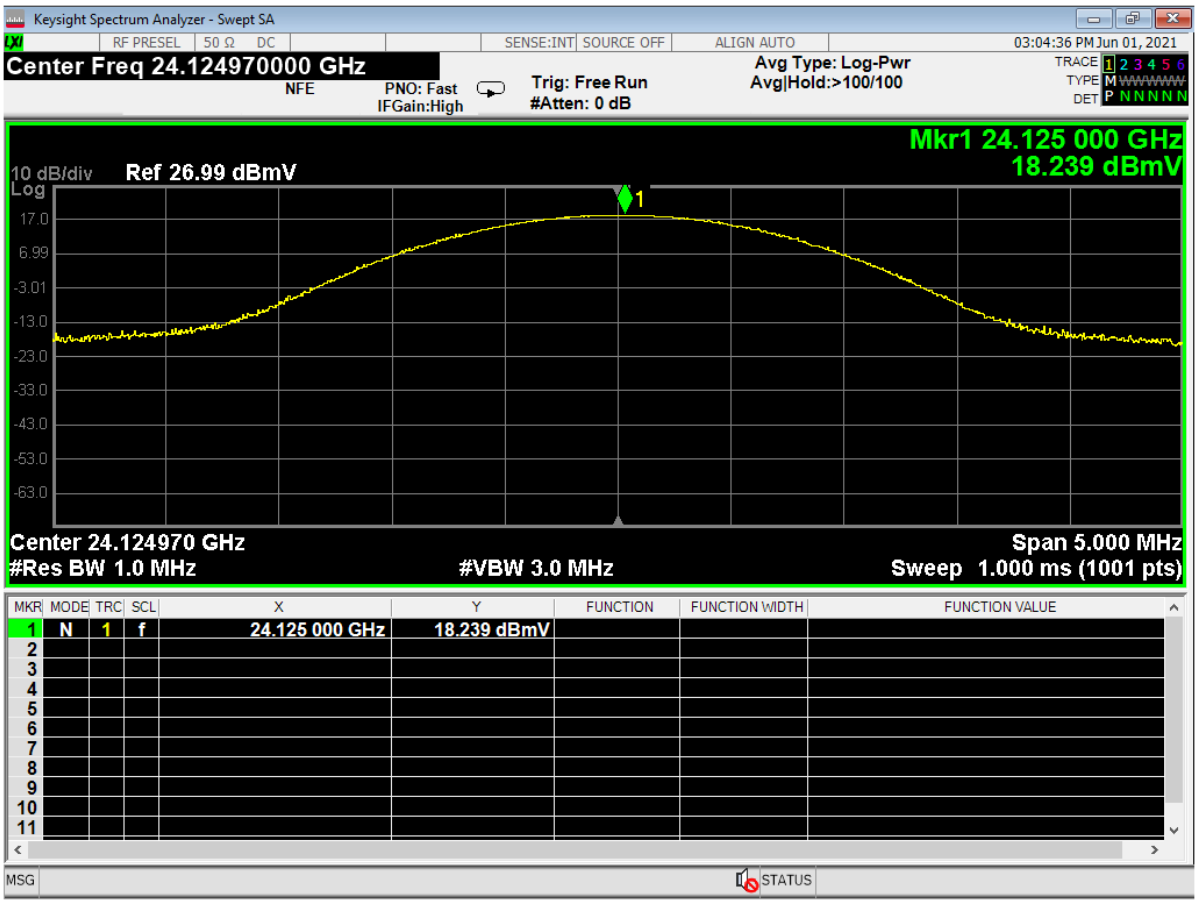

Figure 4 - Analyzer Measurement – Fundamental, Mid Channel

Uncorrected measurement as recorded on spectrum analyzer

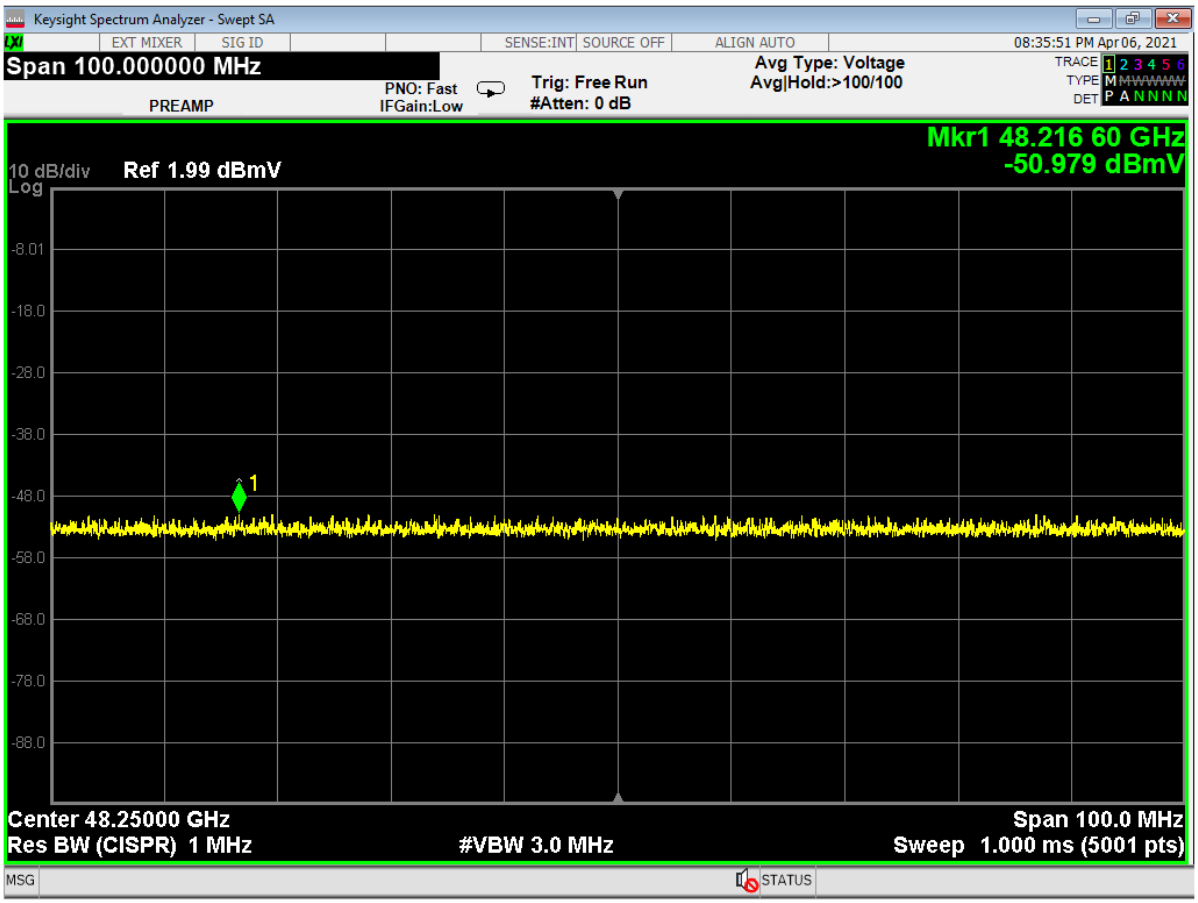

Figure 5 - Analyzer Measurement – 2nd Harmonic, Mid Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

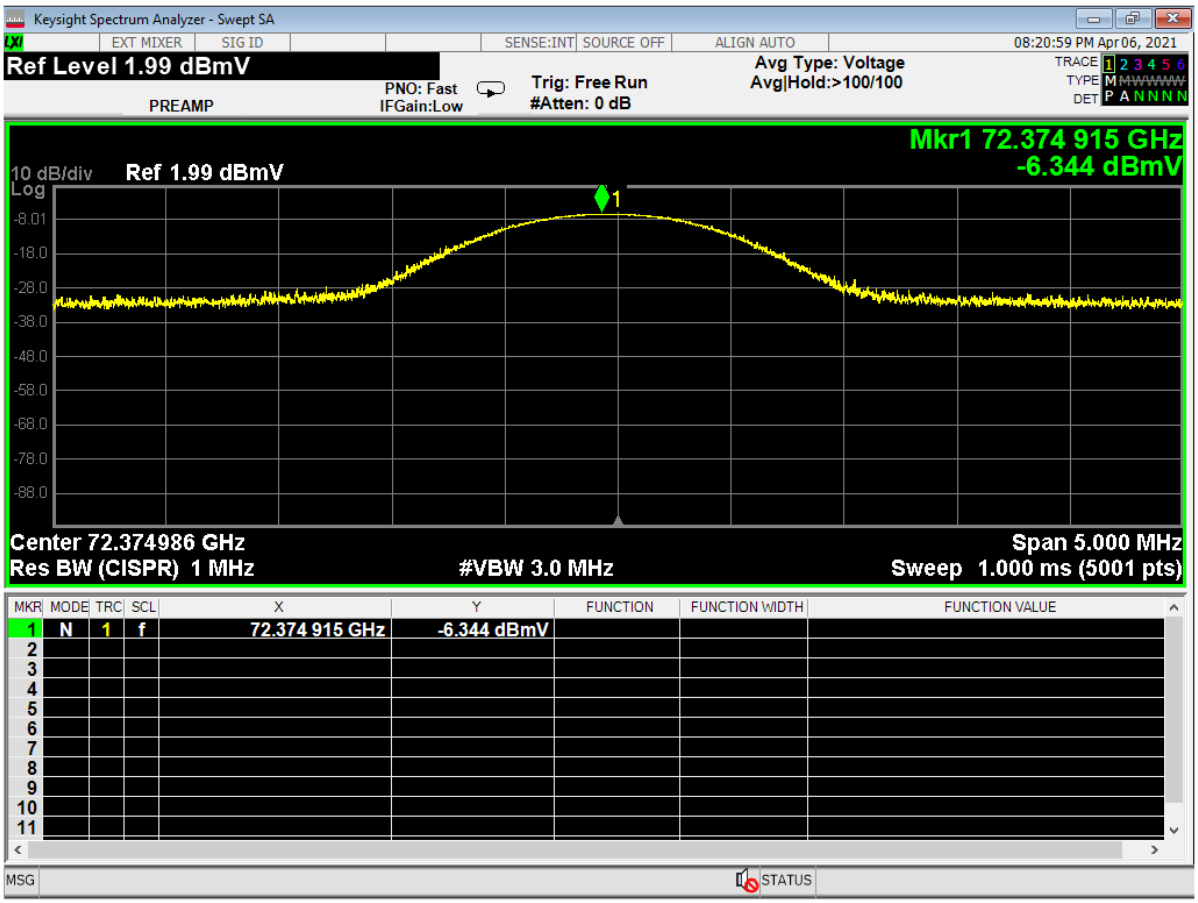

Figure 6 - Analyzer Measurement – 3rd Harmonic, Mid Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

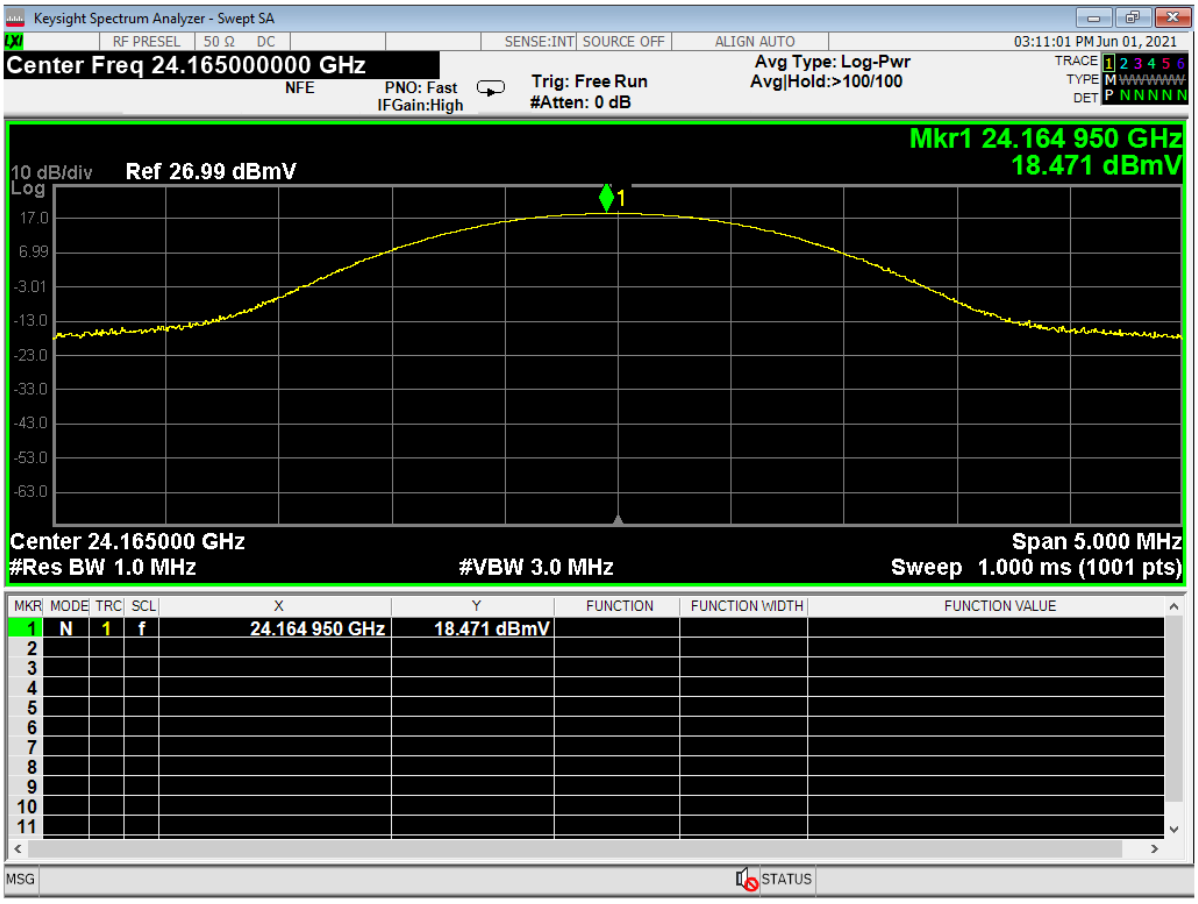

Figure 7 - Analyzer Measurement – Fundamental, High Channel

Uncorrected measurement as recorded on spectrum analyzer

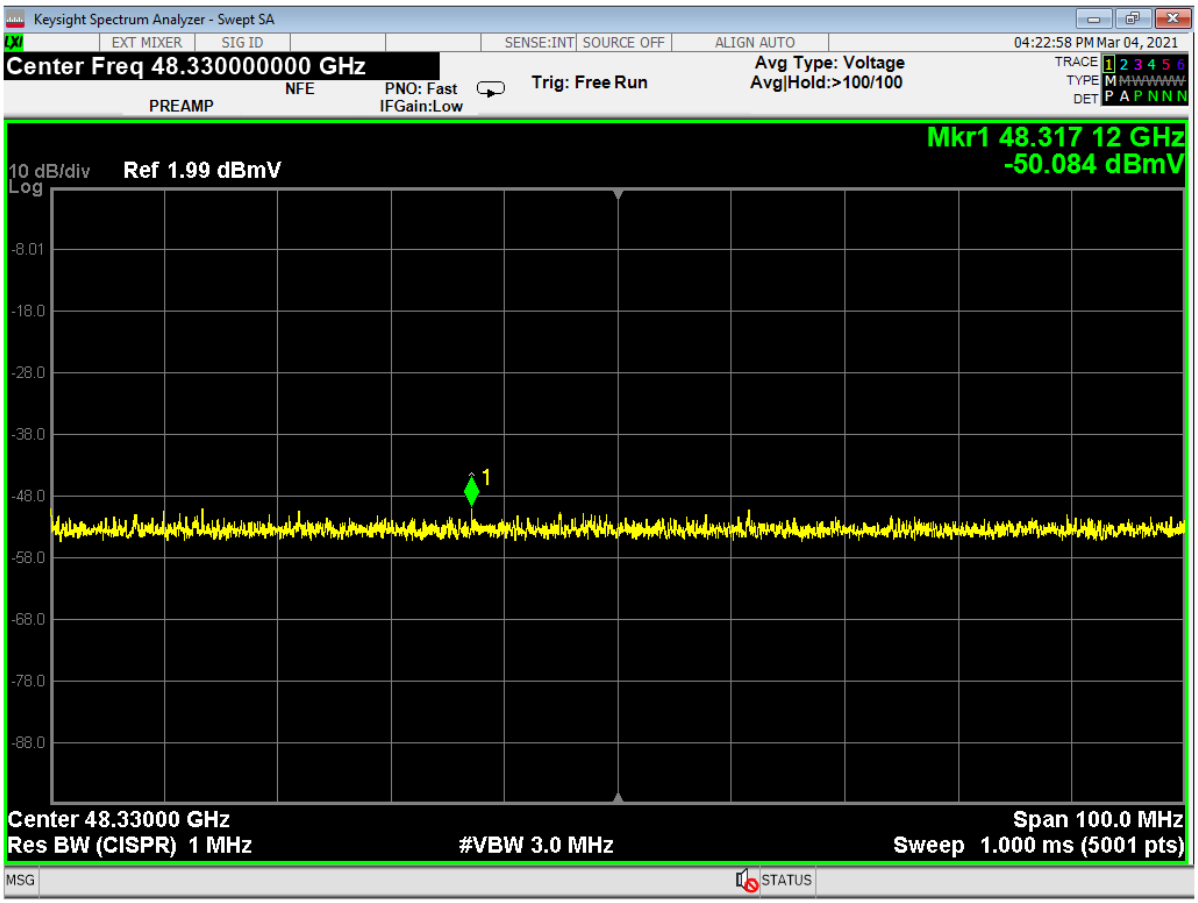

Figure 8 - Analyzer Measurement – 2nd Harmonic, High Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

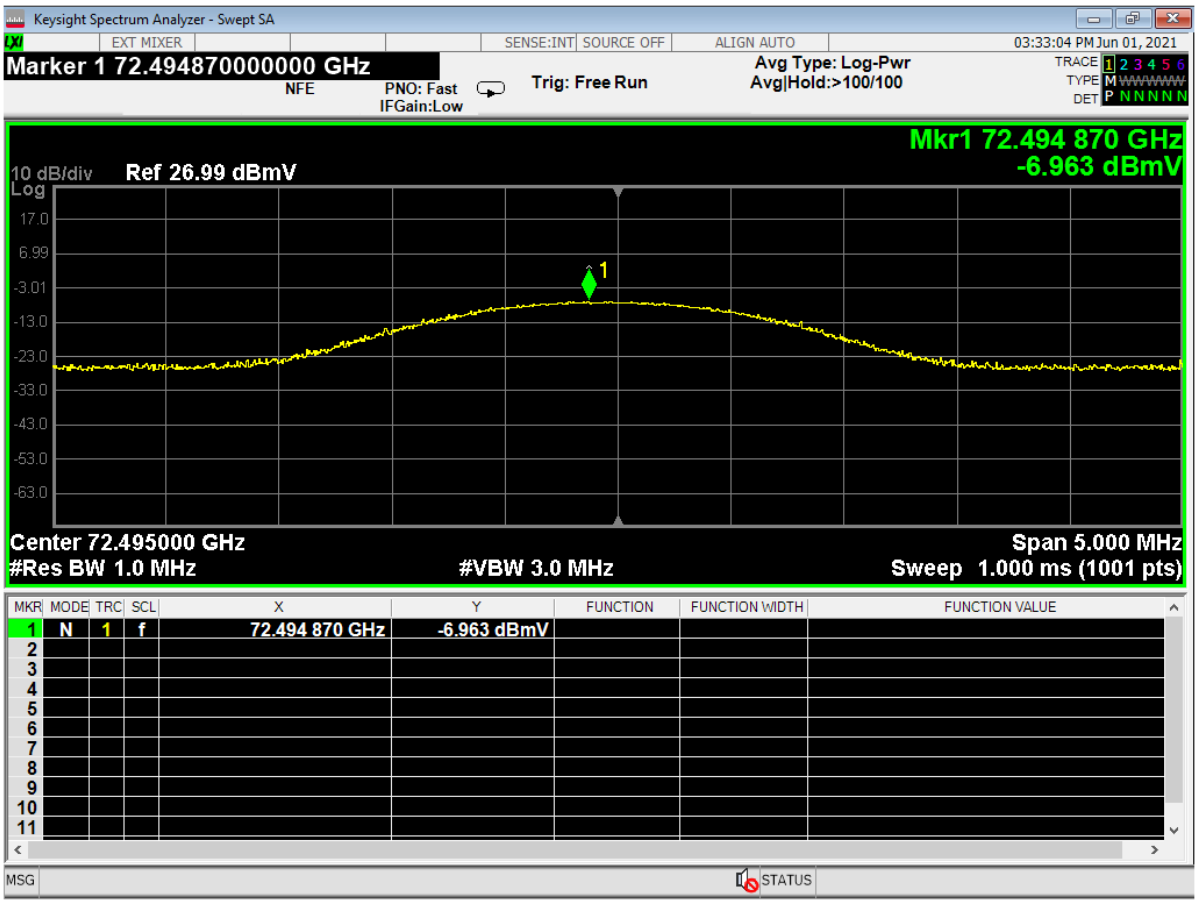

Figure 9 - Analyzer Measurement – 3rd Harmonic, High Channel, Peak

Uncorrected measurement as recorded on spectrum analyzer

3.2 Band edges and Occupied Bandwidth

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

3.2.1 Limits of bandedge measurements:

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.

500 µV/m = 20log (500) = 54 dBµV/m at 3m average

Peak limit = average limit + 20 dB = 74 dBµV/m at 3m peak

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			

3.2.2 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.

3.2.3 Deviations from test standard:

No deviation.

3.2.4 Test setup:

All the measurements were done at 1m test distance.

3.2.5 EUT operating conditions:

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

3.2.6 Band Edges

Test results:

PR, 2TDK,2X470PF,GDS - Unrestricted Band Edge						
Band Edge	**Frequency**	**Fundamental**	**Out of Band level**	**Delta**	**Minimum Delta Limit**	**Margin**
	GHz	**dBmV**	**dBmV**	**dB**	**dB**	
Average LBE at 0.5m	24.085	21.297	-37.55	58.847	50	-8.847
Average HBE at 0.5m	24.165	23.052	-39.411	62.463	50	-12.463
Relative Measurements						Passing

PR, 2TDK,2X470PF,GDS - Restricted Band Edge									
Band Edge	**Frequency**	**SA reading (SA)**	**Antenna Factor (AF)**	**Cable Loss (CL)**	**FS level @ 0.5m (FS0.5)**	**FS level @ 3m (FS3 dBmV)**	**FS level @ 3m (FS3 dBuV)**	**Limit Part 15.209**	**Margin**
	GHz	**dBmV**	**dB**	**dB**	**dBmV/m**	**dBmV/m**	**dBµv/m**	**dBµv/m**	
Peak LBE at 0.5m	24.085	-42.914	45.564	1.89	2.65	-12.913	47.08697499	74	26.913025
Average LBE at 0.5m	24.085	-55.072	45.564	1.89	-9.508	-25.071	34.92897499	54	19.071025
Peak HBE at 0.5m	24.165	-27.07	45.502	1.89	18.432	2.868975	62.86897499	74	11.131025
Average HBE at 0.5m	24.165	-54.1	45.502	1.89	-8.598	-24.161	35.83897499	54	18.161025
	FS 0.5= SA+AF+LC; FS 3 dBmV= FS0.5 +20*log(0.5/3); FS3 dBuV =FS3 dBmV+60								

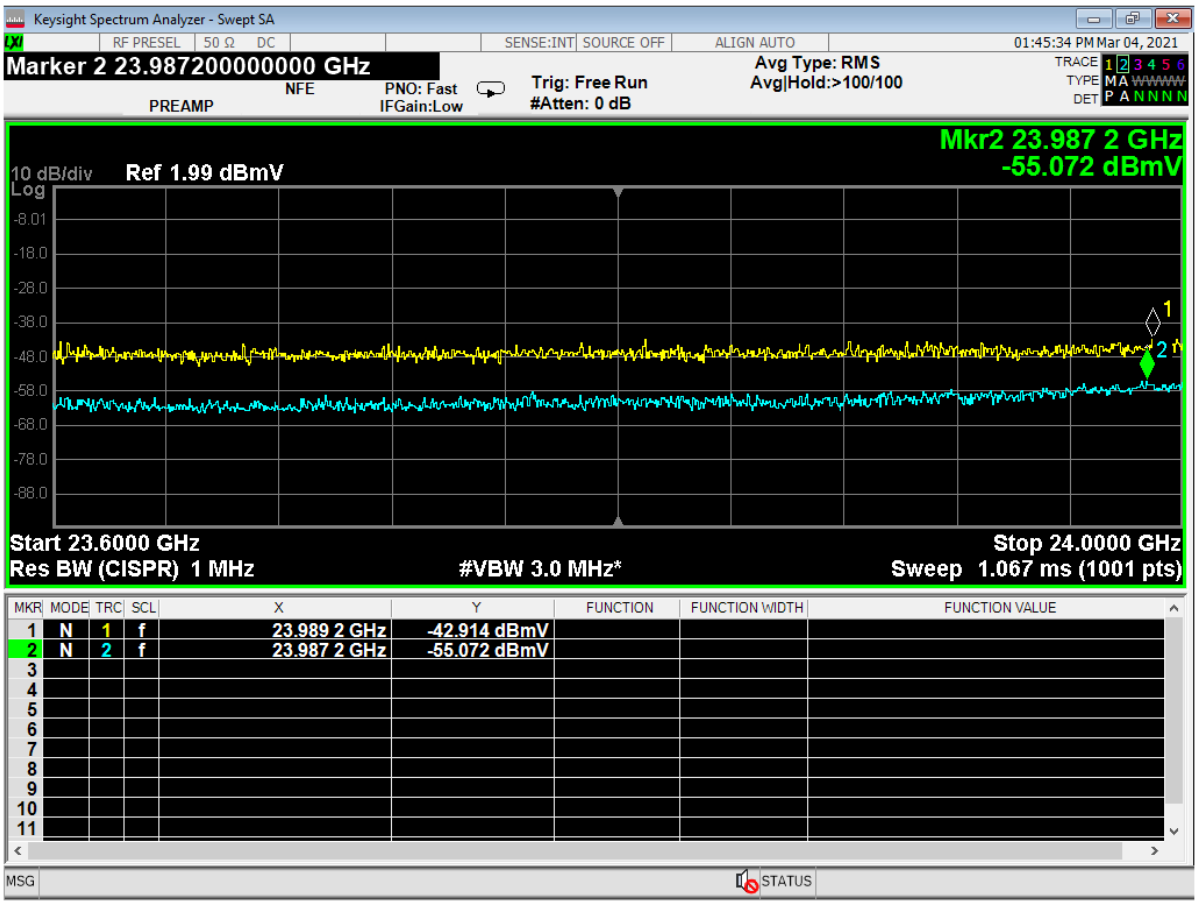

Figure 10 – Restricted Lower Band Edge

Uncorrected measurement as recorded on spectrum analyzer, 0.5m test distance

Restricted Low Band Edge Measurement at 24.00 GHz

Measurements were performed at 0.5m to achieve required sensitivity without preamplifier saturation

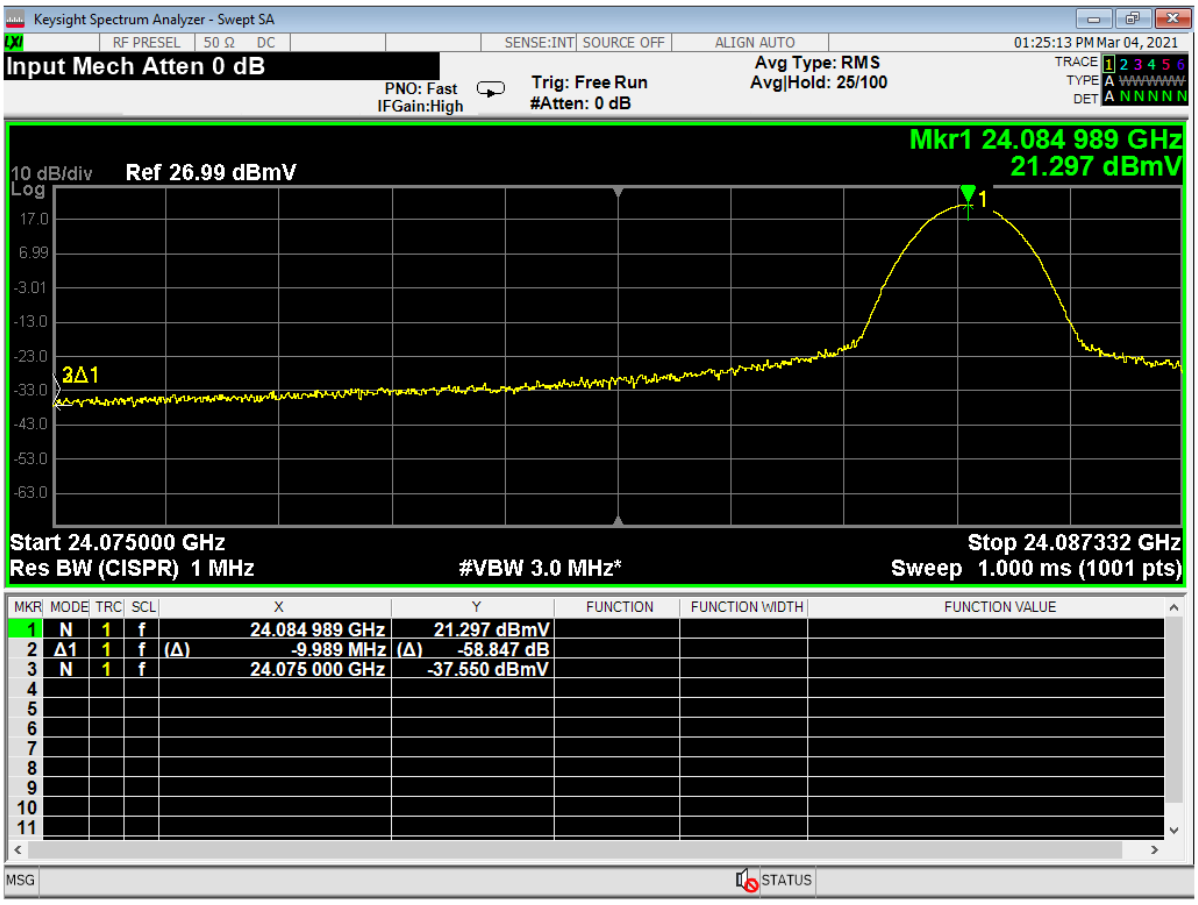

Figure 11 – Unrestricted Lower Band Edge

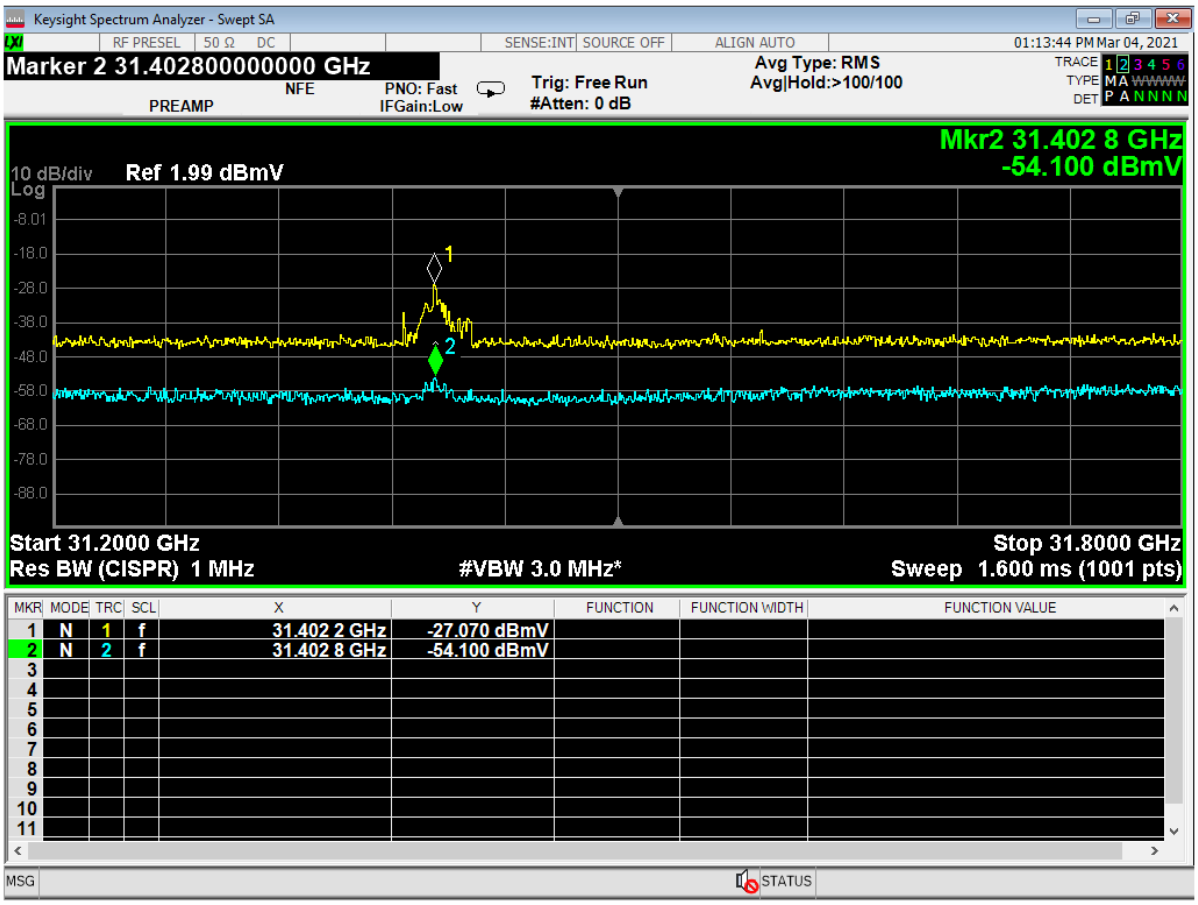

Figure 12 – Restricted Higher Band Edge

Uncorrected measurement as recorded on spectrum analyzer, 0.5m test distance

Restricted High Band Edge Measurement at 31.2 GHz

Measurements were performed at 0.5m to achieve required sensitivity without preamplifier saturation

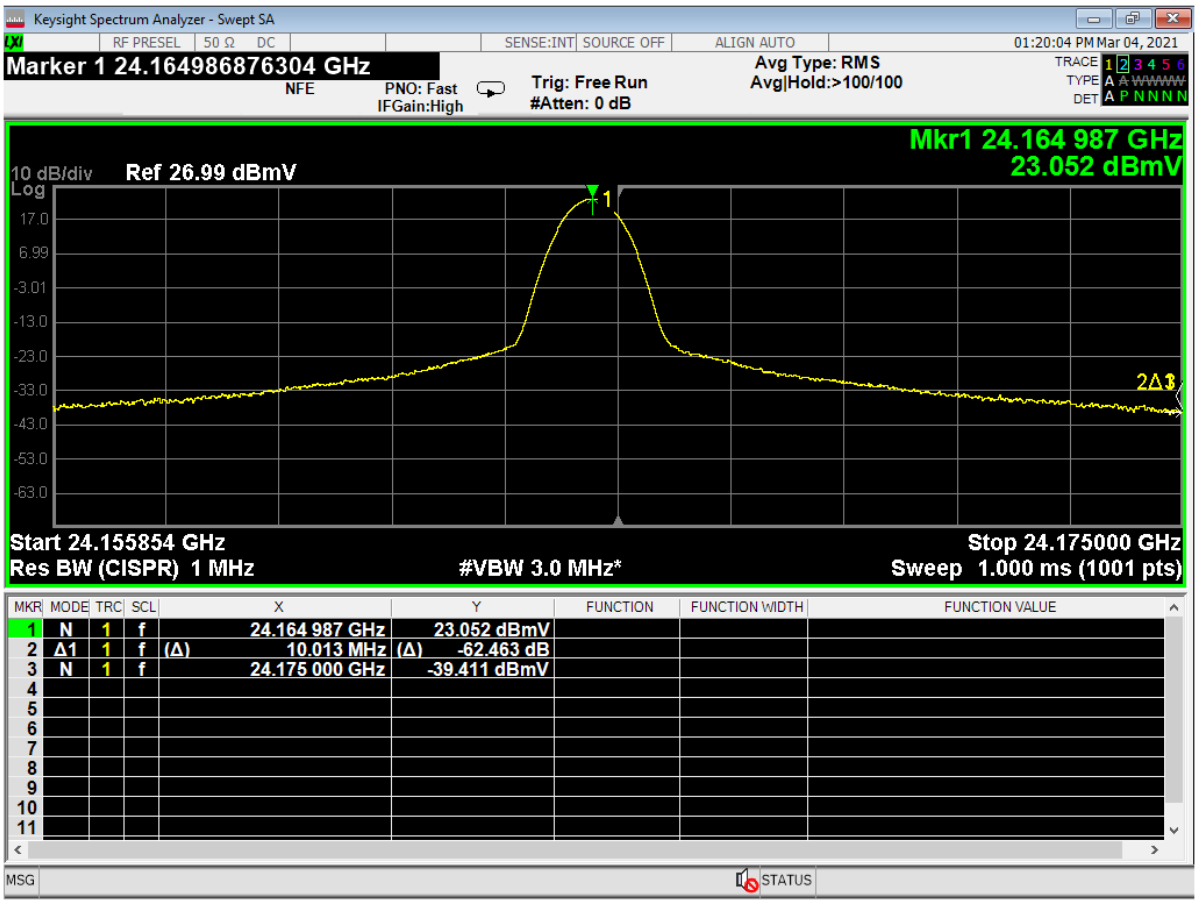

Figure 13 – Unrestricted Higher Band Edge

Occupied Bandwidth

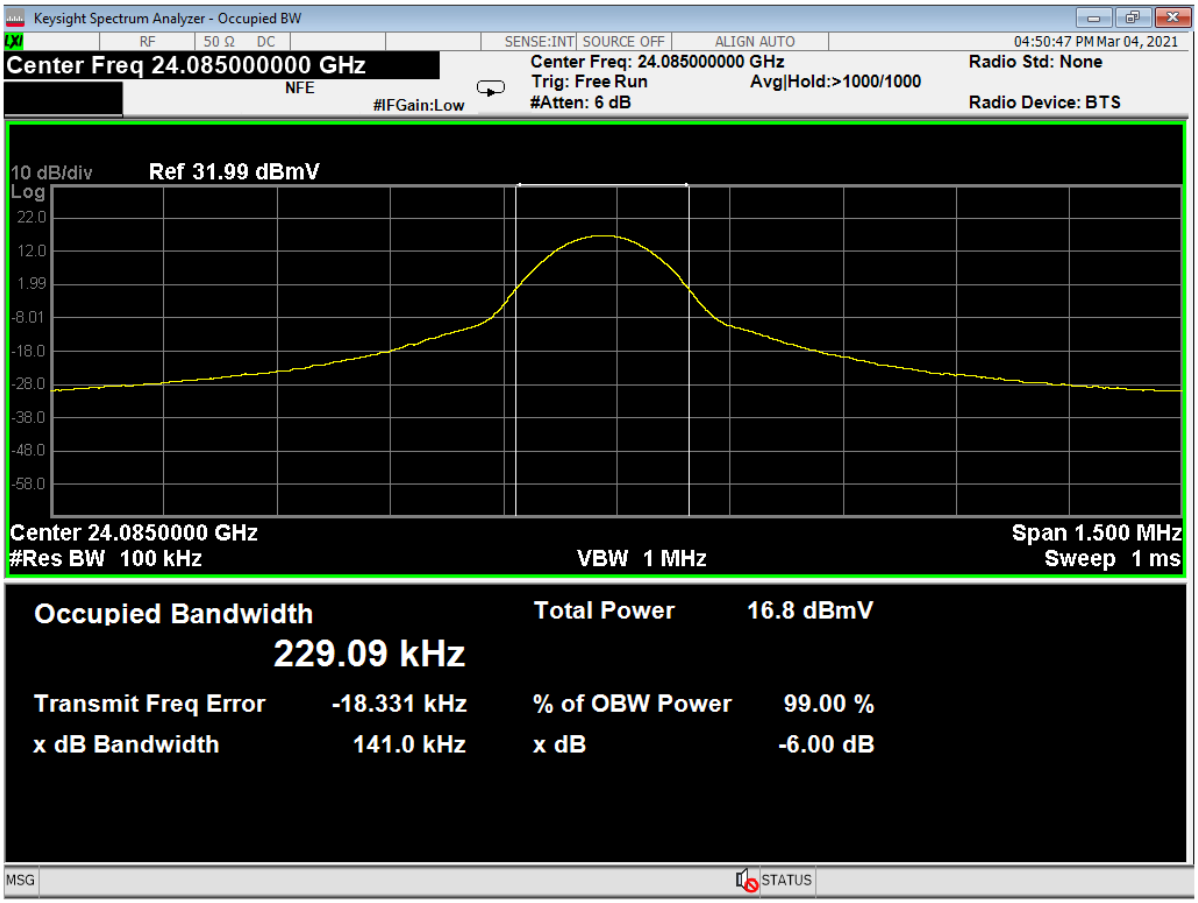

Figure 14 – Occupied Bandwidth, Low channel
Uncorrected measurement as recorded on spectrum analyzer

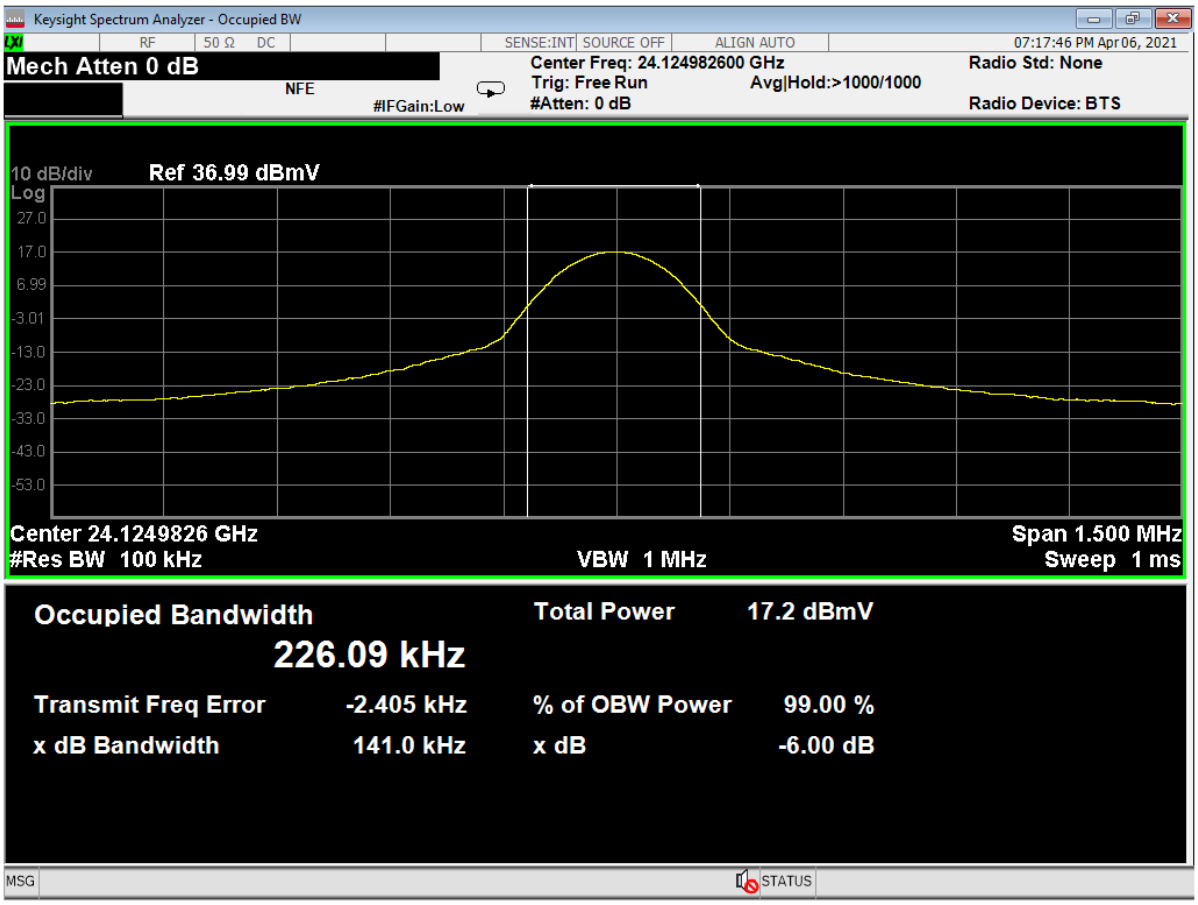

Figure 15 – Occupied Bandwidth, Mid channel
Uncorrected measurement as recorded on spectrum analyzer

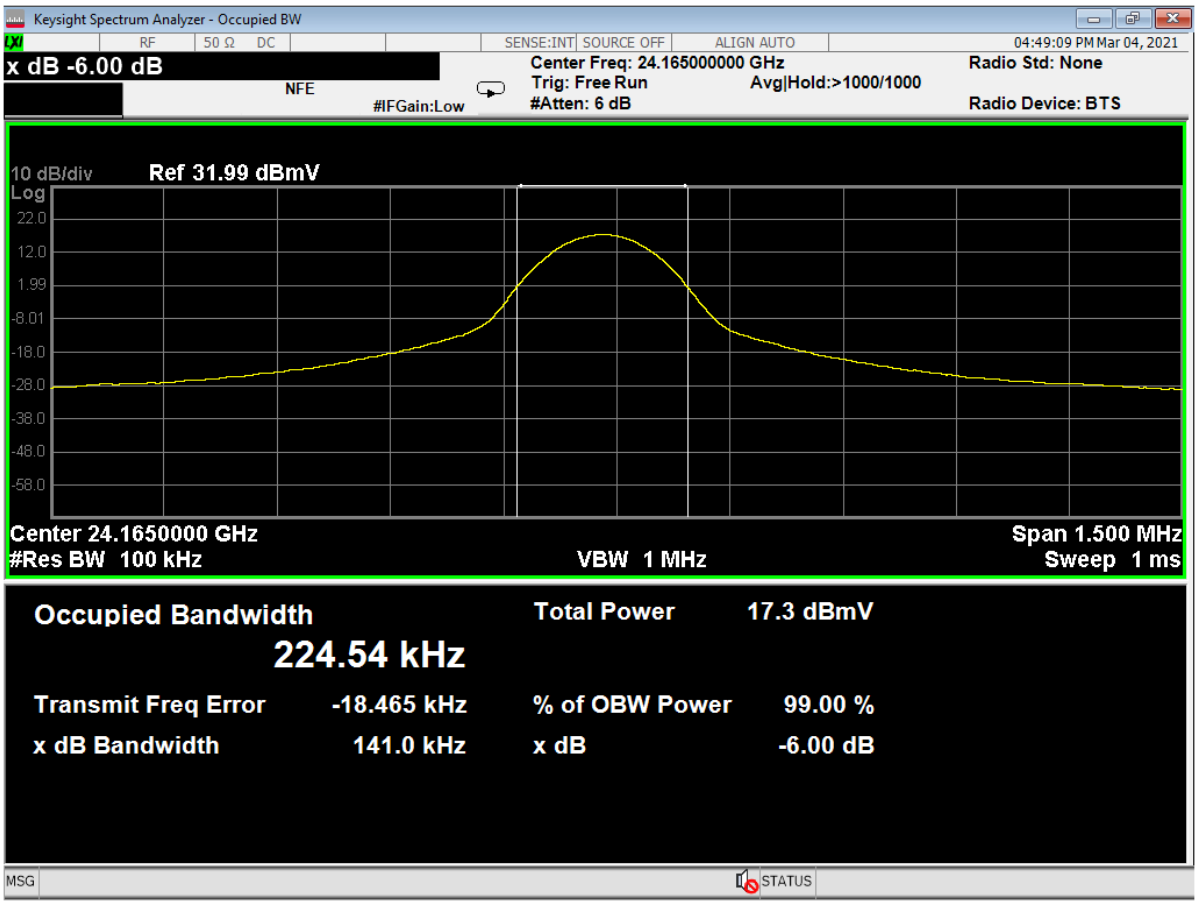

Figure 16 – Occupied Bandwidth, High channel
Uncorrected measurement as recorded on spectrum analyzer

3.3 Radiated emissions

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

Limits for radiated emissions measurements:

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

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

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

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.

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

Test setup:

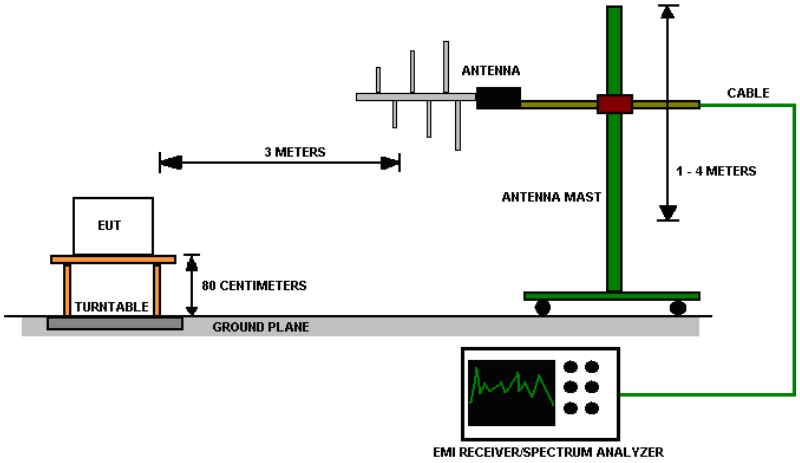

Figure 17 - Radiated Emissions Test Setup

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:

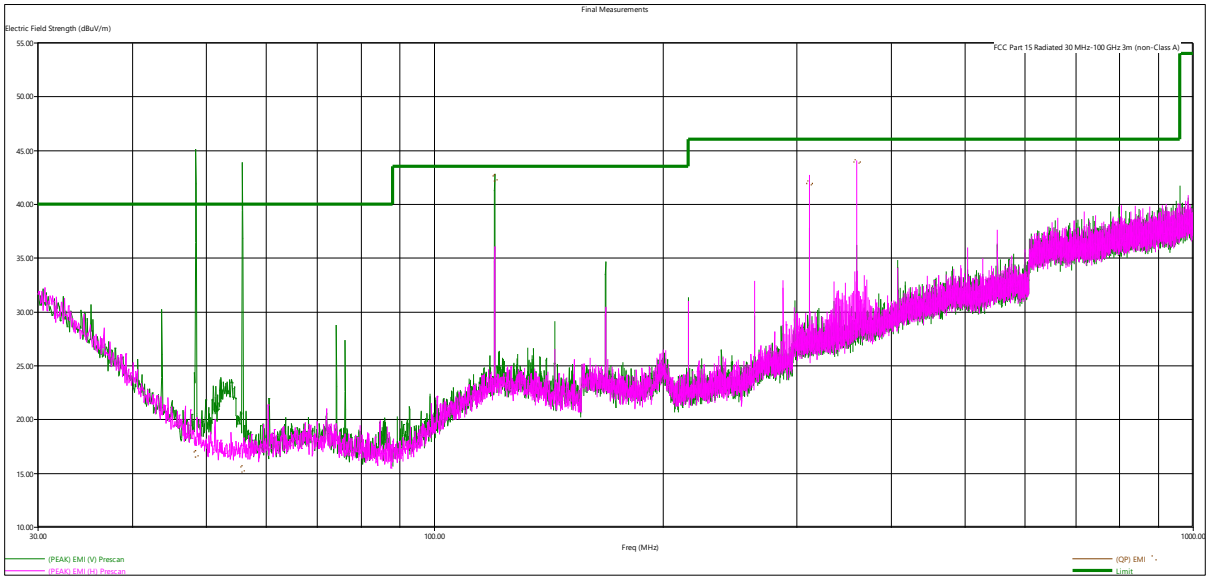

Figure 18 - Radiated Emissions Plot, Low Channel

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

Quasi-Peak Measurements, 30MHz – 1GHz, Radar, Low							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol.**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**		
312.110160	41.95	46.02	4.07	107.00	94.00	H	Low
359.990160	43.95	46.02	2.07	104.00	66.00	H	Low
48.384240	16.71	40.00	23.29	136.00	268.00	V	Low
55.921200	15.35	40.00	24.65	123.00	164.00	V	Low
119.993760	42.42	43.52	1.10	106.00	65.00	V	Low

The EUT was maximized in all 3 orthogonal axis and on the low, middle and high channels. The worst-case axis and channel are shown in the plot and table above.

Harmonics of fundamental frequency are shown in Section 3.1.

Peak Measurements, 1GHz – 100 GHz, GMSK							
Frequency	Level	Limit	Margin	Height	Angle	Pol.	Channel
MHz	dBµV/m	dBµV/m	dB	cm	deg		
2413.938000	49.51	73.98	24.47	272.00	13.00	V	High
16243.260000	59.41	73.98	14.57	191.00	285.00	H	High
17931.326000	60.93	73.98	13.05	128.00	40.00	H	High
4531.024000	49.46	73.98	24.52	233.00	328.00	V	High
7551.488000	54.55	73.98	19.43	131.00	359.00	V	High
10572.330000	52.99	73.98	20.99	181.00	76.00	V	High
1488.374000	40.18	73.98	33.80	295.00	195.00	H	Low
2412.368000	57.34	73.98	16.64	360.00	0.00	V	Low
4515.936000	50.98	73.98	23.00	209.00	340.00	V	Low
7526.546000	54.76	73.98	19.22	171.00	4.00	V	Low
10536.902000	53.87	73.98	20.11	124.00	67.00	V	Low

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

Average Measurements, 1GHz – 100 GHz, GMSK							
Frequency	Level	Limit	Margin	Height	Angle	Pol.	Channel
MHz	dBµV/m	dBµV/m	dB	cm	deg		
2413.938000	30.75	53.98	23.23	272.00	13.00	V	High
16243.260000	46.31	53.98	7.67	191.00	285.00	H	High
17931.326000	48.04	53.98	5.94	128.00	40.00	H	High
4531.024000	45.65	53.98	8.33	233.00	328.00	V	High
7551.488000	50.72	53.98	3.26	131.00	359.00	V	High
10572.330000	46.76	53.98	7.22	181.00	76.00	V	High
1488.374000	33.85	53.98	20.13	295.00	195.00	H	Low
2412.368000	34.92	53.98	19.06	360.00	0.00	V	Low
4515.936000	47.57	53.98	6.41	209.00	340.00	V	Low
7526.546000	50.58	53.98	3.40	171.00	4.00	V	Low
10536.902000	48.72	53.98	5.26	124.00	67.00	V	Low

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

Average measurements were performed with an average detector. The fundamental emission was measured in the time domain and verified to be continuous wave and not pulsed and with no modulation. Measurements with an average detector were of frequencies that were not harmonic frequencies.

3.4 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 powered by 5 VDC unless specified and set to transmit continuously on the middle channel.

Test Results: PASS

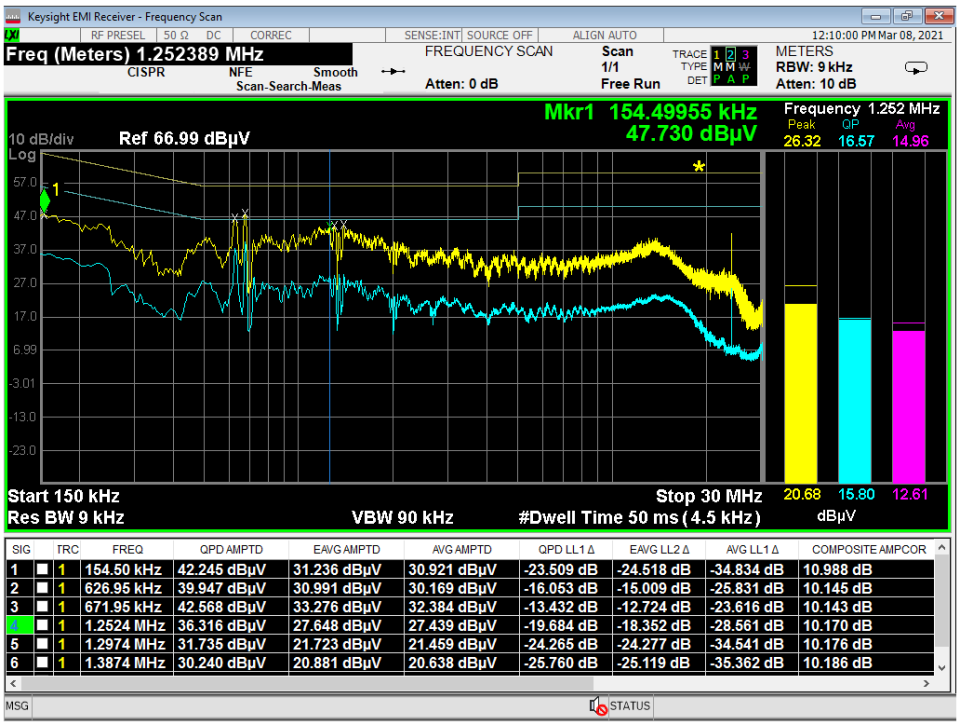

Figure 19 - Conducted Emissions Plot, Tx, Line

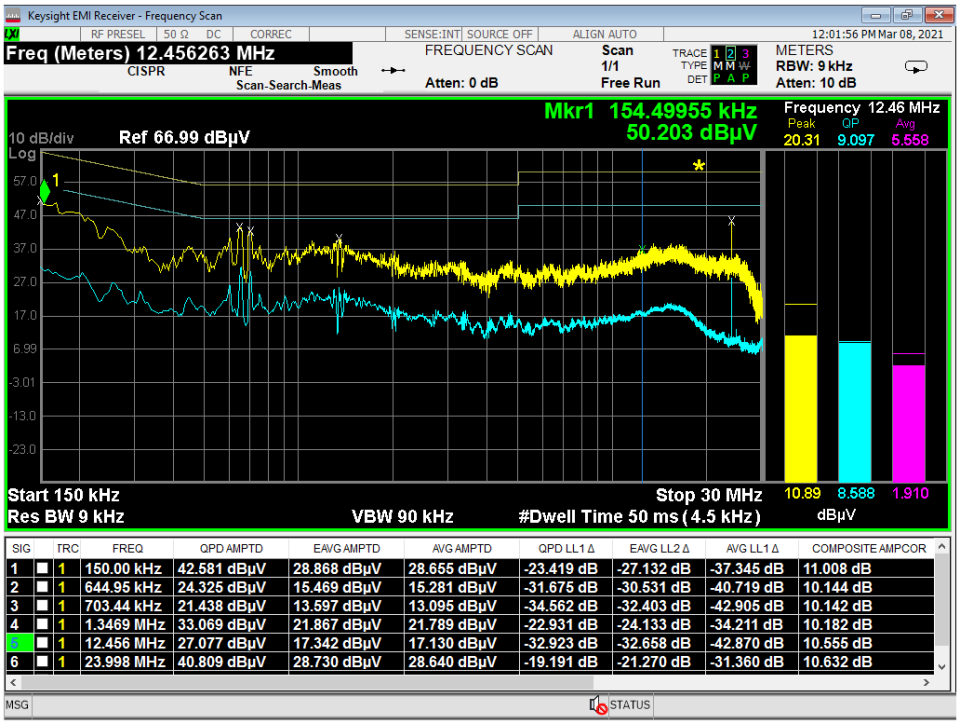

Figure 20 - Conducted Emissions Plot, Tx, Neutral

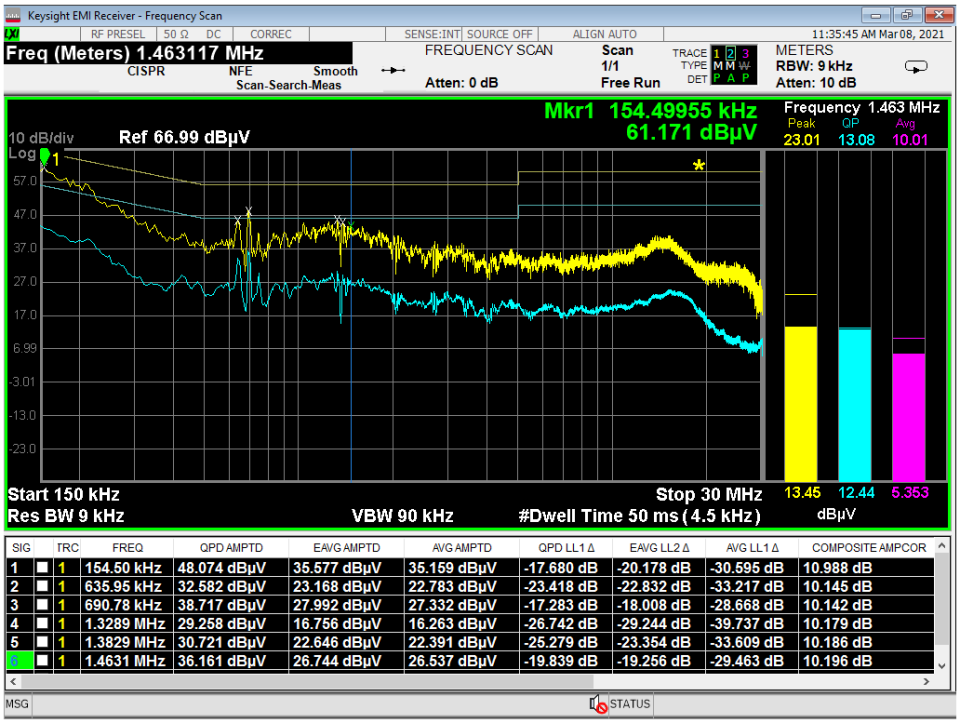

Figure 21 - Conducted Emissions Plot, Rx, Line

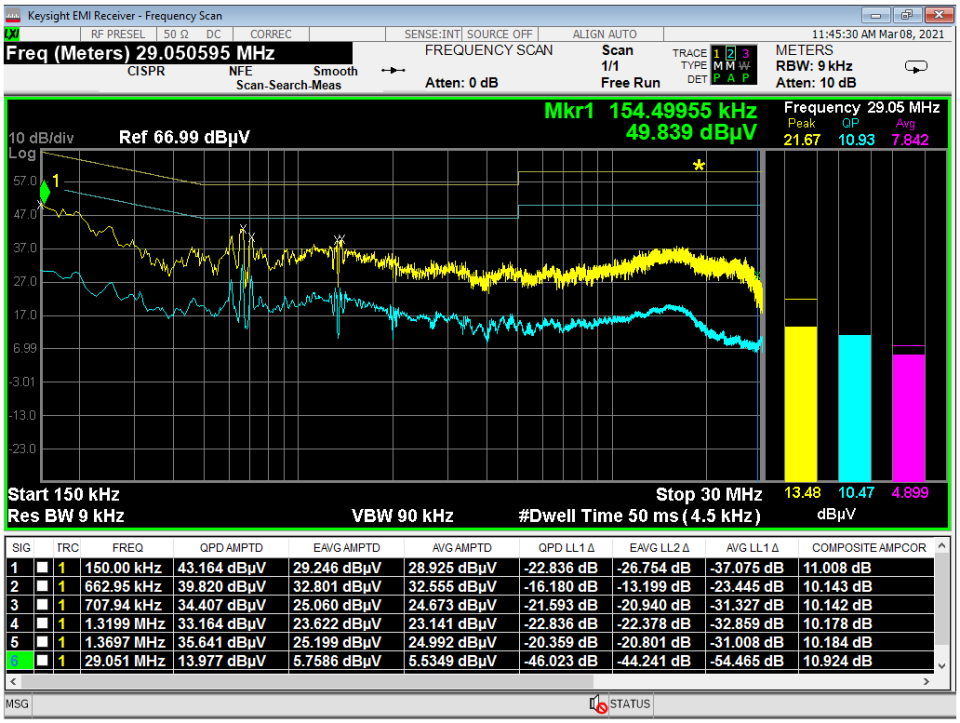

Figure 22 - Conducted Emissions Plot, Rx, Neutral

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

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 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	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	150kHz – 18GHz	3.30

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

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

Annex C – Test Equipment

Serial No.	Manufacturer	Model	Description	Last Cal.	Calibration due
A091418	SunAR RF Motion	JB1	Bicon Antenna	6 Mar 2020	6 Mar 2022
6415	EMCO-ETS	3115	DRG Horn	16 Mar 2020	16 Mar 2022
2576	ETS	3116	Horn Antenna	9 Mar 2020	9 Mar 2022
MY59050109	Keysight	N9038A	MXE Signal Analyzer	23 Apr 2019	23 Apr 2021
MY51391050	Keysight	M1970V-002	Mixer, 50 – 80 GHz	13 Apr 2019	13 Apr 2021
MY56390145	Keysight	M1971W	Mixer, 75 – 110 GHz	12 Apr 2019	12 Apr 2021
700307	V11.25	700307	TDK Emissions Lab S/W	NA	NA
32/2016	Pasternack	PE9881-24	WR-15 Horn Antenna	CNR***	CNR***
16434-01	Sage Millimeter	SAZ-2410-10-S1	WR-10 Horn Antenna	CNR***	CNR***
3903A03916	Agilent	11970Q	Mixer, 33 – 50 GHz	CNR**	CNR**
Ncee1	Pasternack	SH122-23	WR-22 Horn Antenna	CNR***	CNR***
181004-2	OML	DPL313B	Diplexer	CNR**	CNR**
200707-1	OML	M08HWDX	Mixer, 90 – 140 GHz	07 July 2020	07 July 2022
20070701	OML	M08RH	WR-8 Horn Antenna	CNR***	CNR***
200707-1	OML	M05HWDX	Mixer, 140 – 220 GHz	07 July 2020	07 July 2022
20070701	OML	MR05RH	WR-5 Horn Antenna	CNR***	CNR***

All mixers and pre-amplifiers were calibrated with associated cables.

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
MiniCircuits High Pass Filter*	VHF-1320+	15542	April 14, 2020	April 14, 2022
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	April 14, 2020	April 14, 2022
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	April 14, 2020	April 14, 2022
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	April 14, 2020	April 14, 2022
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	April 14, 2020	April 14, 2022
N connector bulkhead (control room)*	PE9128	NCEEBH2	April 14, 2020	April 14, 2022

*Internal Characterization ** Extended Cal

REPORT END