R-Pak™

The Total Package Solution
Company Introduction and Technology Overview
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RJR Polymers, Inc. is the leading supplier of air cavity packages, known as R-Pak™, designed for specialized semiconductor products. We bring together patented adhesives, specialty packaging materials and a custom package assembly process for a world-class solution. Unlike commodity semiconductor products, RJR Polymers, Inc. focuses on packaging for semiconductors in which one or multiple die surfaces must not be exposed to mold compound or other package materials. Die exposure in cavity packages is a requirement for a variety of sensors as well as radio frequency (RF) applications (see box at left). These requirements can include features such as lid transparency, high voltage and extreme temperature tolerance, as well as near-hermeticity. These applications define the markets served by RJR Polymers, Inc. What defines RJR Polymers, Inc., however, are innovation, longevity, and the experience that comes with having shipped millions of units over the last three decades.

Markets Served
- RF power
- Small signal RF
- Sensors
- Imaging

Innovation

RJR Polymers, Inc. has made industry-leading breakthroughs in polymer-based air cavity electronic packaging. Our patented R-Pak™ process employs custom thermoplastic compound injection molded plastic body packages. These represent a tremendous leap forward in low-cost, injection molded packages. R-Pak brings to bear the advantages of using thermal advantages of eutectic die attach materials, between die and backplane, with a revolutionary plastic sidewall. This is designed specifically to manage the high frequency and power output characteristics previously only found in ceramic packaging methods. Unlike using ceramics, however, R-Pak provides both better economics as well as better design flexibility than ceramics. Sealed packages of this type have been environmentally tested and the results indicate a near hermetic package that passes JEDEC moisture sensitivity level 3. In RF applications, the RJR Polymers, Inc. air cavity package design leaves no package material surrounding the die to degrade performance. Typically an R-Pak package costs about 30% less that comparable ceramic packages. Given the average percentage of bill-of-materials dedicated to packaging, the value of the RJR Polymers, Inc. approach is evident.
**Concept and Method: Packaging**

RJR Polymers, Inc. air cavity plastic packages (R-Pak™) are pre-molded with a thermoplastic material around a yet to be populated lead frame. The semiconductor die is mounted into the package cavity, connected to the leads and finally sealed with a separate lid. A typical package is illustrated in figure 1. The die and wirebonds are in a cavity rather than being embedded in epoxy (as is the case with transfer molded packages). (see figure 2) Traditional transfer molded packages are produced by filling a mold with thermosetting epoxy, which encapsulates the entire lead frame and die. Complete immersion of die and wirebonds degrades performance.

**Concept and Method: Adhesives**

In its applied adhesives technology, RJR Polymers, Inc. answers one fundamental question: “What sticks to what?” Patented innovations in the formulation and processing of Liquid Crystal Polymers are key to the products and services offered by RJR Polymers. The same material science that has led to improved polymer materials in many other markets are now revolutionizing the semiconductor packaging industry. Advanced semiconductor packaging calls for highly reliable adhesives—and associated processing techniques—to assure bonding of a range of materials critical to the production of reliable semiconductor packages. While adhesion is one of the important performance criteria in our package manufacturing process, LCP materials formulation is pivotal. Our LCP compounds excel in meeting the unique physical, chemical, and electrical (dielectric and magnetic) requirements of semiconductor cavity packages. RJR Polymers, Inc. LCP materials used in package solutions can be engineered to application-specific requirements. For example, the molded compounds are resistant to typical chemicals used in the manufacturing and processing of electronic components. Polymer properties are modified to adjust conductivity and dielectric and magnetic properties. A further benefit of RJR Polymers, Inc.-based package assembly methods is the flexible nature of the polymers. The compounds are designed to match the thermal expansion properties of the materials being bonded.
Our proprietary adhesive materials derive their extraordinary bonding strength and superb sealing properties from the fundamental principle of covalent bonding; a joining of materials at the atomic level. This is of primary importance for the assembly of LCP frame forms with various base and lid materials.

**Concept and Method: Package Assembly**

Traditional semiconductor packaging techniques face a set of material interface problems related to different thermal expansion rates of semiconductor die, conductive solder materials, conductive and isolating bonding materials, and other package components. The combination of optimized LCP, adhesive materials with our patented assembly process, and semi-automatic sealing equipment, the Isothermal Packaging System (ITS), (see figure 3), provides important advantages to product reliability. This process found its origin in innovations developed by the company in the mid-1980’s; at the time of launch, this proprietary mixing/metering/dispensing equipment line already offered “Sans-Pro” reliability. Proven long-term product integrity and package reliability provide RJR Polymers’ customers with reduced failure rates and improved product quality. This is accomplished by utilizing the patented ITS 400 isothermal sealing process; It eliminates the risk of seal failure caused by blowouts during the sealing process. The key to this process is the equalization of pressure and temperature inside and outside the air cavity and by keeping the lid and package body separated during the heat-up cycle. Not only is this faster than manual sealing methods, it also produces a more accurate seal alignment. As a result, cycle times are as low as four minutes, requiring no additional post-curing and yields approach 100%. The R-Pak system approach to packaging is designed around the processes required to produce high yield packages. Epoxies and mold compounds are optimized with carefully developed processes. Processes, like inverted stamping of lead frames, injection molding, and application and B-staging of epoxy applied to covers are parts of the internal manufacturing flow. Coordinated material and process optimization results in high yield package production but not all elements of the air cavity package assembly processes are internal. The package cover attach is a process performed at the end of the package assembly cycle at the customer location. RJR Polymers, Inc. recognizes that process control and consistency are key to high yield, and thus solutions are designed to enable package assembly by the customer.
Customer Engagement

RJR Polymers, Inc. values its customers’ goals and schedules. As such, the company operates with an intense focus on making your goals our own. We provide customers with unsurpassed service and support. We have also designed our solutions to be flexible enough to allow options for the division of labor during the packaging process. Many process steps can either be performed by RJR Polymers, Inc. for the customer, or be brought in-house by the customers. Please contact our customer team (contact information on back page) to start the dialogue and find out how RJR Polymers, Inc. can take your semiconductor packaging to new levels.

Team

The RJR Polymers, Inc. leadership team is comprised of a potent combination of individuals: successful entrepreneurs and business leaders, veteran semiconductor industry insiders, polymer and applied materials science innovators, packaging technology experts, and operations leaders.

With the exception of lead frame plating, all process steps are performed on-site in Oakland, California by a stable work force of highly trained and experienced people; many of whom have been with RJR Polymers, Inc for nearly 20 years. A majority of the RJR Polymers, Inc. process operations are fully automated and performed in a linear fashion, however, they were all designed and built by RJR Polymers, Inc. in-house engineers. Continuity counts, and we consider our longevity in this hypercompetitive industry one our most valuable assets and proof of our viability as a partner in the industry.

Good management decisions have enabled us grow as a privately owned and funded company. This has also allowed us to benefit from a high degree of freedom for fundamental research in specialty polymers, packaging materials, and adhesives. Best-in-class research and development have made RJR Polymers into the globally-recognized innovator of LCP-based specialty electronics packaging it is today.
CONTACT RJR POLYMERS:

www.RJRPOLYMERS.com

Sales Contact
Joel Klein
+1 480 422 0335
jklein@rjrpolymers.com

Customer Support Contacts
Babita Lakhanpal
+1 510 638 5901 x430
blakhanpal@rjrpolymers.com

Dina Maria Margeirsdottir
+1 510 638 5901 x454
dmmargeirsdottir@rjrpolymers.com

Corporate Headquarters
RJR Polymers, Inc.
7875 Edgewater Drive
Oakland, California 94621
+1 510 638 5901
rjr@rjrpolymers.com

Phoenix Office
9831 South 51st Street – Suite E124
Phoenix, Arizona 85044
+1 480 705 0435

New England and
Metro NY/NJ
O & S Associates
13 Centre Street
New Bedford, MA 02740
+1 508 993 9140
sal@oands.us
website: www.oands.us

United Kingdom
PandA Europe
Lambourn, Berks, RG17 8YP
United Kingdom
+44 1488 73512
andy@pandaeurope.com
website: www.pandaeurope.com

Italy
Alfa Microonde S.N.C.
Via S. Bernadette 76
00167 Roma
+06 66 31 744 office
info@alfamicroonde.it
website: www.alfamicroonde.com

Asia
Damais Mak
+ 85 2 9368 6988
dmak@rjrpolymers.com

WT Loke
+60 12 3992638
wtloke@rjrpolymers.com