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Product Compliance Solutions

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Test Report

Prepared for:	**Ainstein Inc.**
Address:	**1421 Research Park Dr. Suite 2A Lawrence, KS 66049-3858**
Product:	**O79V3**
FCCID:	**2ATMB-O79V3**
IC ID:	**26683-O79V3**
Test Report No:	**R230319-20-E1A**
Approved by:	**Fox Lane, EMC Test Engineer**
DATE:	**October 24, 2023**
Total Pages:	**32**

REVISION PAGE

Rev. No.	Date	Description
0	2 October 2023	Issued by FLane Reviewed by KVepuri Prepared by FLane
A	20 October 2023	Updated mentions to testing guidance Added Bandwidth section Removed photos Added statements to radiated emissions – 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 (Please see the checked box below for the rule part used):

FCC Part 95M ☒

The EUT has been tested according to the following specifications:

(1) US Code of Federal Regulations, Title 47, Part 95M

APPLIED STANDARDS AND REGULATIONS		
Standard Section	**Test Type**	**Result**
FCC Part 95.3367 RSS-251 Section 8/9	Field Strength	Complies
FCC Part 95.3379(a) RSS-251 Section 10 RSS-Gen Issue 5	Unwanted Emissions	Complies
FCC Part 95.3379(b) RSS-251 Section 7 and 11	Occupied Bandwidth Frequency Stability	Complies
RSS-251 Section 6	Modulation Characteristics	Complies

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:
Device had copper foil and foam near the transmitter for testing. This will be replicated in manufacturing.

EUT	O79V3
FCC ID	2ATMB-O79V3
IC ID	26683-O79V3
EUT Received	7 August 2023
EUT Tested	7 August 2023- 27 September 2023
Serial No.	053
Operating Band	76 – 81 GHz
Device Type	☒ FMCW Radar
Power Supply / Voltage	External 12VDC Marine Battery

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 Transmissions:

Channel	Frequency
Low	76.1 GHz
Mid	78.5 GHz
High	80.9 GHz

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 frequencies 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	Testing and Report
2	Karthik Vepuri	Test Engineer	Review

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 17, 2023	July 17, 2025
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 18, 2023	July 17, 2025
SunAR RF Motion	JB1	A091418	July 27, 2023	July 26, 2024
ETS-Lindgren Red Horn Antenna	3115	218576	July 31, 2023	July 30, 2024
EMCO Horn Antenna	3116	2576	July 31, 2023	July 30, 2024
Agilent Preamp	87405A	3950M00669	June 5, 2023	June 5, 2025
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	June 5, 2023	June 5, 2025
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	June 5, 2023	June 5, 2025
Keysight, External Harmonic Mixer, 75-110G	M1971W	MY56390145	April 12, 2019	April 11, 2024
Sage Standard Gain Horn Antenna, 75-110G	SAZ-2410-10-S1	16434-01	CNR***	CNR***
Cable to M1971W, 75-110G	SLU18-SMNM-01.00M	121108	April 12, 2019	April 11, 2024
Cable to M1970V-002, 75-110G	SLU18-SMNM-01.00M	121099	April 13, 2019	April 12, 2024
Keysight, External Harmonic Mixer, 50-80G	M1970V-002	MY51391050	April 13, 2019	April 12, 2024
Pasternack Standard Gain Horn Antenna, 50-80G	PE9881-24	32/2016	CNR***	CNR***
Keysight, External Harmonic Mixer, 220-325G	M03HLWD	230320-1	March 20, 2023	March 19, 2024
Agilient External Harmonic Mixer, 33-50G	11970Q	3903A03916	CNR***	CNR***
Pasternack Standard Gain Horn Antenna, 33-50G	SH122-23	SH122-23	CNR***	CNR***
OML Diplexer	DPL313B	181004-2	CNR***	CNR***
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2024
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 25, 2022	May 25, 2025
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)	PE9128	NCEEBH2	June 5, 2023	June 5, 2025
TDK Emissions Lab Software	V11.25	700307	NA	NA

*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 63.26.

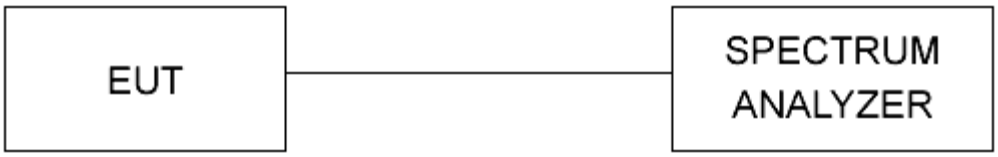

Figure 1 - Bandwidth Measurements Test Setup

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 63.26.

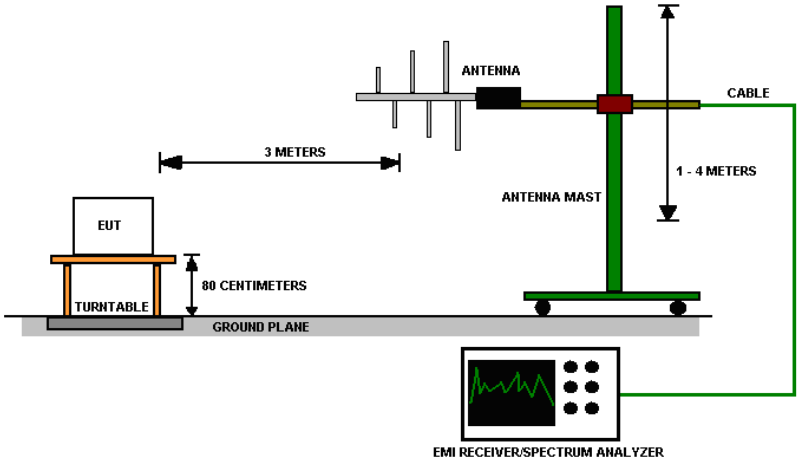

Figure 2 - Radiated Emissions Test Setup

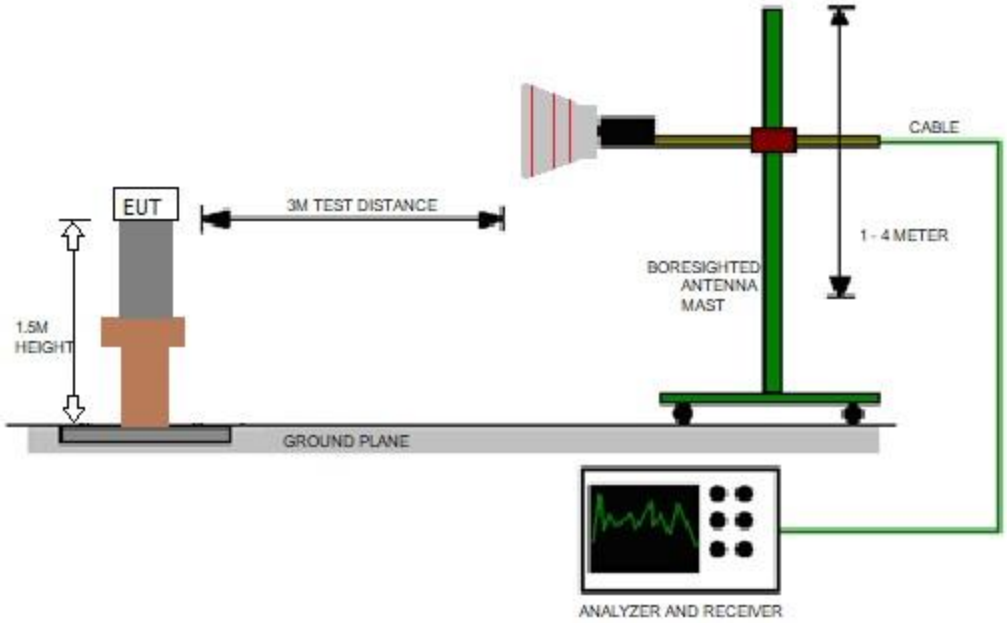

Figure 3 - Radiated Emissions Test Setup

4.0 RESULTS

Fundamental, 95M									
Ch	Frequency	SA Reading (Peak) (SAR)	Antenna Factor (AF)	Cable loss (CL)	FS Level (Peak) (FSL)	Test Distance (TD)	EIRP	Average Limit (Part 95M)	Margin
	GHz	dBm/m	dB	dB	dBm/m	m	dBm EIRP	dBm EIRP	dB
Low	76.100	-28.263	44.891	0.000	16.63	1	18.86	50.00	31.14
Mid	78.500	-30.574	45.161	0.000	14.59	1	16.82	50.00	33.18
High	80.900	-34.816	45.423	0.000	10.61	1	12.84	50.00	37.16
FSL=SAR+MF+AF+CL-PA+DCCF+107; FSL3=FSL+20*log(TD/3); Margin=Limit-FSL3; MF=0 if it's accounted for in the plot.									

*Plots shown in Output Power/Field Strength Section

Harmonics - Avg Limit FCC 95M													
Ch	Harm.	Frequency	SA reading (Peak Detector) (SAR)	Test Distance (TD)	Cable loss (CL)	Mixer Factor (MF)	Antenna Factor (AF)	Preamp (PA)	DCCF	Field Strength Level (@TD) (FSL)	FS extrapolated to 3m (FSL 3)	Avg Limit (at 3m FCC Part 95)	Margin
		GHz	dBm/m	m	dB	dB	dB	dB	dB	dBµv/m	dBµv/m	dBµv/m	dB
Low	*2nd*	152.200	-85.002	0.1	0	44.346	49.91	0.00	-22.18	94.076	64.53	93.54	29.01
Mid	*2nd*	157.000	-87.187	0.1	0	45.236	50.18	0.00	-22.18	93.051	63.51	93.54	30.03
High	*2nd*	161.800	-86.006	0.1	0	44.179	50.44	0.00	-22.18	93.436	63.89	93.54	29.65
Low	*3rd*	228.300	-81.218	0.1	0	67.02	52.93	23.93	-22.18	99.626	70.08	95.76	25.68
FSL=SAR+MF+AF+CL-PA+DCCF+107; FSL3=FSL+20*log(TD/3); Margin=Limit-FSL3; if MF, CL, or PA =0 it's accounted for in the plot.													

*Worst case plots shown in Radiated emissions section

Peak Spurious Measurements, some included Restricted Band Edge											
Ch	Detector	Frequency	SA reading (SAR)	Antenna Factor (AF)	Cable loss (CL)	Test Distance	FS level @ Test Distance	FS level @ 3m (FS 3 dBm/m)	FS level @ 3m (FS 3 dBuV)	Peak Limit Part 95M	Margin
		GHz	dBm	dB	dB	m	dBm/m	dBm/m	dBµv/m	dBµV/m	dB
Low	*Peak*	19.0240	-69.26	45.14	2.34	0.50	**-21.78**	**-37.34**	**69.66**	74	4.34
Mid	*Peak*	19.6240	-69.32	45.75	2.34	0.50	**-21.23**	**-36.80**	**70.20**	74	3.80
High	*Peak*	20.2240	-71.55	45.72	2.64	0.50	**-23.19**	**-38.76**	**68.24**	74	5.76
Low	*Peak*	38.0486	-80.06	44.94	3.40	0.50	**-31.72**	**-47.28**	**59.72**	74	14.28
Mid	*Peak*	39.2486	-81.84	44.93	3.30	0.50	**-33.62**	**-49.18**	**57.82**	74	16.18
High	*Peak*	40.4486	-80.38	48.53	3.25	0.50	**-28.59**	**-44.16**	**62.84**	93.54	30.70
FSL=SAR+AF+CL; FSL3=FSL+20*log(TD/3); Margin=Limit-FSL3											

*Worst case plots shown in Radiated emissions section

Average Spurious Measurements, some included Restricted Band Edge												
Ch	Detector	Frequency	SA reading (SAR)	Antenna Factor (AF)	DCCF	Cable loss (CL)	Test Distance (TD)	FS level @ Test Distance (FSL)	FS level @ 3m (FS 3 dBm) (FSL3)	FS level @ 3m (FS 3 dBuV)	Average Limit Part 95M	Margin
		GHz	dBm	dB	dB	dB	m	dBm/m	dBm/m	dBµv/m	dBµV/m	dB
Low	*Peak*	19.0240	-69.26	45.14	-22.18	2.34	0.50	**-43.96**	**-59.52**	**47.48**	54	6.52
Mid	*Peak*	19.6240	-69.32	45.75	-22.18	2.34	0.50	**-43.41**	**-58.98**	**48.02**	54	5.98
High	*Peak*	20.2240	-71.55	45.72	-22.18	2.64	0.50	**-45.37**	**-60.94**	**46.06**	54	7.94
Low	*Peak*	38.0486	-80.06	44.94	-22.18	3.40	0.50	**-53.90**	**-69.46**	**37.54**	54	16.46
Mid	*Peak*	39.2486	-81.84	44.93	-22.18	3.30	0.50	**-55.80**	**-71.36**	**35.64**	54	18.36
High	*Peak*	40.4486	-80.38	48.53	-22.18	3.25	0.50	**-50.77**	**-66.34**	**40.66**	93.54	52.88
FSL=SAR+AF+DCCF+CL; FSL3=FSL+20*log(TD/3); Margin=Limit–FSL3												

*Worst case plots shown in Radiated emissions section

4.1 OUTPUT POWER/FIELD STRENGTH

Test Method:
All the radio measurements were performed using the sections from ANSI C63.26 Sec. 5.2.4.3

Limits of field strength measurements:
For FCC Part 95.3367 76–81 GHz Band Radar Service radiated power limits:
The fundamental radiated emission limits within the 76–81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:
(a) The maximum power (EIRP) within the 76–81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).
(b) The maximum peak power (EIRP) within the 76–81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

RSS-251 Section 8:
The radar device's total average e.i.r.p. shall not exceed 50 dBm over the occupied bandwidth.

RSS-251 Section 9:
The radar device's peak e.i.r.p. spectral density shall not exceed 55 dBm/MHz.

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

Deviations from test standard:
No deviation.

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

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

Test results:

Pass

Comments:
1. All the measurements were found to be compliant.
2. Compiled values can be found in the Results section, 4.

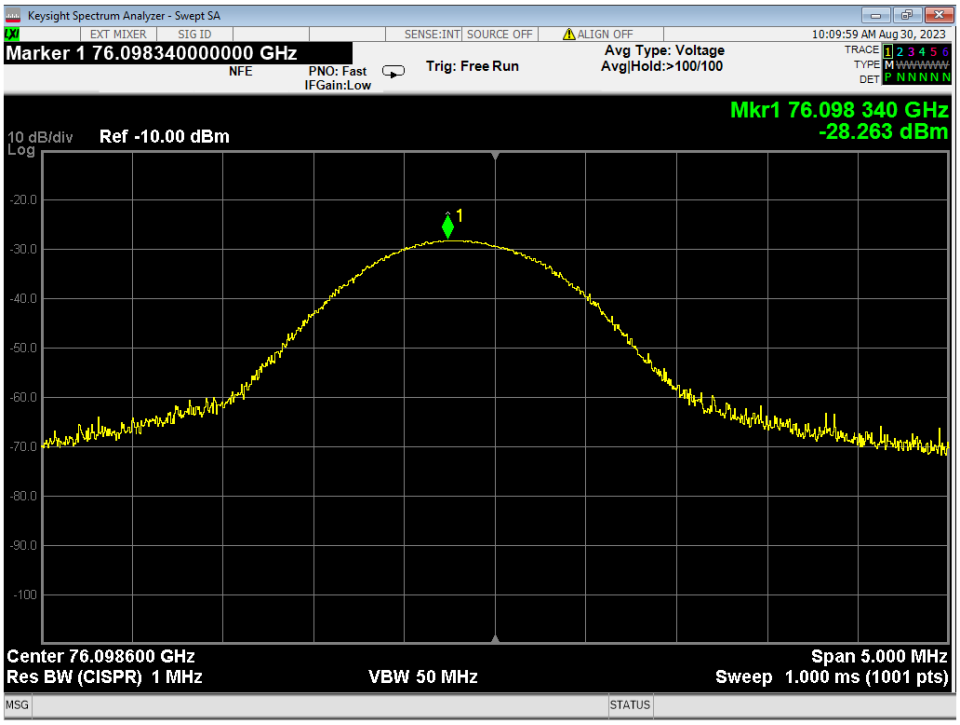

Figure 4 - Analyzer Measurement – Fundamental, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

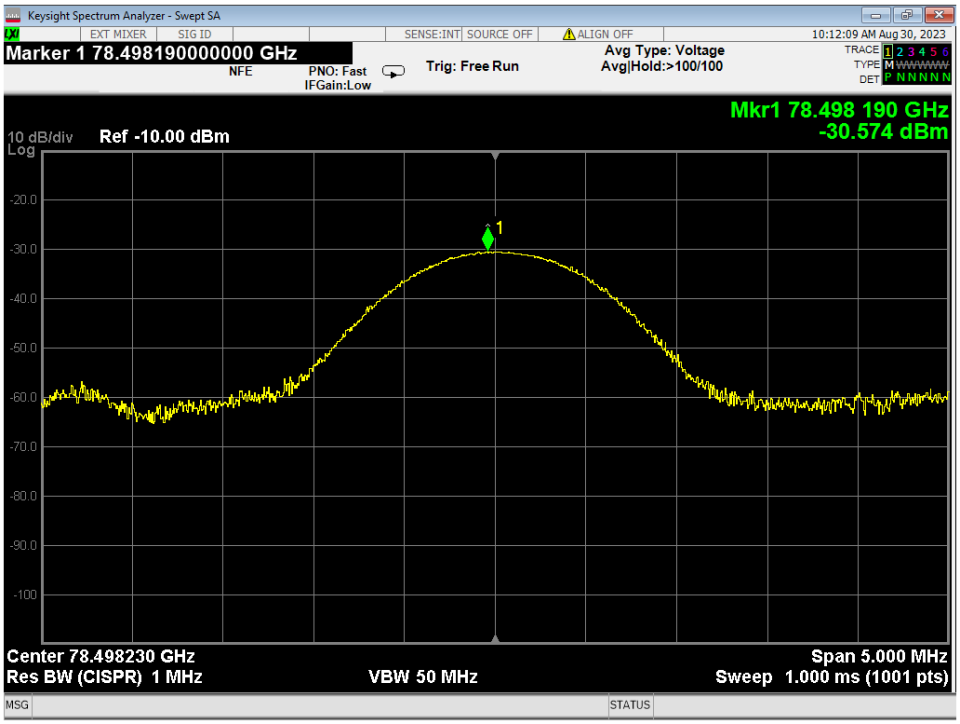

Figure 5 - Analyzer Measurement – Fundamental, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

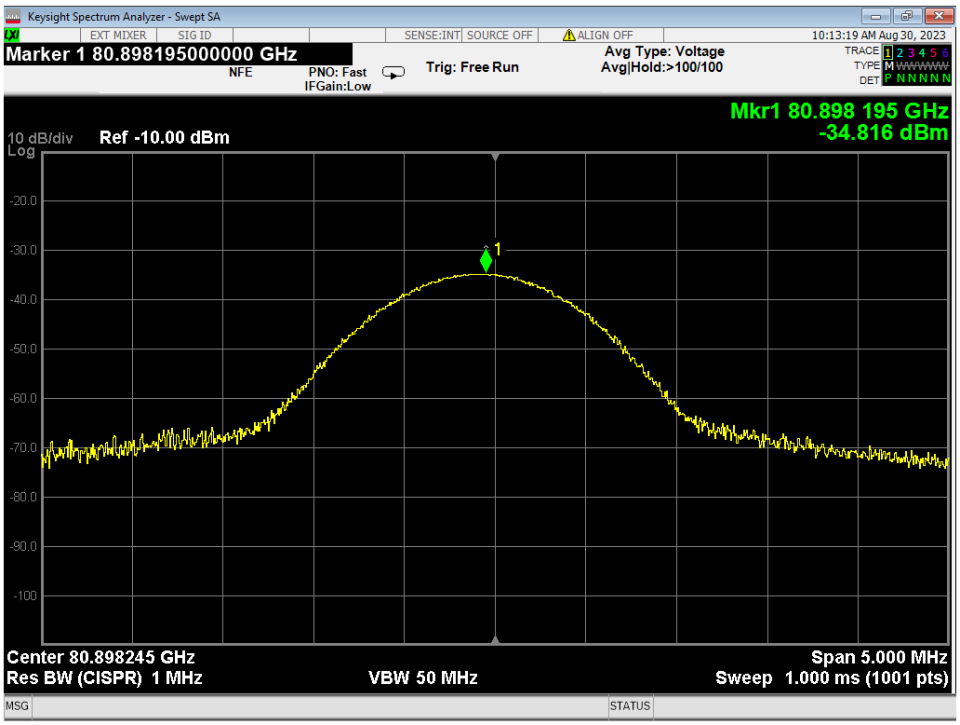

Figure 6 - Analyzer Measurement – Fundamental, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

4.2 BANDWIDTH

Test Method:
All the radio measurements were performed using the sections from ANSI C63.26 Sec. 5.4

Limits of bandwidth measurements:
For FCC Part 95 Device:
Device must remain within the allotted band.

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 measurements were found to be compliant.

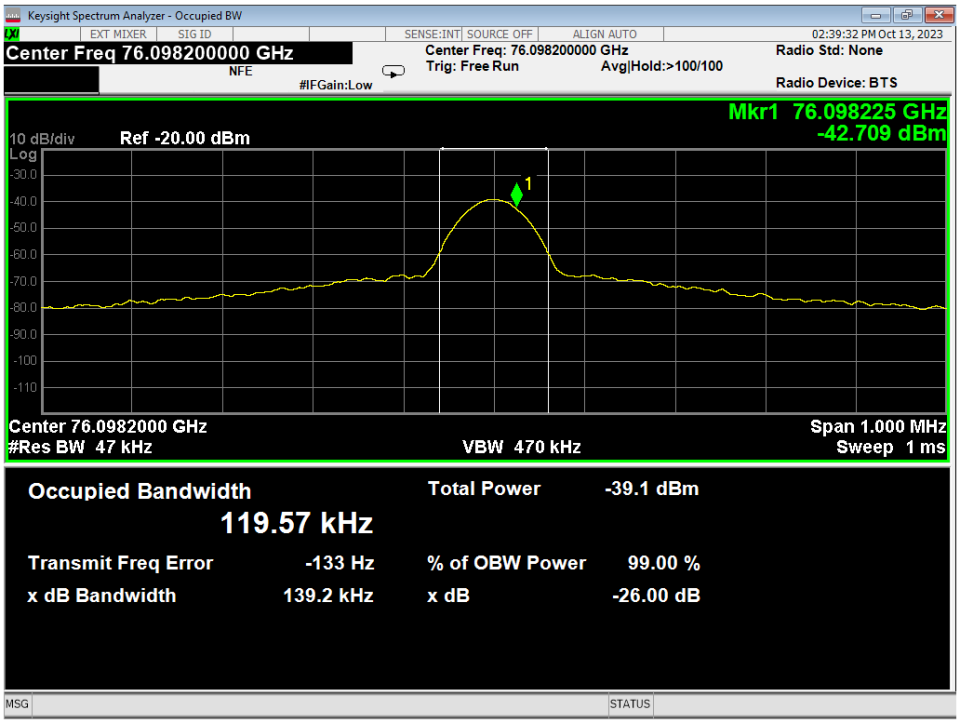

Figure 7 - Analyzer Measurement – 99% Bandwidth, Low Channel

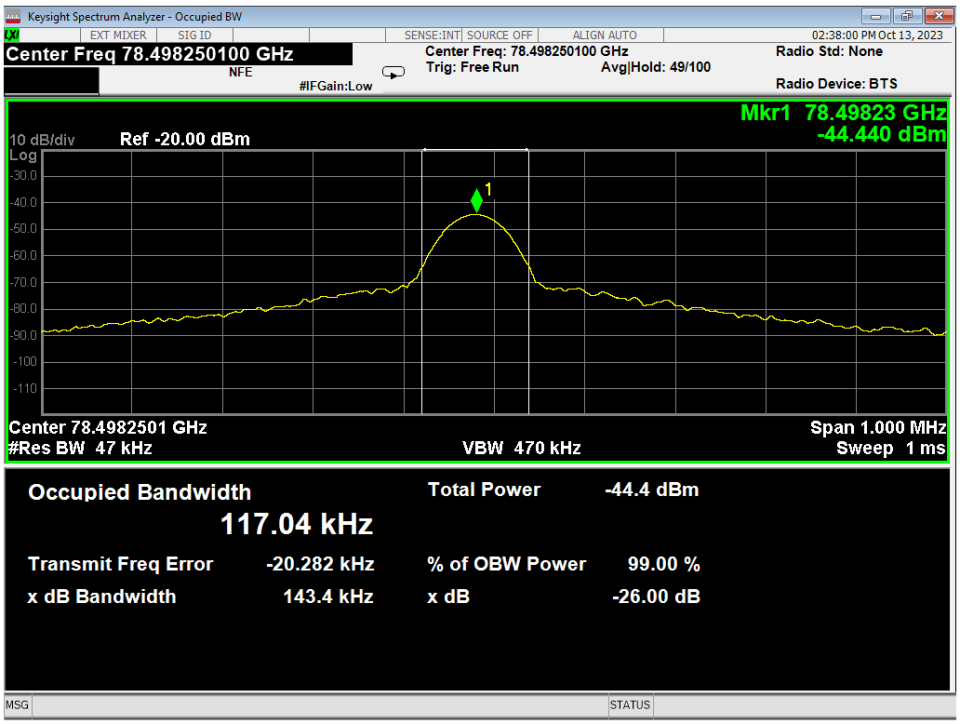

Figure 8 - Analyzer Measurement – 99% Bandwidth, Mid Channel

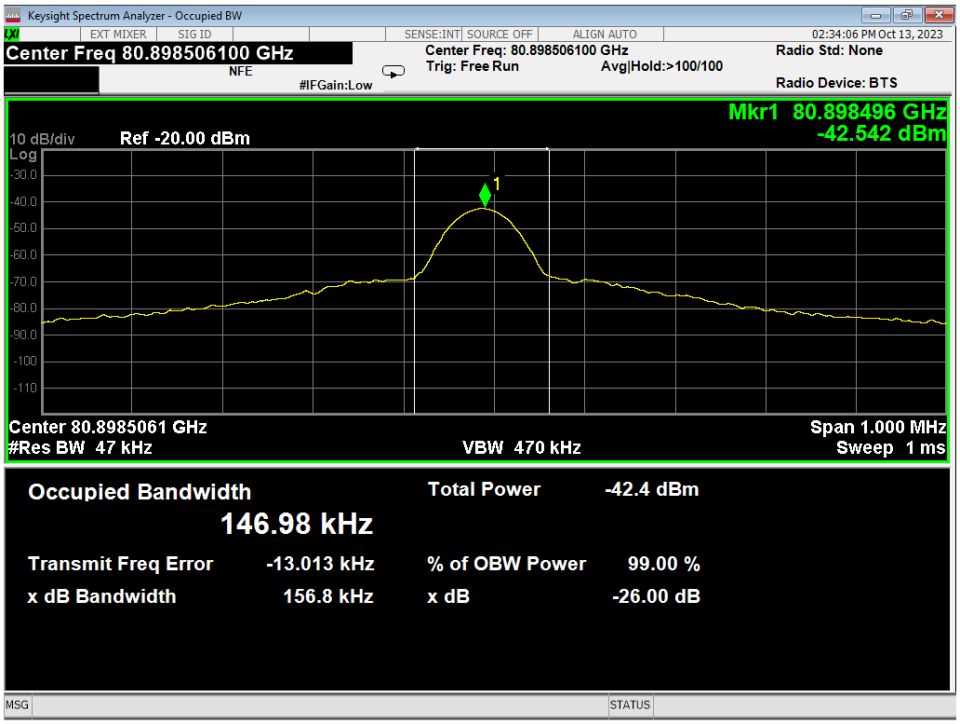

Figure 9 - Analyzer Measurement – 99% Bandwidth, High Channel

4.3 DUTY CYCLE

Transmissions of Unit under test maintained a duty cycle of >98%

The following duty cycles were calculated and provided by customer as the worst case:

Worst case frequency is starting frequency F1 = 77.2GHz/4 = 19.3GHz
Radiates during 5us inter-chirp idle time.
Disabled during interframe off time.
transmission_time_for_1MHz = 1536/30 + 5*1536 = 7782.2us
Duty Cycle Correction = 20*log(7782.2us/100ms) = 20*log(0.077822) = -22.18dB

4.4 RADIATED EMISSIONS

Test Method: ANSI C63.26 Sec. 5.5

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 95.3379. see section 4.0 for further spurious emissions.

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. The worst-case emissions 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 measurements >18GHz EUT was placed before a high frequency horn antenna and rotated to emit worst case emissions. Distance was varied, see corresponding section for details.

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:

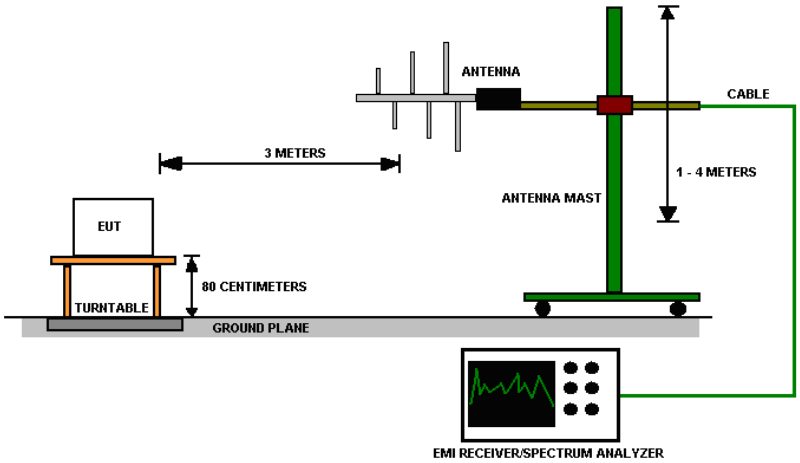

Figure 10 - Radiated Emissions Test Setup

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 was 1 MHz for all measurements and at frequencies above 1GHz, A peak detector and average 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:

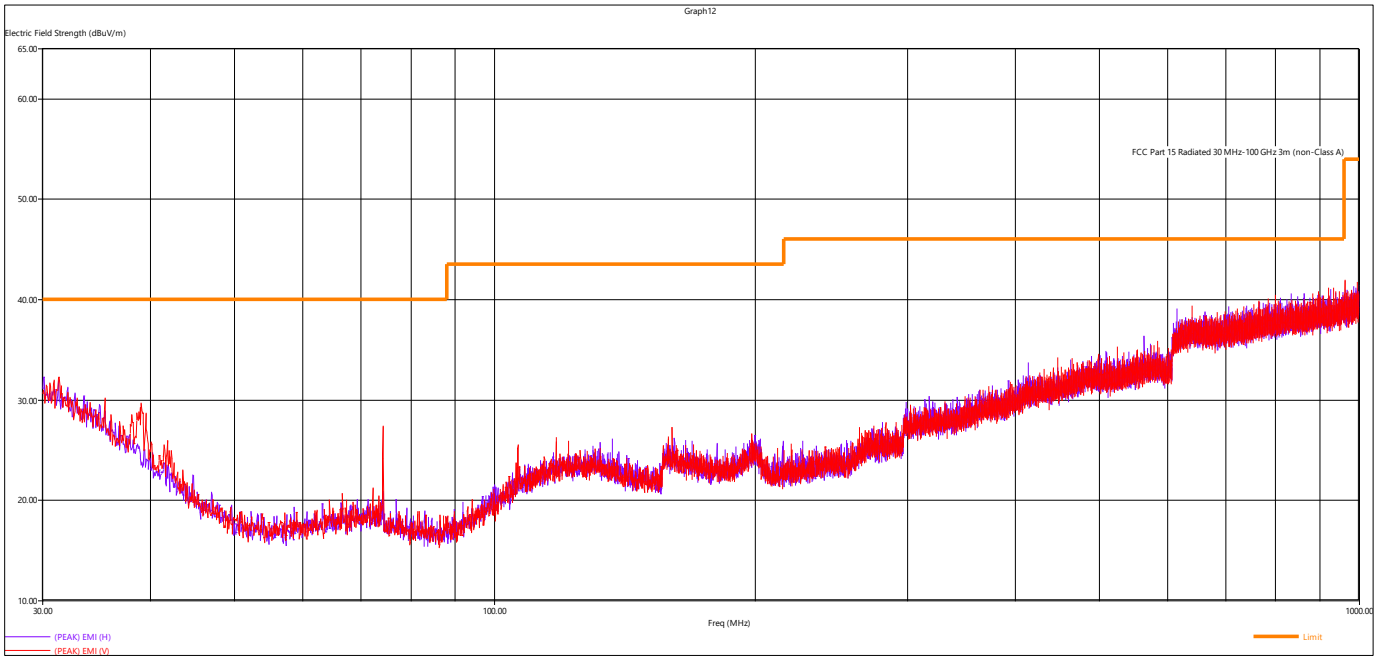

Figure 11 - Radiated Emissions Plot, 30MHz – 1GHz, Radar

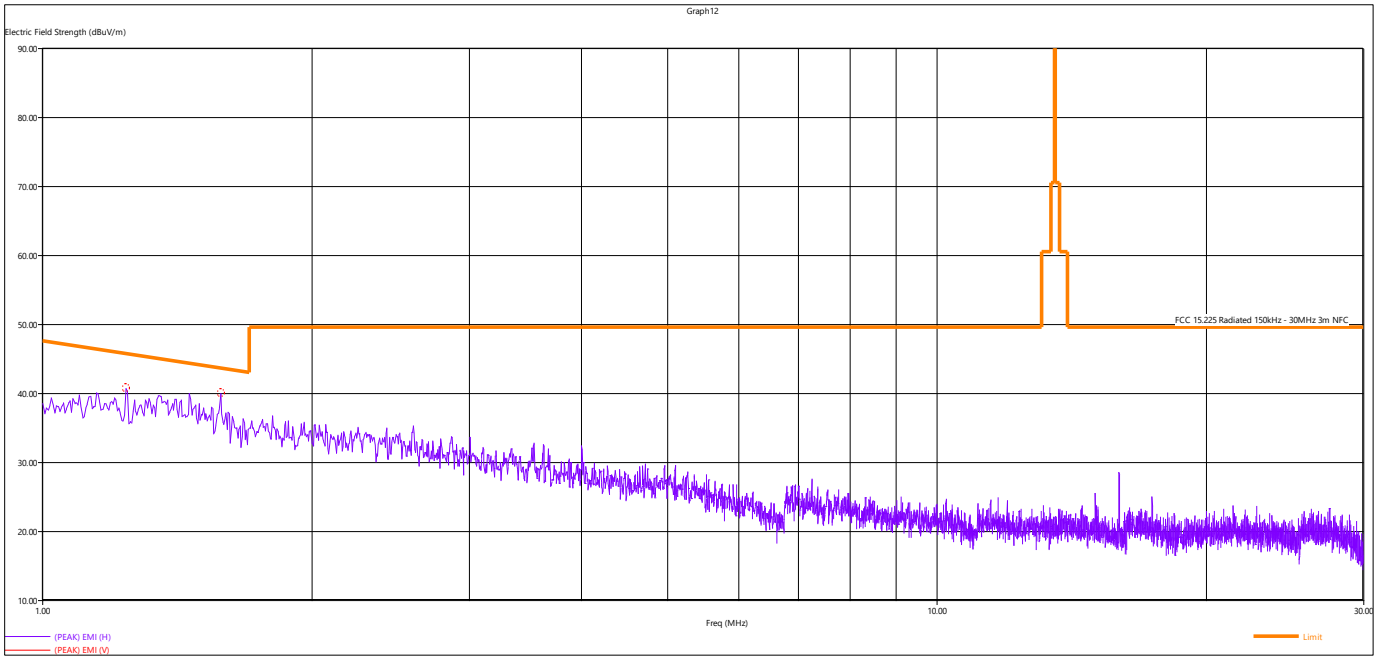

Figure 12 - Radiated Emissions Plot, 1MHz – 30MHz, Radar

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

Peak Measurements, 1MHz – 30MHz			
Frequency	**Level***	**Limit**	**Margin**
MHz	**dBµV/m**	**dBµV/m**	**dB**
1.24	40.78	45.74	4.96
1.58	40.01	43.63	3.62

*Peak levels were compared against Quasi-Peak limits

Peak Measurements							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**		
1755.196000	24.51	53.98	29.47	529.07	164.50	V	Default

All other emissions were found to be at least 6dB below the appropriate limits.

Average Measurements							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**		
1755.196000	40.15	73.98	33.83	529.07	164.50	V	Default

All other emissions were found to be at least 6dB below the appropriate limits.

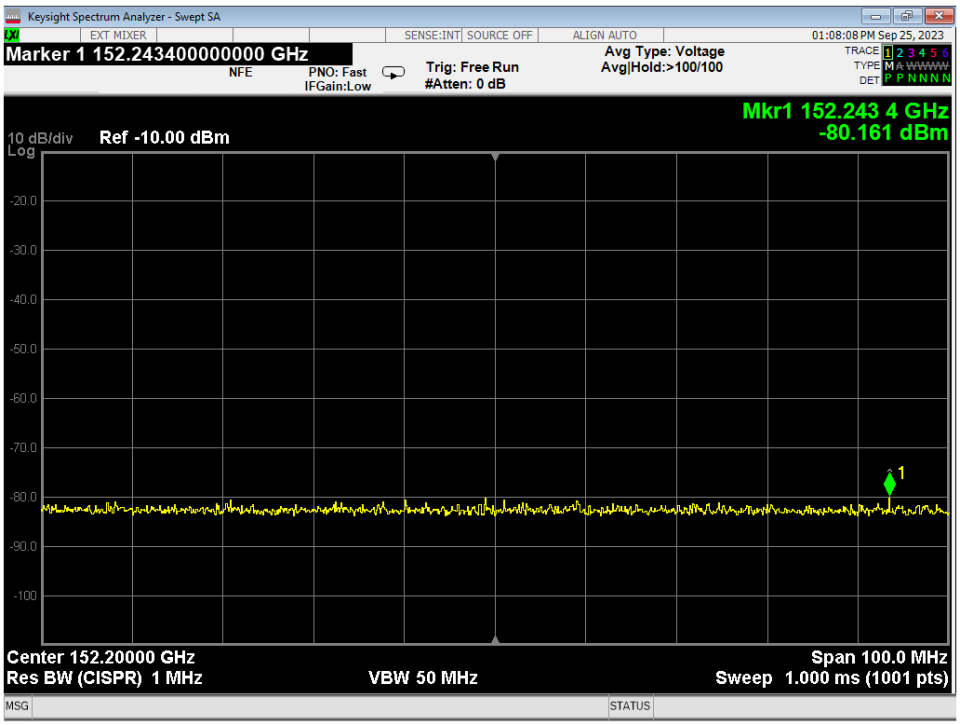

Figure 13 - Analyzer Measurement – 2nd Harmonic, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

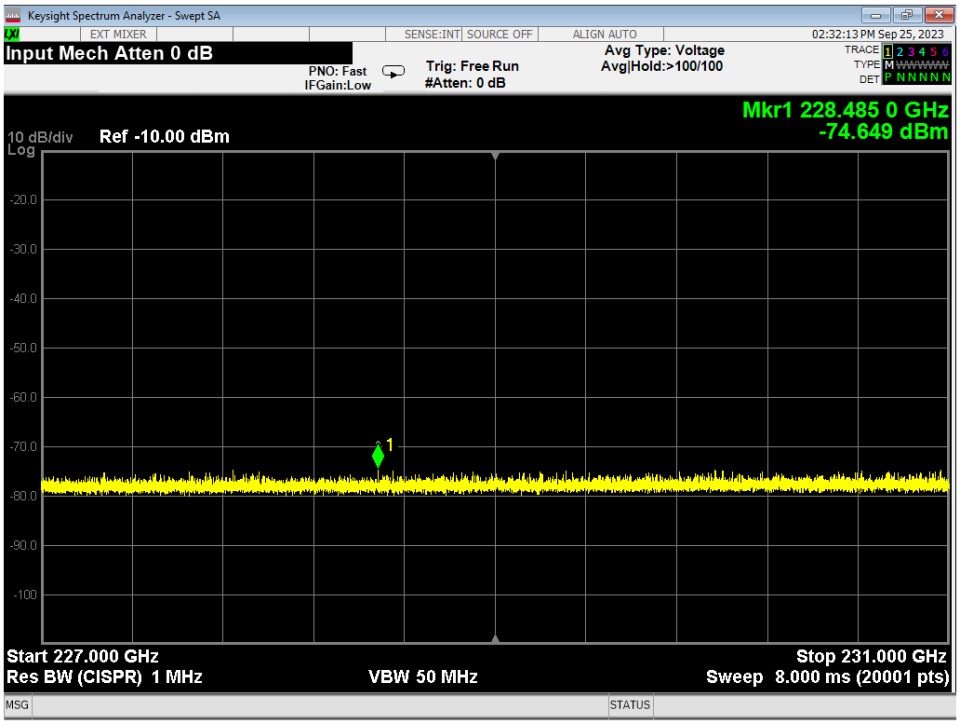

Figure 14 - Analyzer Measurement – 3rd Harmonic, Low Channel
Uncorrected measurement as recorded on spectrum analyzer.

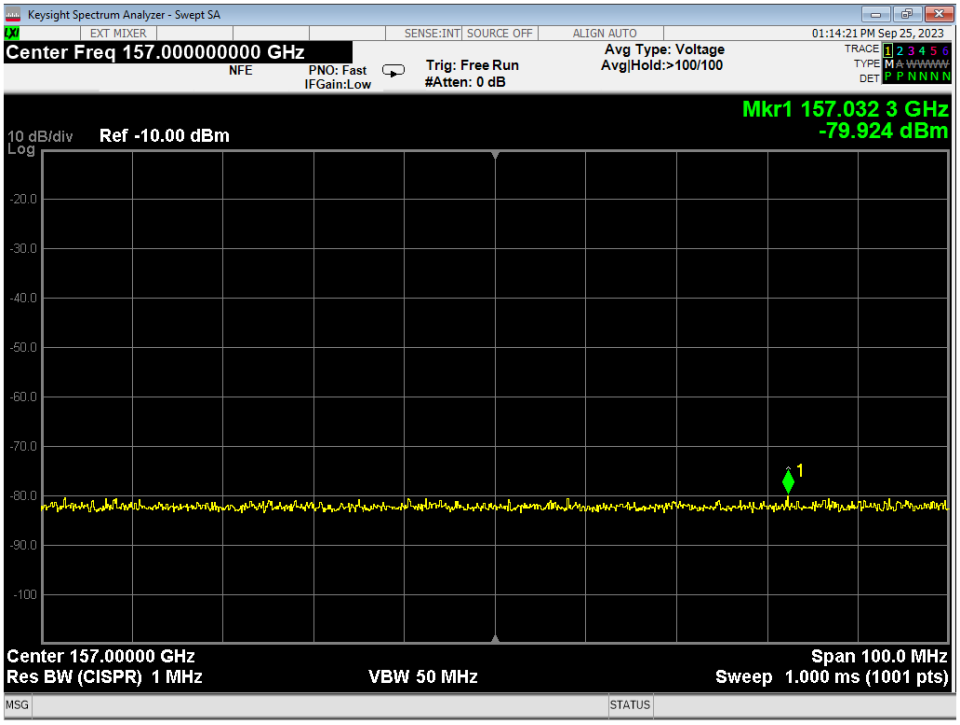

Figure 15 - Analyzer Measurement – 2nd Harmonic, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

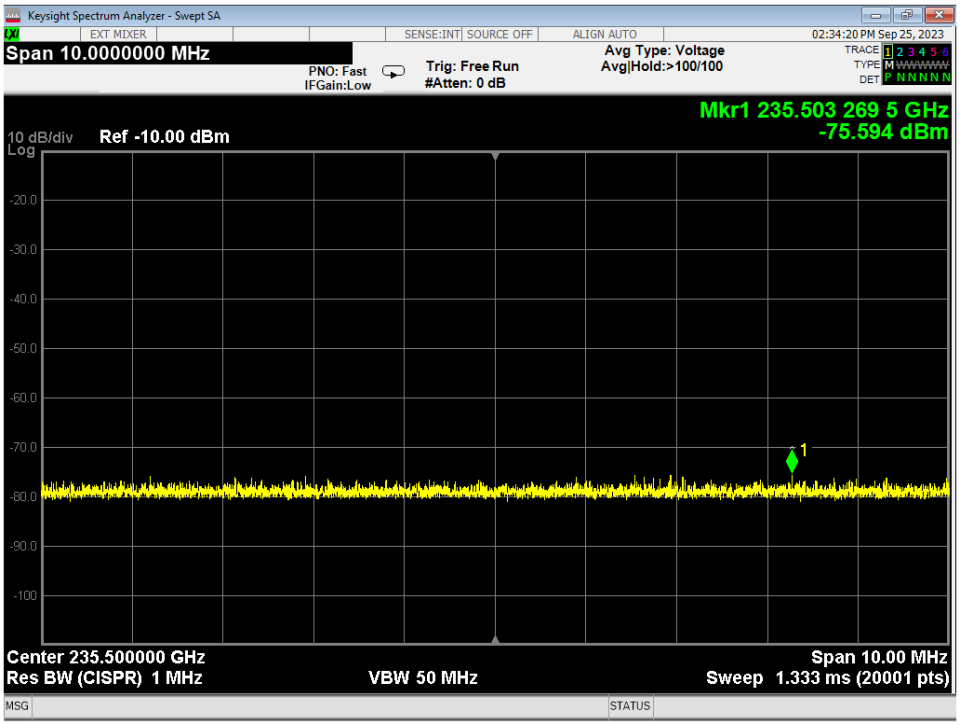

Figure 16 - Analyzer Measurement – 3rd Harmonic, Mid Channel
Uncorrected measurement as recorded on spectrum analyzer.

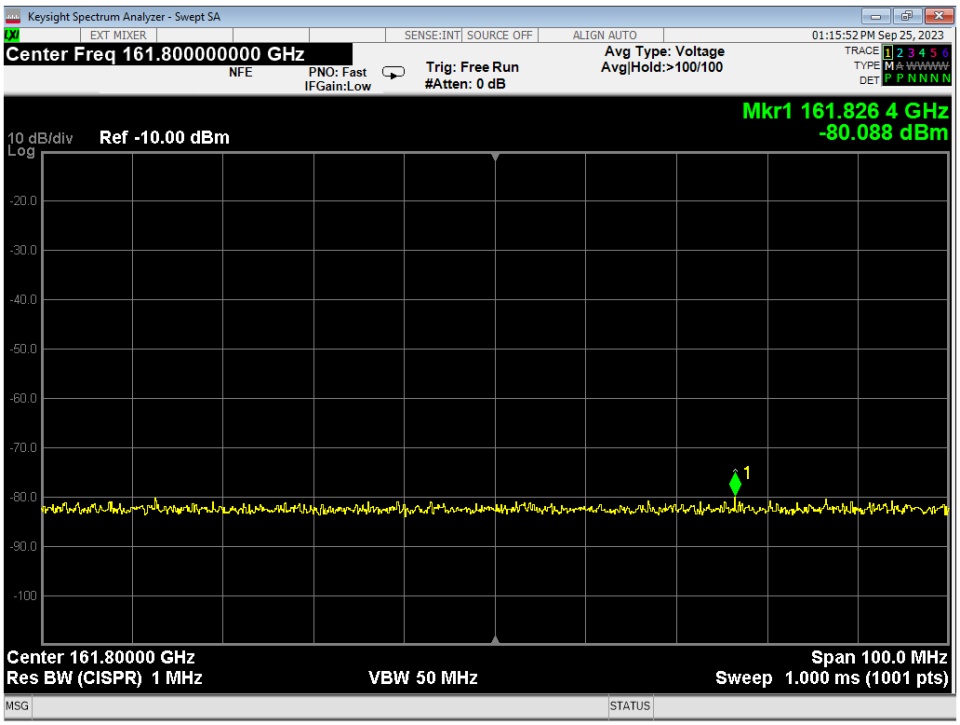

Figure 17 - Analyzer Measurement – 2nd Harmonic, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

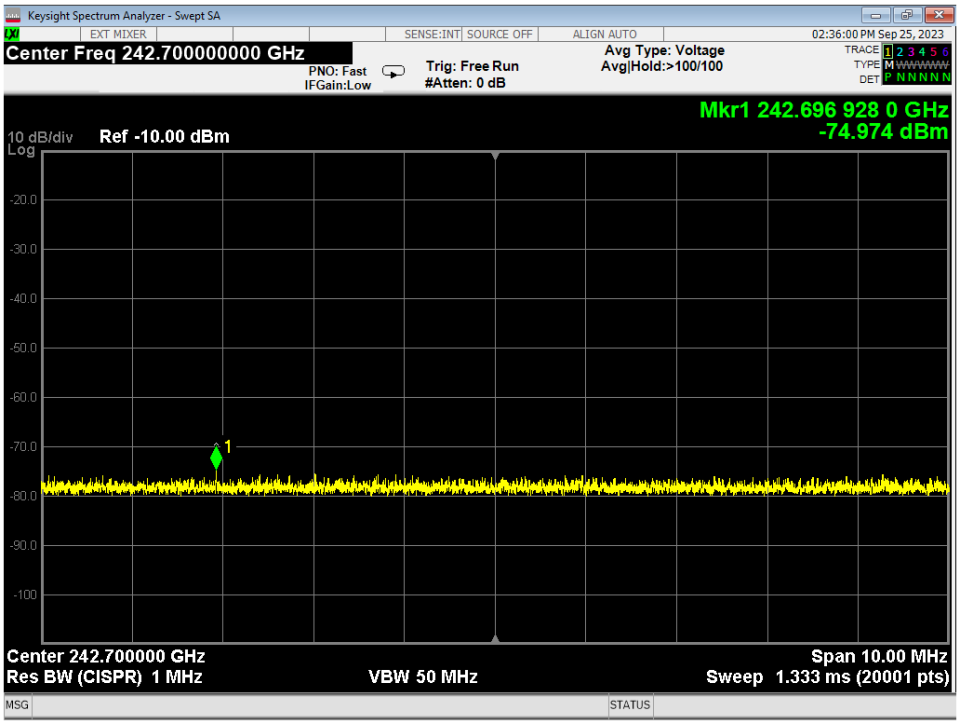

Figure 18 - Analyzer Measurement – 3rd Harmonic, High Channel
Uncorrected measurement as recorded on spectrum analyzer.

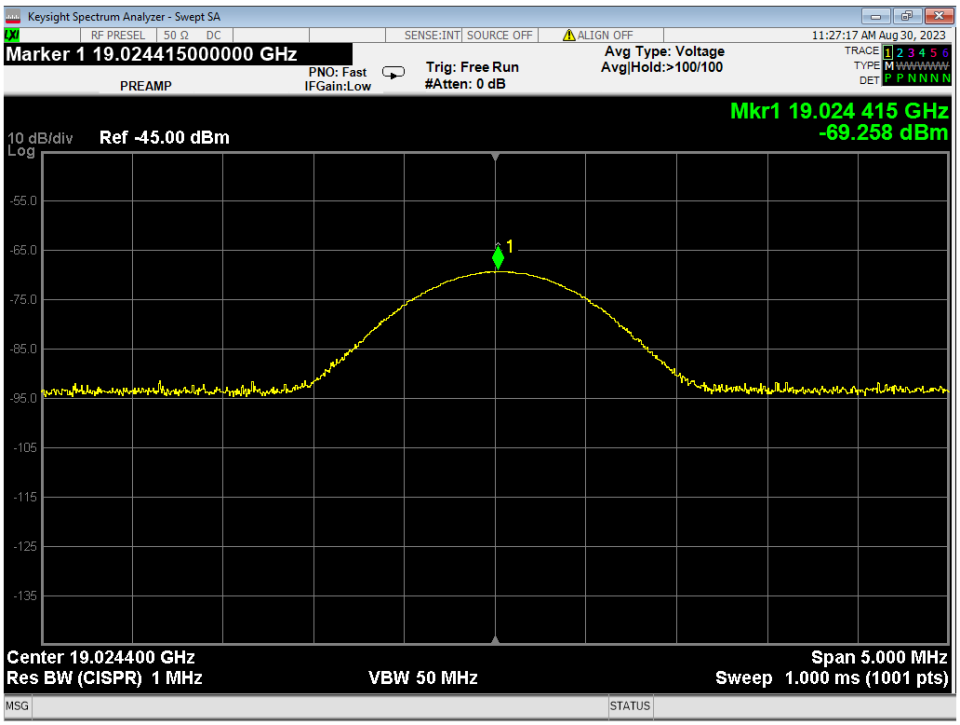

Figure 19 – Spurious Emissions Plot, Radar

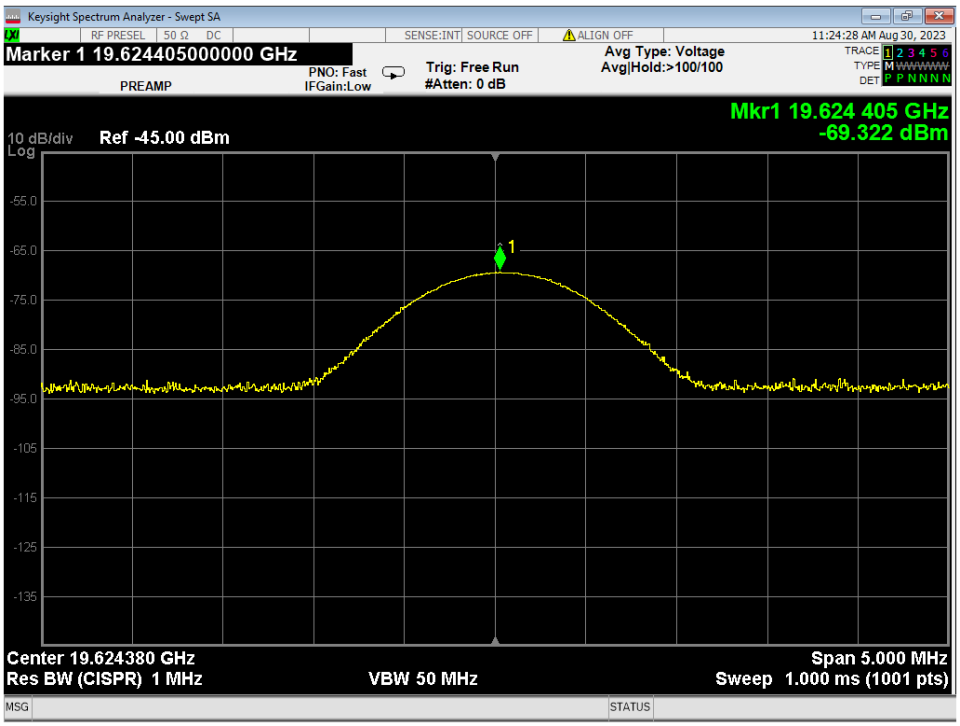

Figure 20 – Spurious Emissions Plot, Radar, 19.624GHz

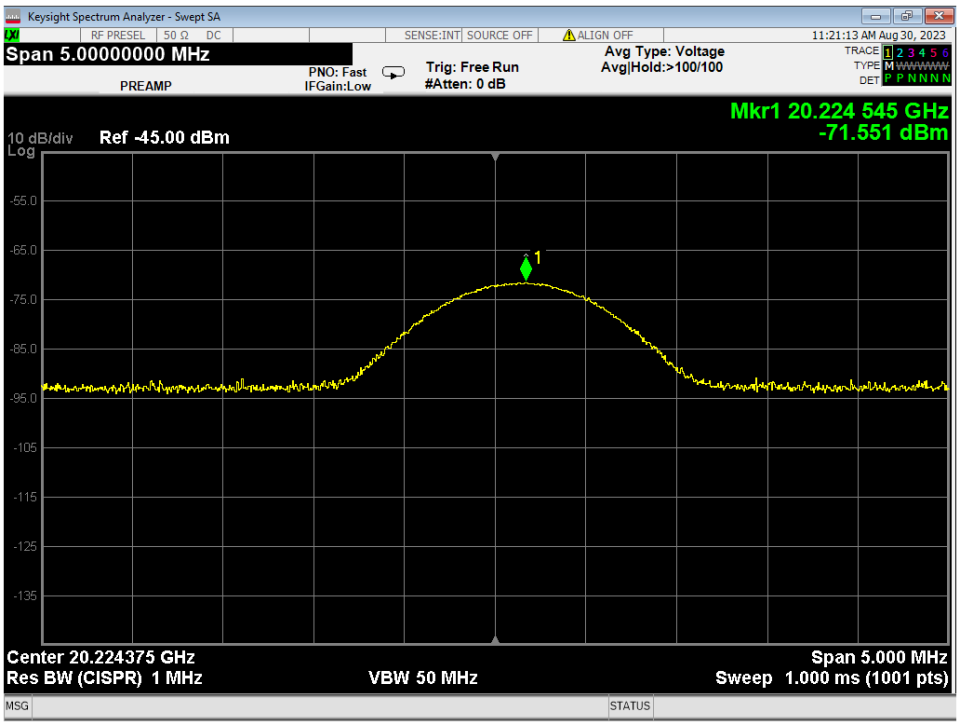

Figure 21 – Spurious Emissions Plot, Radar

More emissions were investigated

4.5 FREQUENCY ERROR

Test Method:
All the radio measurements were performed using the sections from ANSI C63.26 Sec. 5.6

Limits of Frequency Error:
95.3379 76–81 GHz Band Radar Service unwanted emissions limits:
Fundamental emissions must be contained within the frequency bands(76GHz - 81GHz). specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

RSS-251 Section 7:
The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be contained in the 76-81 GHz frequency band.

RSS-251 Section 11:
The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be maintained within the 76-81 GHz frequency band while subjected to all conditions of operation specified in RSS-Gen.

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

Deviations from test standard:
Temperature range tested -20C to 50C

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.

Comments:
1. All the measurements were found to be compliant.

Test results:
Complies, all emissions stayed within 76-81GHz

Radar Temperature Deviation				
Temperature (°C)	Voltage (VDC)	Frequency Error (MHz)		
		Ch 1	Ch 2	Ch 3
		Nom = 76.1G	Nom = 78.5G	Nom = 80.9G
-20°C	12	+1.16	+1.15	+1.10
-10°C	12	-0.0031	+0.147	+0.222
0°C	12	-0.980	-1.07	-1.27
10°C	12	-2.50	-2.35	-2.22
20°C	12	-1.85	-1.82	-1.81
30°C	12	-2.38	-2.22	-2.25
40°C	12	-3.07	-3.16	-3.25
50°C	12	-3.76	-3.86	-3.97

Radar Voltage Deviation		Nominal Voltage: 12V		
Voltage (V)	Temperature	Frequency Error (MHz)		
		Ch1 = 76.1GHz	Ch2 = 78.5GHz	Ch3 = 80.9GHz
13.8	20°C	-1.59	-1.62	-1.71
12.0	20°C	-1.78	-1.79	-1.81
10.2	20°C	-1.91	-2.00	-2.07

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 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, conducted	30MHz – 18GHz	±3.03

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

REPORT END