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RF Test Report

Test Report Number	SRF-22021042-LC-FCC-IC-RF-CK
FCC ID	CO6-SPCK
ISED ID	11390A-SPCK
Applicant	SpotterRF, LLC
Applicant Address	720 Timpanogos Parkway, Orem, UT 84097, USA
Product Name	Ground Surveillance Radar
Model (s)	CK2
Family Model (s)	CK20, CK40
Date of Receipt	03/07/2022
Date of Test	03/07/2022 – 03/25/2022
Report Issue Date	04/06/2022
Test Standards	47 CFR Part 15.249 RSS-210 Issue 10, Dec 2019 RSS-Gen Issue 5, Feb 2021
Test Result	**PASS**

Issued by:

Vista Compliance Laboratories
1261 Puerta Del Sol, San Clemente, CA 92673 USA
www.vista-compliance.com

Devin Tai (Test Engineer)

David Zhang (Technical Manager)

REVISION HISTORY

Report Number	Version	Description	Issued Date
SRF-22021042-LC-FCC-IC-RF-CK	01	Initial report	04/06/2022

TABLE OF CONTENTS

1 Test Summary

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15.203	N/A	Pass
Conducted Emissions	47 CFR Part 15,207 RSS-Gen, 8.8	ANSI C63.10 (2013)	Pass
20 dB Bandwidth	47CFR Part 15.215	ANSI C63.10 (2013)	Pass
Occupied Bandwidth	47CFR Part 15.249(e) RSS-Gen, 6.7	ANSI C63.10 (2013)	Pass
Fundamental Field Strength and Radiated Spurious Emission	47CFR Part 15.249 RSS-210, annex B.10 (a)	ANSI C63.10 (2013)	Pass

2 General Information

2.1 Applicant

Applicant	SpotterRF, LLC
Applicant address	720 Timpanogos Parkway, Orem, UT 84097, USA
Manufacturer	SpotterRF, LLC
Manufacturer Address	720 Timpanogos Parkway, Orem, UT 84097, USA

2.2 Product information

Product Name	Ground Surveillance Radar
Model Number	CK2
Family Models	CK20, CK40
Serial Number	SP61220
Frequency Band	24.005 – 24.240 GHz
Type of modulation	Continuous Wave
Equipment Class	DXX
Antenna Information	Integral PCB patch antenna, 12 dBi gain
Clock Frequencies	N/A
Input Power	24VDC, 5A
Power Adapter Manufacturer/Model	AC/DC adapter: Phoenix Contract / PS/1AC/24DC/5 PoE Injector: L-COM / BTD-CAT6-P1
Power Adapter SN	0000708582
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	N/A
Additional Info	K1 Mode: 24.005-24.080 GHz K2 Mode: 24.085-24.160 GHz K3 Mode: 24.165-24.240 GHz Manufacturer declares that the family of models including CK2, CK20 and CK40 are electrically identical with the only difference between models being receive signal filtering and displayed coverage area. The differences on these variants does not affect any product radio or EMC performance. The model of CK20 was tested as worst-case representative.

2.3 Test standard and method

Test standard	47 CFR Part 15.249 RSS-210 Issue 10, Dec 2019 RSS-Gen Issue 5, Feb 2021
Test method	ANSI C63.10: 2013 RSS-Gen Issue 5, Feb 2021

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.2°C	56.9%	1005 mbar

3 Modification of EUT / Deviations from Standards

N/A

4 Test Configuration and Operation

4.1 EUT Test Configuration

The EUT is powered by an external PoE injector. It is connected to a test laptop through a RJ45 cable and receives test commands for RF measurement.

The following software was used for testing and to monitor EUT performance.

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing

4.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
Laptop	Dell	XPS / G1H5102	34917771602
PoE Injector	BTD-CAT6-P1	L-COM	N/A
AC/DC Power supply	PSA60R-240	PHIHONG	P4040093A1
AC/DC adapter	Phoenix Contract	PS/1AC/24DC/5	0000708582

5 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
AC Conducted Emissions (150K-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB
Radiated Emission (above 40GHz)	±3.5 dB

6 Test Results

6.1 Antenna Requirement

6.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

6.1.2 Result

Analysis:

- EUT uses Integral PCB patch antenna. No standard RF connector is used.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

6.2 Conducted Emissions

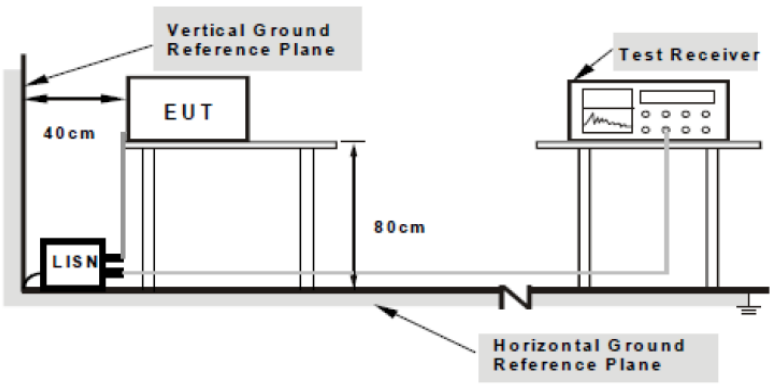
6.2.1 Requirement

Per § 15.207 (a), an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for Conducted Emissions at the Mains Ports

Section	Frequency ranges (MHz)	Limit (dBuV)	
		QP	Average
Class B devices	0.15 – 0.5	66 – 56	56 - 46
	0.5 – 5	56	46
	5 - 30	60	50
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.			

6.2.2 Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

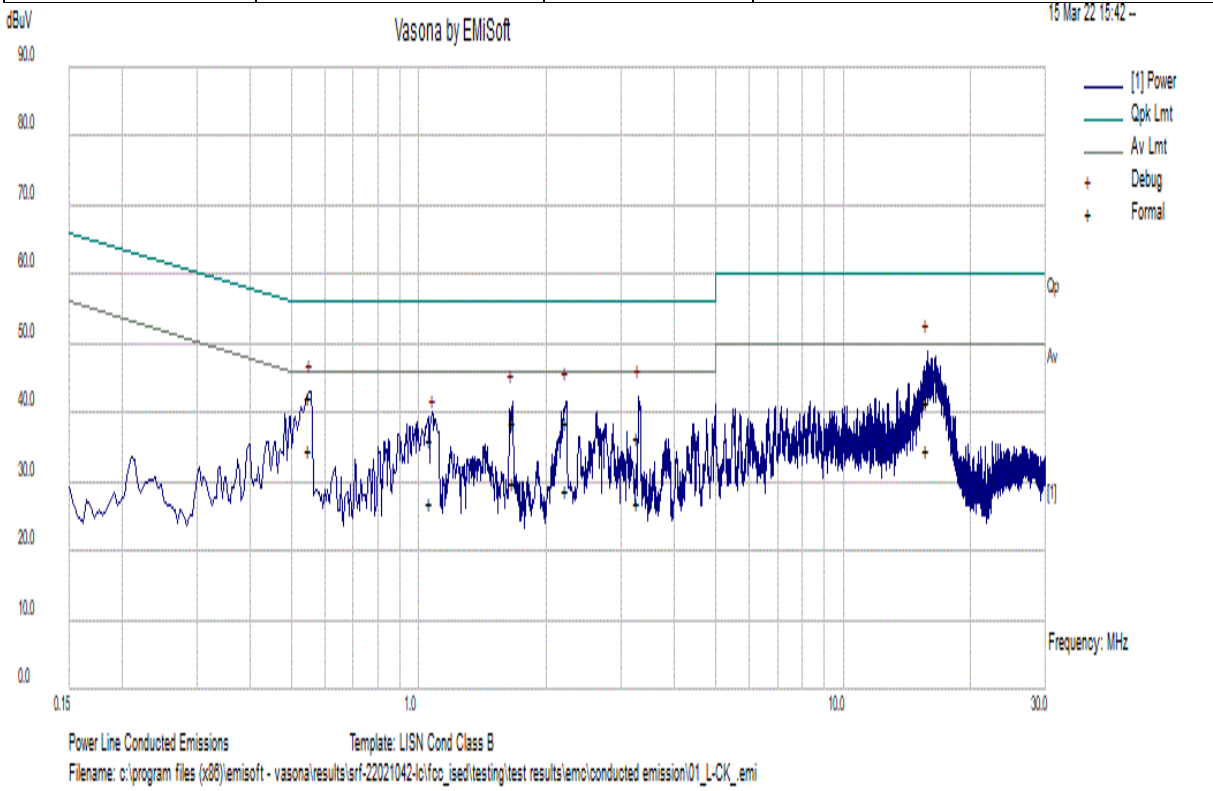
6.2.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made.
9. All possible modes of operation were investigated. Only the worst-case emissions were measured and reported. All other emissions were relatively insignificant.

6.2.4 Test Result

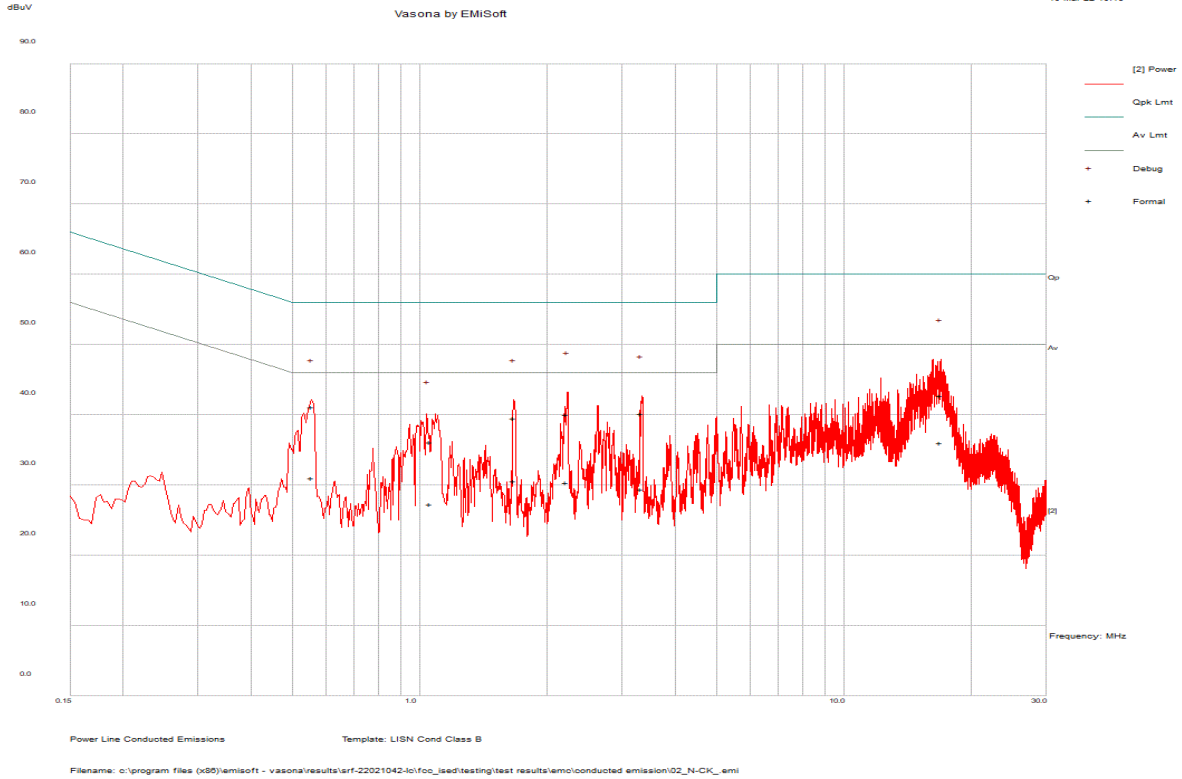
CONDUCTED EMISSIONS

Test Standard:	LISN B Cond Class B	Mode:	Normal Operation
Frequency Range:	0.15 - 30MHz	Test Date:	03/16/2022
Line:	Live	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass/Fail
15.777	31.10	10.10	0.30	41.50	Quasi Peak	Live	60.00	-18.50	Pass
0.552	32.70	9.50	0.10	42.30	Quasi Peak	Live	56.00	-13.70	Pass
3.283	26.60	9.70	0.10	36.40	Quasi Peak	Live	56.00	-19.60	Pass
2.225	28.90	9.60	0.10	38.70	Quasi Peak	Live	56.00	-17.30	Pass
1.666	29.10	9.60	0.10	38.80	Quasi Peak	Live	56.00	-17.20	Pass
1.064	26.40	9.60	0.10	36.10	Quasi Peak	Live	56.00	-19.90	Pass
15.777	24.30	10.10	0.30	34.70	Average	Live	50.00	-15.30	Pass
0.552	25.00	9.50	0.10	34.60	Average	Live	46.00	-11.40	Pass
3.283	17.10	9.70	0.10	27.00	Average	Live	46.00	-19.00	Pass
2.225	19.30	9.60	0.10	29.00	Average	Live	46.00	-17.00	Pass
1.666	20.30	9.60	0.10	30.00	Average	Live	46.00	-16.00	Pass
1.064	17.30	9.60	0.10	27.00	Average	Live	46.00	-19.00	Pass

Test Standard:	LISN B Cond Class B	Mode:	Normal Operation
Frequency Range:	0.15 - 30MHz	Test Date:	03/16/2022
Line:	Neutral	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass/Fail
16.902	32.20	10.10	0.40	42.70	Quasi Peak	Neutral	60.00	-17.30	Pass
2.217	30.40	9.60	0.10	40.10	Quasi Peak	Neutral	56.00	-15.90	Pass
3.322	30.40	9.70	0.10	40.20	Quasi Peak	Neutral	56.00	-15.80	Pass
0.556	31.50	9.50	0.10	41.10	Quasi Peak	Neutral	56.00	-14.90	Pass
1.665	29.80	9.60	0.10	39.60	Quasi Peak	Neutral	56.00	-16.40	Pass
1.060	26.50	9.60	0.10	36.20	Quasi Peak	Neutral	56.00	-19.80	Pass
16.902	25.50	10.10	0.40	36.00	Average	Neutral	50.00	-14.00	Pass
2.217	20.70	9.60	0.10	30.40	Average	Neutral	46.00	-15.60	Pass
3.322	19.60	9.70	0.10	29.50	Average	Neutral	46.00	-16.50	Pass
0.556	21.50	9.50	0.10	31.10	Average	Neutral	46.00	-14.90	Pass
1.665	20.90	9.60	0.10	30.60	Average	Neutral	46.00	-15.40	Pass
1.060	17.60	9.60	0.10	27.30	Average	Neutral	46.00	-18.70	Pass

6.3 20 dB Bandwidth

6.3.1 Requirement

§ 15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

6.3.2 Test Setup

6.3.3 Test Procedure

According to subclause 6.9.2 of ANSI C63.10-2013:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Steps a) through c) might require iteration to adjust within the specified tolerances.

e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.

f) Set detection mode to peak and trace mode to max hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the “−xx dB down amplitude” using [(reference value) - xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

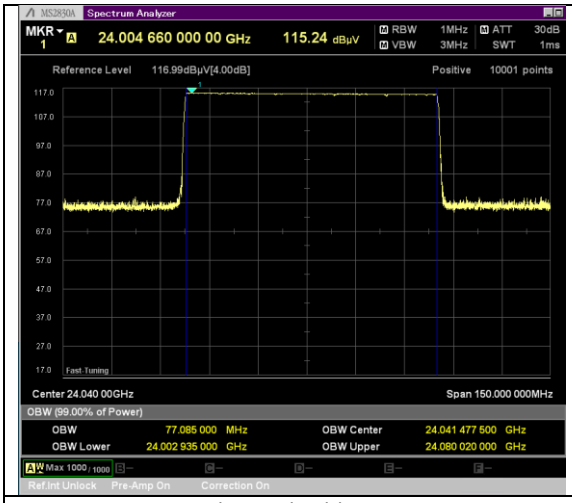
i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

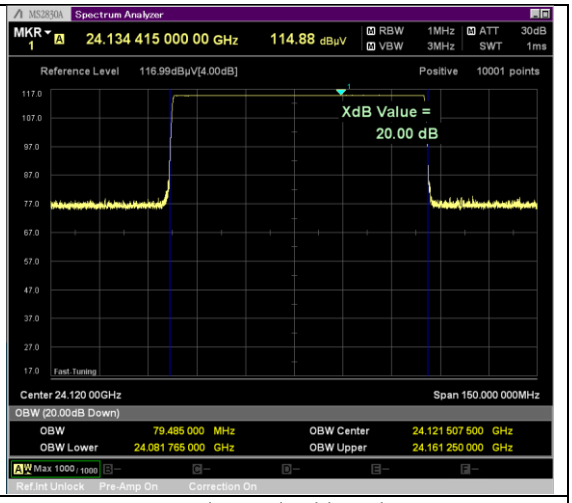
k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labelled. Tabular data may be reported in addition to the plot(s).

6.3.4 Test Result

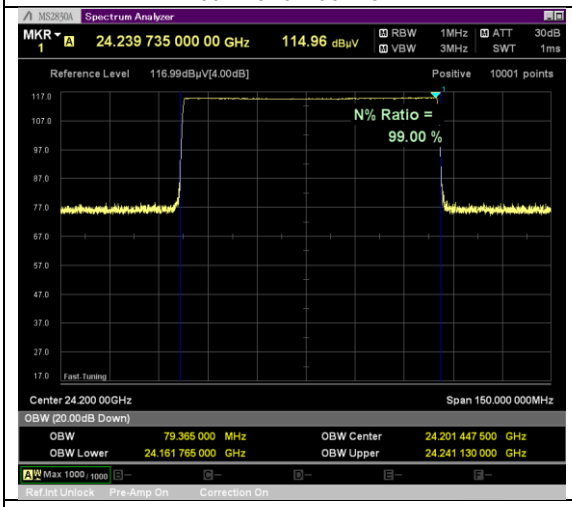
Channel	Frequency (MHz)	Measured Bandwidth (MHz)	Frequency Lower (MHz)	Frequency Upper (MHz)	Result
Low	24040	77.085	24002.935	24080.020	Pass
Mid	24120	79.485	24081.765	24161.250	Pass
High	24200	79.365	24161.765	24241.130	Pass



20dB Bandwidth-Low



20dB Bandwidth-Mid



20dB Bandwidth-High

6.4 Occupied Bandwidth (99%)

6.4.1 Requirement

The 99% OBW is for reporting purpose only. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

6.4.2 Test Procedure

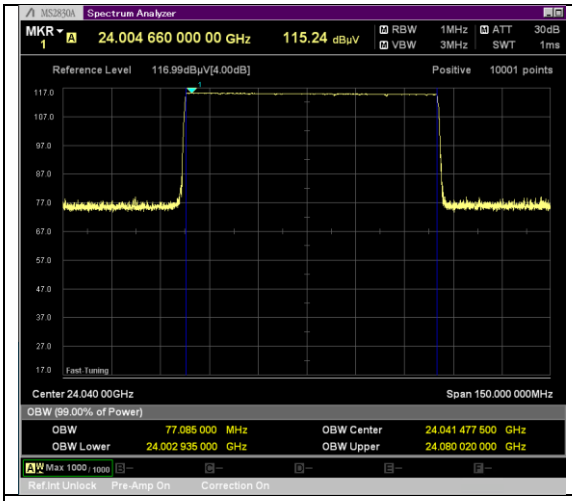
According to subclause 6.9.3 of ANSI C63.10-2013:

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

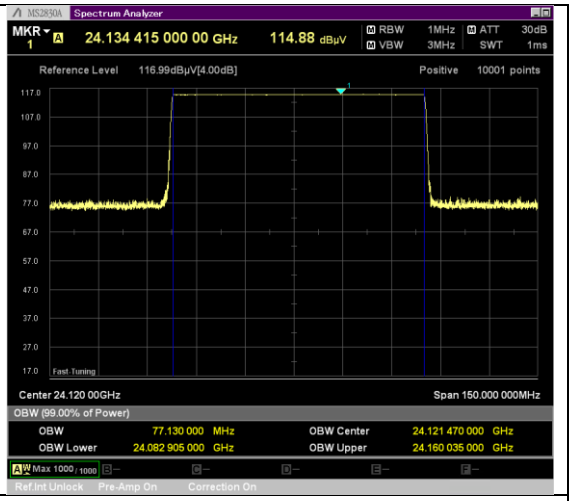
6.4.3 Test Setup

6.4.4 Test Results

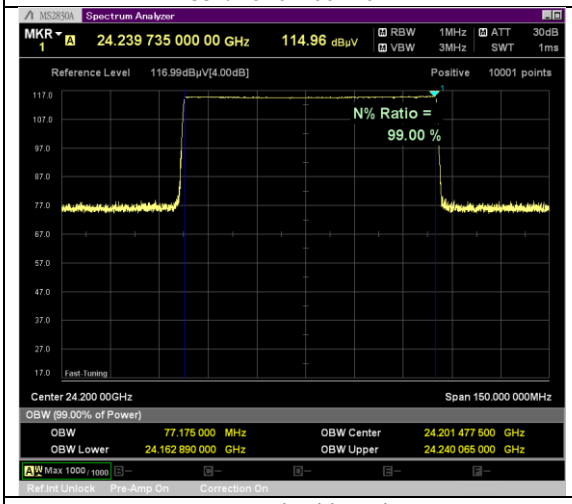
Channel	Frequency (MHz)	Measured Bandwidth (MHz)	Limit (MHz)	Result
Low	24040	77.085	Reference only	N/A
Mid	24120	77.130	Reference only	N/A
High	24200	77.175	Reference only	N/A



99% Bandwidth-Low



99% Bandwidth-Mid



99% Bandwidth-High

6.5 Fundamental Field Strength and Radiated Spurious Emission

6.5.1 Requirement

§ 15.249 (a)

Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(c) Field strength limits are specified at a distance of 3 meters.

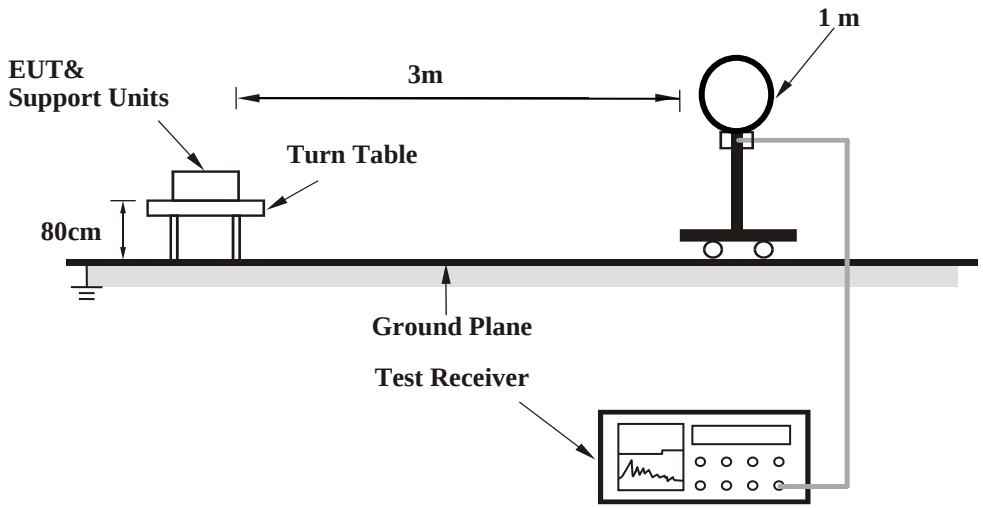
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Frequency Range (MHZ)	Field Strength (μV/m)
0.009~0.490	2400/F(kHz)
0.490~1.705	24000/F(kHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

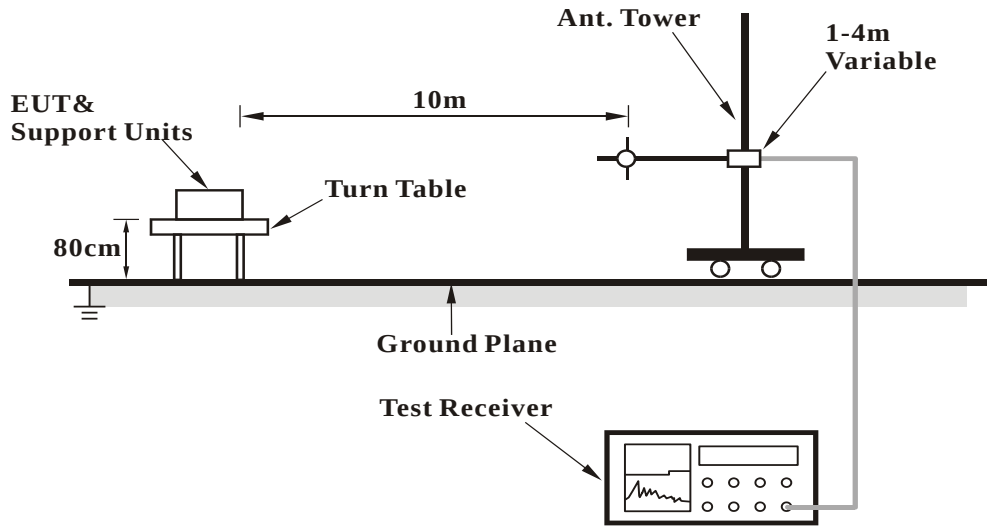
(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth

6.5.2 Test Setup

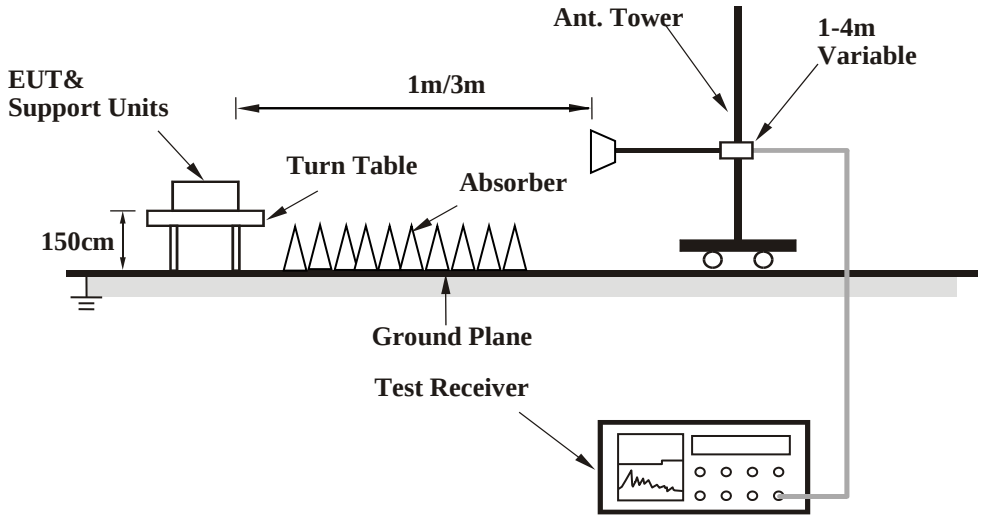
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



6.5.3 Test Procedure

According to subclause 11.12.2.7, Radiated spurious emission measurements, in ANSI C63.10-2013:

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:

a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT was chosen.

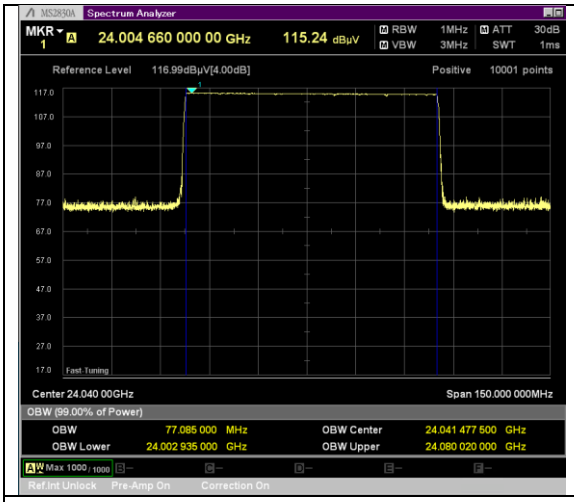
b. The EUT was then rotated to the direction that gave the maximum emission.

c. Finally, the antenna height was adjusted to the height that gave the maximum emission.

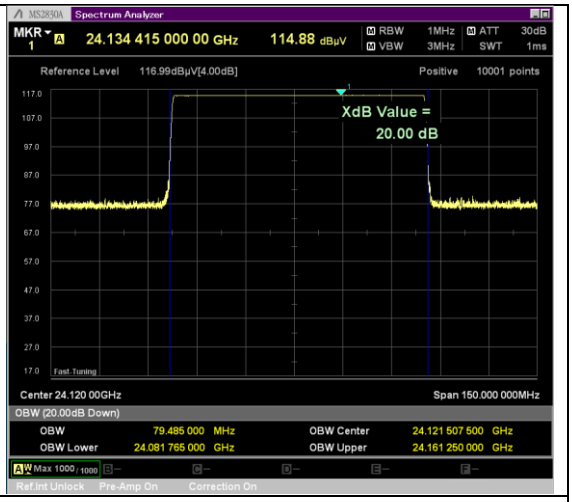
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequencies below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

6.5.4 Test Result

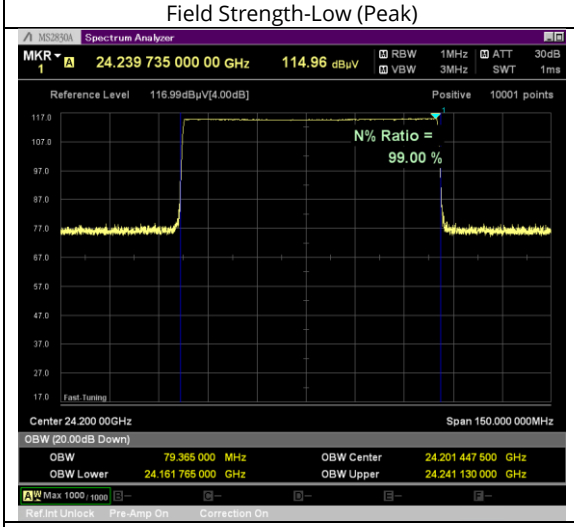
FUNDAMENTAL FIELD STRENGTH



Field Strength-Low (Peak)



Field Strength-Mid (Peak)



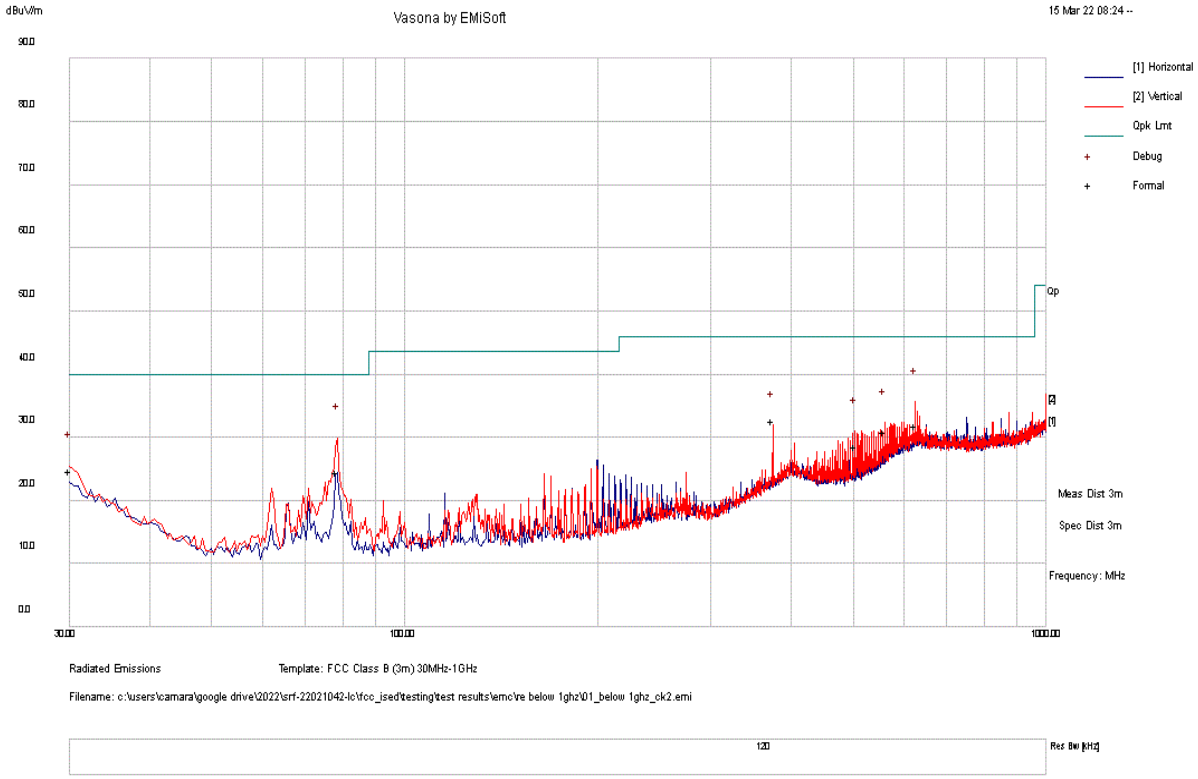
Field Strength-High (Peak)

Test Channel	Frequency MHz	Level dBuV/m	Measurement Type	Limit dBuV/m	Margin dB	Pass/Fail
Low	24040	115.24	Peak	128	-12.76	Pass
Mid	24120	114.88	Peak	128	-13.12	Pass
High	24200	114.96	Peak	128	-13.04	Pass
Low	24040	92.84	Average	108	-15.16	Pass
Mid	24120	92.17	Average	108	-15.83	Pass
High	24200	92.60	Average	108	-15.40	Pass

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.249, RSS-210	Mode:	Radiated Emission
Frequency Range:	30 MHz - 1 GHz	Test Date:	03/15/2022
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Devin Tai
Remark:	N/A	Test Result:	Pass

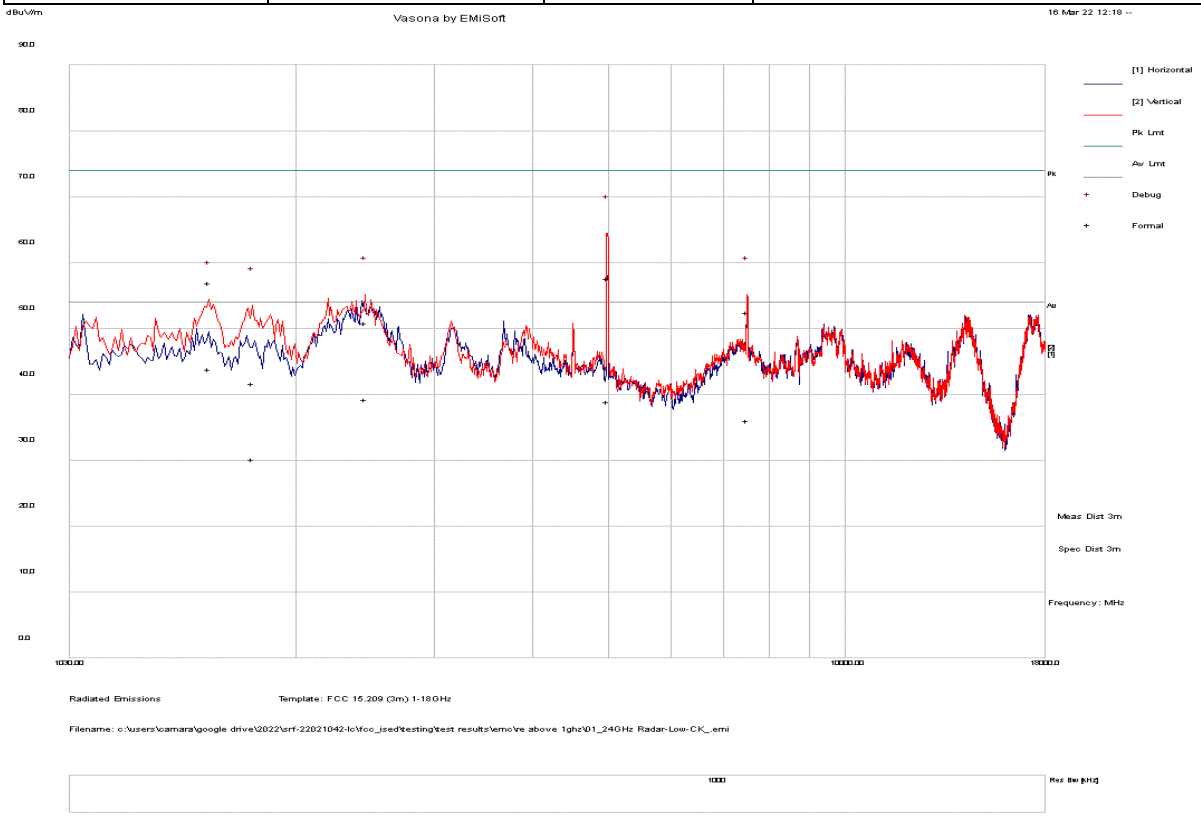
Radiated Emission



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
78.39	41.60	3.30	-20.30	24.60	Quasi Max	V	151	290	40.00	-15.40	Pass
624.90	29.80	7.20	-5.00	31.90	Quasi Max	V	161	177	46.00	-14.10	Pass
560.01	30.40	6.80	-6.20	30.90	Quasi Max	V	195	178	46.00	-15.10	Pass
374.99	35.90	6.20	-9.40	32.70	Quasi Max	V	128	280	46.00	-13.30	Pass
30.01	34.10	2.20	-11.50	24.80	Quasi Max	V	291	0	40.00	-15.20	Pass
503.57	30.70	6.10	-8.30	28.60	Quasi Max	V	117	0	46.00	-17.40	Pass

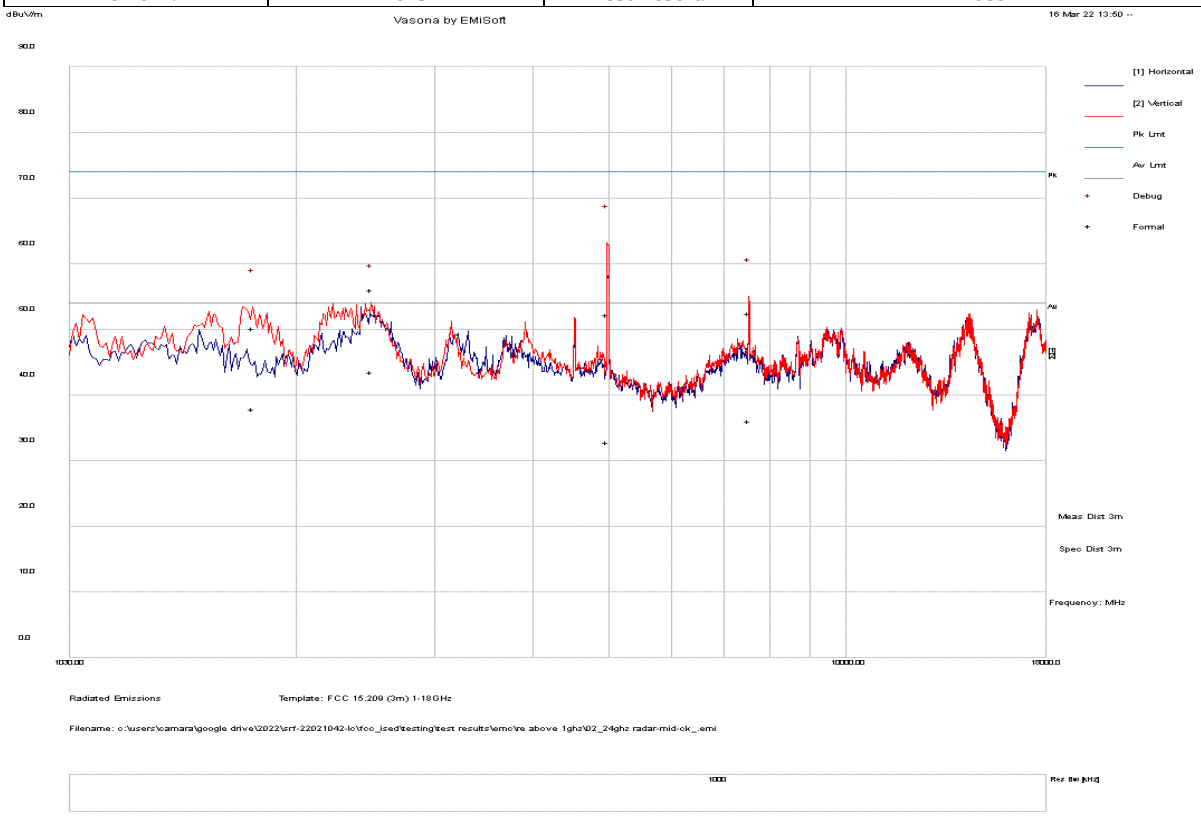
RADIATED EMISSIONS ABOVE 1 GHZ

Test Standard:	15.249, RSS-210	Mode:	Radiated Emission
Frequency Range:	1 GHz - 18 GHz	Test Date:	03/16/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	Low CH	Test Result:	Pass



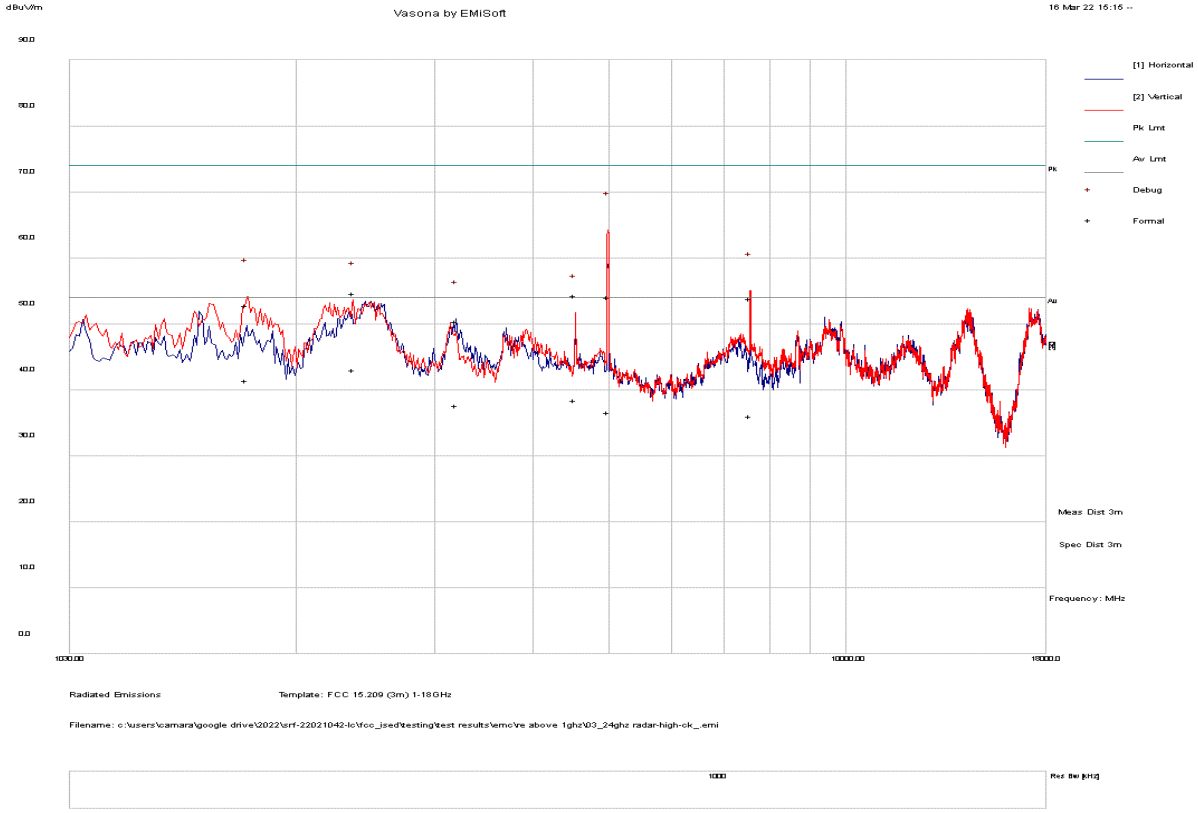
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4985.87	45.9	9.1	2.7	57.7	Peak Max	V	199	106	74	-16.3	Pass
2450.10	49	6.3	-4.4	50.9	Peak Max	V	108	293	74	-23.1	Pass
7509.16	36.2	11.9	4.4	52.5	Peak Max	V	112	42	74	-21.5	Pass
1549.91	59.1	5	-7.2	57	Peak Max	V	101	256	74	-17	Pass
1762.09	42.1	5.4	-5.9	41.7	Peak Max	V	239	271	74	-32.3	Pass
4985.87	27.2	9.1	2.7	39	Average Max	V	199	106	54	-15	Pass
2450.10	37.5	6.3	-4.4	39.3	Average Max	V	108	293	54	-14.7	Pass
7509.16	19.7	11.9	4.4	36.1	Average Max	V	112	42	54	-17.9	Pass
1549.91	46.1	5	-7.2	43.9	Average Max	V	101	256	54	-10.1	Pass
1762.09	30.8	5.4	-5.9	30.3	Average Max	V	239	271	54	-23.7	Pass

Test Standard:	15.249, RSS-210	Mode:	Radiated Emission
Frequency Range:	1 GHz - 18 GHz	Test Date:	03/16/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	Mid CH	Test Result:	Pass



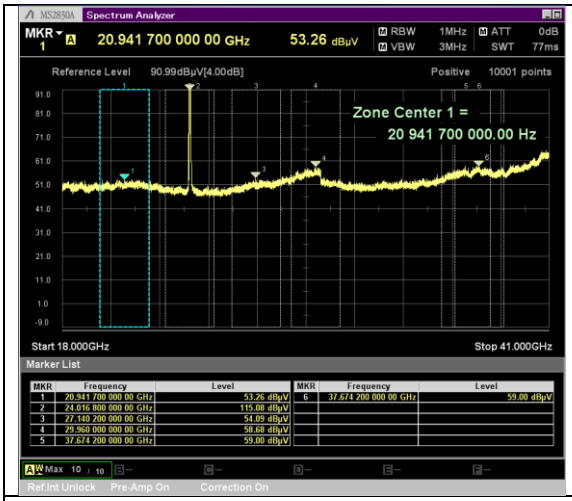
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4976.03	40.4	9.1	2.7	52.3	Peak Max	V	290	124	74	-21.7	Pass
7531.63	35.9	12	4.6	52.5	Peak Max	V	244	313	74	-21.5	Pass
2493.11	54.3	6.3	-4.5	56.1	Peak Max	V	130	264	74	-17.9	Pass
1762.79	50.7	5.4	-5.9	50.2	Peak Max	V	158	138	74	-23.8	Pass
4976.03	21	9.1	2.7	32.9	Average Max	V	290	124	54	-21.1	Pass
7531.63	19.5	12	4.6	36.1	Average Max	V	244	313	54	-17.9	Pass
2493.11	41.8	6.3	-4.5	43.6	Average Max	V	130	264	54	-10.4	Pass
1762.79	38.4	5.4	-5.9	37.9	Average Max	V	158	138	54	-16.1	Pass

Test Standard:	15.249, RSS-210	Mode:	Radiated Emission
Frequency Range:	1 GHz - 18 GHz	Test Date:	03/16/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	High CH	Test Result:	Pass

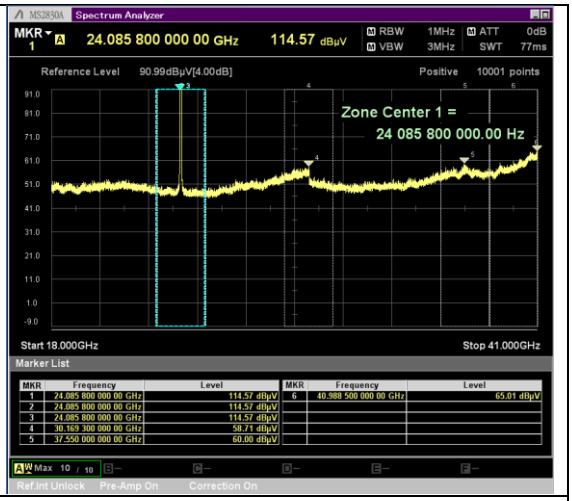


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4986.38	42.3	9.1	2.7	54.1	Peak Max	V	170	165	74	-19.9	Pass
7573.58	36.8	12.2	4.9	53.9	Peak Max	V	108	40	74	-20.1	Pass
1730.97	53.6	5.4	-6.2	52.8	Peak Max	V	153	226	74	-21.2	Pass
2366.05	52.5	6.3	-4.1	54.7	Peak Max	V	167	0	74	-19.3	Pass
4530.68	44	8.7	1.7	54.3	Peak Max	V	172	11	74	-19.7	Pass
3194.33	44.9	7.1	-1.6	50.5	Peak Max	H	166	254	74	-23.5	Pass
4986.38	24.9	9.1	2.7	36.7	Average Max	V	170	165	54	-17.3	Pass
7573.58	19	12.2	4.9	36.1	Average Max	V	108	40	54	-17.9	Pass
1730.97	42.3	5.4	-6.2	41.5	Average Max	V	153	226	54	-12.5	Pass
2366.05	40.9	6.3	-4.1	43.1	Average Max	V	167	0	54	-10.9	Pass
4530.68	28.2	8.7	1.7	38.6	Average Max	V	172	11	54	-15.4	Pass
3194.33	32.1	7.1	-1.6	37.7	Average Max	H	166	254	54	-16.3	Pass

RADIATED EMISSIONS (18-40GHZ)



Radiated Emission 18-40GHz -Low (Peak)



Radiated Emission 18-40GHz -Mid (Peak)

Radiated Emission 18-40GHz -High (Peak)

Test Channel	Frequency MHz	Level dBuV/m	Measurement Type	Limit dBuV/m	Margin dB	Pass/Fail
Low	20941.70	53.26	Peak	74.00	-20.74	Pass
Low	27140.20	54.09	Peak	74.00	-19.91	Pass
Low	29960.00	58.68	Peak	74.00	-15.32	Pass
Low	37674.20	59.00	Peak	74.00	-15.00	Pass
Low	20941.70	44.99	Average	54.00	-9.01	Pass
Low	27140.20	45.16	Average	54.00	-8.84	Pass
Low	29960.00	50.41	Average	54.00	-3.59	Pass
Low	37674.20	50.09	Average	54.00	-3.91	Pass
Mid	30169.30	58.71	Peak	74.00	-15.29	Pass
Mid	37550.00	60.00	Peak	74.00	-14.00	Pass
Mid	40988.50	65.01	Peak	74.00	-8.99	Pass
Mid	30169.30	49.94	Average	54.00	-4.06	Pass
Mid	37550.00	51.58	Average	54.00	-2.42	Pass
Mid	40988.50	52.74	Average	54.00	-1.26	Pass
High	18913.00	53.06	Peak	74.00	-20.94	Pass
High	21650.10	54.12	Peak	74.00	-19.88	Pass
High	29665.60	58.93	Peak	74.00	-15.07	Pass
High	37545.40	59.33	Peak	74.00	-14.67	Pass
High	18913.00	44.74	Average	54.00	-9.26	Pass
High	21650.10	45.78	Average	54.00	-8.22	Pass
High	29665.60	50.45	Average	54.00	-3.55	Pass
High	37545.40	51.15	Average	54.00	-2.85	Pass

Note:
The emission at around 24 GHz is fundamental emission. No other outstanding emission was found except noise floor.

RADIATED EMISSIONS (40-60GHZ)

Test Channel	Frequency MHz	Level dBuV/m	Measurement Type	Limit dBuV/m	Margin dB	Pass/Fail
Low	48080	72.5	Peak	88	-15.5	Pass
Mid	48240	72.4	Peak	88	-15.6	Pass
High	48400	72.8	Peak	88	-15.2	Pass
Low	48080	59.0	Average	68	-9.0	Pass
Mid	48240	61.5	Average	68	-6.5	Pass
High	48400	56.5	Average	68	-11.5	Pass

Note:
The emission at around 24 GHz is fundamental emission. No other outstanding emission was found except noise floor.

RADIATED EMISSIONS (60-90GHZ)

Test Channel	Frequency MHz	Level dBuV/m	Measurement Type	Limit dBuV/m	Margin dB	Pass/Fail
Low	72120	77.3	Peak	88	-10.7	Pass
Mid	72360	77.7	Peak	88	-10.3	Pass
High	72600	77.6	Peak	88	-10.4	Pass
Low	72120	59.6	Average	68	-8.4	Pass
Mid	72360	61.6	Average	68	-6.4	Pass
High	72600	59.6	Average	68	-8.4	Pass

RADIATED EMISSIONS (90-100GHZ)

Test Channel	Frequency MHz	Level dBuV/m	Measurement Type	Limit dBuV/m	Margin dB	Pass/Fail
Low	96160	73.2	Peak	88	-14.8	Pass
Mid	96480	72.2	Peak	88	-15.8	Pass
High	96800	71.6	Peak	88	-16.4	Pass
Low	96160	57.5	Average	68	-10.5	Pass
Mid	96480	56.7	Average	68	-11.4	Pass
High	96800	60.1	Average	68	-7.9	Pass

7 EUT and Test Setup Photos

See FCC exhibits

8 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2020	10/18/2022
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	06/17/2021	06/17/2022
Spectrum Analyzer	Anritsu	MS2830A	6201145210	05/15/2020	05/15/2022
EMC Test Receiver	R&S	ESL6	100230	06/14/2021	06/14/2022
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	05/04/2021	05/04/2022
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2021	11/15/2022
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	05/14/2021	05/14/2022
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	06/24/2021	06/24/2022
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2021	07/16/2022
True RMS Multi-meter	UNI-T	UT181A	C173014829	05/05/2021	05/05/2022
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	05/15/2021	05/15/2022
RF Attenuator	Pasternack	PE7005-3	VL061	07/16/2021	07/16/2022
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	07/16/2021	07/16/2022
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	05/16/2021	05/16/2022
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2021	07/16/2022
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2021	07/16/2022
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2021	07/16/2022
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2021	07/16/2022
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2021	07/16/2022
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2021	07/16/2022
Vector Signal Generator	Keysight	N5182A	US47080548	06/17/2021	06/17/2022
RF Power Amplifier (80-1000MHz)	Ophir	5226FE	1013/1815	N/A	N/A
RF Power Amplifier (700-6000MHz)	Ophir	5293FE	1063/1815	N/A	N/A
Horn Antenna (1-18GHz)	FT-RF	HA-07M18G-NF	180010HA	N/A	N/A
Horn Antenna (40-60GHz)	OML.Inc	M19RH	19121801-19	12/13/2019	12/13/2022
Harmonic Mixer (40-60GHz)	OML.Inc	M19HWA	191213-1-19	12/13/2019	12/13/2022
Horn Antenna (60-90GHz)	OML.Inc	M12RH	19121801-12	12/13/2019	12/13/2022

Harmonic Mixer (60-90GHz)	OML.Inc	M12HWA	191213-1-12	12/13/2019	12/13/2022
Horn Antenna (90-140GHz)	OML.Inc	M08RH	19121801-08	12/13/2019	12/13/2022
Harmonic Mixer (90-140GHz)	OML.Inc	M08HWA	191213-1-08	12/13/2019	12/13/2022