RJR POLYMERS, INC.
The Total Electronic Package Solution

Introductory Presentation
On
LCP Packaging
Why Liquid Crystal Polymer?

LCP Barrier Properties

Water Vapor Permeability

(gram-m/25 m/100m2-24 hrs-atm) at 23°C

Oxygen Permeability

(cc-25 µm/m²-24 hrs-atm) at 23°C

Similar to Frit Glass
RJR Package Elements

Offered in two piece or three piece configurations

- Two piece for applications using epoxy die attach
- Three piece for applications using eutectic die attach
Market Space

- **RJR Polymers, LCP Packaging Technology:**
  - The market is ready for a drop in replacement to existing Air Cavity Packaging Technology
  - Provide Customers with cost reduction in comparison to legacy ceramic without diminished performance
  - Offer high degree of design flexibility
  - Lower cost of specialization
  - Optimize process on both sides of Manufacturer/Customer relationship.
  - Bridge the Power and Frequency spectrums
    - Lo to Hi-Power
    - Low to MM Wave frequencies
  - Build a diverse product portfolio

Brazed Ceramic/Metal, Seam Sealed

Classic Overmold/Transfer Molded packaging

volume
cost
R-Pak LCP Air Cavity Packages

Thermally enhanced metal based for microwave and power applications

- RF/ Wireless
  - Power
  - Signal
  - Microwave
- Imaging
- Sensors
- Fiber Optical
- MEMS
Power Packaging

- Flexible Platforms for product customization
- Full layout of open tools
- Wide array of available thermal bases

RJR Polymers, Inc.
## Package Base Materials Offering

<table>
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<th>Material</th>
<th>Thermal Conductivity - W/mK</th>
<th>Avg CTE</th>
<th>Plating types</th>
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Microwave Packaging

- The best performance is achieved in air cavity packages
- RF and microwave devices aren’t fond of being smothered in epoxy
  - detunes, shifts, degrades
- LCP is a very stable, low loss dielectric
  - loss tangent of .003 @ 10 GHz
  - good environmental protection
- Full metal base is an ideal ground plane and heat sink
- Many of RJR’s packages currently function well into millimeter wave frequencies

- Partially matched package
  - Integrated matching structures in the package provide impedance transform without additional cost
Why RPAK™?

- Can handle a wide range of power levels
- Can handle frequencies through millimeter wave frequencies
- Can utilize very high thermal conductivity materials
- Can tolerate CTE mismatch between package base and package sidewall.
- Maintains equivalent levels of mechanical stability as legacy ceramic packaging
- Maintains equivalent levels of moisture resistance as legacy ceramic packaging
- Is lower in cost than ceramic packaging
- Automation in both package manufacturing and assembly will provide for higher levels of future cost reduction
- Allows for higher degrees of materials selection (base materials, plating types, etc.) which can relate to reduced product cost.
- High degree of dimensional repeatability
- Provides for very high degree of product flexibility and integrated features.
Next generation packaging

- **Integration**
  - More Functionality in same or smaller space
  - *Injection molding offers the opportunity for additional features and added functionality*
  - *LCP can be electrically conductive*

- **Added Features/ Added Value**
  - Integrated Package housing and cable
  - Round packages
  - Impedence Transform
  - Integrated features such as integrated ferrules
  - Integrated package lids
    - Antenna/ radiating element in lid connected to elements of the package.
    - Radio in a package
  - RF Shielding
  - LCP Films/ Board level integration