

Spartan Radar

EMC TEST REPORT FOR

Sensor
Model: HSENIXX

Tested to The Following Standards:

FCC Part 95 Subpart M
The 76–81GHz Band Radar Service

Report No.: 107654-11A

Date of issue: June 13, 2023



This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.



We strive to create long-term, trust-based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

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TABLE OF CONTENTS

Administrative Information	3
Test Report Information	3
Revision History	3
Report Authorization	3
Test Facility Information	4
Software Versions	4
Site Registration & Accreditation Information	4
Summary of Results	5
Modifications During Testing	5
Conditions During Testing	5
Equipment Under Test	6
General Product Information	6
FCC Part 95 Subpart M	12
2.1049 Occupied Bandwidth	12
2.1046/95.3367 (a), (b) Power Output	17
2.1055/95.3379 (b) Frequency Stability	29
2.1053/95.3379 (a)(1), (a)(2) Radiated Emissions	32
Appendix B: Data Conversion	52
Supplemental Information	53
Measurement Uncertainty	53
Emissions Test Details	53

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Spartan Radar
10541 Calle Lee Unit 125
Los Alamitos, CA 90720

Representative: Matt Reyes
Customer Reference Number: MU0150179211

REPORT PREPARED BY:

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Project Number: 107654

DATE OF EQUIPMENT RECEIPT:

March 21, 2023

DATE(S) OF TESTING:

March 21, 2023 and April 3, 5, 6, and 7, 2023

Revision History

Original: Testing of Senor, Model: HSENIXX to FCC Part 95 Subpart M, the 76-81GHz Band Radar Service.

Revision A: Revised the section 2.1046/95.3367 (a), (b) Power Out, Power Average (RMS) measurements, plots and data sheet.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable, and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

SUMMARY OF RESULTS

Standard / Specification: FCC Part 95 Subpart M – 95.3301

Test Procedure	Description	Modifications	Results
2.1049	Occupied Bandwidth	NA	Pass
2.1046/95.3367 (a), (b)	Power Output: 76–81GHz Band Radar Service radiated power limits	NA	Pass
2.1055/95.3379 (b)	Frequency Stability	NA	Pass
2.1053/95.3379 (a)(1), (a)(2)	Radiated Spurious Emissions: 76–81GHz Band Radar Service unwanted emissions limits	NA	Pass

NA = Not Applicable

ISO/IEC 17025 Decision Rule

The equipment sample utilized for testing is selected by the manufacturer. The declaration of pass or fail herein is a binary statement for simple acceptance rule (ILAC G8) based upon assessment to the specification(s) listed above, without consideration of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions

None

EQUIPMENT UNDER TEST (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Sensor	Spartan Radar	HSENIXX	HSENIXX-2305-11026

Support Equipment:

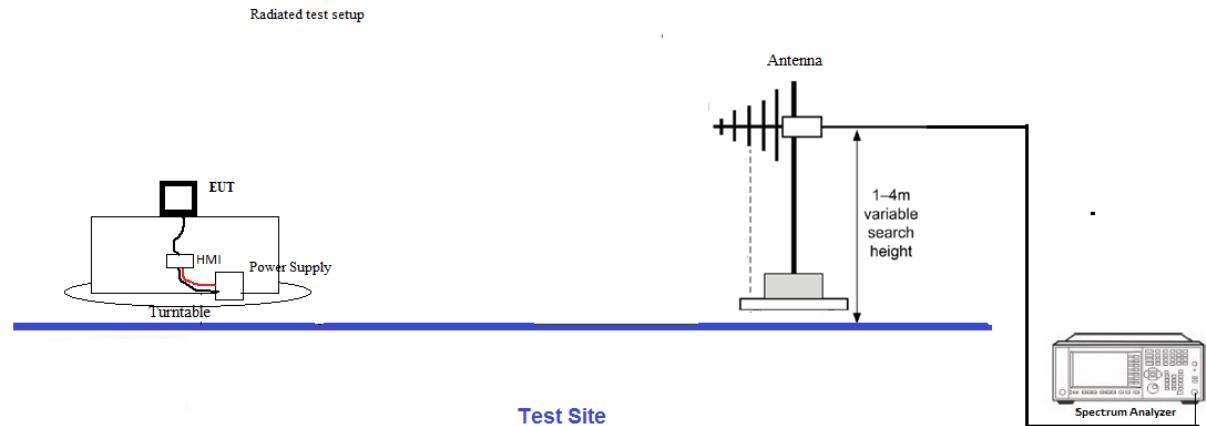
Device	Manufacturer	Model #	S/N
HMI	Spartan Radar	HLCD	HLCD-2313-11001
Power Supply	Topward	6306D	9885614
Multimeter	Fluke	8845A/G	3947018
Laptop Computer	Lenovo	ThinkPad T500	L3B3906

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Transmission System:	Modulated CW Radar
Operating Frequency Range(s):	77.37GHz to 79.97GHz
Modulation Type(s):	Linear FMCW
Maximum Duty Cycle:	7% (98% or better for the entire band of operation)
Number of TX Chains:	3
Antenna Type(s) and Gain:	Microstrip Patch Antenna / 12dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	12.0VDC
Firmware used for test:	v0.9.0.3

The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.

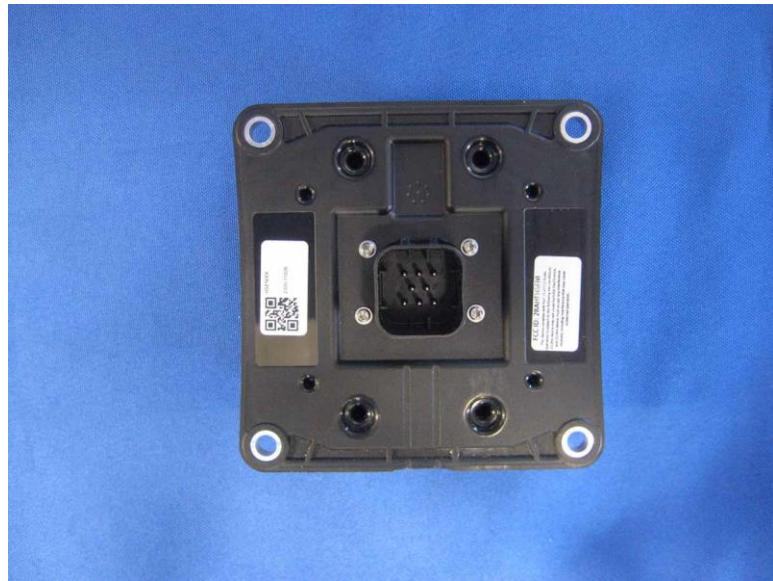
Block Diagram(s) of Test Setup



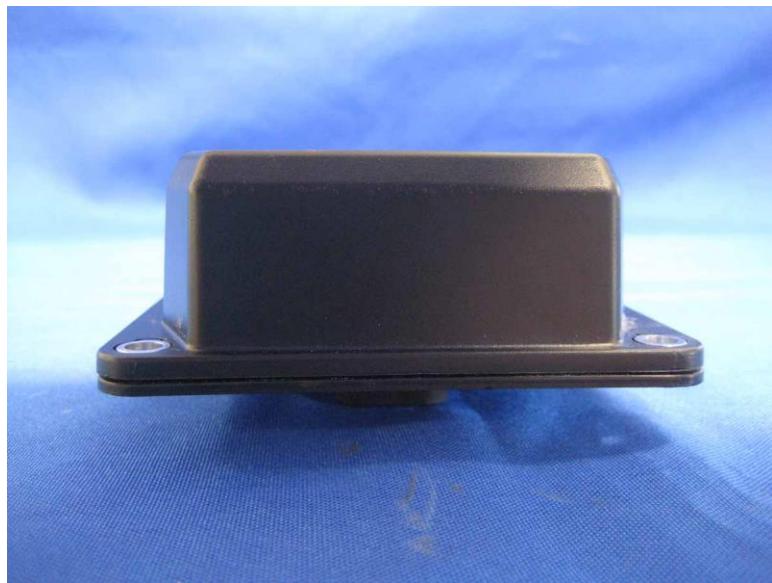
EUT and Accessory Photo(s)



Front View



Back View



Left View



Right View



Top View



Bottom View

Support Equipment Photo(s)



FCC Part 95 Subpart M

2.1049 Occupied Bandwidth

Test Setup/Conditions

Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.26 (2015) KDB 653005 D01 76-81 GHz Radars v01r02	Test Date(s):	3/21/2023
Configuration:	1		
Test Setup:	The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode. TX Frequency: 77.37 GHz, 78.65GHz, 79.97GHz		
Declaration:	NA		

Environmental Conditions

Temperature (°C)	18	Relative Humidity (%):	45
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Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
02348	Horn Antenna	OML	M12HWA	2/14/2023	2/14/2025
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

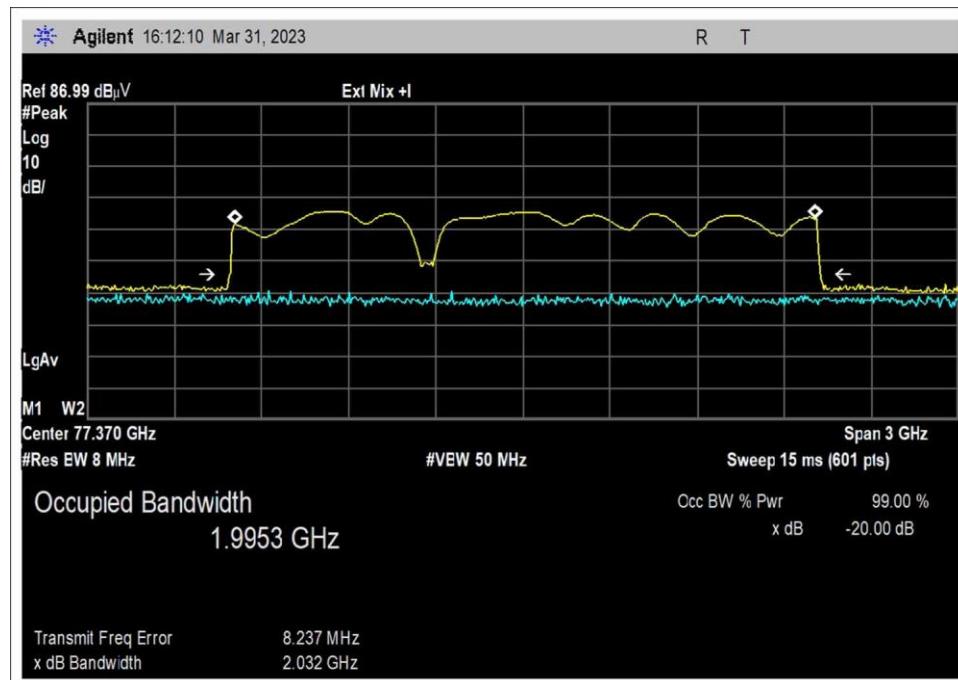
20dB Occupied Bandwidth

Test Data Summary				
Frequency (GHz)	Modulation	Measured (GHz)	Limit (GHz)	Results
77.37	Linear FMCW	2.03	NA	NA
78.65	Linear FMCW	2.02	NA	NA
79.97	Linear FMCW	2.03	NA	NA

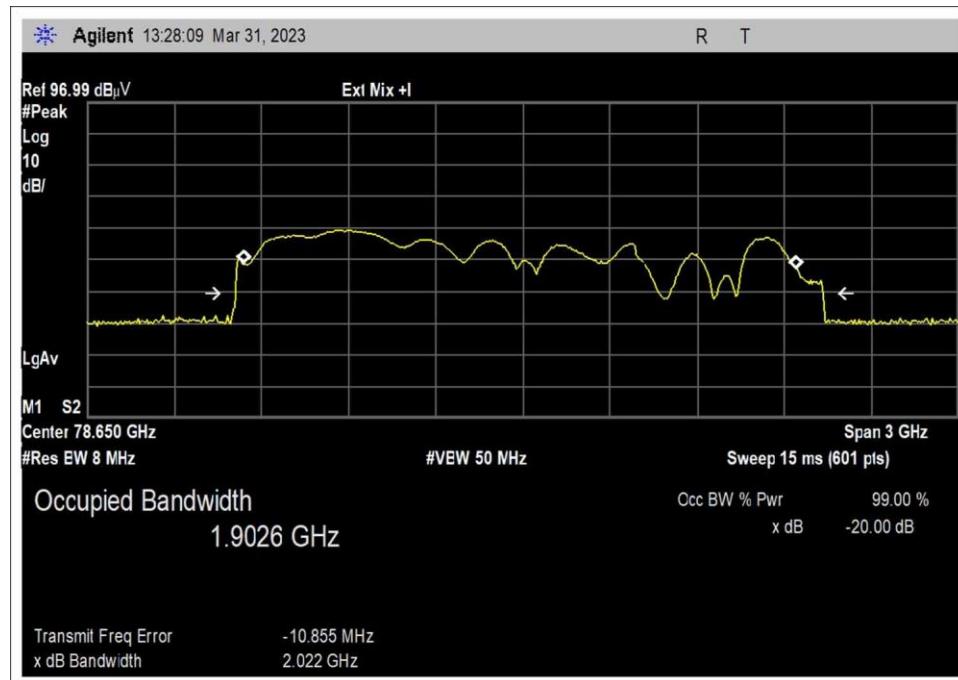
99% Occupied Bandwidth

Test Data Summary					
Frequency (GHz)	Modulation	Measured (GHz)	Range (GHz)	Limit (GHz)	Results
77.37	Linear FMCW	2.00	76.37 - 78.37	76- 81	Pass
78.65	Linear FMCW	1.90	77.73 - 79.60	76- 81	Pass
79.97	Linear FMCW	2.00	78.97 - 80.97	76- 81	Pass

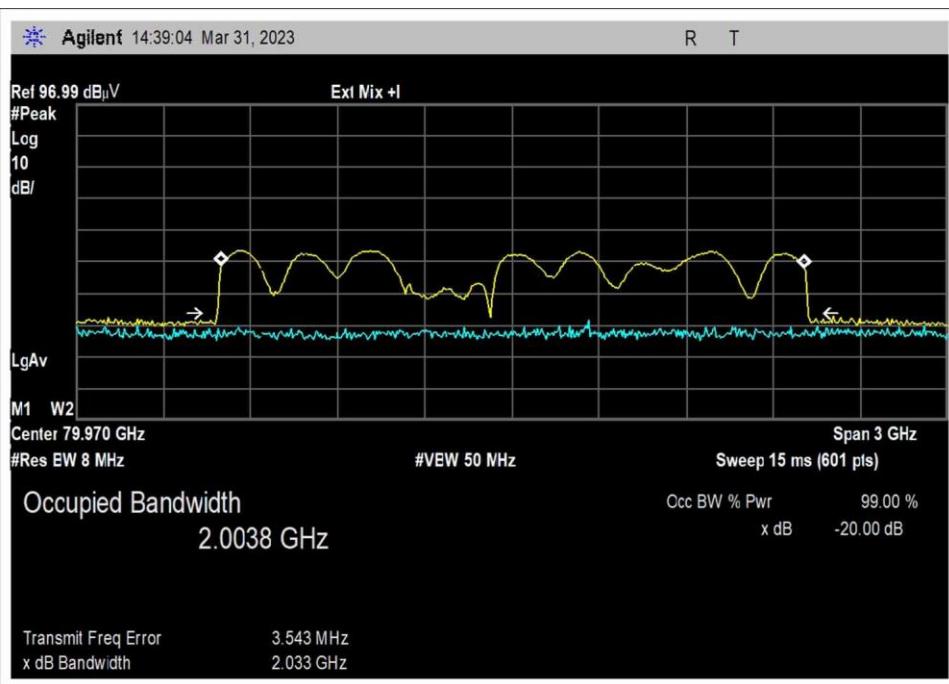
Plot(s)



Low Channel



Middle Channel



High Channel

Test Setup Photo(s)



2.1046/95.3367 (a), (b) Power Output

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.26 (2015) KDB 653005 D01 76-81 GHz Radars v01r02	Test Date(s):	4/3/2023
Configuration:	1		
Test Setup:	<p>The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.</p> <p>TX Frequency: 77.37GHz , 78.65GHz, 79.97GHz</p> <p>1000MHz-231 000MHz; RBW=1MHz ,VBW=3MHz.</p> <p>Peak = peak Ave = RMS detector for Fundamental power Peak EIRP, measured at 1 meter test distance due to low signal strength Integrated RMS EIRP measured 10 cm test distance due to low signal strength.</p> <p>No signal detected with the receiving antenna placed in horizontal polarity.</p>		

Environmental Conditions			
Temperature (°C)	18	Relative Humidity (%):	44

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
02348	Horn Antenna	OML	M12HWA	2/14/2023	2/14/2025
07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

Test Data Summary - RF Radiated Measurement					
Peak**					
Frequency (GHz)	Modulation	Ant. Type / Gain (dBi)	*Measured EIRP (dBm)	Limit (dBm)	Results
77.350	Linear FMCW	Microstrip Patch Antenna / 12dBi	8.7	55	Pass
78.315	Linear FMCW	Microstrip Patch Antenna / 12dBi	9.7	55	Pass
80.183	Linear FMCW	Microstrip Patch Antenna / 12dBi	8.6	55	Pass

Test Data Summary - RF Radiated Measurement					
Power Average (RMS)					
Frequency (GHz)	Modulation	Ant. Type / Gain (dBi)	*Measured EIRP (dBm)	Limit (dBm)	Results
77.37	Linear FMCW	Microstrip Patch Antenna / 12dBi	4.0	50	Pass
78.65	Linear FMCW	Microstrip Patch Antenna / 12dBi	4.6	50	Pass
79.97	Linear FMCW	Microstrip Patch Antenna / 12dBi	3.6	50	Pass

(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). (Integrated power IAW KDB)

(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.

* Conversion: $EIRP = E(\text{dBuV/m}) + 20\text{LOG}(d) - G - 104.77$, for EIRP, G=0

** No Pulse desensitizing correction factor (PDCF) applied as investigation with various sweep time, and using simulated signal according to the signal parameter shows the peak emission remains unchanged.

Note, for reference only as a possible worst case scenario the Agilent application note 5952-1039, P15 indicates PDCF for the PSA series instrument used would be

$K = 1.479$

$\alpha p \text{ dB} = 20 \text{ Log} (T_{eff} k \text{ rbw})$

$T_{eff} = 32.68 \text{ kHz}$

$\text{PRF} = 1/32.38 \text{ kHz}$

$\text{Rbw} = 1000 \text{ kHz}$

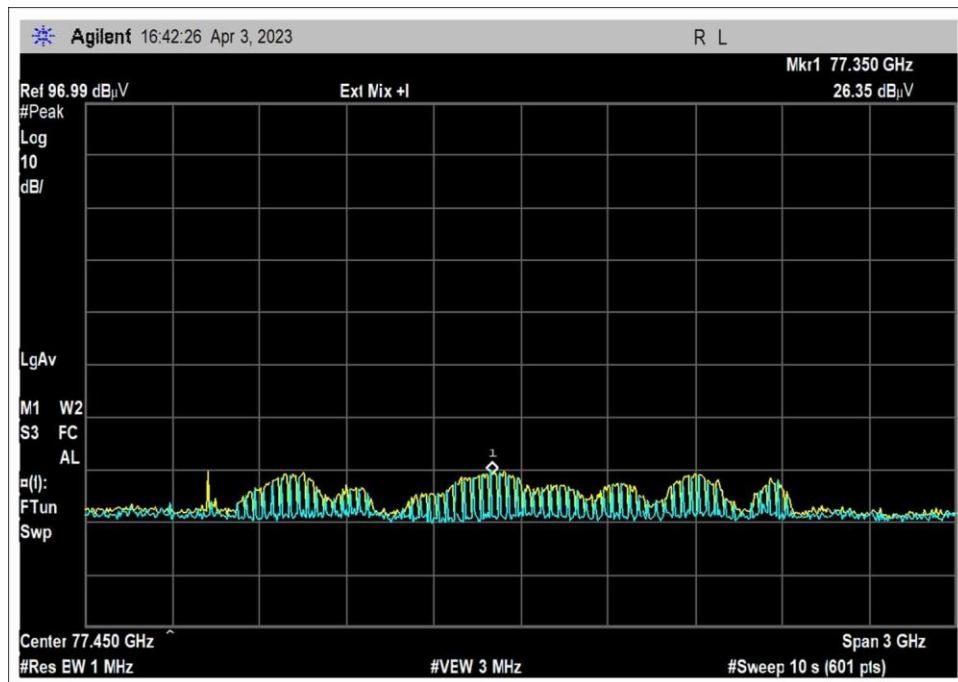
$T_{eff} = 1/32.32 \text{ kHz} = 0.0309 \text{ ms}$

$PDCF \quad \alpha p \text{ dB} = 20 \text{ Log} (0.0309 \times 1.476 \times 1000) = 33.2 \text{ dB}$

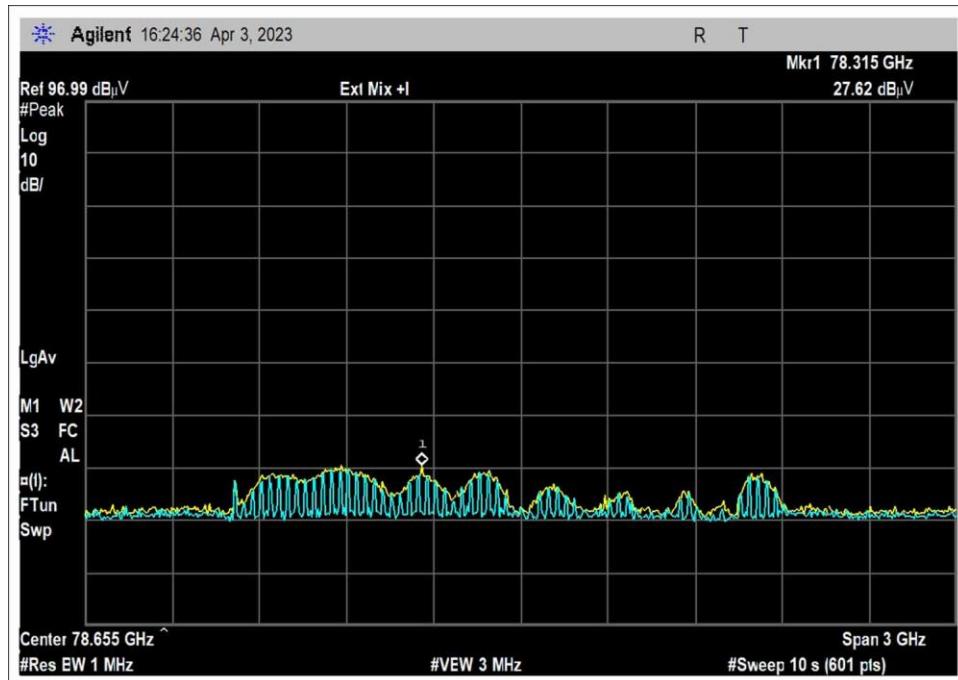
Frequency (GHz)	Modulation	Ant. Type / Gain (dBi)	For reference only *Measured EIRP with PDCF of 33.2dB applied. (dBm)	Limit (dBm)	Results
Peak with worse case correction					
77.350	Linear FMCW	Microstrip Patch Antenna / 12dBi	41.9	55	Pass
78.315	Linear FMCW	Microstrip Patch Antenna / 12dBi	42.9	55	Pass
80.183	Linear FMCW	Microstrip Patch Antenna / 12dBi	41.8	55	Pass

Plot(s)

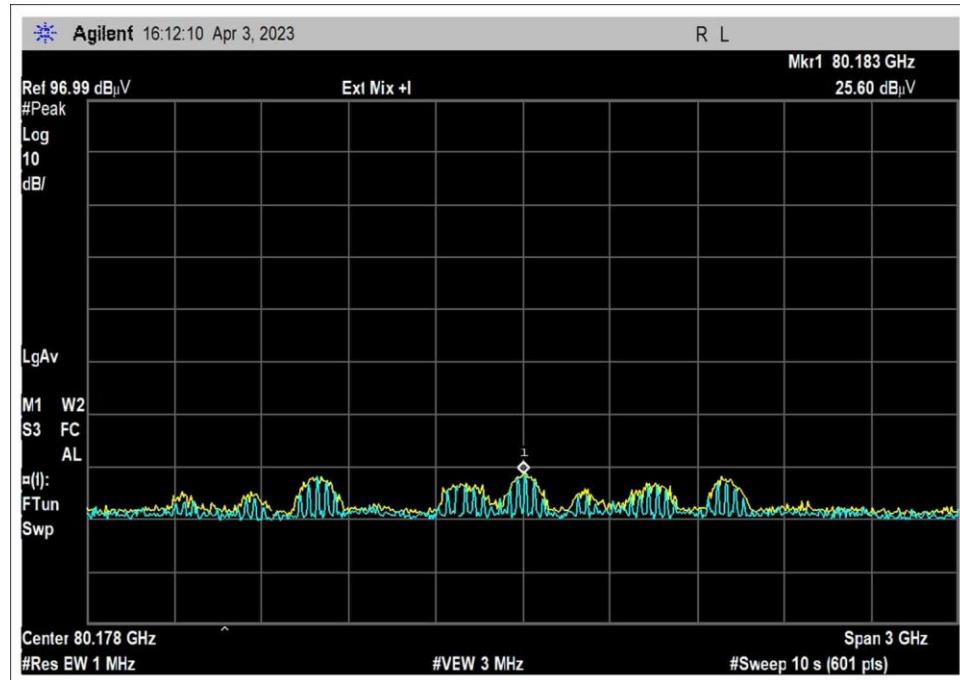
Peak



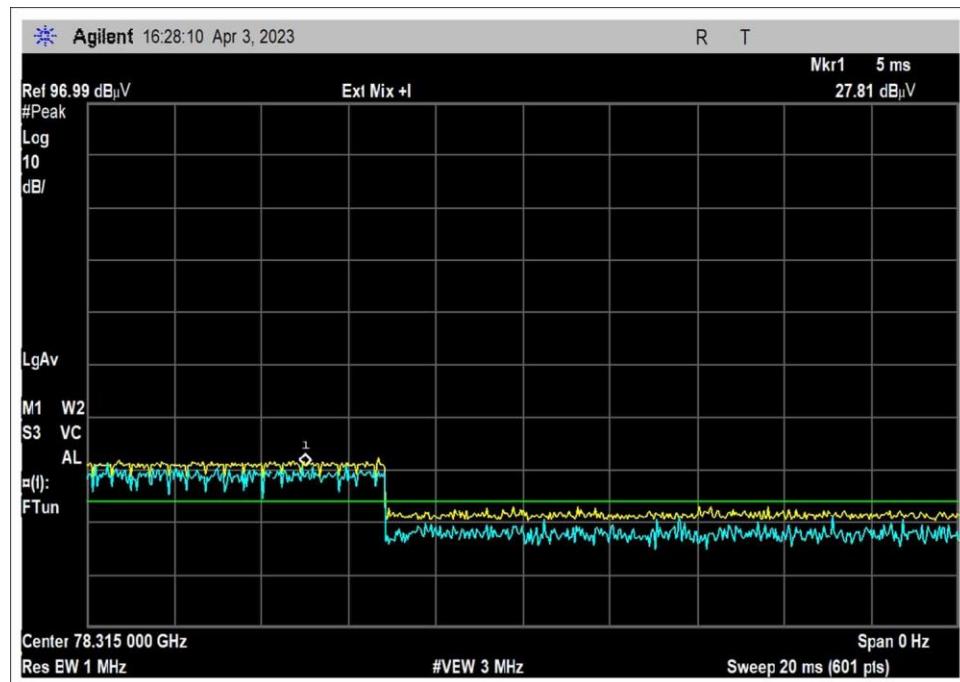
Low Channel



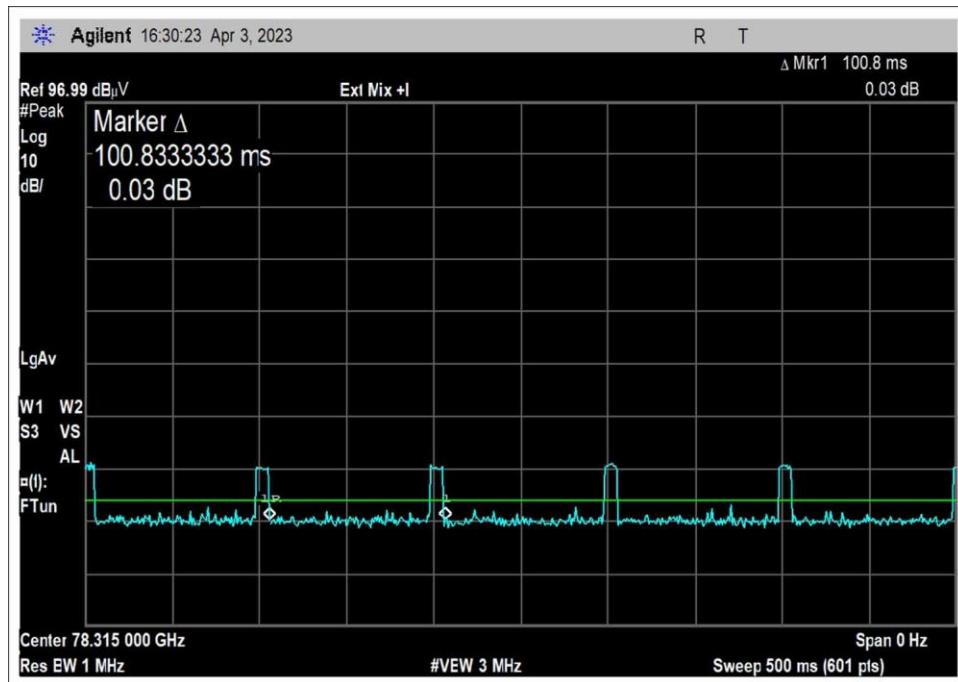
Middle Channel



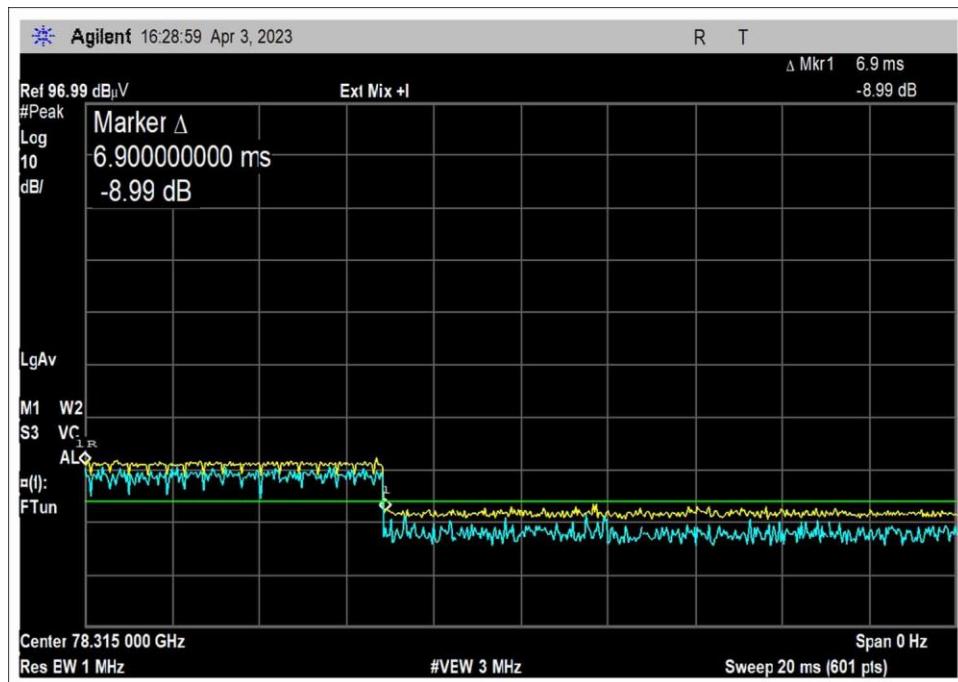
High Channel



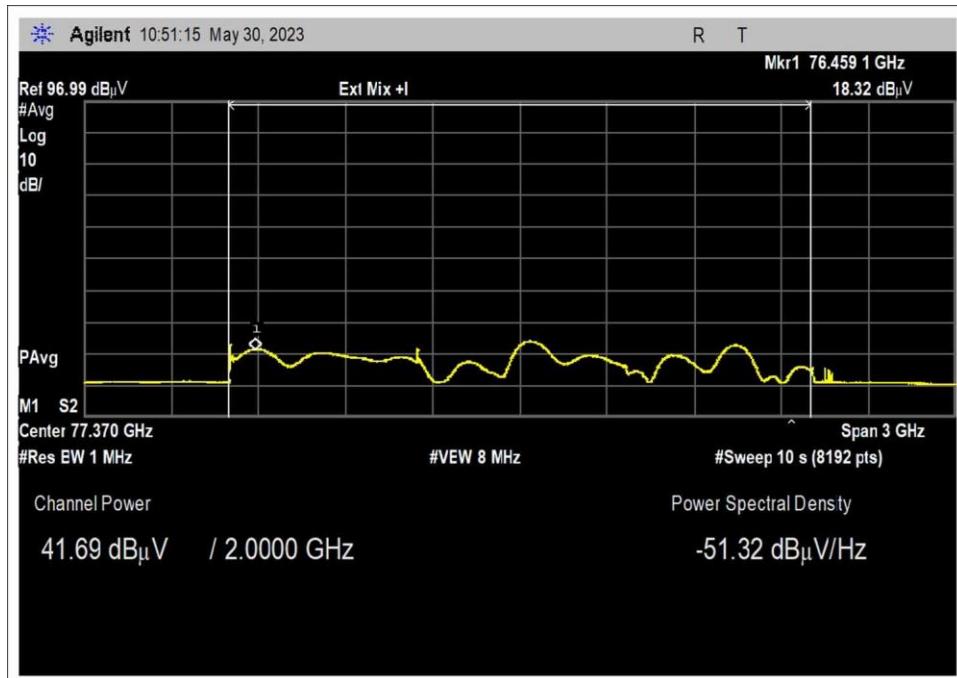
Amplitude



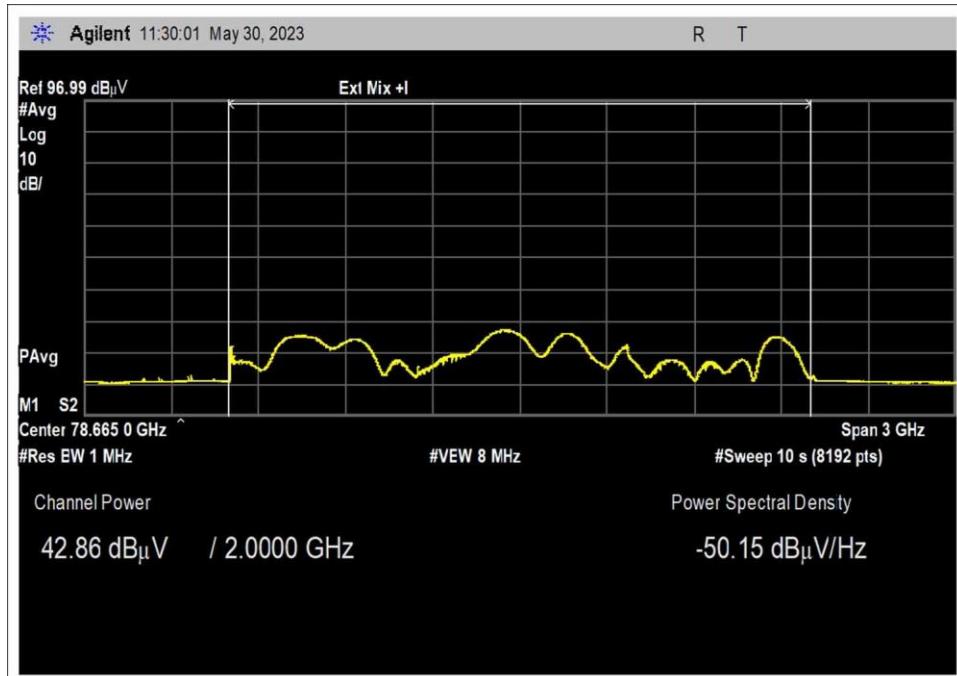
Bust Period



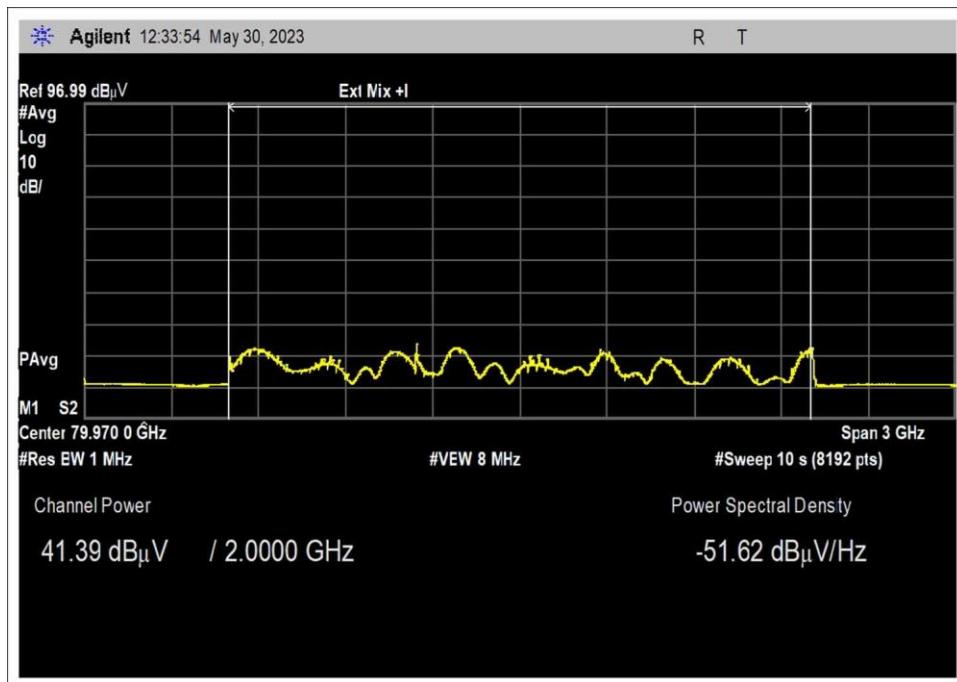
Bust Time

RMS


Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • (714) 993-6112
 Customer: **Spartan Radar**
 Specification: **95.3367 Radiated Emissions (Peak)**
 Work Order #: **107654** Date: 4/3/2023
 Test Type: **Maximized Emissions** Time: 11:59:11
 Tested By: E. Wong Sequence#: 3
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.

TX Frequency: 77.37GHz, 78.65GHz, 79.97GHz

Frequency Range of Measurement: Fundamental GHz.
 1000 MHz-231 000 MHz; RBW=1MHz, VBW=3 MHz.

Test Environment Conditions:

Temperature: 18°C

Relative Humidity: 45%

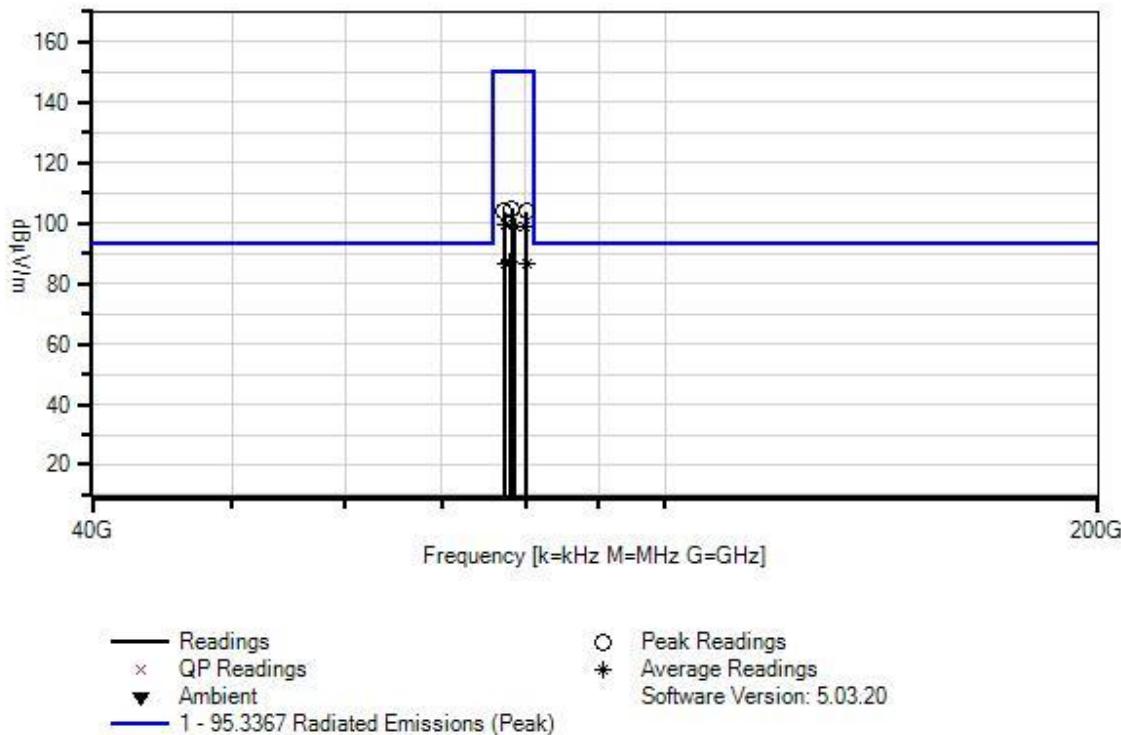
Pressure: 100kPa

Test Method: ANSI C63.26 (2015), 653005 D01 76-81 GHz Radars v01r02

Site D

Peak = Peak

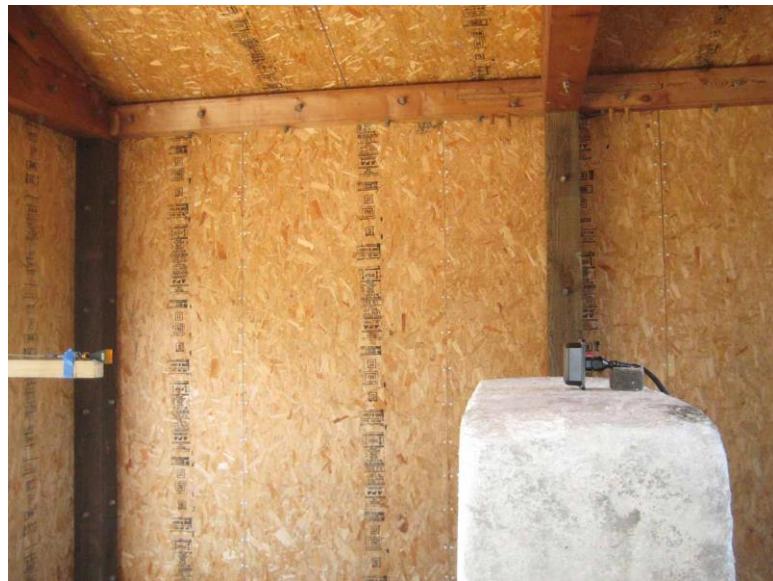
Ave = RMS detector for Fundamental integrated power

Spartan Radar WO#: 107654 Sequence#: 3 Date: 4/3/2023
 95.3367 Radiated Emissions (Peak) Test Distance: 0.1meter Vert

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	ANP07655-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T2	ANP07656-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T3	ANP07659-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	ANP07660-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T5	AN02348	Horn Antenna	M12HWA	2/14/2023	2/14/2025

Measurement Data:			Reading listed by margin.				Test Distance: 0.1meter				
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5				Table	dB μ V/m	dB μ V/m		
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V/m	dB μ V/m		Ant
1	78315.000M	27.6	+0.7	+0.7	+0.6	+0.6	-9.5	104.9	150.2	-45.3	Vert
			+84.2								M_Fundamental
2	77350.000M	26.4	+0.7	+0.7	+0.6	+0.7	-9.5	103.9	150.2	-46.3	Vert
			+84.3								L_Fundamental
3	80183.000M	26.6	+0.7	+0.8	+0.7	+0.7	-9.5	103.8	150.2	-46.4	Vert
			+83.8								H_Fundamental
4	78665.000M	42.9	+0.7	+0.7	+0.6	+0.6	-29.5	99.8	150.2	-50.4	Vert
	Ave		+83.8								M_Fundamental_C
											hannel
											power_RMS_10cm
5	77370.000M	41.7	+0.7	+0.7	+0.6	+0.7	-29.5	99.2	150.2	-51.0	Vert
	Ave		+84.3								L_Fundamental_Ch
											annel
											power_RMS_10cm
6	79970.000M	41.4	+0.7	+0.8	+0.7	+0.7	-29.5	98.8	150.2	-51.4	Vert
	Ave		+84.0								H_Fundamental_Ch
											annel
											power_RMS_10cm
7	77990.000M	9.3	+0.7	+0.7	+0.6	+0.6	-9.5	87.1	145.2	-58.1	Horiz
	Ave		+84.7								M_Fundamental_noise
											floor
^	77990.000M	19.8	+0.7	+0.7	+0.6	+0.6	-9.5	97.6	150.2	-52.6	Horiz
			+84.7								M_Fundamental_noise
											floor
9	77415.000M	9.3	+0.7	+0.7	+0.6	+0.7	-9.5	86.8	145.2	-58.4	Horiz
	Ave		+84.3								L_Fundamental_noi
											se floor
^	77415.000M	17.5	+0.7	+0.7	+0.6	+0.7	-9.5	95.0	150.2	-55.2	Horiz
			+84.3								L_Fundamental_noi
											se floor
11	80190.000M	9.5	+0.7	+0.8	+0.7	+0.7	-9.5	86.6	145.2	-58.6	Horiz
	Ave		+83.7								H_Fundamental_no
											ise floor
^	80190.000M	18.4	+0.7	+0.8	+0.7	+0.7	-9.5	95.5	150.2	-54.7	Horiz
			+83.7								H_Fundamental_no
											ise floor

Test Setup Photo(s)



1 Meter



10cm

2.1055/95.3379 (b) Frequency Stability

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	S. Yamamoto
Test Method:	ANSI C63.26 (2015) KDB 653005 D01 76-81 GHz Radars v01r02	Test Date(s):	4/7/2023
Configuration:	1		
Test Setup:	The equipment under test (EUT) is placed stand alone in the temperature room. Connected to the EUT is a DC power supply and laptop computer. The laptop computer is used to set the EUT to the low, middle, and high channels. The DC power supply provides input voltage to the EUT.		

Environmental Conditions			
Temperature (°C)	19	Relative Humidity (%):	36

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P07164	Multimeter	Fluke	8845A/G	8/13/2021	8/13/2023
01438	Power Supply	Topward	6306D	4/4/2023	4/4/2025
01878	Temperature Chamber	Thermotron Corp.	S 1.2 Mini-Max	4/4/2023	4/4/2025
P05947	Thermometer	Fluke	51	5/19/2022	5/19/2024

Test Data Summary					
Declared Temperature Range: -40 °C to +85 °C					
Manufacturer declares the equipment does not utilize heater type crystal oscillators.					
Temp (°C)	Voltage (V _{nominal} except as noted)	Low Channel Band Edge Reading, Average (dBuV/m)	High Channel Band Edge Reading, Average (dBuV/m)	Band Edge Limit Line (dBuV/m)	Results
-30		84.4	84.6	93.5	Pass
-20		84.4	84.6	93.5	
-10		84.4	84.6	93.5	
0		84.4	84.6	93.5	
10		84.4	84.6	93.5	
20	V _{Minimum}	84.4	84.6	93.5	
20		84.4	84.6	93.5	
20	V _{Maximum}	84.4	84.6	93.5	
30		84.4	84.6	93.5	
40		84.4	84.6	93.5	
50		84.4	84.6	93.5	
Maximum Deviation		0.0	0.0		

Test Data Summary

Declared Temperature Range: -40 °C to +85 °C

Manufacturer declares the equipment does not utilize heater type crystal oscillators.

Temp (°C)	Voltage (V _{nominal} except as noted)	FL* (GHz)	FH * (GHz)	Authorize band Limit (GHz)	Results
-30		76.4	80.95	76 – 81	Pass
-20		76.4	80.95	76 – 81	
-10		76.4	80.95	76 – 81	
0		76.4	80.95	76 – 81	
10		76.4	80.95	76 – 81	
20	V _{Minimum}	76.4	80.95	76 – 81	
20		76.4	80.95	76 – 81	
20	V _{Maximum}	76.4	80.95	76 – 81	
30		76.4	80.95	76 – 81	
40		76.4	80.95	76 – 81	
50		76.4	80.95	76 – 81	
Maximum Deviation		0.0	0.0		

*FL and FH are the lower and upper frequency point of the intended emission inside the authorized band at which the measured emission level is at the Spurious emission limit

No change in emission amplitude was observed.

Parameter Definitions:

Measurements performed at input voltage V_{nominal} ± 15%.

Parameter	Value
V _{Nominal} :	12.0VDC
V _{Minimum} :	10.2VDC
V _{Maximum} :	13.8VDC

Test Setup Photo(s)



2.1053/95.3379 (a)(1), (a)(2) Radiated Emissions

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong, S.Yamamoto
Test Method:	ANSI C63.26 (2015) KDB 653005 D01 76-81 GHz Radars v01r02	Test Date(s):	4/3/2023
Configuration:	1		
Test Setup:	<p>The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.</p> <p>TX Frequency: 77.37GHz, 78.65GHz, 79.97GHz</p> <p>Frequency Range of Measurement: 9 kHz- 231 GHz. 9 kHz -150 kHz; RBW=200 Hz, VBW=600 Hz; 150 kHz-30 MHz; RBW=9 kHz, VBW=27 kHz; 30 MHz-1000 MHz; RBW=120 kHz, VBW=360 kHz, 1000 MHz-231 000 MHz; RBW=1MHz, VBW=3 MHz.</p> <p>Peak = peak Ave = RMS detector for Fundamental power, Average detector for spurious emission.</p>		

Environmental Conditions			
Temperature (°C)	14	Relative Humidity (%):	44

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
00314	Loop Antenna	EMCO	6502	3/29/2022	3/29/2024
02672	Spectrum Analyzer	Agilent	E4446A	5/9/2022	5/9/2024
P06978	Cable	Huber & Suhner Inc	Sucoflex 104A	3/4/2022	3/4/2024
00010	Preamp	HP	8447D	1/3/2022	1/3/2024
P04382	Cable	andrew	LDF-50	5/18/2022	5/18/2024
P05569	Cable	Pasternack	RG-214/U	12/31/2022	12/31/2024
01994	Antenna	Chase	CBL6111C	6/1/2022	6/1/2024
P07655	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
P07656	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
P07659	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
P07660	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
P07691	Cable	CommScope	LDF1-50	9/9/2022	9/9/2024

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P07657	Cable	Astrolab, Inc.	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
02347	Antenna	OML	M19HWA	2/14/2023	2/14/2025
02348	Antenna	OML	M12HWA	2/14/2023	2/14/2025
02349	Antenna	OML	M08HWA	2/14/2023	2/14/2025
02350	Antenna	OML	M05HWA	2/14/2023	2/14/2025
03763	Mixer	OML Inc.	M03HWD	2/14/2023	2/14/2025
03158A	Antenna	Dorado	GH-28-25	8/10/2021	8/10/2023
01413	Antenna	HP	84125-80008	10/3/2022	10/3/2024
00787	Preamp	HP	83017A	6/23/2021	6/23/2023
01646	Antenna	Emco	3115	3/21/2022	3/21/2024
03367	Antenna	Dorado	62-GH-62-25.	8/3/2021	8/3/2023

Test Data Summary

Frequency (MHz)	Polarity	Pk/Ave/QP	Measured (dBuV/m)	Limit (dBuV/m)	Results
28799.52	Horizontal	Ave	52.7	54.0	Pass
28799.52	Horizontal	Pk	54.2	74.0	Pass
150.000	Vertical	QP	41.3	43.5	Pass
304.267	Vertical	Pk	43.7	46.0	Pass

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • (714) 993-6112
 Customer: **Spartan Radar**
 Specification: **95.3379(a) Radiated Emissions**
 Work Order #: **107654** Date: 4/6/2023
 Test Type: **Maximized Emissions** Time: 14:08:53
 Tested By: S. Yamamoto Sequence#: 5
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.

TX frequency: Low 77.37GHz, Middle 78.65GHz, High 79.97GHz

Frequency Range Of Measurement: 9kHz - 1GHz.
 9kHz to 150kHz; RBW=200Hz, VBW=600Hz;
 150kHz to 30MHz; RBW=9kHz, VBW=27kHz;
 30MHz to 1000MHz; RBW=120kHz, VBW=360kHz,

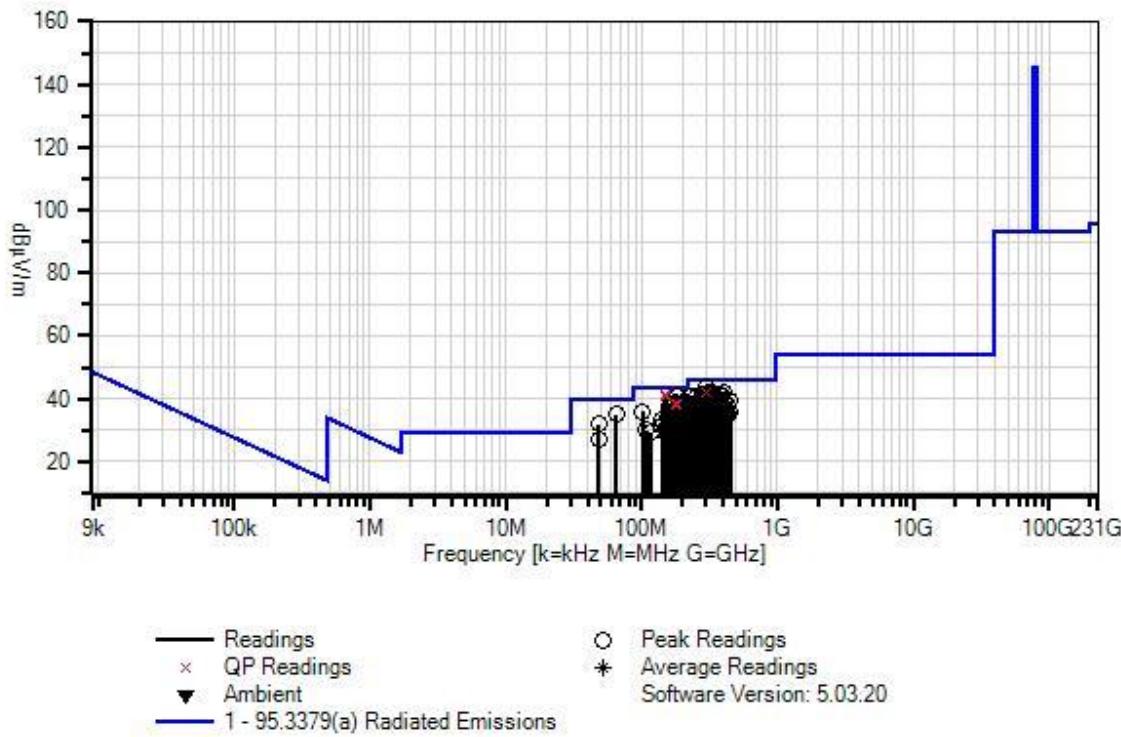
Test Environment Conditions:

Temperature: 19°C
 Humidity: 35%
 Pressure: 99kPa

Test Method: ANSI C63.26 (2015), 653005 D01 76-81 GHz Radars v01r02

Site D

Spartan Radar WO#: 107654 Sequence#: 5 Date: 4/6/2023
 95.3379(a) Radiated Emissions Test Distance: 3 Meters Parallel



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	ANP06978	Cable	Sucoflex 104A	3/4/2022	3/4/2024
T2	AN00010	Preamp	8447D	1/3/2022	1/3/2024
T3	ANP04382	Cable	LDF-50	5/18/2022	5/18/2024
T4	ANP05569	Cable-Amplitude +15C to +45C (dB)	RG-214/U	12/31/2022	12/31/2024
T5	AN01994	Biconilog Antenna	CBL6111C	6/1/2022	6/1/2024
	AN00314	Loop Antenna	6502	3/29/2022	3/29/2024

Measurement Data:			Reading listed by margin.				Test Distance: 3 Meters				
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5				Table	dB μ V/m	dB μ V/m		
			MHz	dB μ V	dB	dB	dB	Table	dB μ V/m	dB	Ant
1	150.000M	48.5	+0.2	-26.9	+1.4	+1.3	+0.0	41.3	43.5	-2.2	Vert
	QP		+16.8								
^	150.000M	55.8	+0.2	-26.9	+1.4	+1.3	+0.0	48.6	43.5	+5.1	Vert
			+16.8								
3	304.267M	46.9	+0.2	-26.5	+2.0	+1.9	+0.0	43.7	46.0	-2.3	Vert
			+19.2								
4	150.000M	48.1	+0.2	-26.9	+1.4	+1.3	+0.0	40.9	43.5	-2.6	Horiz
	QP		+16.8								
^	150.000M	55.4	+0.2	-26.9	+1.4	+1.3	+0.0	48.2	43.5	+4.7	Horiz
			+16.8								
6	182.606M	49.5	+0.2	-26.8	+1.5	+1.4	+0.0	40.4	43.5	-3.1	Horiz
			+14.6								
7	312.408M	45.2	+0.2	-26.6	+2.0	+2.0	+0.0	42.1	46.0	-3.9	Horiz
			+19.3								
8	312.457M	45.2	+0.2	-26.6	+2.0	+2.0	+0.0	42.1	46.0	-3.9	Horiz
			+19.3								
9	304.357M	45.2	+0.2	-26.5	+2.0	+1.9	+0.0	42.0	46.0	-4.0	Horiz
	QP		+19.2								
^	304.357M	46.3	+0.2	-26.5	+2.0	+1.9	+0.0	43.1	46.0	-2.9	Horiz
			+19.2								
11	328.571M	44.6	+0.2	-26.7	+2.1	+2.0	+0.0	41.8	46.0	-4.2	Vert
			+19.6								
12	401.725M	42.3	+0.3	-27.3	+2.3	+2.3	+0.0	41.8	46.0	-4.2	Horiz
			+21.9								
13	328.650M	44.4	+0.2	-26.7	+2.1	+2.0	+0.0	41.6	46.0	-4.4	Horiz
			+19.6								
14	174.452M	47.5	+0.2	-26.8	+1.5	+1.4	+0.0	39.0	43.5	-4.5	Vert
			+15.2								
15	214.979M	47.4	+0.2	-26.6	+1.7	+1.6	+0.0	38.9	43.5	-4.6	Vert
			+14.6								
16	198.753M	47.4	+0.2	-26.7	+1.6	+1.5	+0.0	38.8	43.5	-4.7	Vert
			+14.8								
17	377.421M	42.8	+0.3	-27.1	+2.2	+2.2	+0.0	41.2	46.0	-4.8	Horiz
			+20.8								
18	279.965M	45.0	+0.2	-26.5	+2.0	+1.8	+0.0	41.2	46.0	-4.8	Vert
			+18.7								
19	64.800M	47.9	+0.1	-27.1	+1.0	+0.8	+0.0	35.0	40.0	-5.0	Vert
			+12.3								
20	280.033M	44.7	+0.2	-26.5	+2.0	+1.8	+0.0	40.9	46.0	-5.1	Horiz
			+18.7								
21	231.321M	47.7	+0.2	-26.6	+1.8	+1.6	+0.0	40.8	46.0	-5.2	Horiz
			+16.1								
22	174.490M	46.7	+0.2	-26.8	+1.5	+1.4	+0.0	38.2	43.5	-5.3	Horiz
			+15.2								
23	178.473M	47.0	+0.2	-26.8	+1.5	+1.4	+0.0	38.2	43.5	-5.3	Vert
			+14.9								

24	328.630M	43.5	+0.2 +19.6	-26.7	+2.1	+2.0	+0.0	40.7	46.0	-5.3	Vert
25	182.573M	47.2	+0.2 +14.6	-26.8	+1.5	+1.4	+0.0	38.1	43.5	-5.4	Vert
^	182.573M	48.3	+0.2 +14.6	-26.8	+1.5	+1.4	+0.0	39.2	43.5	-4.3	Vert
27	385.514M	41.9	+0.3 +21.1	-27.2	+2.2	+2.2	+0.0	40.5	46.0	-5.5	Horiz
28	308.424M	43.8	+0.2 +19.2	-26.6	+2.0	+1.9	+0.0	40.5	46.0	-5.5	Horiz
29	255.635M	44.0	+0.2 +19.2	-26.5	+1.9	+1.7	+0.0	40.5	46.0	-5.5	Horiz
30	211.008M	46.4	+0.2 +14.9	-26.7	+1.7	+1.5	+0.0	38.0	43.5	-5.5	Horiz
31	186.583M	47.2	+0.2 +14.5	-26.8	+1.5	+1.4	+0.0	38.0	43.5	-5.5	Vert
32	178.548M	46.8	+0.2 +14.8	-26.8	+1.5	+1.4	+0.0	37.9	43.5	-5.6	Horiz
^	178.548M	49.9	+0.2 +14.8	-26.8	+1.5	+1.4	+0.0	41.0	43.5	-2.5	Horiz
34	312.386M	43.4	+0.2 +19.3	-26.6	+2.0	+2.0	+0.0	40.3	46.0	-5.7	Vert
35	158.258M	45.4	+0.2 +16.4	-26.9	+1.4	+1.3	+0.0	37.8	43.5	-5.7	Horiz
36	288.117M	43.8	+0.2 +18.8	-26.5	+2.0	+1.9	+0.0	40.2	46.0	-5.8	Horiz
37	215.034M	46.1	+0.2 +14.6	-26.6	+1.7	+1.6	+0.0	37.6	43.5	-5.9	Horiz
38	381.456M	41.3	+0.3 +20.9	-27.2	+2.2	+2.2	+0.0	39.7	46.0	-6.3	Horiz
39	158.254M	44.7	+0.2 +16.4	-26.9	+1.4	+1.3	+0.0	37.1	43.5	-6.4	Vert
40	405.811M	39.8	+0.3 +22.1	-27.3	+2.3	+2.3	+0.0	39.5	46.0	-6.5	Horiz
41	361.149M	41.5	+0.2 +20.5	-27.0	+2.1	+2.1	+0.0	39.4	46.0	-6.6	Horiz
42	198.834M	45.5	+0.2 +14.8	-26.7	+1.6	+1.5	+0.0	36.9	43.5	-6.6	Horiz
43	353.053M	41.4	+0.2 +20.4	-26.9	+2.1	+2.1	+0.0	39.3	46.0	-6.7	Horiz
44	450.000M	39.1	+0.3 +22.8	-27.7	+2.4	+2.4	+0.0	39.3	46.0	-6.7	Vert
45	308.314M	42.5	+0.2 +19.2	-26.6	+2.0	+1.9	+0.0	39.2	46.0	-6.8	Vert
46	353.002M	40.9	+0.2 +20.4	-26.9	+2.1	+2.1	+0.0	38.8	46.0	-7.2	Vert
47	263.785M	41.0	+0.2 +20.3	-26.5	+1.9	+1.8	+0.0	38.7	46.0	-7.3	Horiz
48	202.810M	44.7	+0.2 +14.9	-26.7	+1.6	+1.5	+0.0	36.2	43.5	-7.3	Vert
49	401.658M	39.1	+0.3 +21.9	-27.3	+2.3	+2.3	+0.0	38.6	46.0	-7.4	Vert

50	357.117M	40.6	+0.2 +20.5	-27.0	+2.1	+2.1	+0.0	38.5	46.0	-7.5	Horiz
51	190.640M	44.9	+0.2 +14.5	-26.7	+1.6	+1.5	+0.0	36.0	43.5	-7.5	Vert
52	101.391M	44.5	+0.1 +16.0	-27.0	+1.2	+1.0	+0.0	35.8	43.5	-7.7	Vert
53	344.931M	40.5	+0.2 +20.2	-26.9	+2.1	+2.1	+0.0	38.2	46.0	-7.8	Horiz
54	332.740M	40.9	+0.2 +19.8	-26.8	+2.1	+2.0	+0.0	38.2	46.0	-7.8	Horiz
55	332.671M	40.8	+0.2 +19.8	-26.8	+2.1	+2.0	+0.0	38.1	46.0	-7.9	Vert
56	158.221M	43.2	+0.2 +16.4	-26.9	+1.4	+1.3	+0.0	35.6	43.5	-7.9	Vert
57	296.257M	41.5	+0.2 +19.0	-26.5	+2.0	+1.9	+0.0	38.1	46.0	-7.9	Horiz
58	206.954M	43.9	+0.2 +15.0	-26.7	+1.6	+1.5	+0.0	35.5	43.5	-8.0	Horiz
59	194.697M	44.1	+0.2 +14.7	-26.7	+1.6	+1.5	+0.0	35.4	43.5	-8.1	Vert
60	426.078M	37.6	+0.3 +22.6	-27.5	+2.4	+2.4	+0.0	37.8	46.0	-8.2	Horiz
61	48.692M	42.1	+0.1 +15.0	-27.1	+0.9	+0.7	+0.0	31.7	40.0	-8.3	Vert
62	288.033M	41.2	+0.2 +18.8	-26.5	+2.0	+1.9	+0.0	37.6	46.0	-8.4	Vert
63	243.528M	42.6	+0.2 +17.6	-26.5	+1.9	+1.7	+0.0	37.5	46.0	-8.5	Horiz
64	239.404M	43.3	+0.2 +17.0	-26.5	+1.8	+1.7	+0.0	37.5	46.0	-8.5	Horiz
65	336.771M	39.7	+0.2 +19.9	-26.8	+2.1	+2.1	+0.0	37.2	46.0	-8.8	Vert
66	361.069M	39.2	+0.2 +20.5	-27.0	+2.1	+2.1	+0.0	37.1	46.0	-8.9	Vert
67	377.292M	38.6	+0.3 +20.8	-27.1	+2.2	+2.2	+0.0	37.0	46.0	-9.0	Vert
68	405.694M	37.2	+0.3 +22.1	-27.3	+2.3	+2.3	+0.0	36.9	46.0	-9.1	Vert
69	357.035M	39.0	+0.2 +20.5	-27.0	+2.1	+2.1	+0.0	36.9	46.0	-9.1	Vert
70	336.827M	39.3	+0.2 +19.9	-26.8	+2.1	+2.1	+0.0	36.8	46.0	-9.2	Horiz
71	385.423M	38.1	+0.3 +21.1	-27.2	+2.2	+2.2	+0.0	36.7	46.0	-9.3	Vert
72	409.852M	36.9	+0.3 +22.3	-27.4	+2.3	+2.3	+0.0	36.7	46.0	-9.3	Horiz
73	166.358M	42.2	+0.2 +15.8	-26.8	+1.4	+1.3	+0.0	34.1	43.5	-9.4	Vert
74	344.845M	38.9	+0.2 +20.2	-26.9	+2.1	+2.1	+0.0	36.6	46.0	-9.4	Vert
75	162.301M	41.8	+0.2 +16.1	-26.8	+1.4	+1.3	+0.0	34.0	43.5	-9.5	Vert

76	206.863M	42.4	+0.2 +15.0	-26.7	+1.6	+1.5	+0.0	34.0	43.5	-9.5	Vert
77	162.316M	41.7	+0.2 +16.1	-26.8	+1.4	+1.3	+0.0	33.9	43.5	-9.6	Horiz
78	235.354M	42.9	+0.2 +16.5	-26.6	+1.8	+1.6	+0.0	36.4	46.0	-9.6	Horiz
79	247.545M	40.8	+0.2 +18.1	-26.5	+1.9	+1.7	+0.0	36.2	46.0	-9.8	Horiz
80	324.538M	39.0	+0.2 +19.5	-26.7	+2.1	+2.0	+0.0	36.1	46.0	-9.9	Vert
81	190.717M	42.5	+0.2 +14.5	-26.7	+1.6	+1.5	+0.0	33.6	43.5	-9.9	Horiz
82	324.538M	39.0	+0.2 +19.5	-26.7	+2.1	+2.0	+0.0	36.1	46.0	-9.9	Vert
83	227.230M	43.4	+0.2 +15.7	-26.6	+1.8	+1.6	+0.0	36.1	46.0	-9.9	Horiz
84	154.207M	41.0	+0.2 +16.6	-26.9	+1.4	+1.3	+0.0	33.6	43.5	-9.9	Horiz
85	202.894M	42.1	+0.2 +14.9	-26.7	+1.6	+1.5	+0.0	33.6	43.5	-9.9	Horiz
86	292.191M	39.6	+0.2 +18.9	-26.5	+2.0	+1.9	+0.0	36.1	46.0	-9.9	Horiz
87	365.218M	37.8	+0.2 +20.6	-27.0	+2.2	+2.2	+0.0	36.0	46.0	-10.0	Horiz
88	300.341M	39.3	+0.2 +19.1	-26.5	+2.0	+1.9	+0.0	36.0	46.0	-10.0	Horiz
89	142.037M	40.4	+0.2 +17.2	-26.9	+1.3	+1.2	+0.0	33.4	43.5	-10.1	Horiz
90	320.608M	39.0	+0.2 +19.4	-26.7	+2.0	+2.0	+0.0	35.9	46.0	-10.1	Horiz
91	255.594M	39.4	+0.2 +19.2	-26.5	+1.9	+1.7	+0.0	35.9	46.0	-10.1	Vert
92	296.196M	39.3	+0.2 +19.0	-26.5	+2.0	+1.9	+0.0	35.9	46.0	-10.1	Vert
93	389.590M	36.8	+0.3 +21.3	-27.2	+2.3	+2.3	+0.0	35.8	46.0	-10.2	Horiz
94	450.453M	35.6	+0.3 +22.8	-27.7	+2.4	+2.4	+0.0	35.8	46.0	-10.2	Horiz
95	324.630M	38.7	+0.2 +19.5	-26.7	+2.1	+2.0	+0.0	35.8	46.0	-10.2	Horiz
96	284.100M	39.5	+0.2 +18.7	-26.5	+2.0	+1.8	+0.0	35.7	46.0	-10.3	Horiz
97	316.534M	38.6	+0.2 +19.4	-26.6	+2.0	+2.0	+0.0	35.6	46.0	-10.4	Horiz
98	369.264M	37.4	+0.2 +20.7	-27.1	+2.2	+2.2	+0.0	35.6	46.0	-10.4	Horiz
99	251.595M	39.5	+0.2 +18.7	-26.5	+1.9	+1.7	+0.0	35.5	46.0	-10.5	Horiz
100	259.735M	38.4	+0.2 +19.8	-26.5	+1.9	+1.7	+0.0	35.5	46.0	-10.5	Horiz
101	348.964M	37.6	+0.2 +20.3	-26.9	+2.1	+2.1	+0.0	35.4	46.0	-10.6	Horiz

102	381.359M	37.0	+0.3 +20.9	-27.2	+2.2	+2.2	+0.0	35.4	46.0	-10.6	Vert
103	271.820M	39.1	+0.2 +18.9	-26.5	+1.9	+1.8	+0.0	35.4	46.0	-10.6	Vert
104	170.416M	41.1	+0.2 +15.5	-26.8	+1.5	+1.4	+0.0	32.9	43.5	-10.6	Vert
105	430.152M	35.2	+0.3 +22.5	-27.5	+2.4	+2.4	+0.0	35.3	46.0	-10.7	Horiz
106	271.959M	38.9	+0.2 +18.9	-26.5	+1.9	+1.8	+0.0	35.2	46.0	-10.8	Horiz
107	434.267M	35.2	+0.3 +22.5	-27.6	+2.4	+2.4	+0.0	35.2	46.0	-10.8	Horiz
108	373.381M	37.0	+0.2 +20.7	-27.1	+2.2	+2.2	+0.0	35.2	46.0	-10.8	Horiz
109	320.505M	38.2	+0.2 +19.4	-26.7	+2.0	+2.0	+0.0	35.1	46.0	-10.9	Vert
110	397.695M	35.8	+0.3 +21.7	-27.3	+2.3	+2.3	+0.0	35.1	46.0	-10.9	Horiz
111	418.009M	34.5	+0.3 +22.7	-27.4	+2.3	+2.3	+0.0	34.7	46.0	-11.3	Horiz
112	422.025M	34.5	+0.3 +22.7	-27.5	+2.3	+2.3	+0.0	34.6	46.0	-11.4	Horiz
113	369.193M	36.3	+0.2 +20.7	-27.1	+2.2	+2.2	+0.0	34.5	46.0	-11.5	Vert
114	219.230M	42.6	+0.2 +15.0	-26.6	+1.7	+1.6	+0.0	34.5	46.0	-11.5	Horiz
115	292.066M	37.8	+0.2 +18.9	-26.5	+2.0	+1.9	+0.0	34.3	46.0	-11.7	Vert
116	267.876M	37.2	+0.2 +19.7	-26.5	+1.9	+1.8	+0.0	34.3	46.0	-11.7	Horiz
117	373.293M	35.9	+0.2 +20.7	-27.1	+2.2	+2.2	+0.0	34.1	46.0	-11.9	Vert
118	365.143M	35.8	+0.2 +20.6	-27.0	+2.2	+2.2	+0.0	34.0	46.0	-12.0	Vert
119	300.023M	37.2	+0.2 +19.1	-26.5	+2.0	+1.9	+0.0	33.9	46.0	-12.1	Vert
120	413.955M	33.5	+0.3 +22.6	-27.4	+2.3	+2.3	+0.0	33.6	46.0	-12.4	Horiz
121	142.008M	38.1	+0.2 +17.2	-26.9	+1.3	+1.2	+0.0	31.1	43.5	-12.4	Vert
122	275.959M	37.3	+0.2 +18.7	-26.5	+2.0	+1.8	+0.0	33.5	46.0	-12.5	Horiz
123	231.191M	40.3	+0.2 +16.1	-26.6	+1.8	+1.6	+0.0	33.4	46.0	-12.6	Vert
124	275.842M	37.1	+0.2 +18.7	-26.5	+2.0	+1.8	+0.0	33.3	46.0	-12.7	Vert
125	186.681M	39.8	+0.2 +14.5	-26.8	+1.5	+1.4	+0.0	30.6	43.5	-12.9	Horiz
126	284.016M	36.9	+0.2 +18.7	-26.5	+2.0	+1.8	+0.0	33.1	46.0	-12.9	Vert
127	219.026M	41.1	+0.2 +15.0	-26.6	+1.7	+1.6	+0.0	33.0	46.0	-13.0	Vert

128	48.698M	37.4	+0.1 +14.9	-27.1	+0.9	+0.7	+0.0	26.9	40.0	-13.1	Horiz
129	223.104M	40.6	+0.2 +15.4	-26.6	+1.7	+1.6	+0.0	32.9	46.0	-13.1	Vert
130	150.139M	37.4	+0.2 +16.8	-26.9	+1.4	+1.3	+0.0	30.2	43.5	-13.3	Vert
131	109.502M	38.0	+0.1 +16.7	-27.0	+1.2	+1.0	+0.0	30.0	43.5	-13.5	Vert
132	117.616M	36.8	+0.1 +17.2	-27.0	+1.2	+1.1	+0.0	29.4	43.5	-14.1	Vert
133	259.651M	34.4	+0.2 +19.8	-26.5	+1.9	+1.7	+0.0	31.5	46.0	-14.5	Vert
134	251.527M	35.4	+0.2 +18.7	-26.5	+1.9	+1.7	+0.0	31.4	46.0	-14.6	Vert
135	154.196M	35.9	+0.2 +16.6	-26.9	+1.4	+1.3	+0.0	28.5	43.5	-15.0	Vert
136	239.291M	36.3	+0.2 +17.0	-26.5	+1.8	+1.7	+0.0	30.5	46.0	-15.5	Vert
137	247.477M	35.1	+0.2 +18.1	-26.5	+1.9	+1.7	+0.0	30.5	46.0	-15.5	Vert
138	194.791M	36.6	+0.2 +14.7	-26.7	+1.6	+1.5	+0.0	27.9	43.5	-15.6	Horiz
139	223.213M	37.1	+0.2 +15.4	-26.6	+1.7	+1.6	+0.0	29.4	46.0	-16.6	Horiz
140	227.164M	34.9	+0.2 +15.7	-26.6	+1.8	+1.6	+0.0	27.6	46.0	-18.4	Vert

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • (714) 993-6112
 Customer: **Spartan Radar**
 Specification: **95.3379(a) Radiated Emissions**
 Work Order #: **107654** Date: 4/5/2023
 Test Type: **Maximized Emissions** Time: 10:59:47
 Tested By: S. Yamamoto Sequence#: 4
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.

TX Frequency: Low 77.37GHz, Middle 78.65GHz, High 79.97GHz

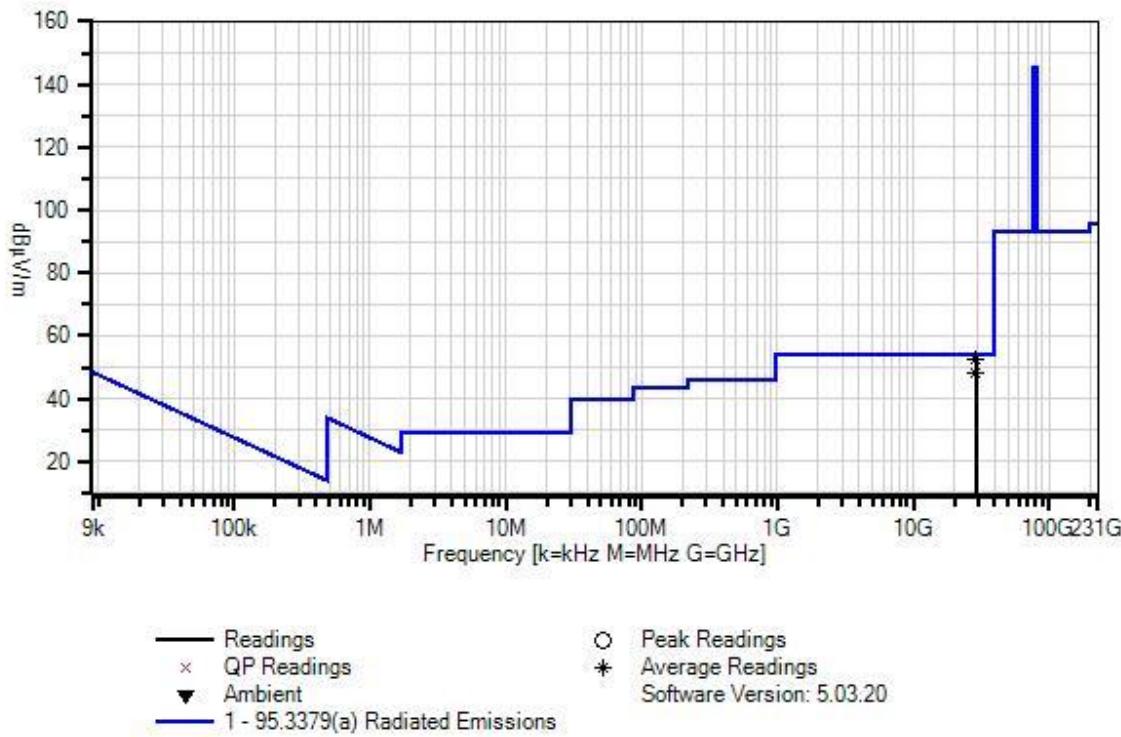
Frequency Range Of Measurement: 1GHz - 243GHz.
1GHz to 243GHz; RBW=1MHz, VBW=3 MHz.

Test Environment Conditions:

Pressure: 19°C
Humidity: 35%
Pressure: 99kPa

Test Method: ANSI C63.26 (2015) 653005 D01 76-81 GHz Radars v01r02

Site D

Spartan Radar WO#: 107654 Sequence#: 4 Date: 4/5/2023
 95.3379(a) Radiated Emissions Test Distance: 3 Meters Vert

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
	ANP07655-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	ANP07656-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	ANP07659-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	ANP07660-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	AN02347	Horn Antenna	M19HWA	2/14/2023	2/14/2025
	AN02348	Horn Antenna	M12HWA	2/14/2023	2/14/2025
	AN02349	Horn Antenna	M08HWA	2/14/2023	2/14/2025
	AN02350	Horn Antenna	M05HWA	2/14/2023	2/14/2025
	AN03763	Horn Antenna	M19HWA	2/14/2023	2/14/2025
T1	ANP07660	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024

T2	ANP07655	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T3	ANP07656	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	ANP07659	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T5	AN03158A	Horn Antenna	GH-28-25	8/10/2021	8/10/2023
	AN01413	Horn Antenna	84125-80008	10/3/2022	10/3/2024
	ANP04382	Cable	LDF-50	5/18/2022	5/18/2024
	ANP07691	Cable	LDF1-50	9/9/2022	9/9/2024
	AN00787	Preamp	83017A	6/23/2021	6/23/2023
	ANP07657	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
	AN01646	Horn Antenna	3115	3/21/2022	3/21/2024
	AN03367	Horn Antenna	62-GH-62-25.	8/3/2021	8/3/2023

Measurement Data:			Reading listed by margin.				Test Distance: 3 Meters				
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	T5				Table	dB μ V/m	dB μ V/m		
1	28799.520	41.7	+1.8	+1.8	+1.8	+1.7	+0.0	52.7	54.0	-1.3	Horiz
	M		+3.9								
	Ave										
^	28799.520	43.2	+1.8	+1.8	+1.8	+1.7	+0.0	54.2	54.0	+0.2	Horiz
	M		+3.9								
3	28799.509	37.4	+1.8	+1.8	+1.8	+1.7	+0.0	48.4	54.0	-5.6	Vert
	M		+3.9								
	Ave										
^	28799.508	39.1	+1.8	+1.8	+1.8	+1.7	+0.0	50.1	54.0	-3.9	Vert
	M		+3.9								

Band Edge

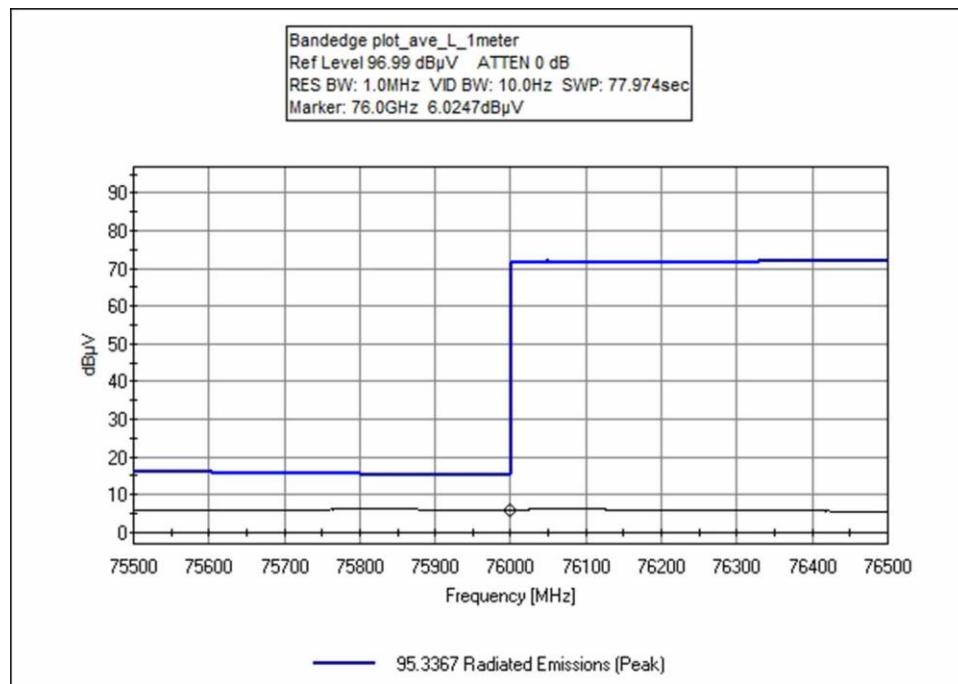
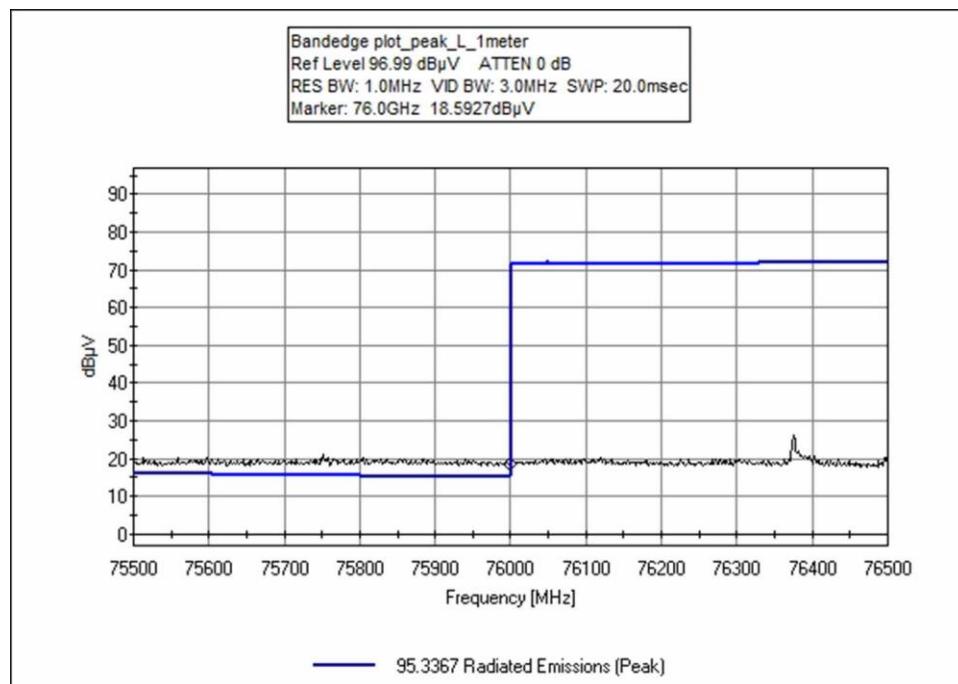
Band Edge Summary

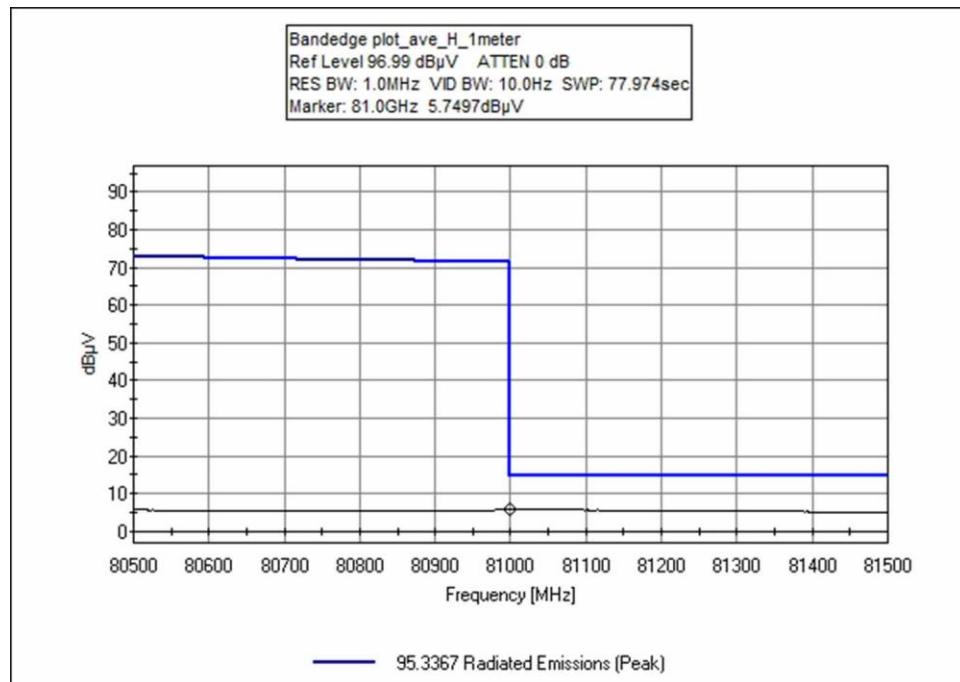
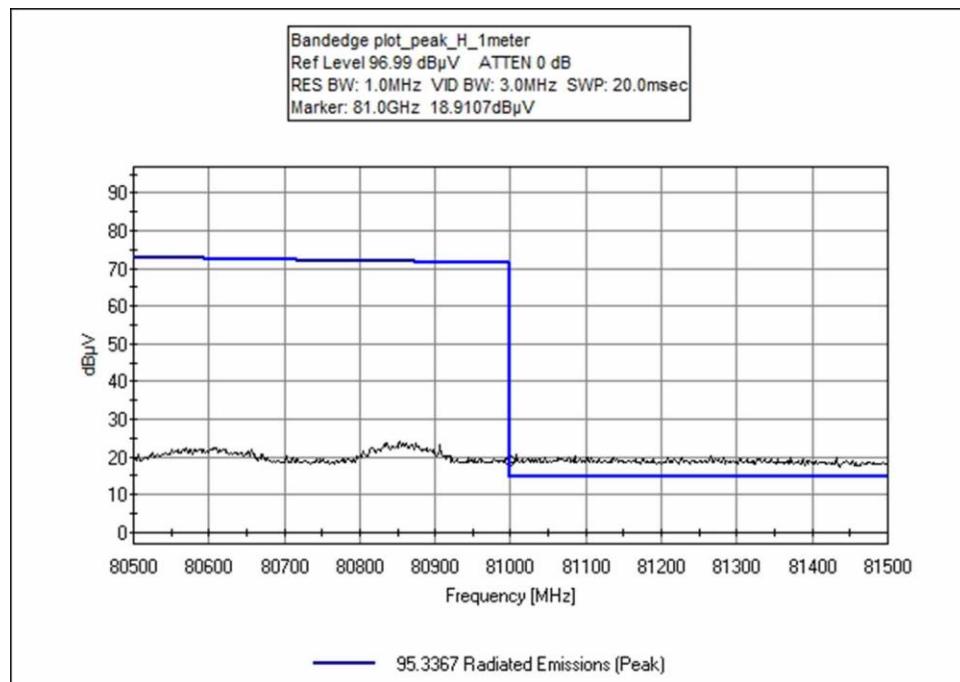
Operating Mode: Low, High

Frequency (GHz)	Modulation	Ant. Type	Field Strength (dBuV/m @3m)	Limit * (dBuV/m @3m)	Results
76.0	Linear FMCW	Integral	97.0 pk	113.5	Pass
76.0	Linear FMCW	Integral	84.4 ave	93.5	Pass
81.0	Linear FMCW	Integral	97.8 pk	113.5	Pass
81.0	Linear FMCW	Integral	84.6 ave	93.5	Pass

* See appendix B for limit conversion

Band Edge Plots





Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • (714) 993-6112
 Customer: **Spartan Radar**
 Specification: **95.3367 Radiated Emissions (Peak)**
 Work Order #: **107654** Date: 4/3/2023
 Test Type: **Maximized Emissions** Time: 11:59:11
 Tested By: E. Wong Sequence#: 3
 Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is placed on the Styrofoam tabletop on the test site. The EUT is connected to a support DC power supply set at 1.1 % of the target battery bank of the EUT and monitor. The EUT is powered on and running in its normal operational mode.

TX Frequency: 77.37GHz, 79.97GHz

Frequency Range of Measurement: band edge 76GHz, 81GHz

1000 MHz-231 000 MHz; RBW=1MHz, VBW=3 MHz.

Test Environment Conditions:

Temperature: 18°C

Relative Humidity: 45%

Pressure: 100kPa

Test Method: ANSI C63.26 (2015), 653005 D01 76-81 GHz Radars v01r02

Site D

Peak = Peak

Ave = Average detector for spurious emission.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02672	Spectrum Analyzer	E4446A	5/9/2022	5/9/2024
T1	ANP07655-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T2	ANP07656-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T3	ANP07659-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T4	ANP07660-B	Cable	32022-29094K-29094K-24TC	6/22/2022	6/22/2024
T5	AN02348	Horn Antenna	M12HWA	2/14/2023	2/14/2025

Measurement Data:

Reading listed by margin.

Test Distance: 1 Meter

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dB μ V	T5				Table	dB μ V/m	dB μ V/m		
1	81000.000	5.7	+0.7	+0.8	+0.7	+0.7	-9.5	84.6	93.5	-8.9	Vert
	M		+85.5								
	Ave										H_bandedge
^	81000.000	18.9	+0.7	+0.8	+0.7	+0.7	-9.5	97.8	93.5	+4.3	Vert
	M		+85.5								
	Ave										H_bandedge
3	76000.000	6.0	+0.6	+0.7	+0.7	+0.8	-9.5	84.4	93.5	-9.1	Vert
	M		+85.1								
	Ave										L_bandedge
^	76000.000	18.6	+0.6	+0.7	+0.7	+0.8	-9.5	97.0	93.5	+3.5	Vert
	M		+85.1								
	Ave										L_bandedge

Test Setup Photo(s)



Test Setup; View 1



Test Setup; View 2



Front View



Back View

APPENDIX B: DATA CONVERSION

Calculation of dBuV/m from pW/cm² or uW/cm²

Useful for units conversions such as FCC Part 95M or FCC Part 30 mmWave measurements

From Frii's equation for free space path loss:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G - 104.77$$

Where G=0 dBi since this is included in the definition of P (EIRP); in other words: we want to find the EIRP, not the conducted power. Solve for E:

$$E(dBuV/m) = P(dBm) - 20LOG(d) + 104.77$$

Now, convert pW/cm² or uW/cm² into power units, which in linear terms is (d is in meters):

$$mW = \frac{pW}{cm^2} * 4\pi d^2 * 10^{-9} (mw/pW) * 10^4 (cm^2/m^2)$$

And

$$mW = \frac{uW}{cm^2} * 4\pi d^2 * 10^{-3} (mw/uW) * 10^4 (cm^2/m^2)$$

Substituting for pW:

$$E(dBuV/m) = 10LOGP(pW/cm^2) + 10LOG(4\pi d^2) - 50 - 20LOG(d) + 104.77$$

Note that the distance terms cancel; 20Logd -20Logd=0

$$E(dBuV/m) = 10LOGP(pW/cm^2) + 65.76$$

And consequently:

$$E(dBuV/m) = 10LOGP(uW/cm^2) + 125.76$$

Therefore:

Specification Limit	Equivalent E-Field Measurand
60 uW/cm ² @ 3m	143.5 dBuV/m @ 3m
600 pW/cm ² @ 3m	93.5 dBuV/m @ 3m
1000 pW/cm ² @ 3m	95.8 dBuV/m @ 3m

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dB μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS	
Meter reading	(dB μ V)
+	Antenna Factor (dB/m)
+	Cable Loss (dB)
-	Distance Correction (dB)
-	Preamplifier Gain (dB)
=	Corrected Reading (dB μ V/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.