

The logo for EDICON 2018, featuring the text "EDI" in a blue box above "CON" in a white box with a blue border.

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2018

Electronic Design Innovation  
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The event details, including the dates and location, set against a background of circuit diagrams and a circular arrow icon.

October 17-19 2018  
Santa Clara Convention Center  
Santa Clara, CA

# Why RF and High-Speed Circuits Belong Together Under One Roof

How Our Capabilities Help Achieve  
the Art of the Possible

Presented by Daniel Everitt



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# Lark RF Technology Overview

## Our History

- Lark RF Technology is a Benchmark Company, and has provided RF component design and manufacturing for over 25 years.

## Our Mission and Priorities

- We are investing in innovation. We established an **RF and High Speed Design Center of Innovation** in Phoenix for integrated solutions (radios, circuit design, mixed microelectronics, etc.).
- We are the leaders in Liquid Crystal Polymer (LCP) components and high speed circuit miniaturization.
- We are expanding from high-end filters to offering broad RF Components and integrated RF solutions.

## Our Markets

- Aerospace and Defense Sensor Systems (Radar, Electronic Warfare, Munitions, and Avionics)
- Telecommunications (RF Front End)
- High-speed Computing
- Medical and Industrial



## Lark RF Technology: RF High Speed Design Center of Innovation



### **Our Areas of Expertise:**

- High Speed Circuit and Substrate Design and Fabrication
- Integrated Microwave Design and Assembly
- Hybrid and Mixed Technologies
- Surface Mount Technology (SMT) and Microelectronics Integration
- Design and Testing at Millimeter Wave Frequencies

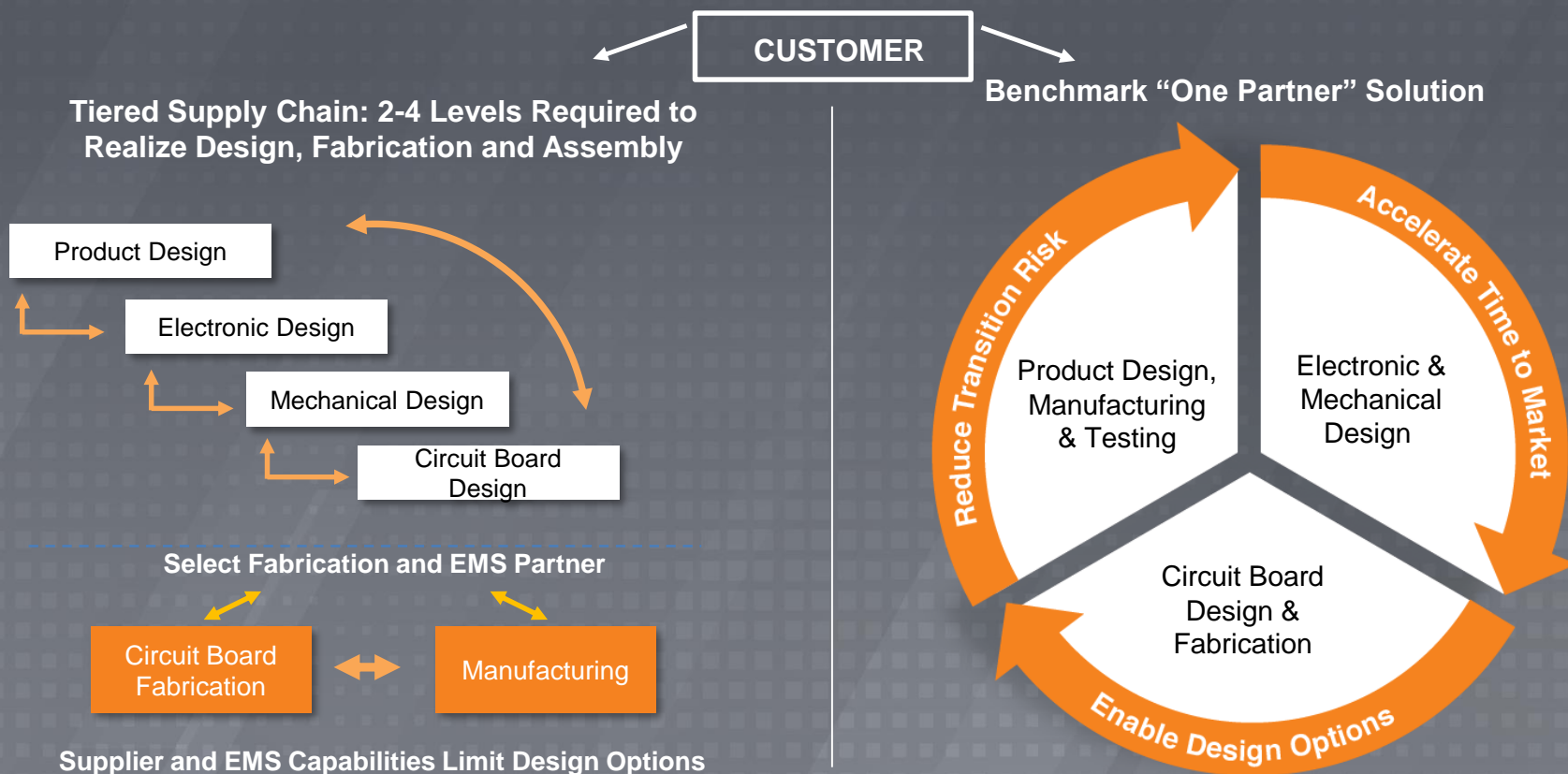


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# Tiered Design & Manufacturing Supply Chain vs. Benchmark "One Partner" Solution



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# RF and High Speed Design Center of Innovation

Our design center is the first facility in the world where customers can have access to:

- Prototyping and design services
- Breakthrough manufacturing processes in substrate and packaging technologies
- Mixed microelectronics
- Complex product assembly and testing

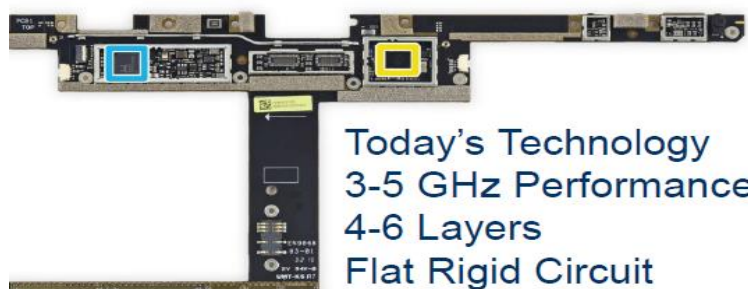


# The Benefits of High Density Interconnect (HDI) Utilizing Liquid Crystal Polymer (LCP)

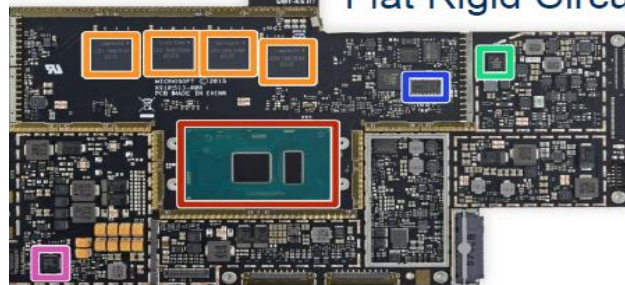
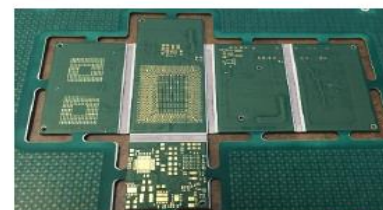
- Enables high frequency circuits beyond 40 GHz
- Smaller lines and spaces with tuned performance
- Up to 10 times thinner than conventional circuits
- 5-10 times more accurate and precise with better registration



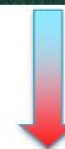
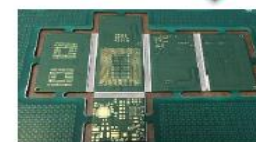
# Miniaturization of a PCB Utilizing LCP



40 GHz Performance  
12 layers  
5X smaller - Foldable



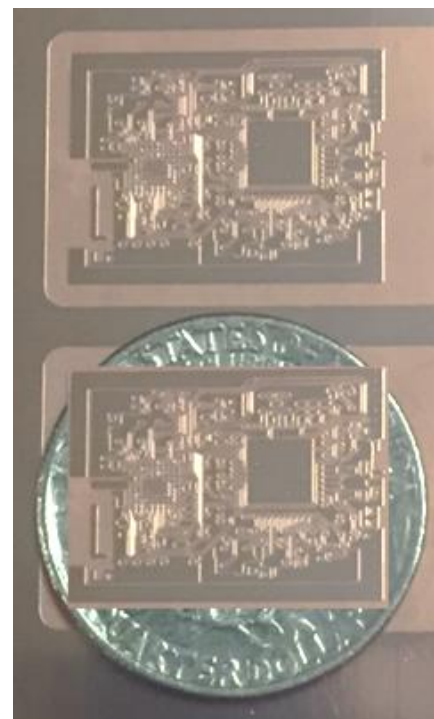
40 GHz Performance  
12-20 layers  
10X smaller – Foldable  
Direct Die Attach  
Embedded Components  
3D Shape Form



# Miniaturizing an IoT Tracking Micro-tag

**Objective: Reduce RTLS tracking module to the size of a US quarter**

- Design includes UWB and BLE capability
- Liquid Crystal Polymer (LCP) for improved RF performance and lower power
- Proprietary embedded antenna design for reduced size

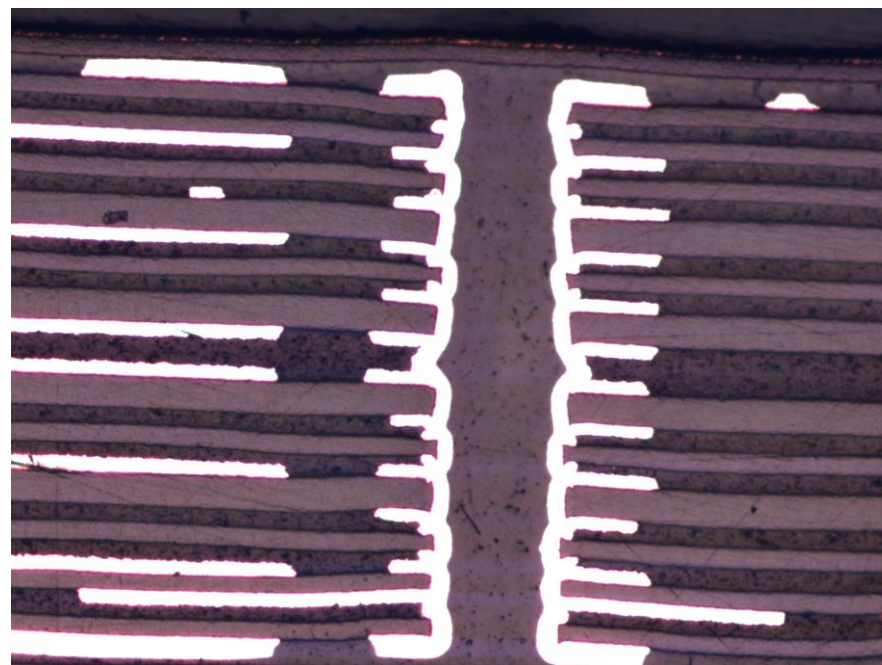




# High Density Interconnect (HDI) Utilizing LCP

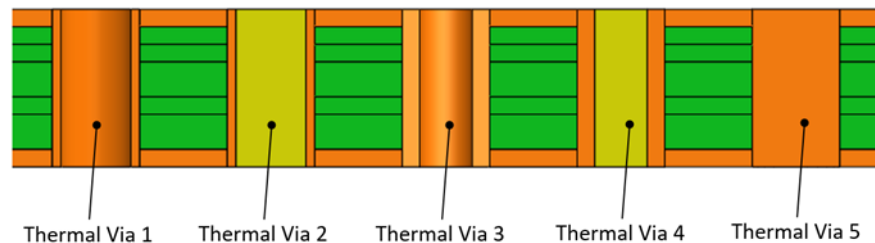
## X-ray of 15 Layer LCP PCB with thru-hole via

- Cross section of x-ray microscope view of a 15 layer LCP PCB with thru-hole via
- Benchmark's patented LCP fabrication processes prevent delamination issues, allowing higher layer count boards



# Thermal Performance Using Different Vias

- Via 1 Standard via with standard plating thickness, low thermal performance
- Via 2 Standard plating with thermal epoxy filling, improved performance
- Via 3 Thicker plating on via increases thermal dissipation path, better performance
- Via 4 Thicker plating with thermal epoxy filling, even more improved performance
- Via 5 Copper filled via maximizes the thermal dissipation path, best thermal performance



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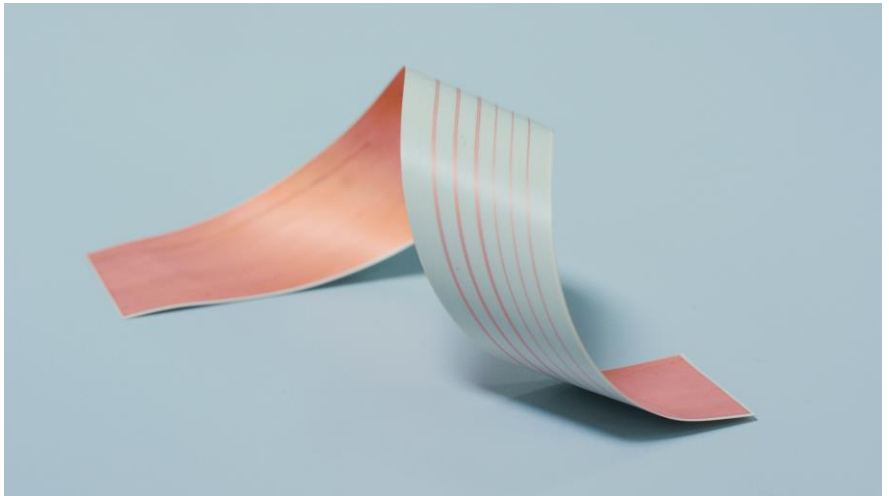
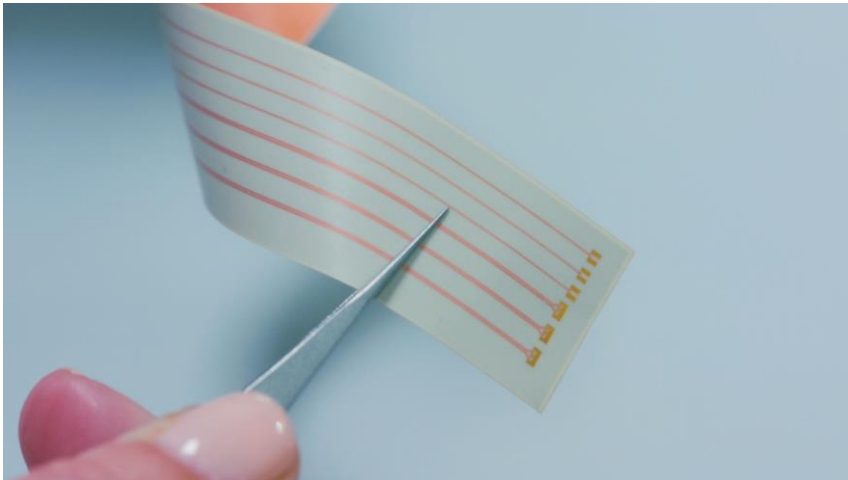
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## Buried Vias Build Solid Walls in LCP



# LCP is Ideal for Flexible Printed Circuit Boards

- Microstrip test coupon on flexible LCP substrate with 1 mil and 3 mil striplines



# LCP Micro “Business Card”

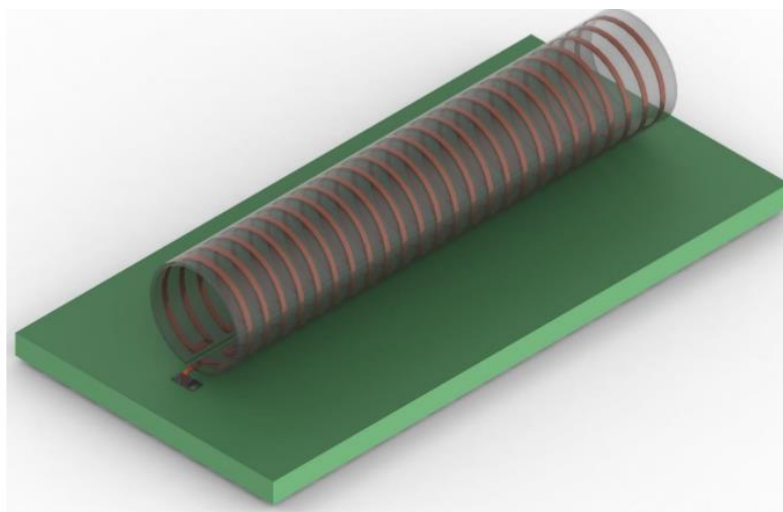
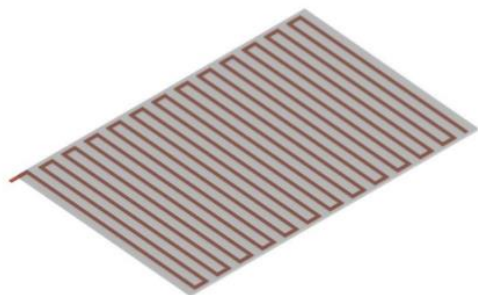
- The LCP card is made using a 2 mil thick LCP sheet
- LCP comes with copper on both sides, which is then etched to get just the thin sheet of LCP
- The card has ten 1 mil (25.4 microns) thick lines with 1 mil of spacing between them
- There are two RF resonators on the card for demonstration purposes
- The road map for the technology is to be able to make lines and spaces less than 0.7 mils (10-12 microns)



# Foldable LCP Example

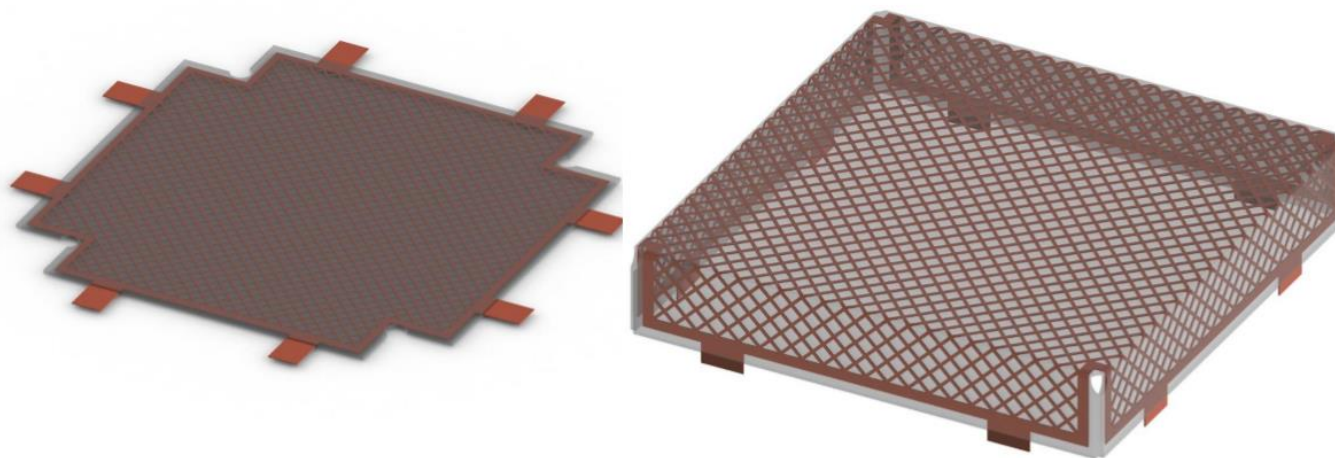
## Formed Circuit Bearing Fusion Bonded Liquid Crystal Polymer (LCP)

- Formable nature of LCP allows the creation of embedded circuitry, allows it to form a shape, and allows a fusion bond to retain shape or to bond to mating components.



# Foldable LCP Example

Formed Circuit Bearing Fusion Bonded Liquid Crystal Polymer (LCP)





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# LCP Enables SWaP Reductions

LCP - Enabling Next-Generation Size, Weight and Power Reduction (SWaP)

- Conveniently bury bare dies, components, and circuit lines inside layers of LCP substrate
- Create a substantial decrease in the overall packaging footprint, while creating significant electronic density
- LCP's near-hermetic sealing eliminates the need to add additional coatings or bulky sealed structures
- Lower overall costs, and reduced system complexity





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