Investigations of All Metal Heat Sink Dual Linear Polarized Phased Array Antenna for Ku-Band Applications

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In this abstract, an 8×8 dual linear polarized phased array antenna, comprised of all metallic radiators serving also as heat sink, is proposed for Ku-band applications. The single polarization heat sink phased array antenna is reported earlier (Sean M. Duffy, Glenn A. Brigham, Kevin B. Newman, and Jeffrey S. Herd, "Stepped Notch Antenna Array Used as a Low Thermal Resistance Heat Sink", IEEE AP-S Symposium 2013) but with conventional beamforming network. The single radiator, with a height nearly equal to λ/2, is shaped intuitively and fed by a stripline through a trapezium shaped balun. Two shaped radiators are placed orthogonally within a metal cavity of square cross section with overall dimension of λ/2 × λ/2, which constitutes the dual linear polarized radiating element. The surface waves generated due to multi-layered substrate is supressed by using a number of vias, placed underneath each element cavity, with a period of nearly λ/6 and diameter 12 mils.

This radiating element is expected to provide wideband performance with respect to S_{11} of 10dB between 12-15 GHz and port to port isolation (S_{21}) of around 25dB. Acceptable radiation pattern with wide beamwidth is observed over the entire bandwidth, while the peak gain is varying between 3-5 dBi. Peak co- to cross- polarization isolation is expected to be better than 20dB. Next, an 8×8 array antenna aperture will be designed with 64 radiating elements as discussed above. Inter-element spacing between is chosen according to expected beam scan range of ±45 degree. Active S-parameter will be computed for this array architecture for the desired scan range over the matching bandwidth. Peak gain versus frequency will be evaluated as beam scans.

Beamforming network will be directly integrated with the array aperture. For the beamforming network implementation, Anokiwave RFICs will be employed. Anokiwave RFIC (AWMF-0117) has features such as 10.5-15 GHz operation for dual polarization, Tx/Rx half duplex operation, +20 dB transmit channel gain with +12 dBm P1dB output power, +28 dB receive channel gain, with 3 dB noise figure, and 6-bit amplitude and 6-bit phase controls with low RMS amplitude and phase errors (https://www.anokiwave.com/products/awmf-0117/index.html).

The phased array antenna aperture will be built using 3D metal printing whereas beamforming network along with RFICs will be built using conventional PCB manufacturing. RFICs will be assembled on the printed circuit board. The full fabricated phased array antenna and the beamforming network will be tested for its impedance matching and scanned radiation pattern in the Antenna and Microwave Lab (AML) at San Diego State University. Analysis, simulation and measurement results will be presented during the symposium.