January 16, 2013
Form 422 File Number: 0009-EX-ML-2013, modification request

Federal Communications Commission
Office of Engineering and Technology
Experimental Licensing Branch
445 12th St., S.W.
Room 7-A322
Washington, DC 20554

To Whom It May Concern:

On behalf of IMSAR LLC, I would like to apply for a modification of Experimental License Call Sign WE2XVR to further the development and testing of low power radar systems. This application modifies or adds the following locations, antennas, and emissions:

1. US/Mexico border: We no longer have a need to operate our radar along the international border and therefore request that this station location be removed from the license.
2. Increase in allowable aircraft altitude: We request an increase in the allowable aircraft altitude during transmission to 10,000 feet above ground level.
3. Frequency change: For locations at Boardman OR, Spanish Fork UT, China Lake CA, Yuma AZ, Whidbey Island WA, and Arlington OR, we request a modification from frequency 16.7 GHz with emission designator 2G00F0N to frequency 16.35 GHz with emission designator 2G00F0N.
4. New location: We request authorization to transmit throughout the entire state of Utah. The majority of our transmissions will still occur in the Spanish Fork, UT region, but at times when the local weather is unfavorable, we would then be able to move our testing offsite to another part of the state where the weather is more agreeable.
5. New location: We request a new station location at the Joint Readiness Training Center in Fort Polk, LA. The location is centered at 31° 4′ 25′′ N, 93° 12′ 9′′ W and an operating radius of 20 km is requested.

The end user of these experimental systems will predominantly be the US Department of Defense. We have operated up to this point under experimental license call sign WE2XVR. I hope the attached document has sufficient information to enable a favorable approval of an experimental license.

Sincerely,
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Purpose of radio operation:

IMSAR LLC has technology that is able to track moving targets, image the surface of the earth, create digital elevation maps, assist in search and rescue operations, and detect small changes in a scene, such as the movement of a vehicle. The US Navy, Army, and Air Force have expressed interest in this technology. The size, weight, power, and cost of IMSAR's Synthetic Aperture Radar (SAR) system, known as NanoSAR, are an order of magnitude less than similar systems. The radical change in weight and power consumption enables tactical use of the radar, which in turn gives surveillance capabilities to small sets of soldiers that were previously unavailable. With the new surveillance capabilities, dangerous and life threatening situations can be further reduced.

Similar radar systems, such as Linx SAR, weigh 85 lbs. and transmit 300 W of power. IMSAR's radar system weighs as little as 2 lbs. and transmits less than 2 W of power. IMSAR requests a license in order to complete product testing and begin customer demonstrations.

IMSAR will use this experimental license to perform tests from a small aircraft flying under 10,000 feet in altitude (above ground level). Directional transmit and receive antennas are nominally pointed toward the earth. Reflected signals are collected and processed to create images of the ground. The resolution of the imagery is directly proportional to the bandwidth of the signal transmitted. In order to obtain resolutions as small as 0.1 m, a transmit bandwidth of 1500 MHz is desired. Transmission is a linear frequency modulated continuous wave with the frequency being swept from the minimum to the maximum frequency 1000 times per second. Because the transmission power is under 2 W and the frequency sweeps very rapid, the average power at a given frequency is extremely low.

Very low UHF frequencies are employed to enable ground penetration and observation of specific targets where UHF reduces the clutter of the background. Ground penetration requirements for radars operating at UHF frequencies may require higher transmission power, up to 5 W. Even at these higher power levels, the rapid, wide-band linear frequency modulated waveform ensures that the average power at a given frequency remains very low.

Transmissions will generally be performed in remote areas over very limited time intervals of roughly 2-3 hours at a time, a few times per week.

Operation Location and Height:

The radar will be operated from a small aircraft at a height above ground level of between 0-10,000 feet. The transmit signal is directed perpendicular to the direction of travel and towards the ground using a directional antenna. The antenna radiation pattern is approximately 25° in elevation and 5° in azimuth (i.e. along the track of the aircraft) in the 16.35 GHz Ku-band frequencies, 45° in elevation and 10° in azimuth in the 10.25 GHz X-band frequencies, and 120° in elevation and 70° in azimuth in the UHF frequencies. The back lobes of the antenna are attenuated significantly. The peak of the antenna pattern has a 45° incident angle to the ground. The return signal is received by an identical receive antenna co-located with the transmit antenna. An example of the geometry of a SAR is shown in Figure 1.

Data collections will occur primarily over rural areas of northern Utah and remote government owned lands to test the functionality and demonstrate the utility of the radar as a tool for both commercial and military applications. Sites of interest to be imaged will be terrains of interest to potential customers, including urban and rural scenes. Additional locations are used for further testing and demonstrating the product to customers.

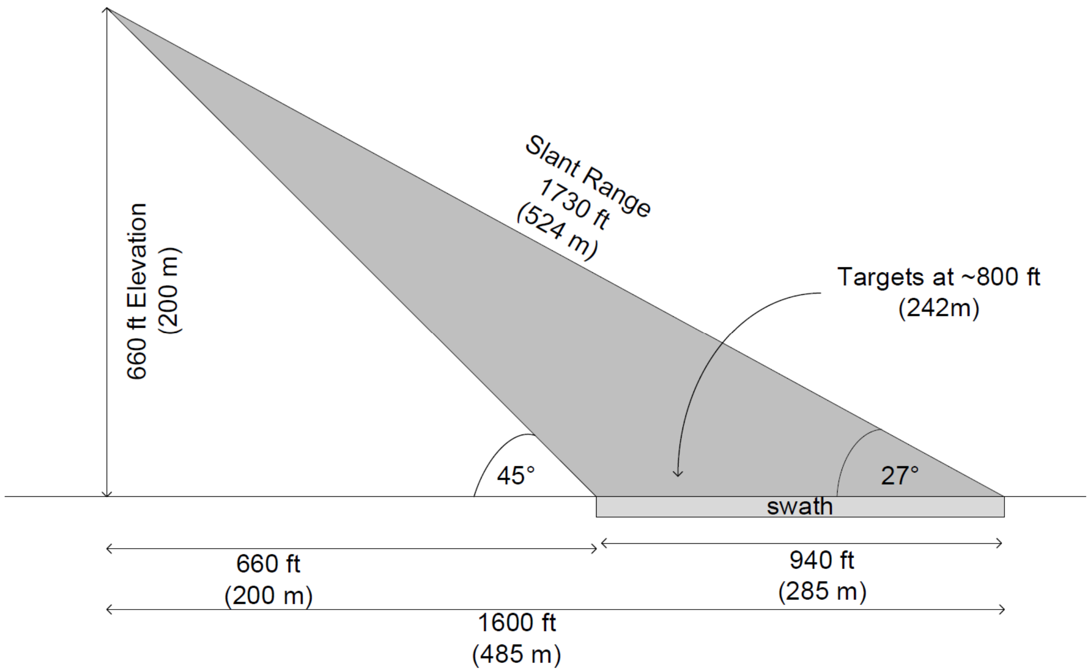

Figure 1 Example SAR geometry

Description of the Transmit Signal:

The transmit signal may be centered at 380 MHz, 435 MHz, 550 MHz, 805 MHz, 10.25 GHz, or 16.35 GHz.

A specific example is illustrative: an X-band radar, with emissions centered at 10.25 GHz and operating from 10 to 10.5 GHz. The signal is continuous and modulated only by frequency. The frequency is ramped from the bottom of the bandwidth to the top of the bandwidth at a 1 kHz rate. The received signal is mixed with the transmitted signal in a homodyne fashion. Frequency is controlled with a highly stable PLL and 25 MHz crystal with 25 ppm stability. The frequency ramp is controlled with a direct digital synthesizer capable of over 60 dB ACPR. The final power amplifier is a linear MMIC based amplifier with excellent linearity. The highest power spectral density we anticipate is -40 dBW/Hz (75 MHz bandwidth).

We have equipment in house to measure out-of-band spurious signals and we regularly measure our transmission signals to minimize harmonics and spurious signals.

Time Period of Operation

We have submitted form 1494 for X band NanoSAR (REA-XB01 and REA-XC01) and Ku band Leonardo (REA-KB01 and REA-KC01) and received 1494 J/12 numbers for use with DoD spectrum management.

A Record of non-interference

IMSAR's radars have logged several hundred hours each of unmanned and manned flights operating this system so far. To date we have observed no detectable interference with other systems including communication equipment, active military radar systems, commercial aircraft, or unmanned aircraft systems. The radar systems IMSAR produces have been found to be tolerant of interference from these systems, up to and including interference from high power broadcast stations, large directional antennas, and high power military radars.