Submission Date: 22 October 2024

Aloft Sensing, Inc. Airborne X-band Radar Experiment

This document describes Aloft Sensing, Inc's (Aloft's) X-band stratospheric-based radar experiments, which are the subject of this FCC Special Temporary Authorization Application File #1966-EX-ST-2024.

Testing Overview:

Aloft is testing an experimental X-band radar system from the stratosphere for an R&D project and is seeking a STA to facilitate testing on a stratospheric vehicle. The flights are centered in a 200-km radius area centered on 33°34'23.02"N,111°24'44.22"W as shown in Figure 1. The nearest town is Tortilla Flat, AZ.

The experiments would begin at the end of November, 2024 and continue through May, 2025. The radar system is designed to generate synthetic aperture radar (SAR) and interferometric synthetic aperture radar (InSAR) imagery from greater than 55 kft altitudes.

During the experiment, an Aloft operator will be able to disable the radar at any time. Transmission of the radar can be stopped by contacting Patrick Rennich at 734-821-3050.

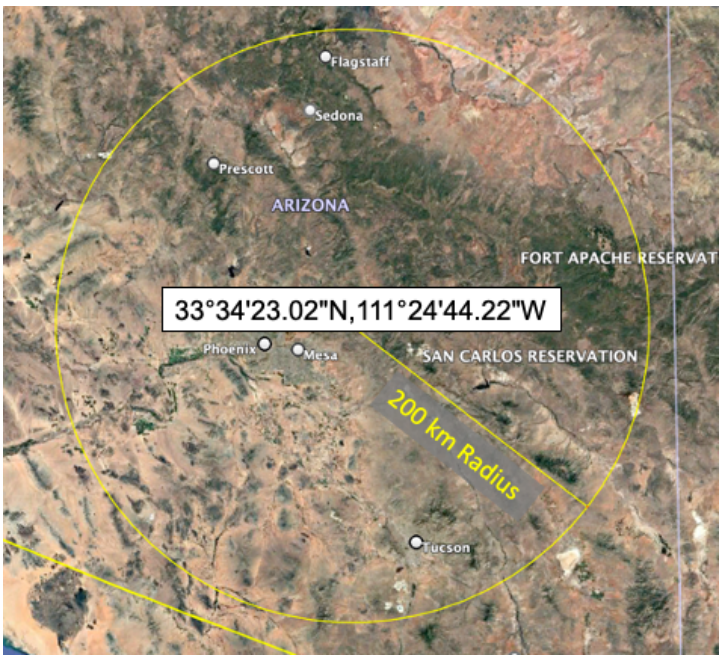

Figure 1. Requested area of operation, 200-km radius centered on 33°34'23.02"N,111°24'44.22"W.

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Radar System Description:

Aloft has integrated the radar system from a custom-built phased array antenna built by EMAG Technologies, Inc. and a custom-built software-defined radar transceiver built by Aloft Sensing, Inc.

DIRECTIONAL ANTENNA INFORMATION: During testing, the radar will be mounted on a stratospheric vehicle. The antennas will be mounted with fixed elevation pointed towards the ground. The elevation will be adjusted to 30 degrees off-nadir. The antenna's azimuth pointing direction will change according to the flight direction, and thus any azimuth direction is possible. The antenna beamwidth is $8° \times 8°$, with a 26 dBi main beam gain.

MODULATING SIGNAL DESCRIPTION: The custom-built software-defined radar (SDRr) uses an arbitrary waveform generator (AWG) with flexibility to control key aspects of the waveform, including pulse width, occupied bandwidth, min and max frequency, and spectral notches. Aloft has configured the SDRr to transmit a pulsed linear FM chirp waveform over a 690 MHz bandwidth at a maximum pulse rate of 10 kHz and pulse widths ranging from 2-20 μs.

NECESSARY BANDWIDTH DESCRIPTION: The 3-dB emission bandwidth was calculated to be 690 MHz and verified with lab measurements. The emitted power attenuates sharply outside this band, with a 710 MHz bandwidth at the -20 dB point.

RADIATION HAZARD ANALYSIS: The minimal safe operating distance of the radar transmitter is calculated to be 32m using a safe power density of $1 mW/cm^2$ and the highest, worst-case value for average power of 12.8W. All key values are given in the following table. The average transmit power is controlled by the SDRr, and in most operational cases the average power will be lower by 10x at a value of 1.28W.

RADAR PAYLOAD TRANSMITTER SUMMARY:

- Frequency Range: 9.21 GHz to 9.9 GHz
- Bandwidth: 690 MHz
- Emission Designation: 690MQ3N
- Waveform Type: Pulsed Linear FM Chirp
- Transmit Power: 1.28W (avg typical), 12.8 W (avg worst case), 128 W (peak)
- Transmit Antenna Gain: 26 dBi
- ERP (peak): 31kW
- Transmitter Equipment: custom-built software-defined radar transceiver by Aloft Sensing, Inc.
- Antenna Equipment: Gen-4 phased-array antenna custom built by EMAG Technologies, Inc.