Design, Fabrication and Test of a Low-Profile Highly-Integrated Ka-Band Array

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Many military and commercial systems on airborne and space platforms require wide-band, compact, low-weight and high gain conformal Electronically Scanning Arrays (ESAs). All these requirements drive the operational frequencies into millimeter-wave bands and beyond, which gives impetus for the development of new technologies and innovative ESA designs that will meet stringent requirements, and at the same time be affordable.

In this work, we have designed, fabricated and evaluated a 16x4 - element low profile, compact, and highly integrated Ka-band array, which could be also the subarray (flat facet) of a larger conformal ESA. The array was fabricated in a Low-Temperature Co-Fired Ceramic (LTCC) technology using commercially available Ferro A6M tape layers. The LTCC process was selected because it offers a high level of integration and has excellent physical and electrical properties. The array was implemented in the form of a multi-layer structure which combines the radiating aperture, beamforming network, DC power distribution network, array digital control network and Transmit/Receive (T/R) modules into a compact, fully operational ESA. To validate the design eight arrays have been built and characterized, Figure 1. The measured data for return loss and radiation patterns agree very well with simulated results over a 20% frequency bandwidth, Figure 2. The array has been checked for DC connectivity of power distribution and control networks as well as registration pads. No errors were found, indicating a yield of 100%. The array thickness, without T/R modules, is about one eighth of an inch which makes this design attractive for conformal applications in military and commercial radar and communication systems.

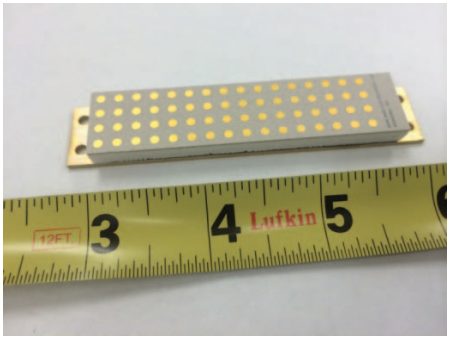

Figure 1. 64-element LTCC array

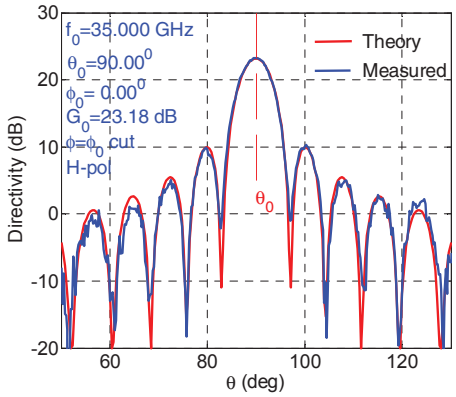

Figure 2. Directivity pattern