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Attention: Application Examiner  
Federal Communications Commission  
Authorization and Evaluation Division  
7435 Oakland Mills Road  
Columbia, Maryland 21046

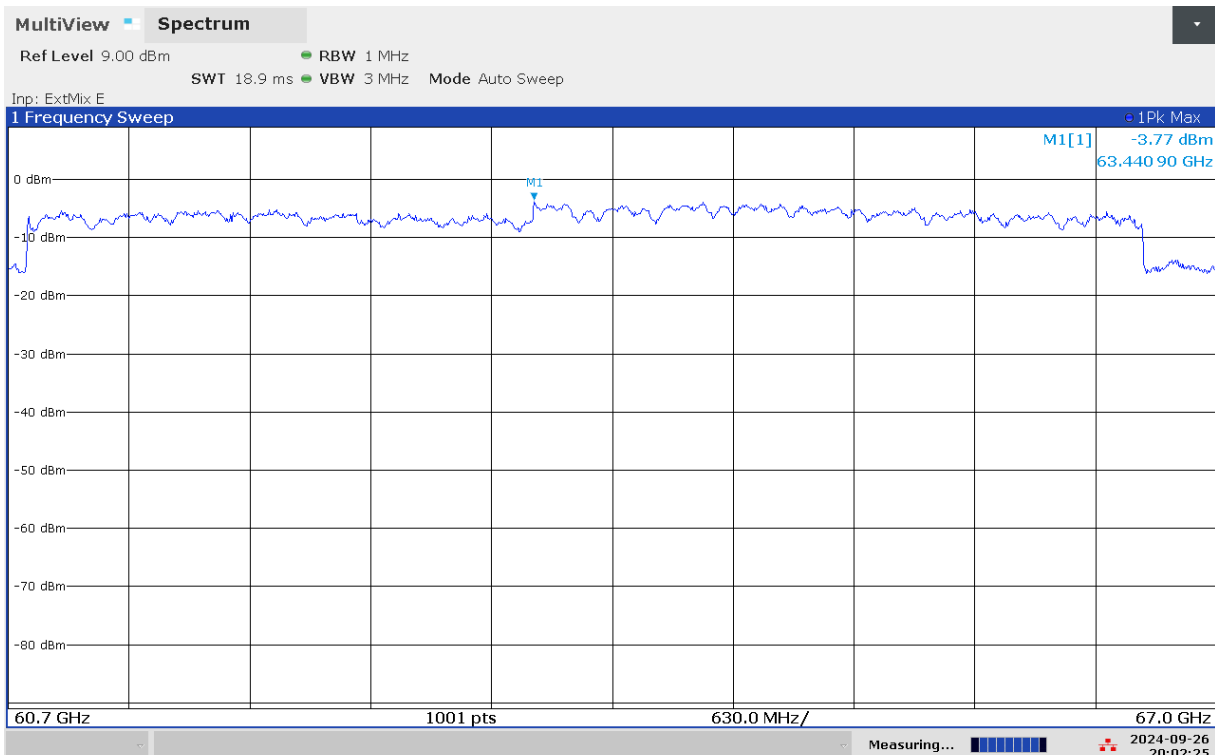
Re: Pre-Approval Guidance (PAG) Checklist  
FCC ID : 2BEKJ-SAFESTV1-1  
Applicant FRN : 0034749952

To whom it may concern,

This letter is to provide information to support Pre-Approval Guidance for the SAFEST V1.1 60-64GHz mmWave Radar device.

**a. Applicants for certification under §15.255(c)(2), in addition to a show of compliance to the specified limits, shall explain how conducted output power was determined and demonstrate compliance to the limits.**

Given that SAFEST uses a frequency band greater than 500MHz but less than 4GHz, SAFEST meets the FCC requirement which limits peak radiated power to +10 dBm and peak conducted power to -10 dBm. In order to accomplish this, SAFEST V1.1 is configured to attenuate the transmission power. As configured, SAFEST V1.1's measured IWR6843AOP's maximum EIRP ( $P_{\text{radiated}}$ ) = -3.77dBm =  $P_{\text{conducted}}$  +  $G_{\text{antenna}}$ :



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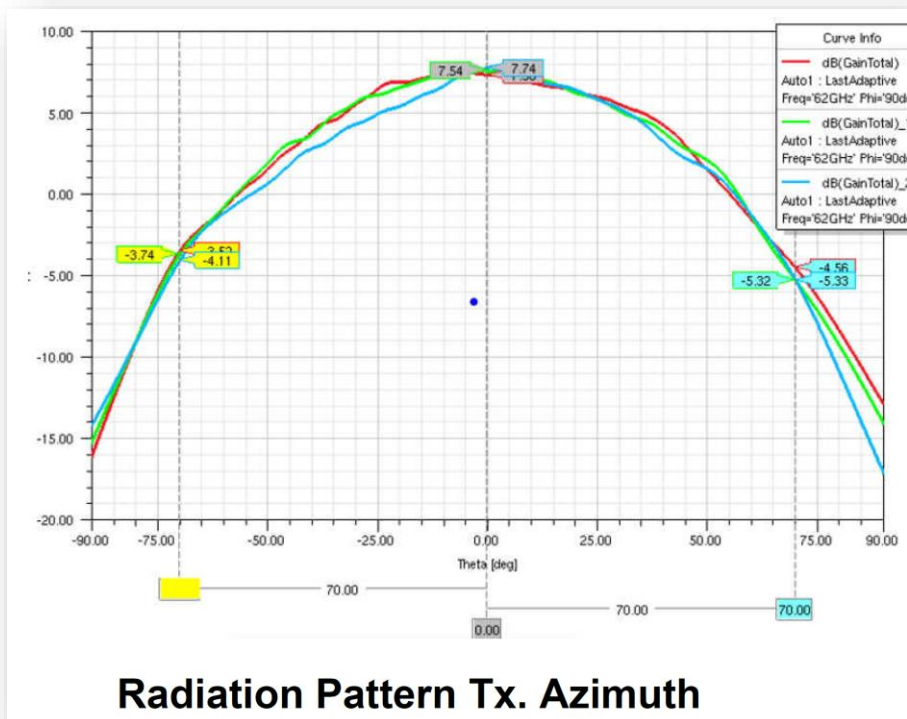
Note 1: Hand scans were performed at close distance around the EUT with vertical and horizontal polarities to find the maximum emissions. The antenna was then moved and placed in a far field at 0.52 m.

Note 2: All factors, mixer conversion loss, antenna factors, cable factors, path loss factors, and distance factors were internally compensated.

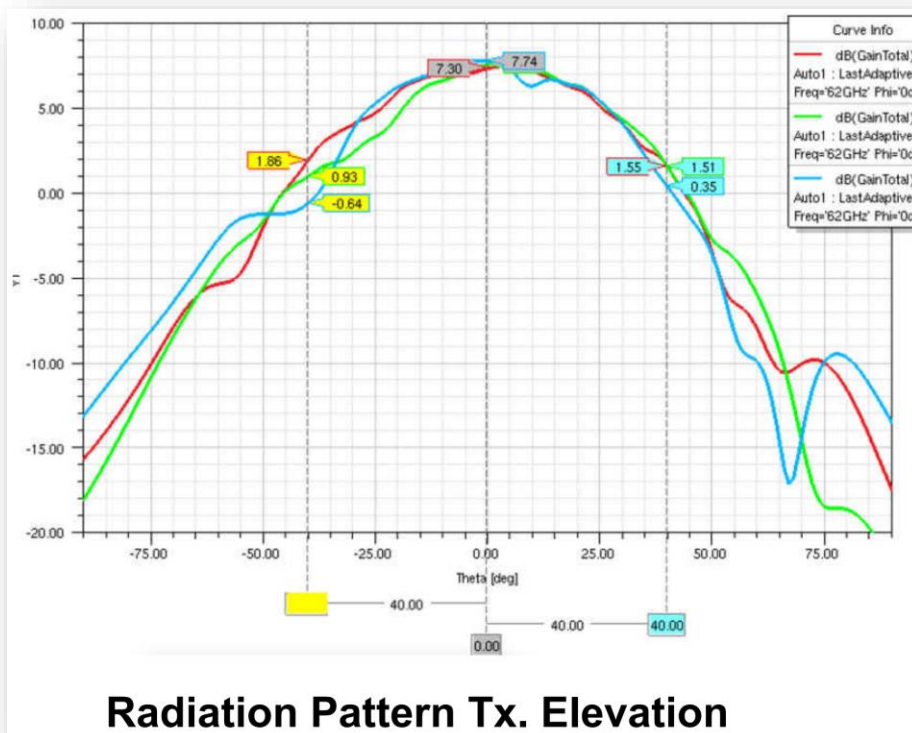
| Product Standard: CFR47 FCC Part 15.255 |                          |                                |                | Limit applied: 10 dB(m)<br>Pretest Verification w/BB source: Yes |                  |                     |                           |
|---|--------------------------|--------------------------------|----------------|--|------------------|---------------------|---------------------------|
| Test Date                               | Test Personnel/ Initials | Supervising Engineer/ Initials | Input Voltage  | Mode   | Atmospheric Data |                     |                           |
|   |                          |                                |                |  | Temp C°          | Relative Humidity % | Atmospheric Pressure mbar |
| 09/26/2024                              | Vathana Ven <i>VSV</i>   | N/A                            | 120VAC<br>60Hz | Continuous sweep   | 24               | 48                  | 1010                      |

Deviations, Additions, or Exclusions: None

The IWR6843AOP antenna gain was obtained from the manufacturer's website (<https://www.ti.com/lit/an/swra705/swra705.pdf> Pages 11 and 14). The typical gain for the IWR6843AOP in the direction of maximal radiation is 7.74dB:



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Given that the typical maximum  $G_{\text{antenna}}$  for the IWR6843AOP is 7.74dB, the SAFEST V1.1  $P_{\text{conducted}} = -3.77\text{dBm}$  - 7.74dB = -11.51dBm which is below the -10dBm limit for conducted output power.

**b. Applicants for certification to operate in the 60.0-61.5 GHz ISM band under §15.255(c)(2)(v), in addition to showing compliance to the stated technical requirements, shall also demonstrate that the fundamental emission bandwidth is entirely contained within the band.**

Not applicable

**c. For radar devices intended for operation in the 60-64 GHz band segment and for use onboard unmanned aircraft per §15.255(b)(3), in addition to a show of compliance to the output power limit, data showing that the fundamental emission bandwidth is contained within the designated band segment and time domain data demonstrating compliance to the off-time requirement shall be provided. Additionally, an explanation must be provided as to how the altitude restriction will be realized. Note that there is also a similar altitude restriction in the FAA rules at §107.51 within Title 14 of the Code of Federal Regulations (CFR).**

Not applicable

**d. Applications for radar operation in the 57.0-59.4 GHz band segment under the §15.255(c)(2)(i) rule provision, in addition to showing compliance to the stated limits, shall also provide data demonstrating that the fundamental emission bandwidth is entirely contained within the designated band segment, and a statement as to whether usage will be limited to indoor or outdoor operations and how such limitations will be ensured.**

Not applicable

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e. For radar devices intended to operate in the 57.0-61.56 GHz band segment under the provisions of §15.255(c)(2)(ii), in addition to a show of compliance to the applicable limits, provide data showing that the fundamental emission bandwidth is fully contained within the authorized band segment. Where appropriate ( $3 \text{ dBm} < \text{EIRP} \leq 20 \text{ dBm}$ ), time domain data showing compliance to the off-time requirement shall be provided.

Not applicable

f. Radar devices intended for operation over the 57.0-64.0 GHz band segment under the requirements of §15.255(c)(2)(iii), in addition to showing compliance with the applicable limits, shall also provide data demonstrating that the fundamental emission bandwidth is fully contained within the designated band segment and time domain data demonstrating that the stated off-time requirement is satisfied under all operational conditions.

See g. below

g. If the radar is to be certified for operation over the 57.0-64.0 GHz band segment under the auspices of §15.255(c)(2)(iii)(A), provide data showing that the fundamental emission bandwidth is wholly contained within the authorized band segment and time domain data demonstrating compliance to the associated off-time requirement, in addition of a show of compliance to the relevant limits.

## Intertek

|                                 |   |
|---------------------------------|---|
| Report Number: 105935432BOX-002 | Issued: 10/07/2024<br>Revised: 10/10/2024, 10/28/2024 |
|---------------------------------|---|

### 8 99% Occupied Bandwidth

#### 8.1 Method

Tests are performed in accordance with CFR47 FCC Part 2.1049.

**TEST SITE:** 10m ALSE

**The 10m ALSE** is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

#### 8.2 Test Equipment Used:

| Asset           | Description                        | Manufacturer         | Model  | Serial      | Cal Date   | Cal Due    |
|-----------------|------------------------------------|----------------------|--------|-------------|------------|------------|
| DAV007          | Weather Station Vantage Vue        | Davis                | 6250   | MS191212003 | 03/27/2024 | 03/27/2025 |
| CBLHF2012-5M-2' | 5m 9kHz-40GHz Coaxial Cable - SET2 | Huber & Suhner       | SF102  | 252676002   | 02/27/2024 | 02/27/2025 |
| ROS005-1'       | Signal and Spectrum Analyzer       | Rohde and Schwartz   | FSW43  | 100646      | 11/22/2023 | 11/22/2024 |
| OML3'           | WR12 Harmonic Mixer, 60 to 90GHz   | Oleson Microwave Lab | M12HWD | E21011-1    | 02/12/2024 | 02/12/2025 |
| OML3'           | OML Horn Antenna, 60 to 90GHz      | Oleson Microwave Lab | M12RH  | Not labeled | 02/12/2024 | 02/12/2025 |

#### Software Utilized:

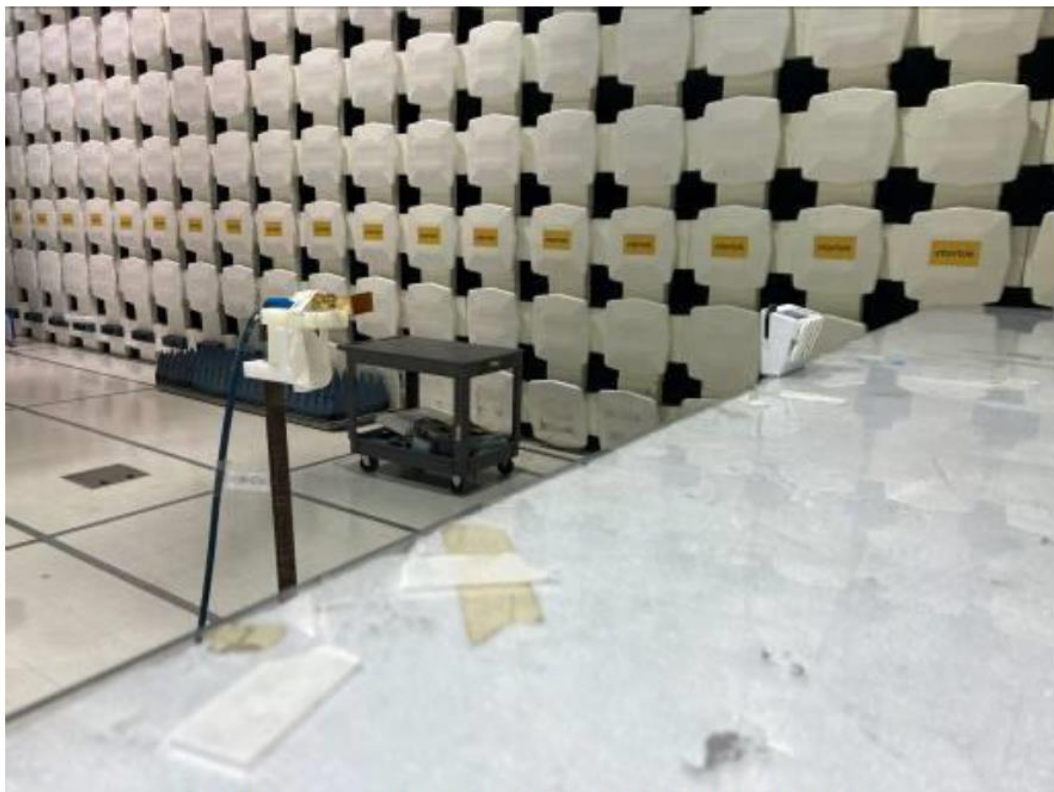
| Name | Manufacturer | Version |
|------|--------------|---------|
| None | N/A          | N/A     |

#### 8.3 Results:

The sample tested was found to Comply.

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8.4 Setup Photographs:



Mixer/Horn Antenna was placed at far field of 0.52 m

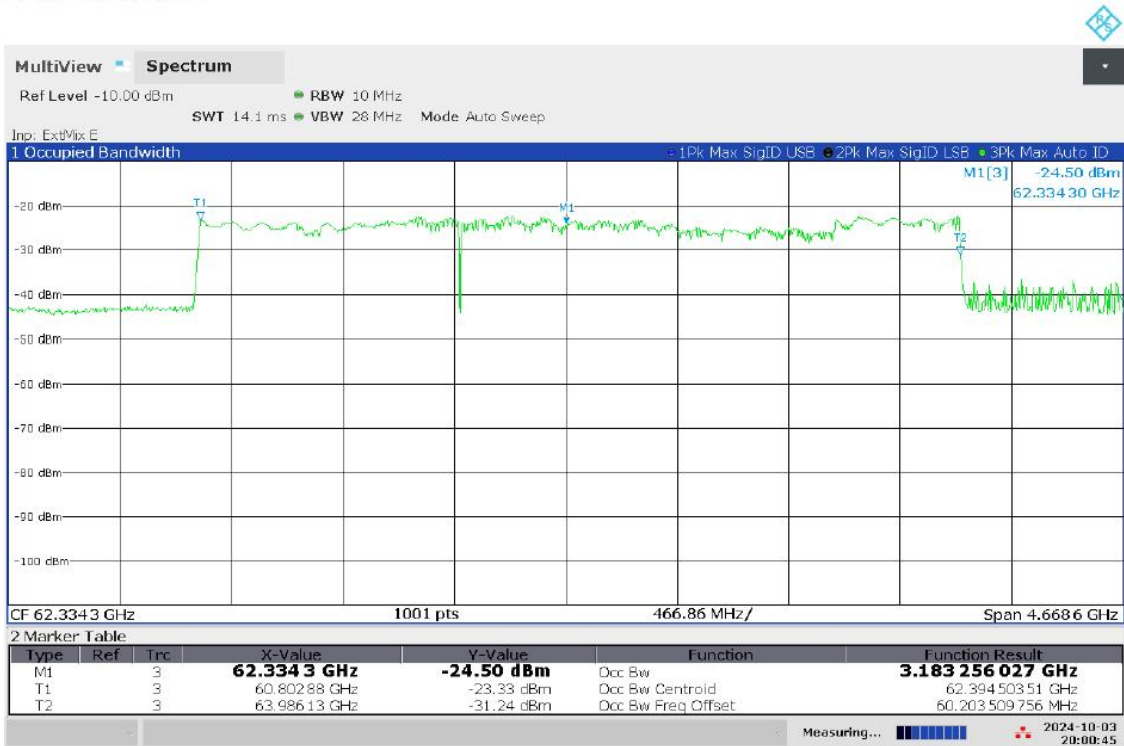


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8.5 Plots/Data:

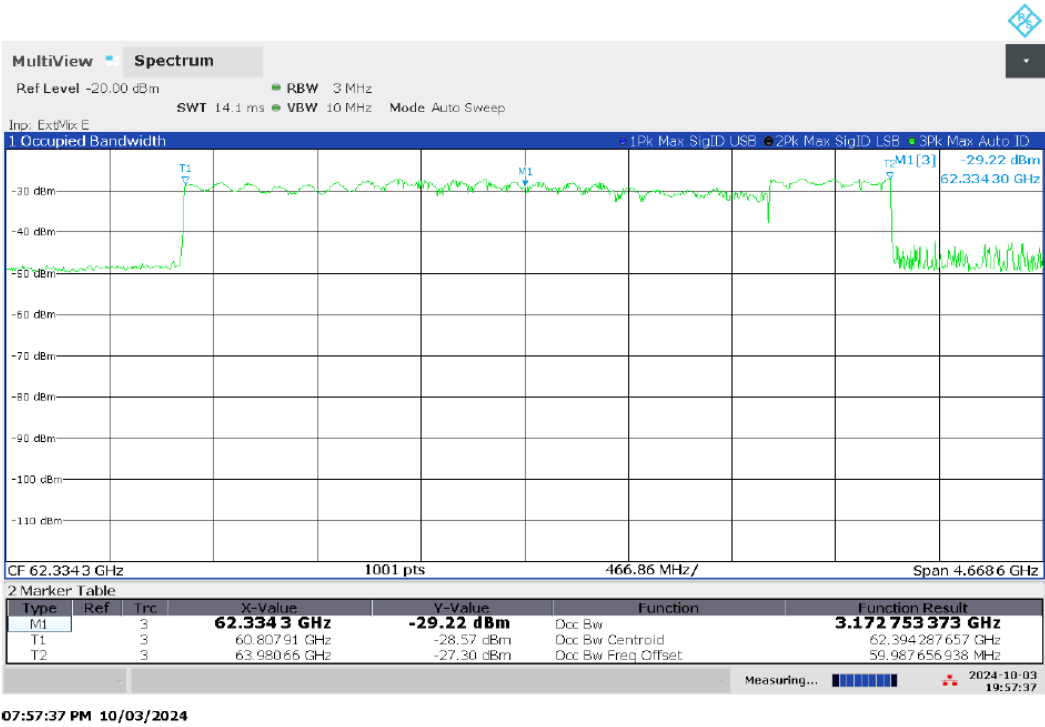


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Note 1: Hand scans were performed at a close distance around the EUT with vertical and horizontal polarities to find the maximum emissions. The antenna was then moved and placed in a far field at 0.52 m.

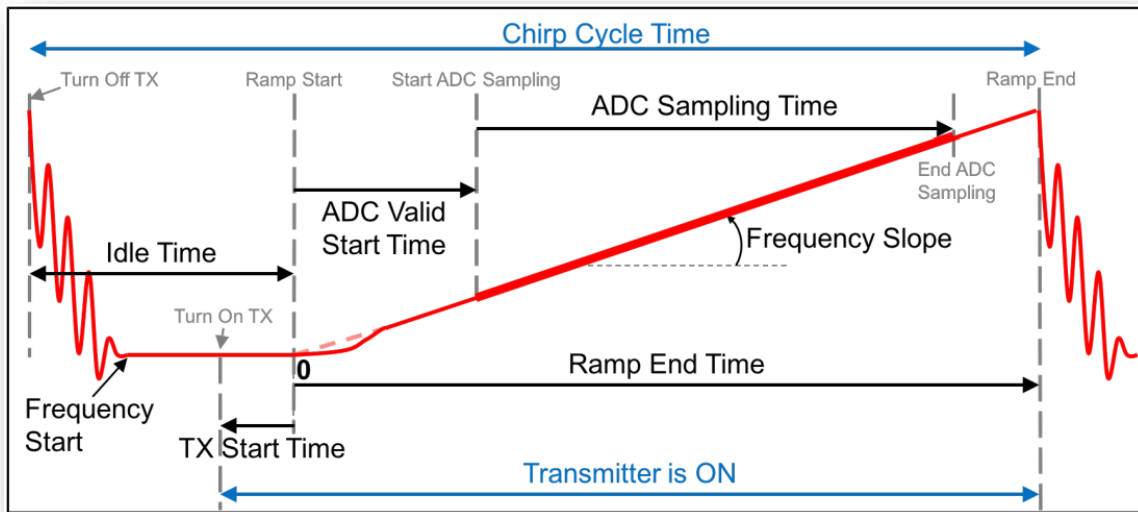
|   |                          |                                |               |  |                  |                     |                           |
|---|--------------------------|--------------------------------|---------------|--|------------------|---------------------|---------------------------|
| Product Standard: CFR47 FCC Part 2.1049 |                          |                                |               | Limit applied: Contained in 57-71 GHz Band |                  |                     |                           |
|   |                          |                                |               | Pretest Verification w/BB source: Yes      |                  |                     |                           |
| Test Date                               | Test Personnel/ Initials | Supervising Engineer/ Initials | Input Voltage | Mode                                       | Atmospheric Data |                     |                           |
|   |                          |                                |               |  | Temp C°          | Relative Humidity % | Atmospheric Pressure mbar |
| 10/03/2024                              | Vathana Ven              | N/A                            | 120VAC 60Hz   | Continuous sweep                           | 23               | 49                  | 1009                      |

Deviations, Additions, or Exclusions: None

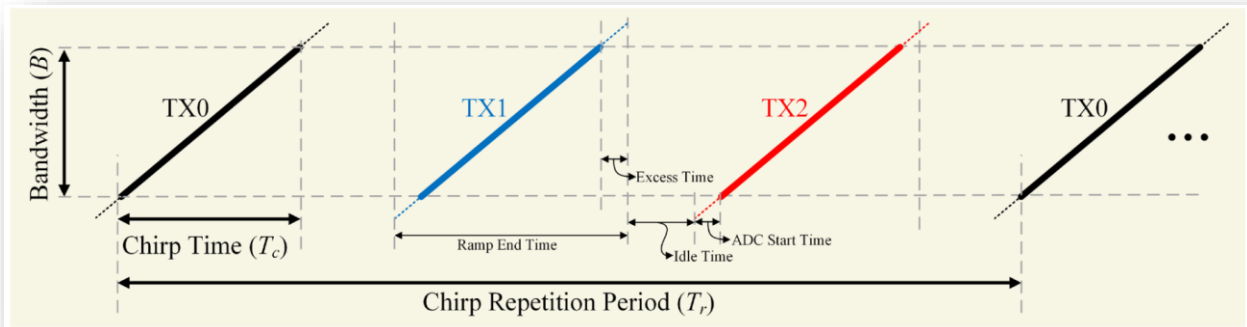
These results show that 99% Occupied Bandwidth resides between 60.797GHz and 63.996GHz.

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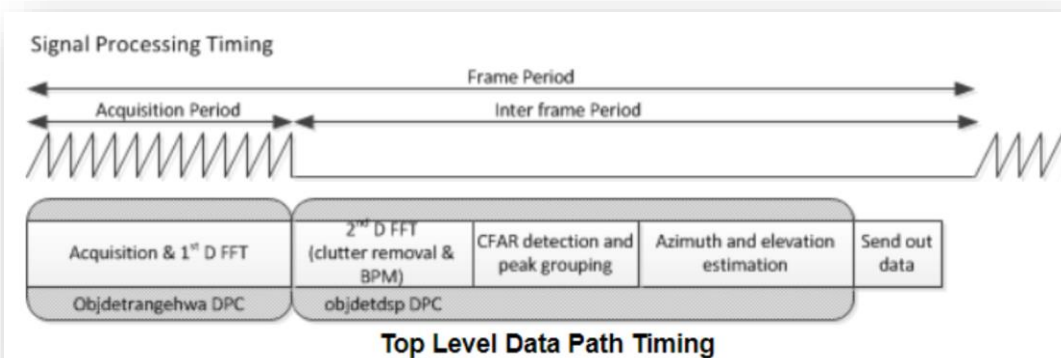
Furthermore, the IWR6843AOP within SAFEST V1.1 is configured to generate a chirp with a frequency rising from 60.75GHz to 63.98GHz over a period of 59.1 $\mu$ s followed by a 30  $\mu$ s pause in transmission.



This chirp is performed 3 times sequentially, once for each of the three transmitter antennas.



Then, this cluster of 3 chirps is repeated consecutively 28 times for a total time of 84 chirps taking a total of 7.48ms, known as the Acquisition Period.





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The total radar transmission time during this Acquisition Period is no more than 7.48ms. Then there is an Interframe Period pause of 47.52ms. Thus, the total length of time to capture a frame of data is 55ms. The Duty Cycle is  $7.48\text{ms}/55\text{ms} = 13.6\%$ .

The maximum amount of time the radar is transmitting in any 33ms timeframe is 7.48ms, and thus the Off-Time during any 33ms interval is 25.52ms, exceeding the minimum Off-Time of 25.5ms specified in FCC 23-35, ET Docket No. 21-264 for devices under 14dBm Peak EIRP operating in the frequency range of 57.0 – 64.0GHz. Item a. above showed the maximum EIRP ( $P_{\text{radiated}}$ ) = -3.77dBm.

**h. If the radar is to be certified for operation over the 57.0-64.0 GHz band segment under the §15.255(c)(2)(iii)(B) requirements, in addition to showing compliance to the stated limits, provide data showing that the fundamental emission bandwidth is wholly contained within the authorized band segment and time domain data demonstrating compliance to the associated off-time requirement. Where applicable, explain comprehensively how the “fixed” requirement will be satisfied and maintained or how the device will be limited to exterior vehicular applications.**

Not applicable

**i. If certifying a pulsed radar for operation over the 57.0-64.0 GHz band under the §15.255(C)(3) rules requirements, in addition to showing compliance with the specified limits, show that the fundamental emission bandwidth is constrained to the designated band segment and provide time domain data showing the maximum pulse duration and the maximum duty cycle within any three- $\mu\text{s}$  time window.**

Not applicable