15-40GHz Tightly-Coupled Dipole Array with Integrated MEMS Phase Shifter

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Unmanned assets in the battlefield require compact, beam-agile, and low-power transceiver systems to address the air-to-air and satellite communication (SATCOM) connectivity requirements. Due to the increased maneuvering agility of such smaller aircraft, traditional beam-tracking techniques based on rotary gimbals are not desired. More importantly, new technologies that are concurrently low weight, low power, and low cost are badly needed. Among such alternatives, reflect-arrays and micro-fluidic beam-scanning techniques suffer from relatively large size, high complexity, and limited beam scan capabilities.

To this end, recently demonstrated tightly-coupled arrays (e.g. J.P. Doane, K. Sertel, and J.L. Volakis, "A wideband, wide scanning tightly coupled dipole array with integrated balun", *IEEE TAP*, vol. 61, no. 9, Sept. 2013) offer key advantages, such as small size and extremely low profile, while concurrently exhibiting continuous coverage of the X- through Ka-bands using a single aperture. Nevertheless, for UWB beam-agile phased-array operation, integrated phase-shifters that can operate over such wide bandwidths are also needed. In this work, we employ the micro electro-mechanical systems (MEMS) phase-shifter technology to develop switched phased-shifters that can be seamlessly-integrated with the tightly-coupled dipole array elements. A tightly coupled K- Ka-band (15-40GHz) dipole array antenna with integrated MEMS phase-shifter from XCOM Wireless is presented. In particular, the dipole elements and the feed lines are printed on low-loss alumina (Al_2O_3) substrate. Among alternative feeding structures, Marchand baluns provide the required compactness and ultra-wide bandwidth. To achieve optimum inter-element spacing and array element dimensions, full-wave simulations are first carried out the array unit cell and the phased-array performance is evaluated using finite array simulations with the integrated phase-shifters. Design and implementation details, as well as the integration approach and array performance will be presented.