Sept 25, 2011
Form 422 File Number: 0162-EX-ML-2012, 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 a low power radar systems. This application modifies or adds the following locations, antennas, and emissions:

1. Spanish Fork, UT. We request an increased area of operation of 100 km radius centered at 39° 44' 11" N, 111° 52' 00" W (Nephi Municipal Airport, UT) compared to the 50 km radius of operation centered at 40° 7' 40" N, 111° 52' 0" (Spanish Fork, UT). The northern edge of the operating area remains approximately the border between Salt Lake and Utah counties. The modification will allow radar experimentation between ImSAR facilities and Dugway Proving Grounds and other areas in the central and western deserts of Utah and in the mountain valleys in the Wasatch mountain range. Within the current 50 km radius of operation, we have found areas like these particularly suitable for radar experimentation due to the low levels of interference and low likelihood of causing interference.
2. We request an increase in the allowable transmission levels of the 435 MHz and 550 MHz frequencies from 2 W to 5 W within the Spanish Fork, UT and Dugway Proving Grounds, UT locations.
3. We request two additional frequencies for radar experimentation within the Spanish Fork, UT and Dugway Proving Grounds, UT locations, 80 MHz of bandwidth centered at 380 MHz and 310 MHz of bandwidth centered at 805 MHz. The peak transmitted power is also 5 W.
4. We request an additional frequency between 1.625 GHz and 1.850 GHz for a dedicated between the airborne radar and a ground control station for the Spanish Fork, UT location. The radio has a selectable center frequency and will emit up to 1 W of power over an approximately 5, 10 or 30 MHz bandwidth depending on the selected bit rate.

The end user of these experimental systems will be predominantly 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,

Adam Robertson
Vice President, ImSAR, LLC
940 South 2000 West #140
Springville, UT 84663
801-762-7263
adamr@imsar.com

Purpose of radio operation:

ImSARs 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 system (SAR) is an order of magnitude less than similar systems. The radical change is weight and power consumptions 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 weighs 85 lbs and transmit 300W of power. ImSAR's radar system weighs 2 lbs and transmits less than 1W of power. ImSAR requests a license in order to complete product testing and begin customer demonstrations.

ImSAR will use this experimental license to performed tests from a small aircraft flying under 2km in elevation. 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 0.3 m, a transmit bandwidth of 500 MHz is desired. Transmission is 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 1W and the frequency sweeps very rapid, the average power at a given frequency is extremely low.

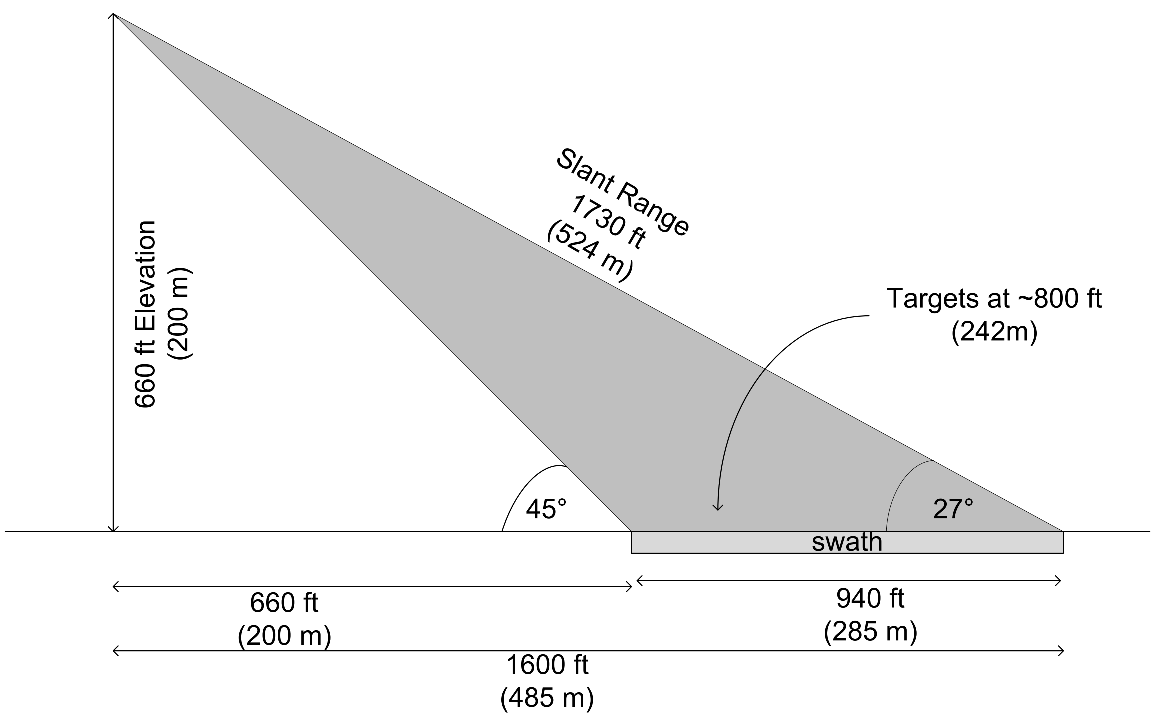
Very low UHF frequencies are employed to enable ground penetration and observation of specific targets where UHF reduces the clutter of the background. Ground penetration requirements for radars operating at UHF frequencies may require higher transmission power, up to 5 W. For this reason, we are requesting an increase in the allowed transmission level in the UHF frequencies. Even at the 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 be generally performed in remote areas over very limited time intervals of roughly an hour at a time, a few times per month.

Operation Location and Height:

The radar will be operated from a small aircraft at a height between 0m and 5000m. The transmit signal is directed perpendicular to the line of site 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 16.7 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.

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. Site at Boardman OR, Arlington OR, China Lake CA, Yuma AZ, and Whidbey Island WA are also areas for testing or potential testing of NanoSAR.



<u>Description of the Transmit Signal:</u>

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.