METRIC SYSTEMS CORPORATION

DESERT SEA

FCC EXPERIMENTAL LICENSING SYSTEM – CONVENTIONAL LICENSE

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OVERVIEW

This program is called Desert Sea and has as its technical goal discovery of the engineering parameters and scientific principles required to efficiently probe and accurately locate underground aquifers at a depth of up to 100 meters using low band VHF synthetic aperture radar technology in arid environments.

The Desert Sea Project Manager is Dr. Essam Heggy. Dr. Heggy is a Senior Geophysical Researcher at the University of Southern California and a Planetary Scientist with NASA. His research involves probing planetary environments using different types of radar imaging and sounding techniques. He is a leading authority in radar sounding of aquifers in hyper-arid environments.

The spectrum choice of low band 45-95 MHz VHF spectrum is based on several factors:

- Multi-variable trade-offs between
    - Operating Frequency
    - Effective radiated peak and average power
    - Antenna gain
    - Antenna type, size and beam width
    - Depth of penetration given the permittivity and conductivity of arid environments.

This application represents the initial Desert Sea prototype using the following parameters:

- Operating Band: 45 to 95 MHz
- Chirp Sub- band widths: 5,10,20,40 MHz
- Modulation: Pulsed Linear Frequency Modulation (LFM)
- Chirp Pulse width range: 0.5 to 2 ms
- Pulse Repetition Frequency Range: 1 to 30 KHz
- Antenna Type: Directable J Pole (See Figure 3)
- Antenna Gain (Estimate): -3 dBi (See Figures 5,6)
- Maximum Peak Output from Power Amplifier: 300 Watts (54.8 dBm) (See Figure 1)
- Maximum Peak Power Input to Antenna: 158.5 Watts (52 dBm) (See Figure 1)
- Nominal Average EIRP: 15 Watts @ 20% duty cycle
- Aircraft type: Rotary Wing Bell 412 Helicopter
    - Nominal Operating Altitude Range: 100 – 1000 meters (328 to 3,281 feet)
    - Nominal Mission Groundspeed Range: 0-90 kts/hr. (0-104 mph)

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SYSTEM ARCHITECTURE

Figure 1: : Transmit through two antennas, receive through two antennas, single linear polarization

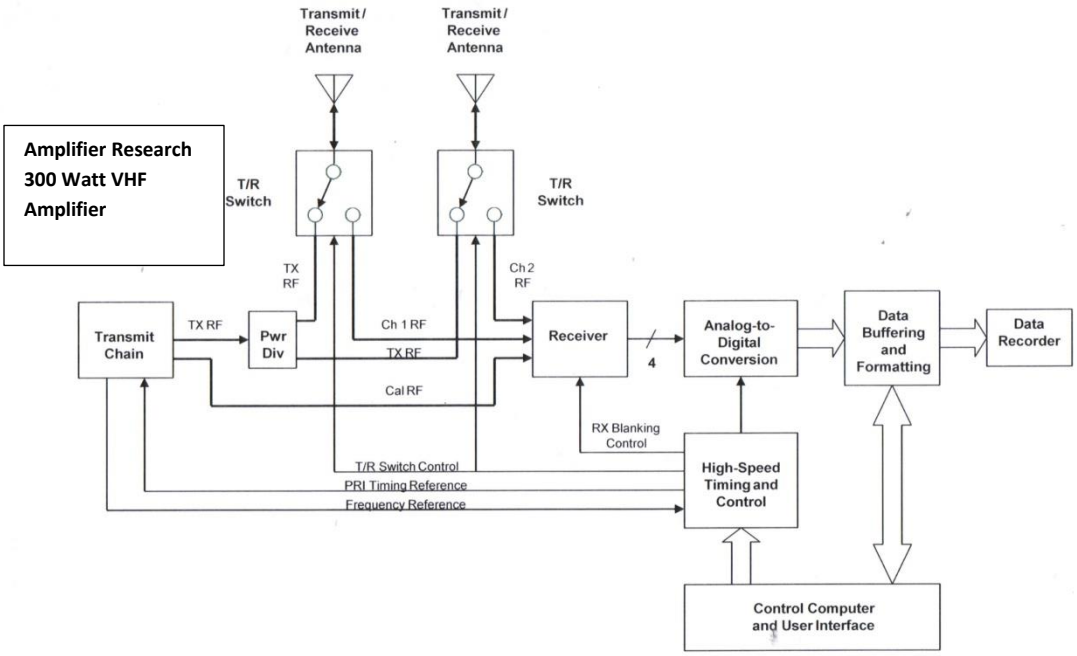

Figure 1 shows the core RF and Processing components of the Desert Sea Synthetic Aperture Radar.

SYSTEM OPERATION

Desert Sea Transmitter Operation: The Desert Sea transmitter chain consists of a precision Arbitrary Waveform Generator from Zurich Instruments driving a 300 Watt Linear Amplifier from Amplifier Research(See Attached Data Sheet). The power amplifier output is selectively filtered to suppress out-of-band emissions to a minimum of -60 dBc. The filtered pulsed LFM signal is then passed on to low distortion transmit/receive switches to select either one or both of the VHF antennas. (See Antenna Description).

Desert Sea Receiver Operation: The receiver architecture is software defined. An analog front-end provides protection from high-level Tx leakage during Tx transmission and reflected energy and provide weak signal amplification and filtering. In addition, the receiver performs real-time spectrum survey and monitoring functions to locate and identify incumbent users to minimize interference.

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ANTENNA OVERVIEW

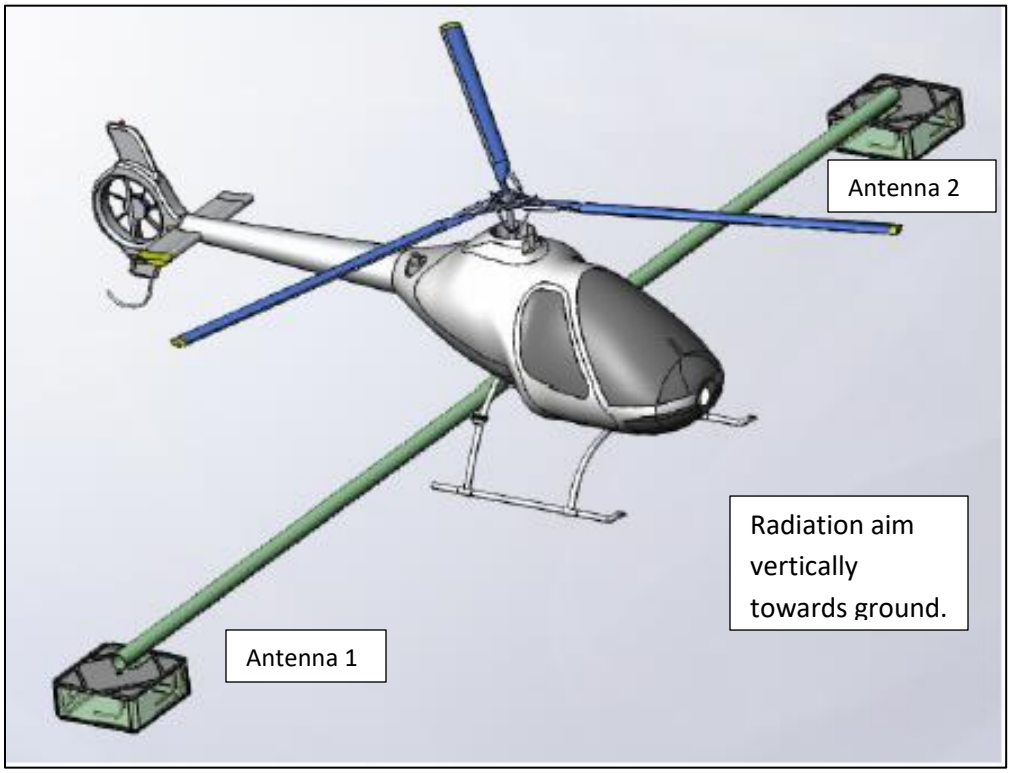

Figure 2: Basic flight configuration showing directional VHF antennas.

ANTENNA DESCRIPTION AND PERFORMANCE

- Frequency: 45-95 MHz
- Polarization: Linear
- Coverage:
  - Aximuth: Omni
  - Elevation: 90° (downward looking)
  - Platform: Airborne

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DESERT SEA ANTENNA CONSTRUCTION DESCRIPTION

Concentric Four Element Inverted F Antenna (IFA) Array Characteristics:

- Linear Polarized
- Nominal directivity (90^o x 90^o)
- Concentric design elements: Low (45-60 MHz) + High band (60-95 MHz) combined through an integrated diplexer
- Antenna elements: Dual Inverted
- Antenna Feeds: Quadrature (0^o, 90^o, 180^o, 270^o)
- Integrated Resistive Loading
- Size: 38”x 38” x 18” (.97 x .97 x .48 m)
- Use: Fixed and Rotary Wing Aircraft

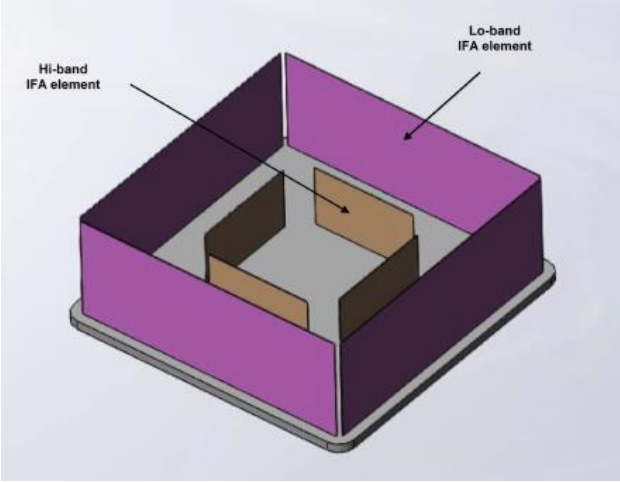

Figure 3: Concentric Antenna Concept

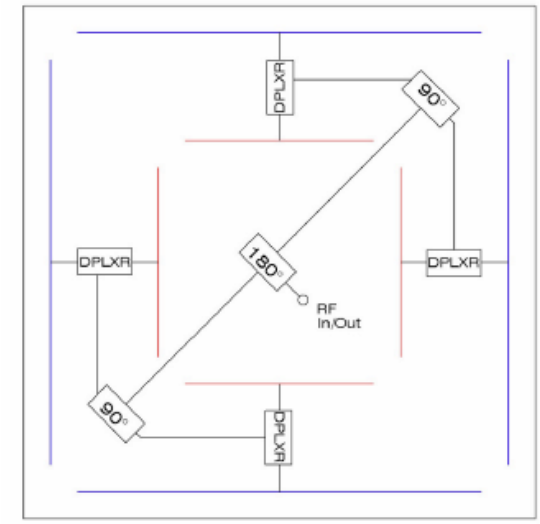

Figure 4: Concentric Antenna Internal Layout

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SIMULATED DESERT SEA RADIATION PATTERNS

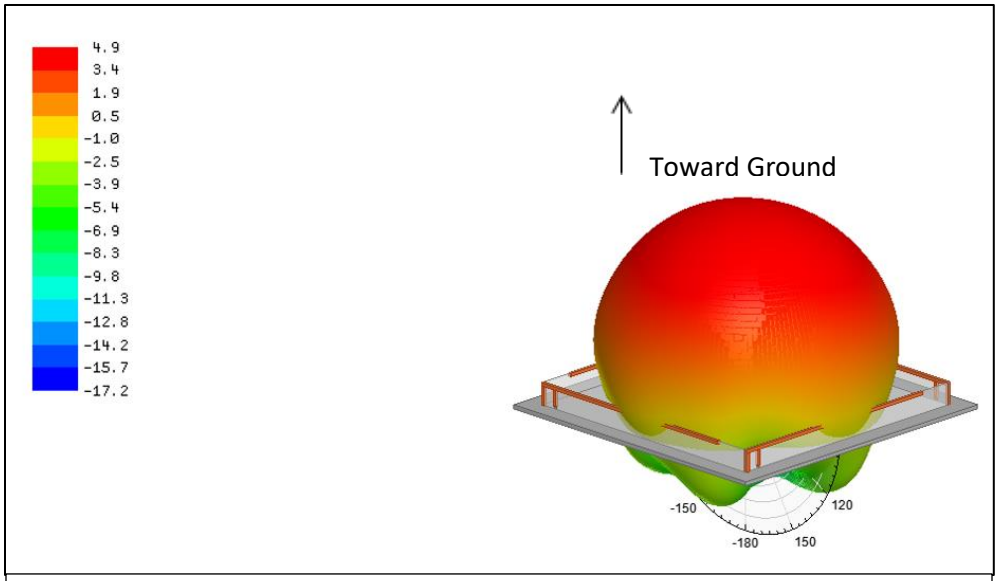

Figure 5

- Simulated Radiation Pattern – Radiation directed in Z direction
- Estimated As Built Gain: -3 dbi @ Nadir

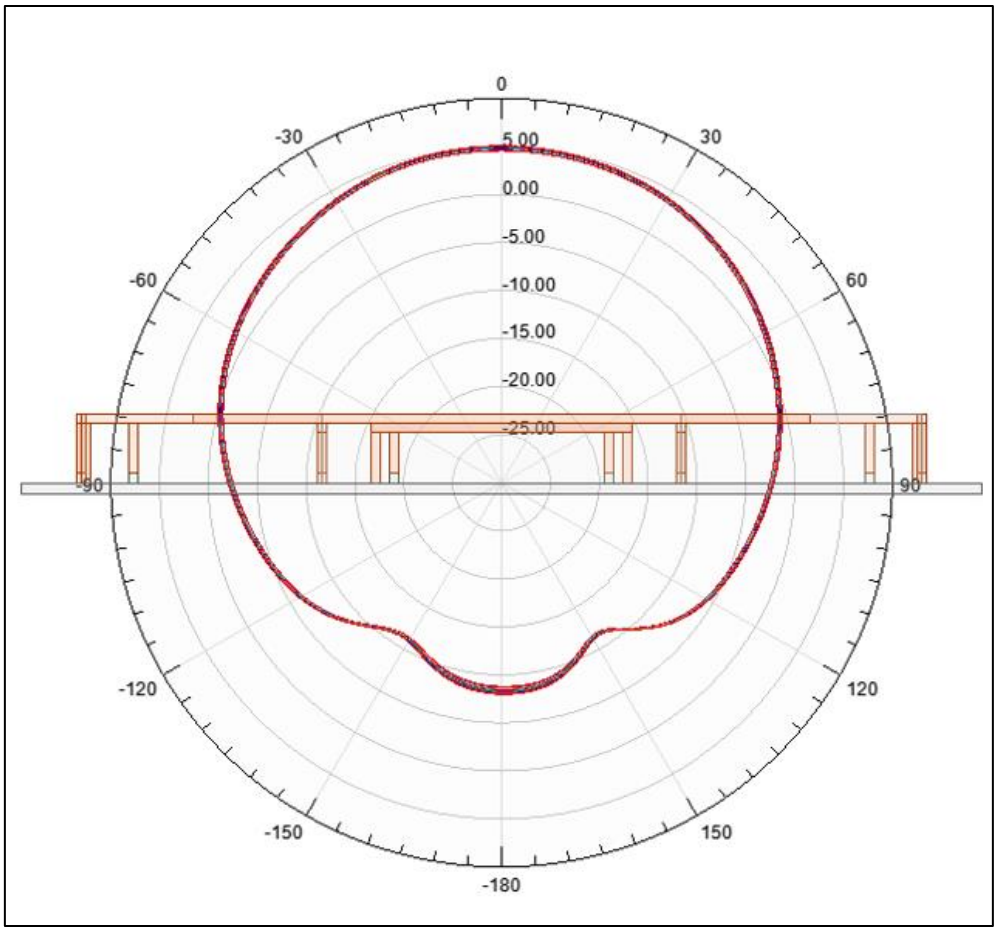

Figure 6:

- Directivity in ZY and ZX planes

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