

# Integrated RF MEMS Devices in Liquid Crystal Polymer Substrate

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## Objective

Develop a large lightweight and deployable phased array using RF MEMS integrated with phase shifters, attenuators and amplifiers.

## Applications

Remote Sensing



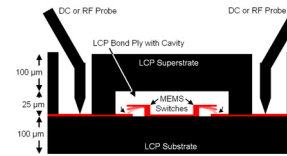
RADAR



Antenna Arrays

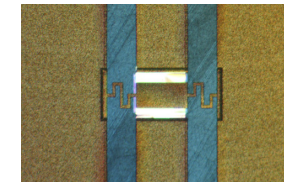
Liquid Crystal Polymer (LCP) is...

- Flexible
- Organic
- Low-loss ( $\tan \delta = 0.004$ )
- Low-cost (~\$10/sq.ft.)
- Light-weight (1.37-1.42 g/cc)
- Near-hermetic (0.02-0.04% water absorption)

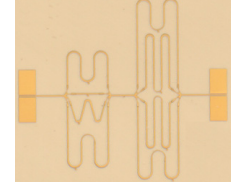


Side view of packaged MEMS Devices

## LCP Packaged Components to Date



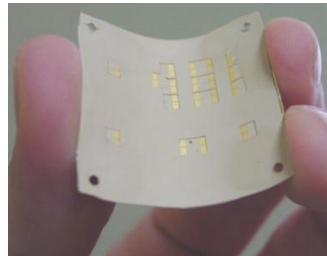
Capacitive, ohmic, cantilever, and air-bridge type MEMS switches



Miniaturized 4-bit phase shifter (16 possible phase shifts)

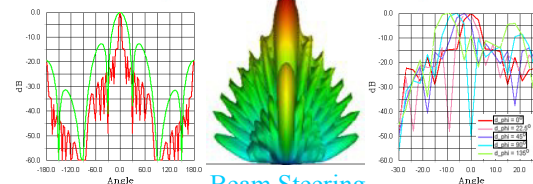
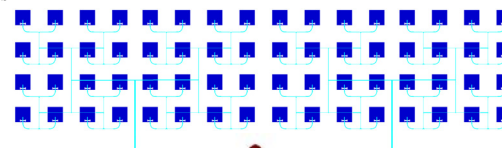
# FIRST EVER

## Flexible, Organic, RF MEMS Devices

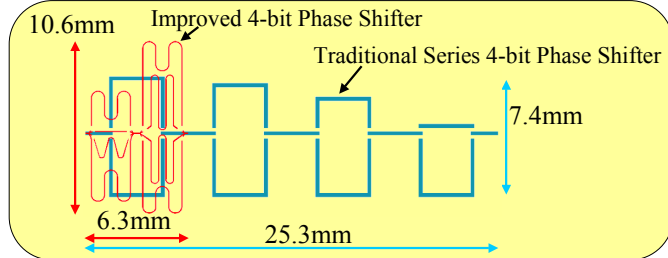


Demonstration of Flexibility

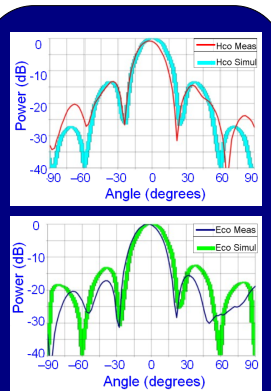
## 16x4 Antenna Array Simulations



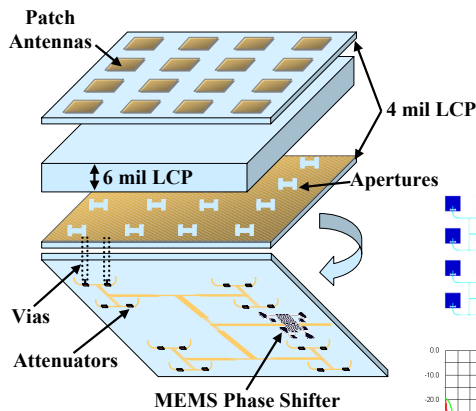
Beam Steering



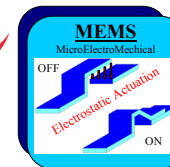
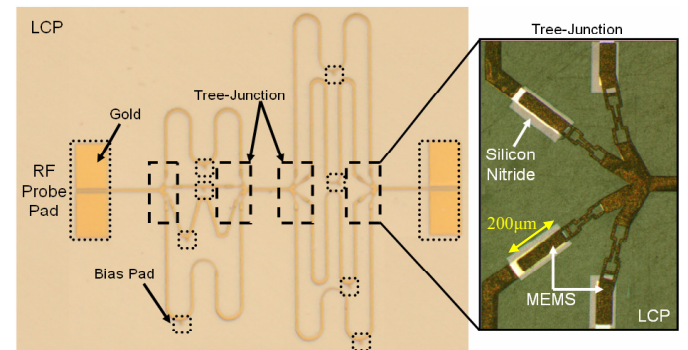
## Multilayer Antenna Array Typology



4x4 Antenna Array  
 $E_{co}$  and  $H_{co}$  Comparison of Measurements with Simulations



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## Further Research

Integrate MEMS phase shifter, planar antenna array, attenuators, and active devices to create a flexible, low-cost, high performance system