

# 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**



**Test Certificate # 803.01**

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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.

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## 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:<br>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:<br>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 |

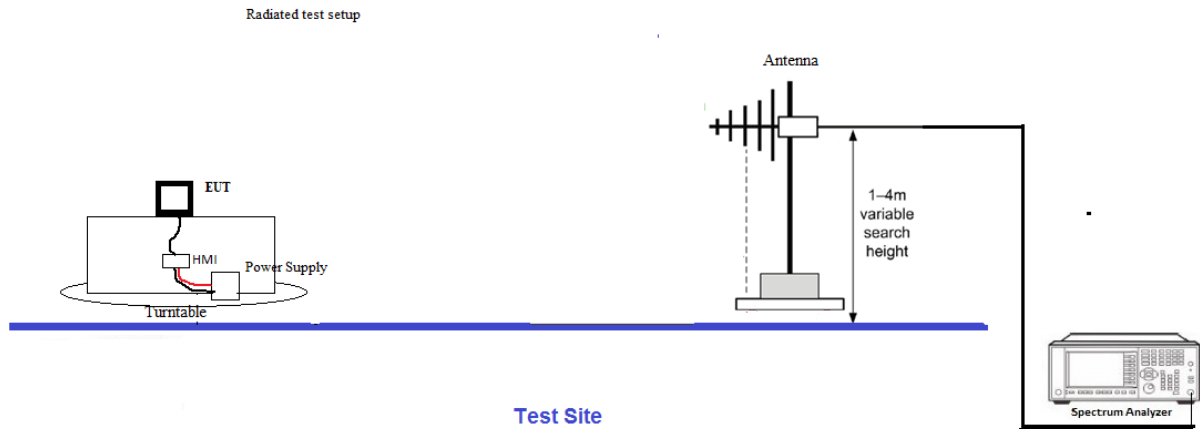
#### Support Equipment:

| 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. |   |

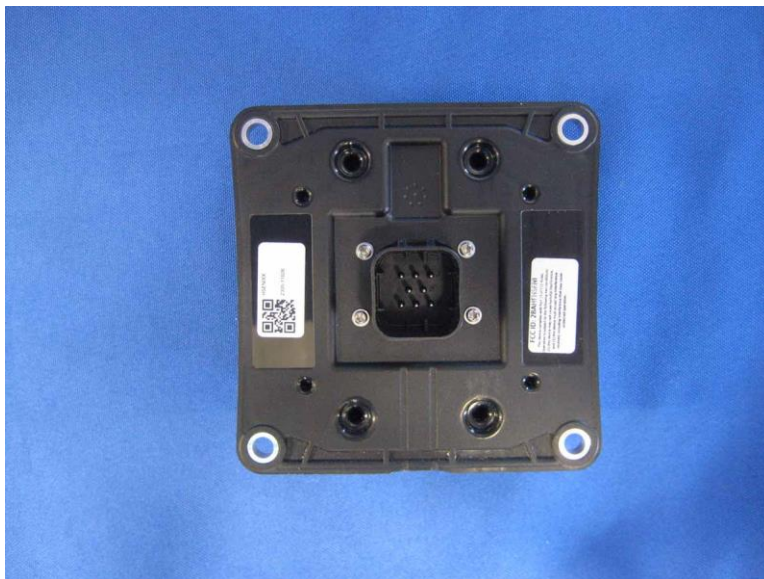
## Block Diagram(s) of Test Setup



EUT and Accessory Photo(s)

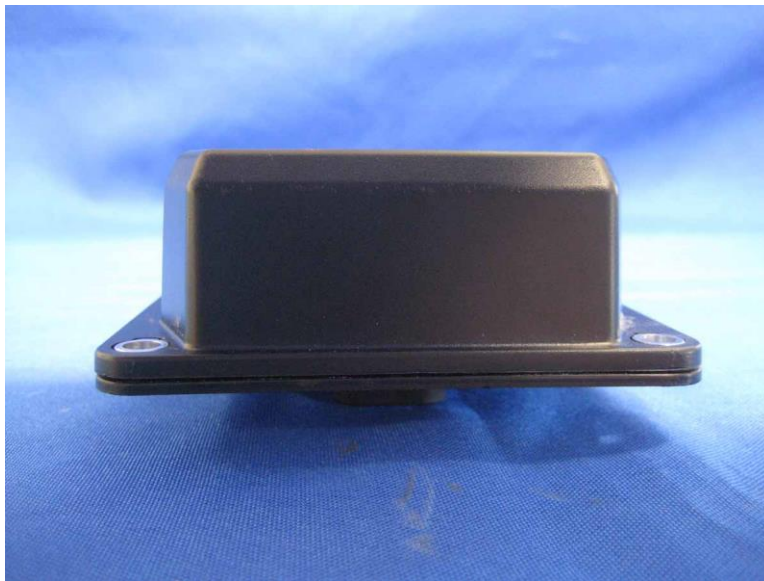


Front View



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)<br>KDB 653005 D01 76-81 GHz<br>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.<br><br>TX Frequency: 77.37 GHz, 78.65GHz, 79.97GHz |                |           |
| Declaration:          | NA  |                |           |

| Environmental Conditions |    |                        |    |
|--------------------------|----|------------------------|----|
| Temperature (°C)         | 18 | Relative Humidity (%): | 45 |

| 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 |

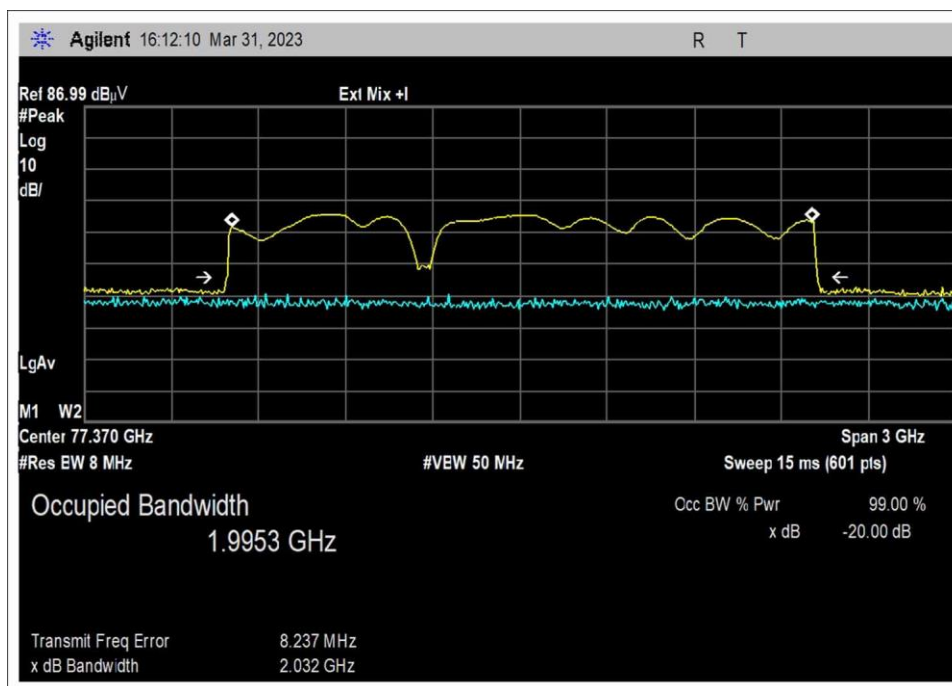
**20dB Occupied Bandwidth**

| 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      |

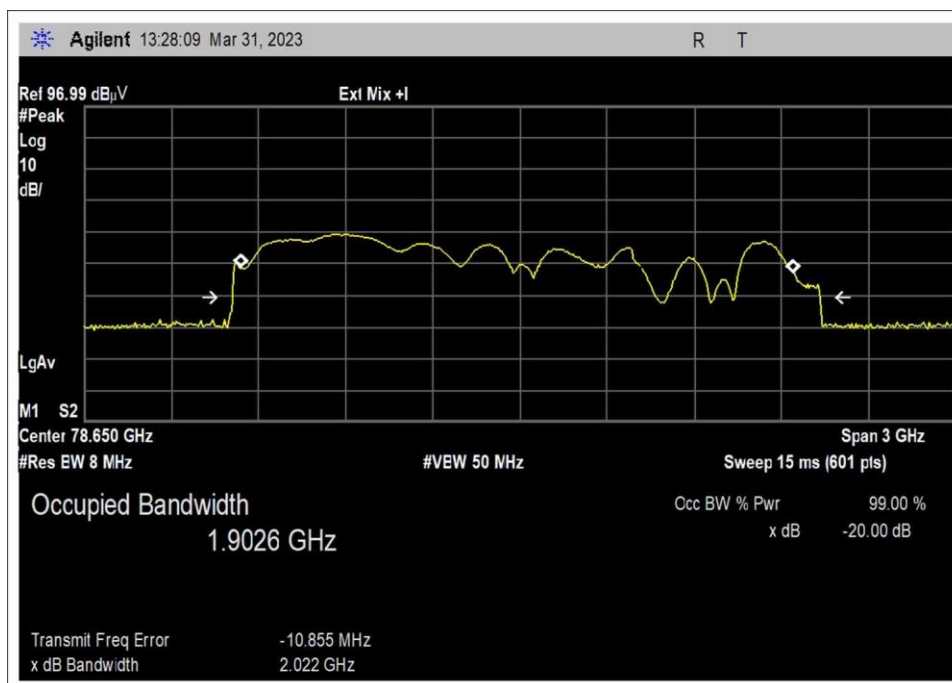
**99% Occupied Bandwidth**

| 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)

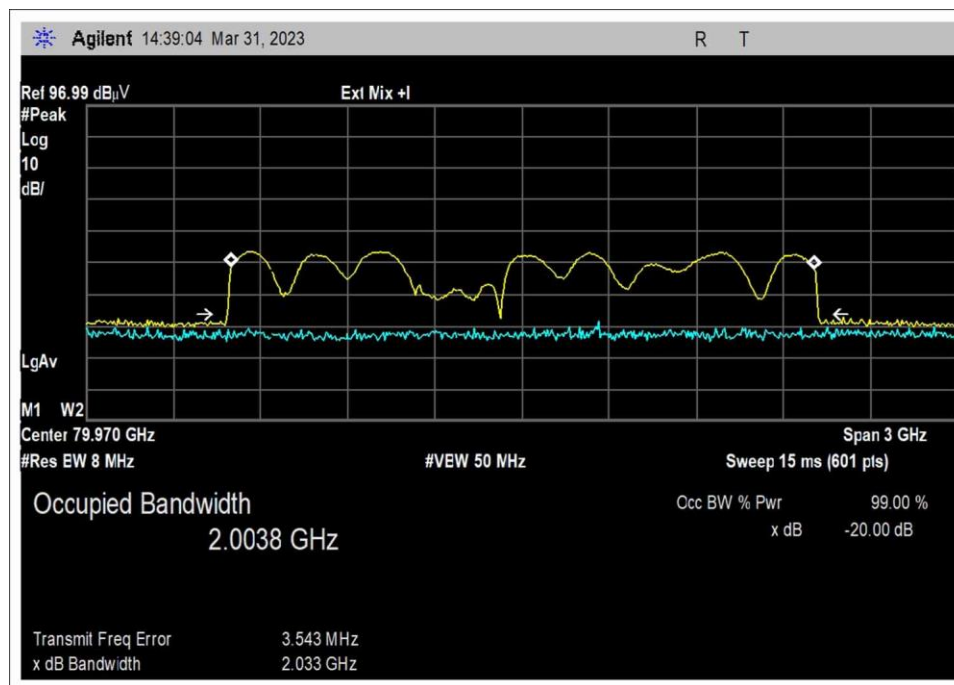


Low Channel



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)<br>KDB 653005 D01 76-81 GHz<br>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<br/>Ave = RMS detector for Fundamental power<br/>Peak EIRP, measured at 1 meter test distance due to low signal strength<br/>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:  $EIRP = E(dBuV/m) + 20\log(d) - G - 104.77$ , 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 PCDF for the PSA series instrument used would be

$K = 1.479$

$\alpha_p \text{ dB} = 20 \log(T_{eff} k_{rbw})$

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

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

$Rbw = 1000 \text{ kHz}$

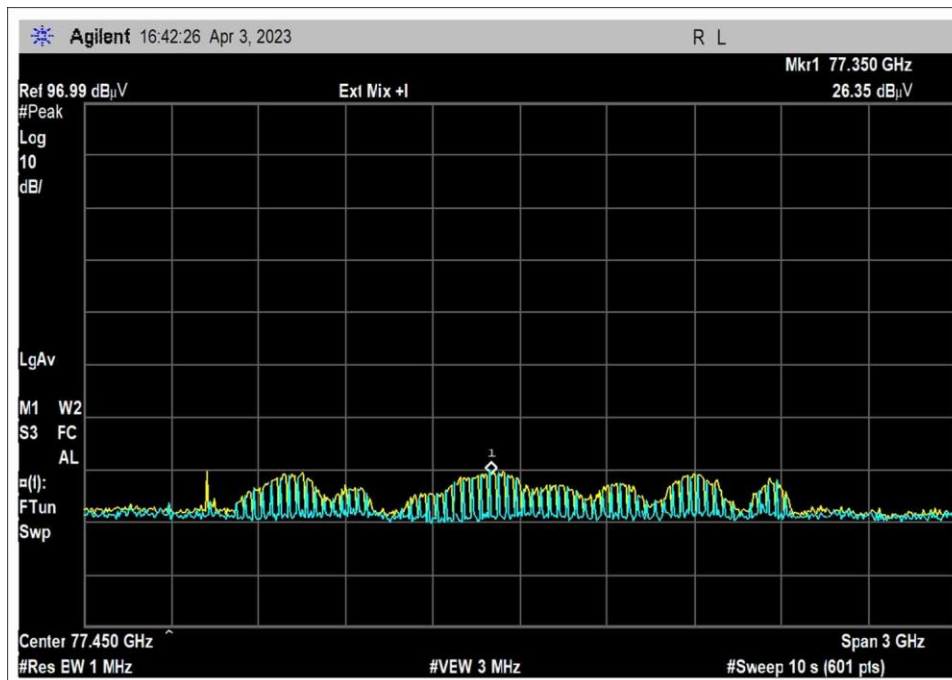
$T_{eff} = 1/32.32 \text{ kHz} = 0.0309 \text{ ms}$

$PDCF \quad \alpha_p \text{ dB} = 20 \log(0.0309 \times 1.476 \times 1000) = 33.2 \text{ dB}$

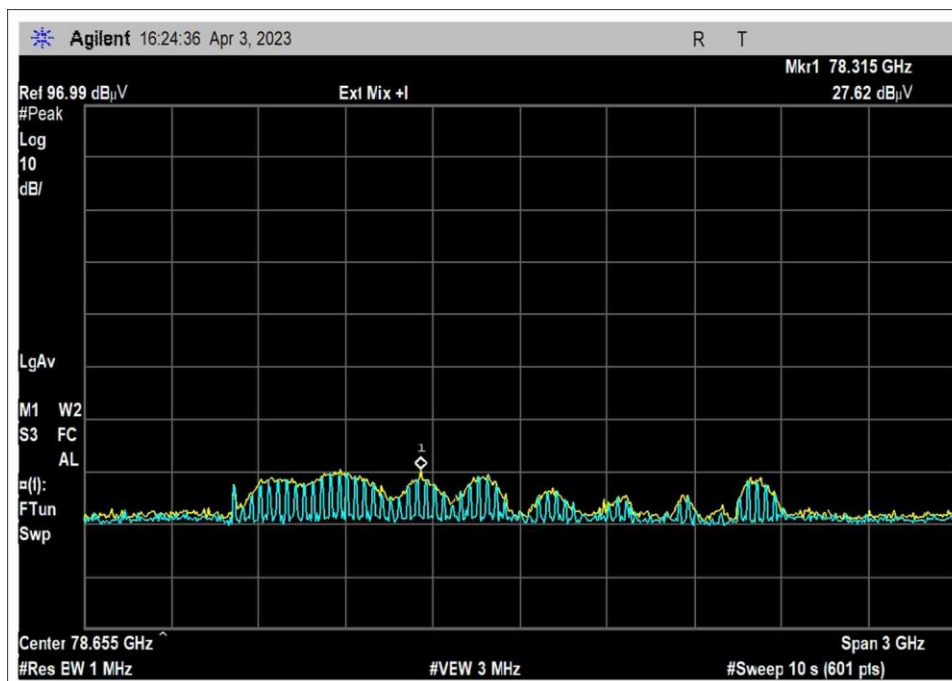
| Frequency (GHz)                        | Modulation  | Ant. Type / Gain (dBi)           | For reference only<br>*Measured EIRP with PDCF of 33.2dB applied. (dBm) | Limit (dBm) | Results |
|--|-------------|----------------------------------|---|-------------|---------|
| <b>Peak with worse case correction</b> |             |                                  |   |             |         |
| 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)

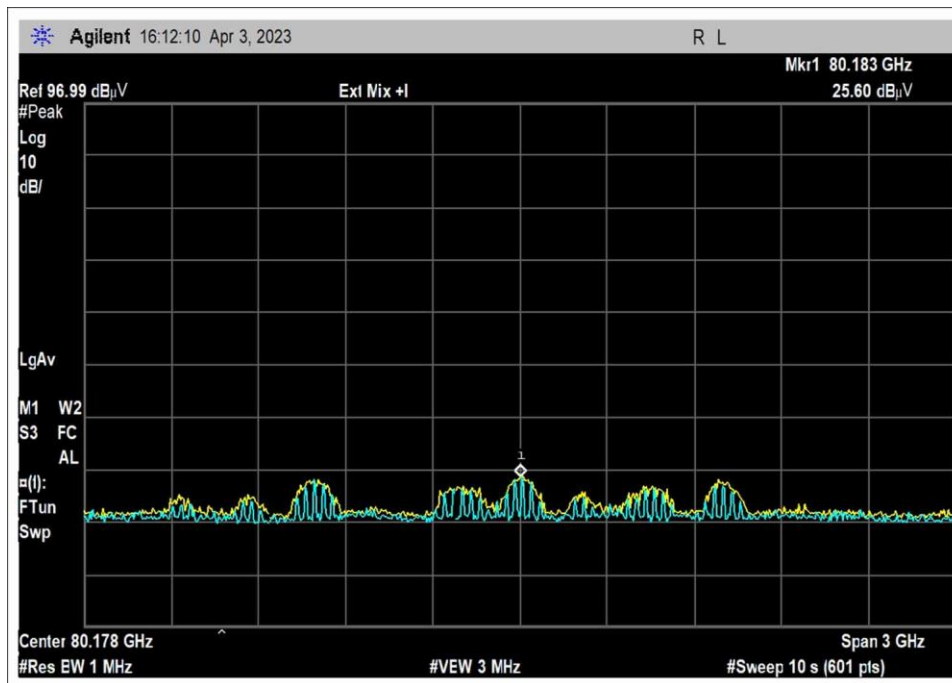
### Peak



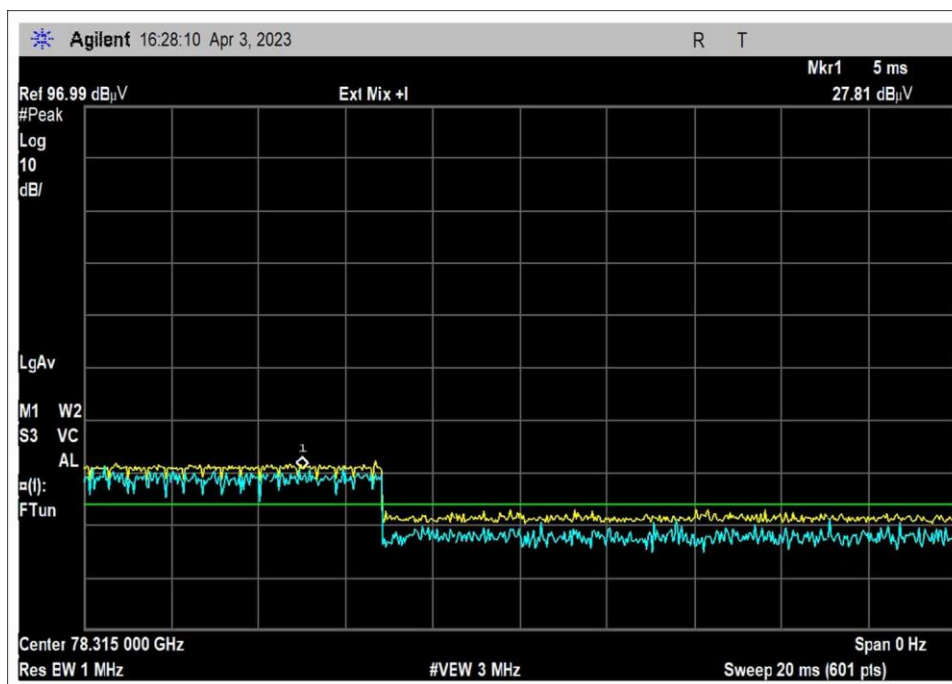
Low Channel



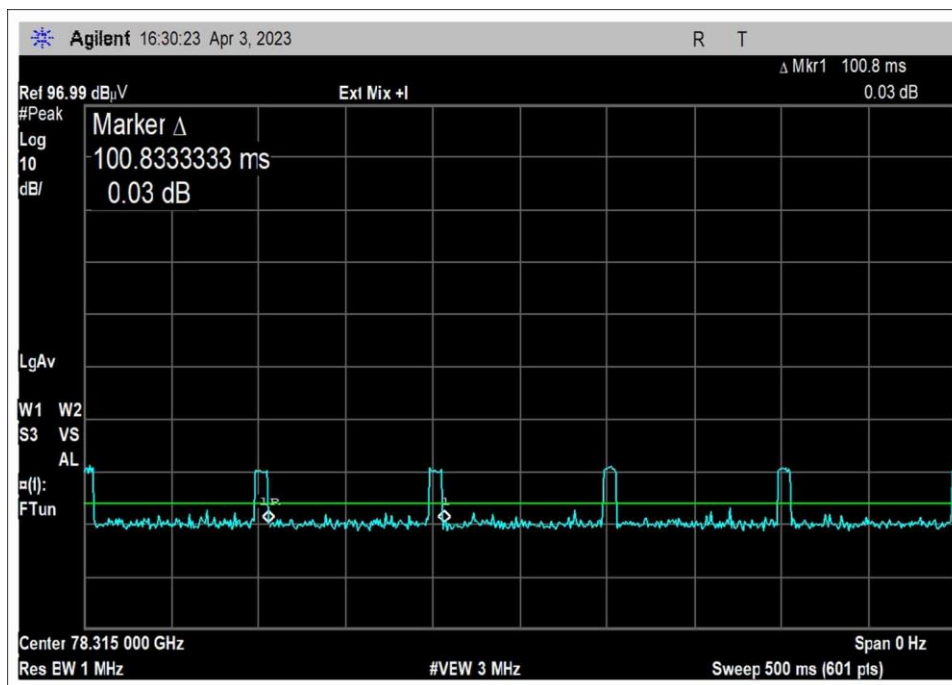
Middle Channel



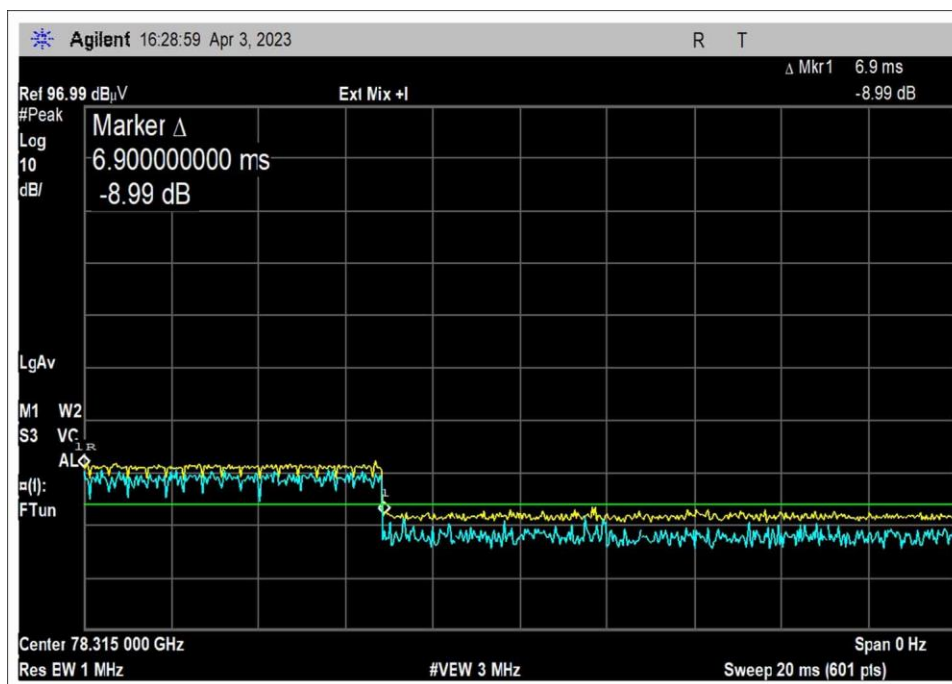
High Channel



Amplitude

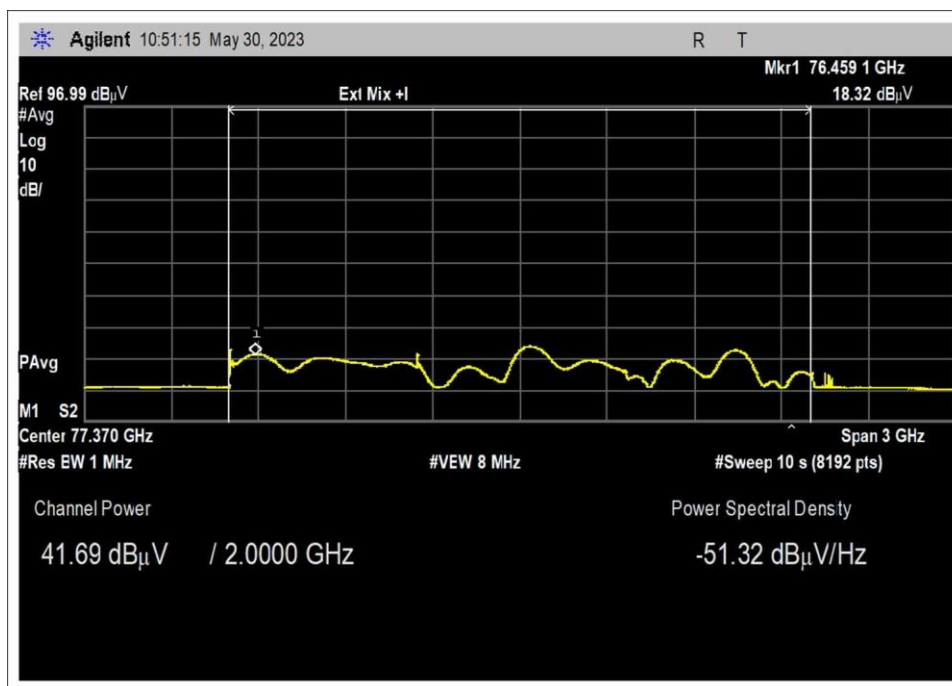


Bust Period

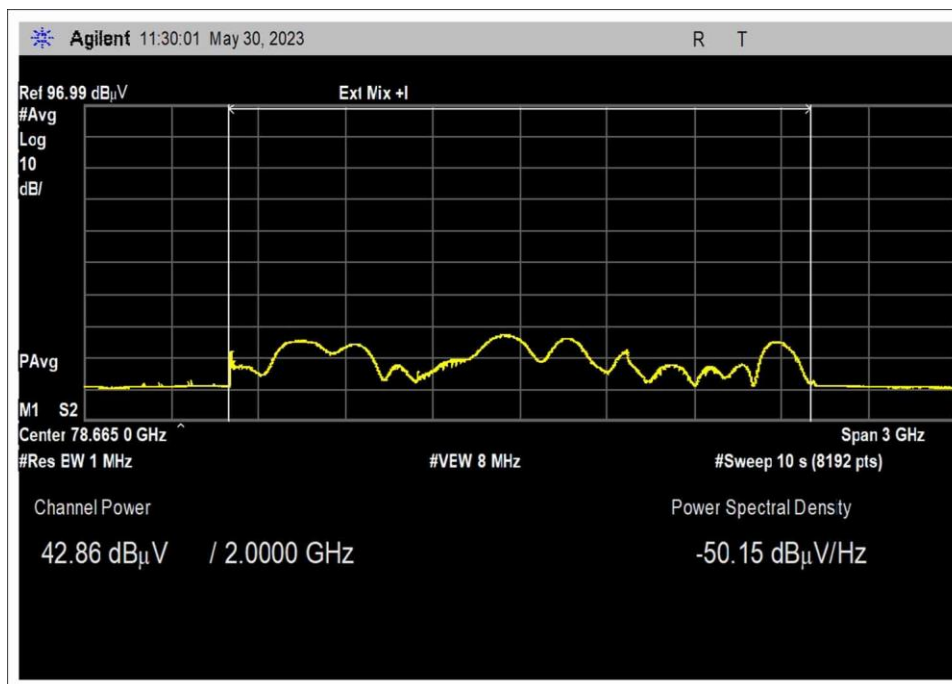


Bust Time

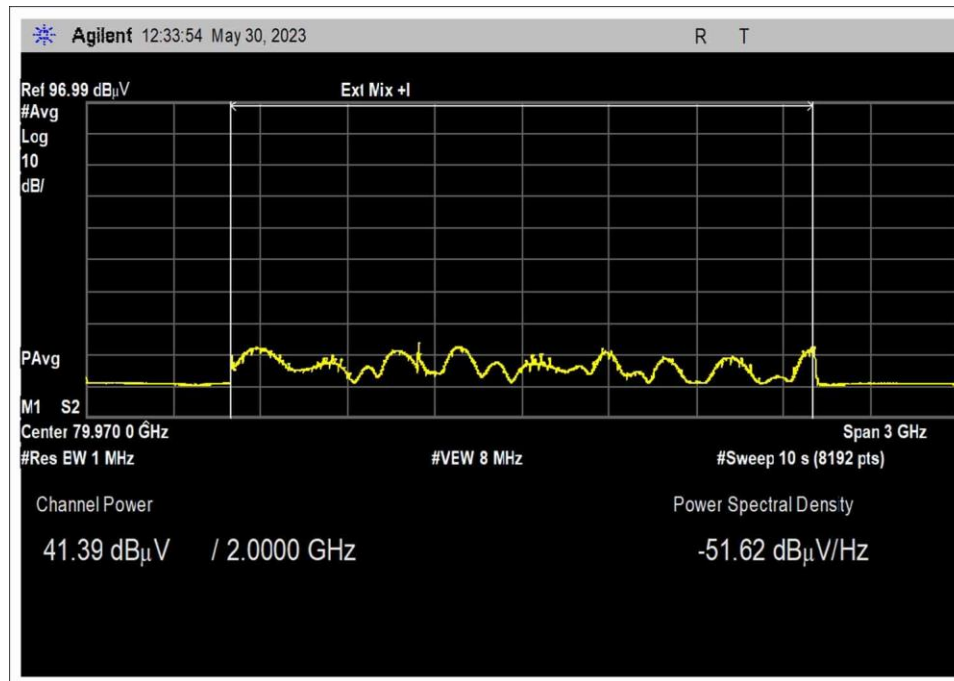
### RMS



### 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.

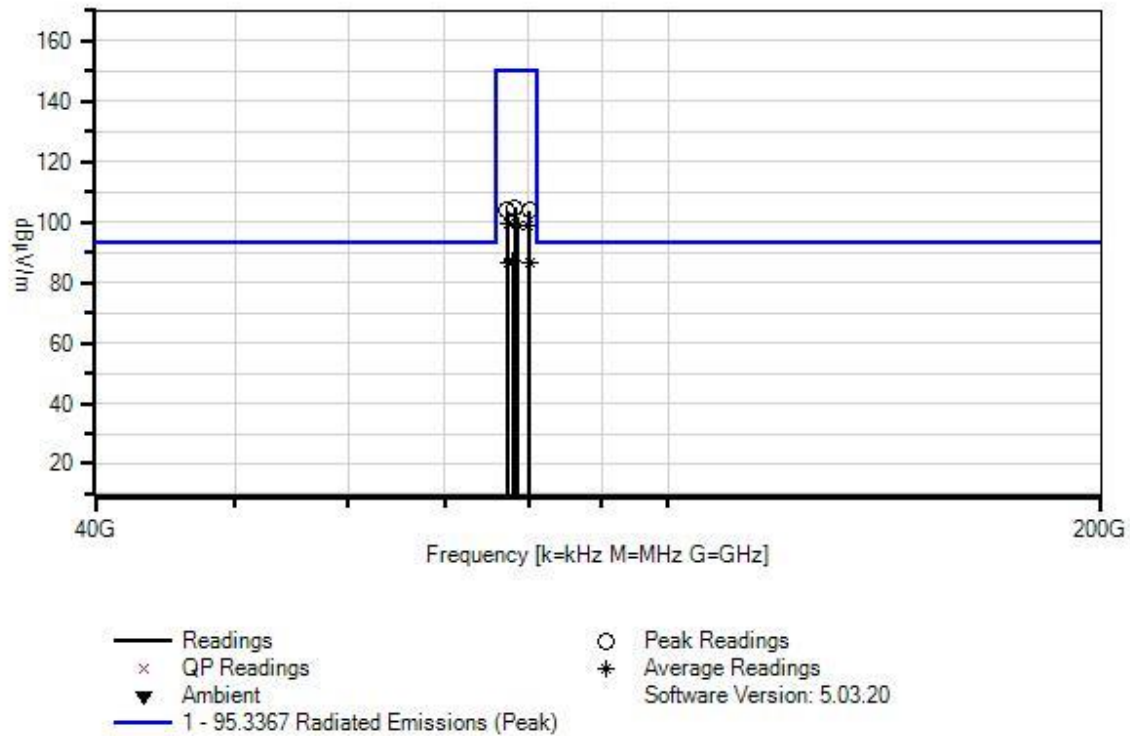
Test Environment Conditions:  
 Temperature: 18°C  
 Relative Humidity: 45%  
 Pressure: 100kPa

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

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)<br>KDB 653005 D01 76-81 GHz<br>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 <sub>nominal</sub> 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 <sub>Minimum</sub>                           | 84.4  | 84.6   | 93.5                          |         |
| 20  |  | 84.4  | 84.6   | 93.5                          |         |
| 20  | V <sub>Maximum</sub>                           | 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 <sub>nominal</sub> 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 <sub>Minimum</sub>                           | 76.4      | 80.95      | 76 – 81                    |         |
| 20                |  | 76.4      | 80.95      | 76 – 81                    |         |
| 20                | V <sub>Maximum</sub>                           | 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

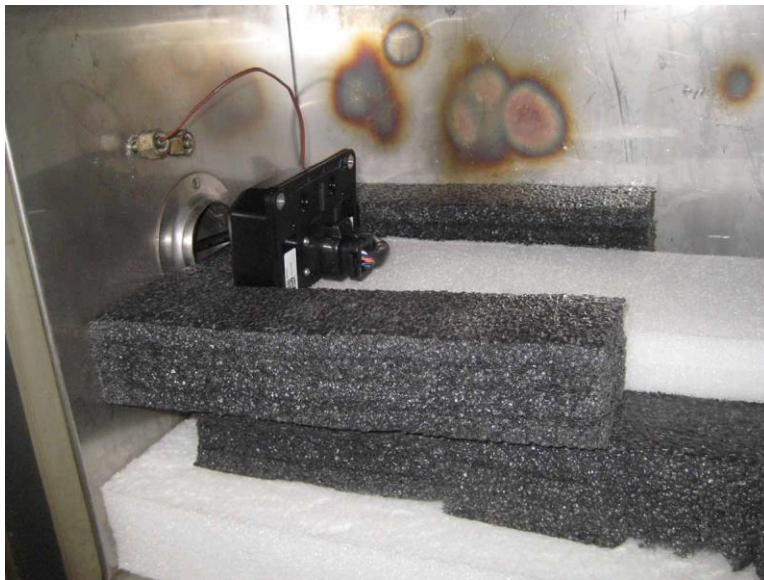
No change in emission amplitude was observed.

### **Parameter Definitions:**

Measurements performed at input voltage V<sub>nominal</sub> ± 15%.

| Parameter              | Value   |
|------------------------|---------|
| V <sub>Nominal</sub> : | 12.0VDC |
| V <sub>Minimum</sub> : | 10.2VDC |
| V <sub>Maximum</sub> : | 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)<br>KDB 653005 D01 76-81 GHz<br>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.<br/>           9 kH -150 kHz; RBW=200 Hz, VBW=600 Hz;<br/>           150 kHz-30 MHz; RBW=9 kHz, VBW=27 kHz;<br/>           30 MHz-1000 MHz; RBW=120 kHz, VBW=360 kHz,<br/>           1000 MHz-231 000 MHz; RBW=1MHz, VBW=3 MHz.</p> <p>Peak = peak<br/>           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          | Preamplifier      | 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

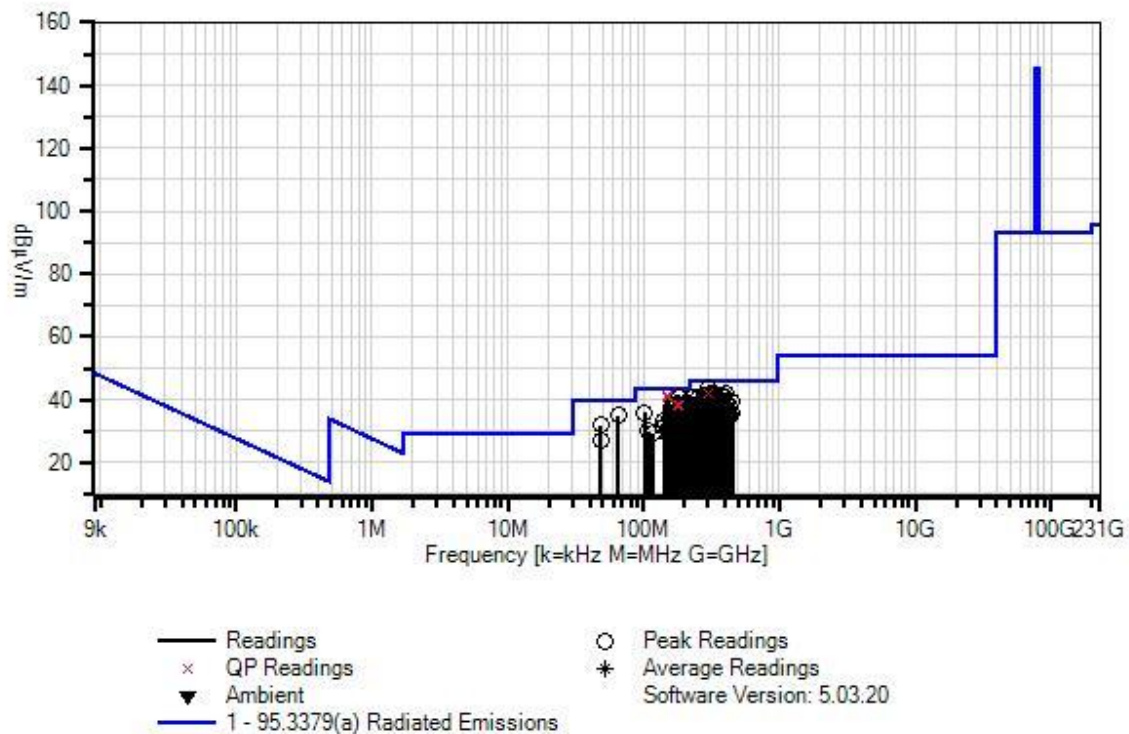
Frequency Range Of Measurement: 9kHz - 1GHz.  
 9kHz to 150kHz; RBW=200Hz, VBW=600Hz;  
 150kHz to 30MHz; RBW=9kHz, VBW=27kHz;  
 30MHz to 1000MHz; RBW=120kHz, VBW=360kHz,

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

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

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

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

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



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

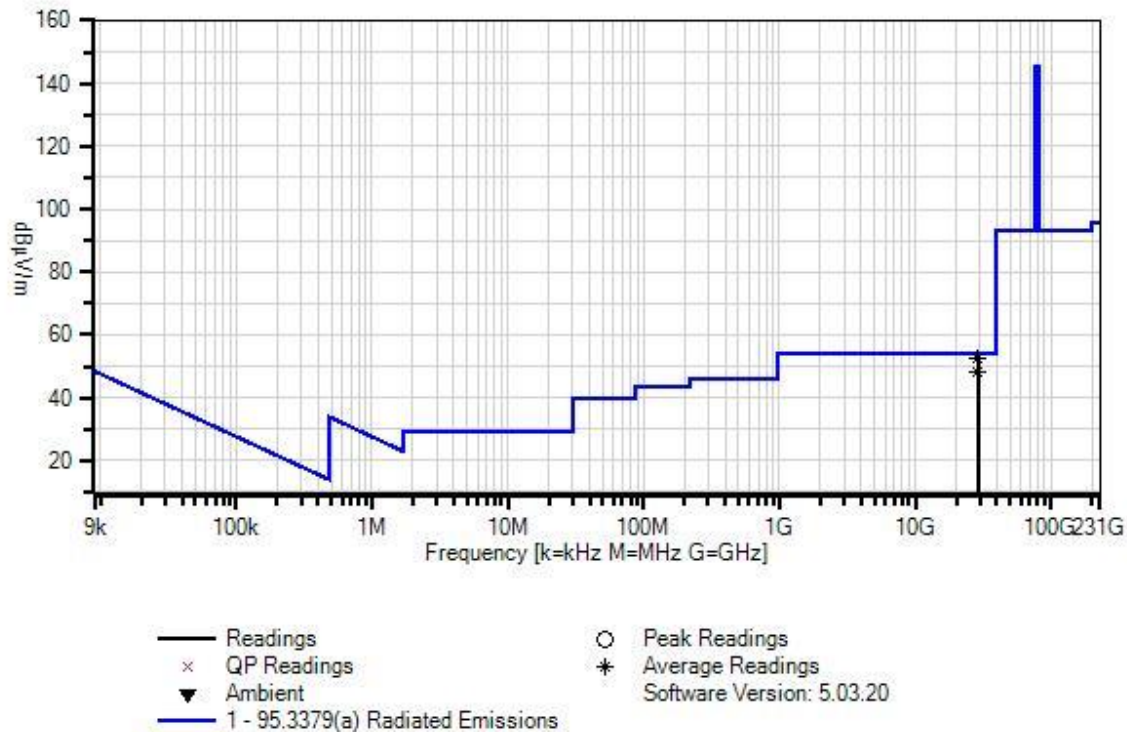
Frequency Range Of Measurement: 1GHz - 243GHz.  
 1GHz to 243GHz; RBW=1MHz, VBW=3 MHz.

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<br>T5     | T2   | T3   | T4   | Dist  | Corr   | Spec   | Margin | Polar |
|-----|----------------|------|--------------|------|------|------|-------|--------|--------|--------|-------|
|     | MHz            | dBμV | dB           | dB   | dB   | dB   | Table | dBμV/m | dBμV/m | dB     | Ant   |
| 1   | 28799.520<br>M | 41.7 | +1.8<br>+3.9 | +1.8 | +1.8 | +1.7 | +0.0  | 52.7   | 54.0   | -1.3   | Horiz |
| Ave |                |      |              |      |      |      |       |        |        |        |       |
| ^   | 28799.520<br>M | 43.2 | +1.8<br>+3.9 | +1.8 | +1.8 | +1.7 | +0.0  | 54.2   | 54.0   | +0.2   | Horiz |
| 3   | 28799.509<br>M | 37.4 | +1.8<br>+3.9 | +1.8 | +1.8 | +1.7 | +0.0  | 48.4   | 54.0   | -5.6   | Vert  |
| Ave |                |      |              |      |      |      |       |        |        |        |       |
| ^   | 28799.508<br>M | 39.1 | +1.8<br>+3.9 | +1.8 | +1.8 | +1.7 | +0.0  | 50.1   | 54.0   | -3.9   | Vert  |

## Band Edge

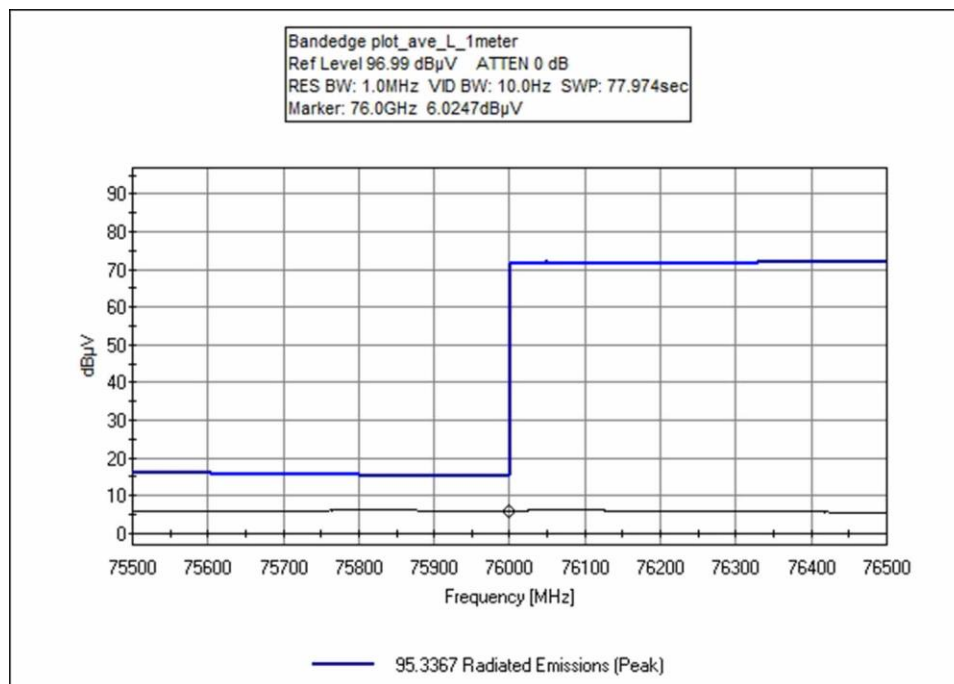
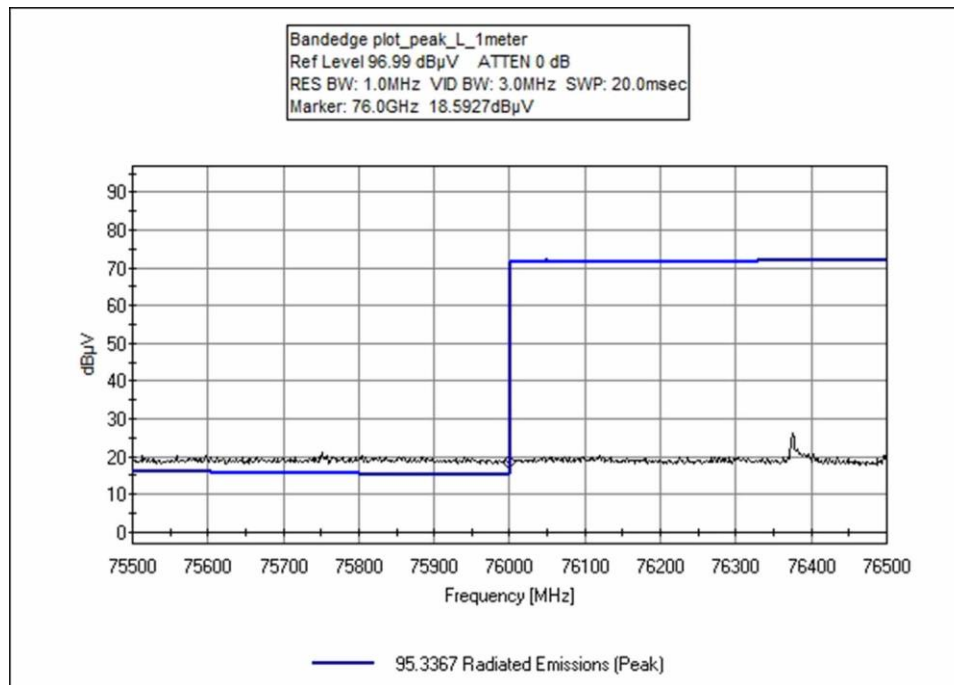
### Band Edge Summary

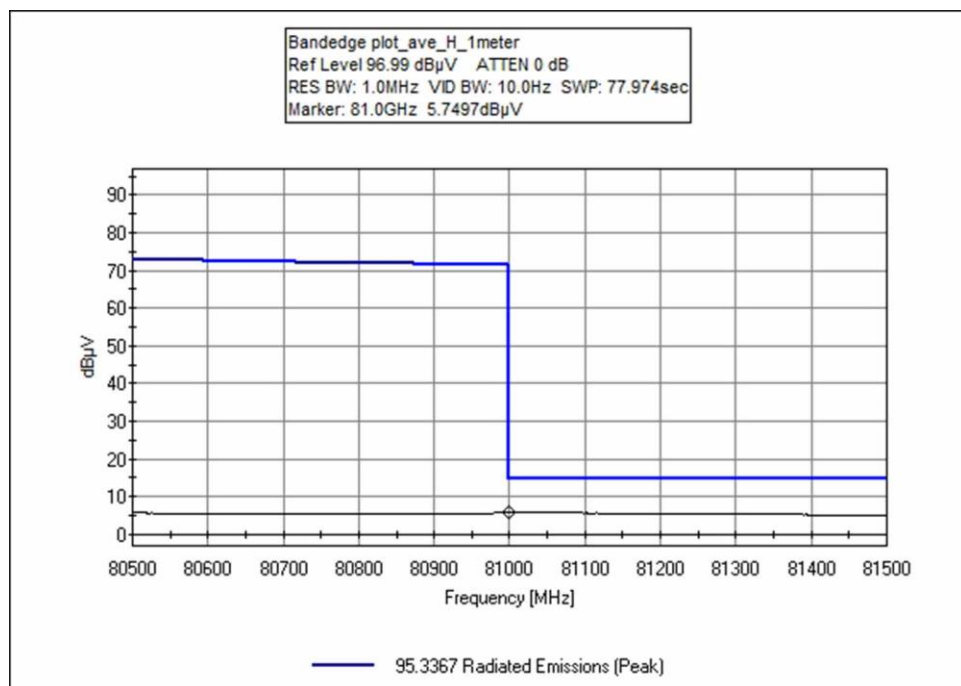
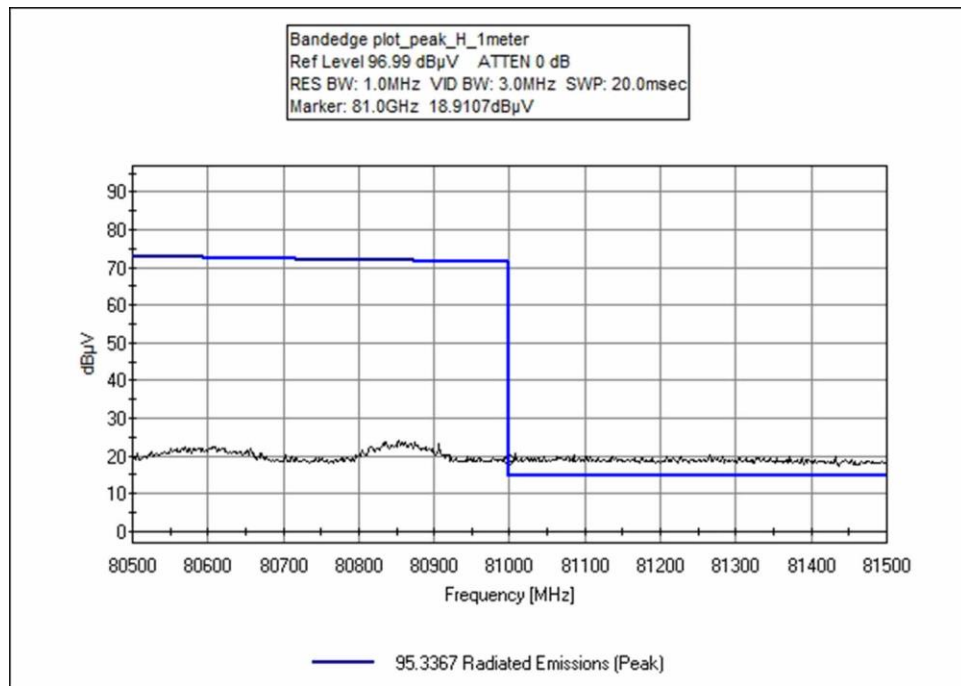
Operating Mode: Low, High

| 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<br>T5      | T2   | T3   | T4   | Dist  | Corr         | Spec         | Margin | Polar |
|---|-----------|------------|---------------|------|------|------|-------|--------------|--------------|--------|-------|
|   | MHz       | dB $\mu$ V | dB            | dB   | dB   | dB   | Table | dB $\mu$ V/m | dB $\mu$ V/m | dB     | Ant   |
| 1 | 81000.000 | 5.7        | +0.7<br>+85.5 | +0.8 | +0.7 | +0.7 | -9.5  | 84.6         | 93.5         | -8.9   | Vert  |
|   | M         |            |               |      |      |      |       |              |              |        |       |
|   | Ave       |            |               |      |      |      |       |              | H_bandedge   |        |       |
| ^ | 81000.000 | 18.9       | +0.7<br>+85.5 | +0.8 | +0.7 | +0.7 | -9.5  | 97.8         | 93.5         | +4.3   | Vert  |
|   | M         |            |               |      |      |      |       |              |              |        |       |
|   |           |            |               |      |      |      |       |              | H_bandedge   |        |       |
| 3 | 76000.000 | 6.0        | +0.6<br>+85.1 | +0.7 | +0.7 | +0.8 | -9.5  | 84.4         | 93.5         | -9.1   | Vert  |
|   | M         |            |               |      |      |      |       |              |              |        |       |
|   | Ave       |            |               |      |      |      |       |              | L_bandedge   |        |       |
| ^ | 76000.000 | 18.6       | +0.6<br>+85.1 | +0.7 | +0.7 | +0.8 | -9.5  | 97.0         | 93.5         | +3.5   | Vert  |
|   | M         |            |               |      |      |      |       |              |              |        |       |
|   |           |            |               |      |      |      |       |              | 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/cm<sup>2</sup> or uW/cm<sup>2</sup>

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/cm<sup>2</sup> or uW/cm<sup>2</sup> 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 <sup>2</sup> @ 3m   | 143.5 dBuV/m @ 3m            |
| 600 pW/cm <sup>2</sup> @ 3m  | 93.5 dBuV/m @ 3m             |
| 1000 pW/cm <sup>2</sup> @ 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  $\text{dB}\mu\text{V}/\text{m}$ , the spectrum analyzer reading in  $\text{dB}\mu\text{V}$  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       | ( $\text{dB}\mu\text{V}$ )          |
| +                   | Antenna Factor      | ( $\text{dB}/\text{m}$ )            |
| +                   | Cable Loss          | ( $\text{dB}$ )                     |
| -                   | Distance Correction | ( $\text{dB}$ )                     |
| -                   | Preamplifier Gain   | ( $\text{dB}$ )                     |
| =                   | Corrected Reading   | ( $\text{dB}\mu\text{V}/\text{m}$ ) |

#### 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.