PariPoser® Anisotropic Conducting Material

Description

Paricon Technologies Corporation has developed a family of high performance materials specially designed for high-density electrical interconnections, such as test and burn-in sockets, production level integrated circuit sockets, as well as custom cable and other connector systems. These specially designed anisotropically conductive materials are referred to as PariPoser® Interconnects. PariPoser Interconnects make electrical connections uniformly between opposing contact areas using conductive columns, which are regularly distributed within a sheet of silicone rubber. PariPoser Interconnects are custom formulated depending on the application's pad pitch.

Characterized by excellent thru-conductance and high in-plane isolation, the properties of PariPoser Interconnects make them an excellent choice for applications requiring fine-pitch, non-planar interconnections. The material is formulated and manufactured to provide high mechanical shock relief while maintaining superior mechanical stability over an extended service life.

Easy to Use

PariPoser Interconnects are ideally suited for high-density I/O interconnections where soldering is difficult – such as LAND-grid-array, BALL-grid array connections and device test interconnections. Interconnections are made by simply placing the PariPoser Interconnect between the pads to be joined and applying pressure.

In addition, the quick and uncomplicated disassembly of PariPoser Interconnections facilitates scalability, field terminations, component repair, and use in test components. Since both solder and flux are eliminated, no heat damage is induced during testing or repairs, and the use of hazardous cleaning solvents is eliminated.

Natural Resilience

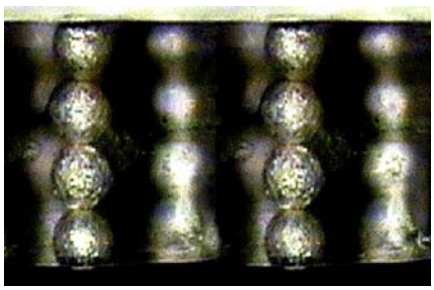
The primary ingredient in the standard PariPoser Interconnect is naturally resilient silicone rubber. Its elasticity allows the material to compensate for surface irregularities between adjoined components; a characteristic that lowers component and assembly costs and reduces rejection rates.

Inherently reliable and re-usable, the silicone-rubber base material features robust mechanical properties and may be used confidently in harsh environments, sealing-out contaminants. PariPoser Interconnects can be easily shaped and cut, allowing designers greater flexibility in product configuration and product changes.

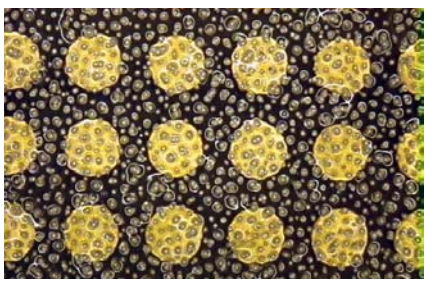
High Reliability

PariPoser Interconnection reliability in prototype connector assemblies has been thoroughly proven by using standard testing regimens for the qualification of Bell Laboratories connectors and printed wiring boards. The capability of PariPoser Interconnects to withstand repeated high-compression excursions has been verified to 500,000 cycles (test limit) against gold-plated connectors, in laboratory conditions.

No special handling procedures are required. The material is readily cleaned with water; the surface may be air-blown to remove particle contaminants.



Cross Section of PariPoser® Fabric



Pads Seen Through PariPoser®Fabric

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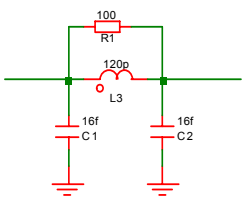
PariPoser® Material Typical Characteristics

Pitch	1.00 mm	0.50 mm
Physical		
Recommended Pad Diameter (Filled Vias)	0.60 mm	0.30 mm
Minimum Pad Edge to Edge Gap	0.40 mm	0.20 mm
Thickness (uncompressed)	0.25 mm	0.13 mm
Hardness (shore A)	55	55
Tensile Strength	0.295 kg/mm^2	0.295 kg/mm^2
Elongation of Base Elastomer	300 %	300 %
Tear Strength	0.91 kg/mm^2	0.91 kg/mm^2
Electrical		
Voltage Breakdown	1000 V	750 V
Typical Contact Resistance	<15m Ω	<25m Ω
Isolation Resistance	> 10^9 Ω	> 10^9 Ω
Current Carrying Capability	2 amps	1 amp
Time Domain: Signal Delay Risetime, thru into 50 Ω	 2 ps 30 ps (test system risetime)	 2 ps 30 ps (test system risetime)
Frequency Domain: Insertion loss	 < 0.5 dB to 25 GHz < 1 dB to 40 GHz	 < 0.5 dB to 25 GHz < 1 dB to 40 GHz
Equivalent Circuit Parameters: Inductance: S to GND capacitance: Transmission line:	 0.094 nH 0.023 pF Z_0=55 Ω T_1 = 2 (typ) ps	 0.094 nH 0.023 pF Z_0=55 Ω T_1 = 2 (typ) ps
Reliability		
Temperature Cycling (contact resistance after 315 cycles, -20 °C to +100 °C): Gold-plated contacts	 <1% change	 <1% change
Corrosive Atmosphere (contact resistance after 1000 hrs. with temperature-humidity cycling): Gold-plated contacts	<5% change	<5% change
Shock and Vibration per EIA-540, Test Procedure FP2 and FP3:	pass	pass

Frequency Domain

The lumped element model for the elastomer itself consist of a Pi-section consisting of a 120 pH inductor and two 0.016 pF shunt capacitors.



Lumped element equivalent circuit

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PariPoser® Connector Products
Application Guidelines

Introduction

When using copper based contacts, it is well understood that the design of the contact must follow design rules which match the application to the physical capability (and limitations) of the copper alloy. When these design rules are not followed, the resulting product will most likely not meet its intended use.

Elastomeric connectors, like copper contacts, must be constructed utilizing design rules based on an understanding of the mechanics of elastomers. Paricon has combined the efforts of more than 10 years of focused research at a cost of over $30 million dollars to develop a high quality elastomeric interconnection capability as well as the design rules to create a broad range of high quality products. These products include test, burn-in and OEM applications.

To achieve optimum performance with PariPoser® materials, it is important to understand their structure and to provide the correct mechanical interface. Paricon's studies have shown that when the design rules are followed, very high performance electrical interconnection capability can be obtained for a wide range of applications including test, burn-in and production interconnection products.

PariPoser Structure

The PariPoser fabric is comprised of columns of silver-plated nickel particles uniformly distributed in a thin sheet of silicone. Typical sheet thickness ranges from 0.0025" to 0.015". When the PariPoser fabric is compressed between a pair of flat conductors the silicone elastically moves allowing the columns to electrically interconnect the conductors. The contact loading force is generated by the elastic displacement of the silicone. Paricon markets these products under the name "BallWire contact". Unlike wire based elastomeric products, BallWire contacts are not easily damaged by excessive loading and are not subject to Euler Column failure. The nickel particles are very hard and are very effective at penetrating oxide layers.

The column density is such that multiple columns will contact each interconnection pad. The PariPoser column density is much greater than the contact spacing. Multiple BallWire columns will be present at each pad location. As a result, no orientation of the material, relative to the pads, is required. One just has to make sure that the components being interconnected are aligned to each other.

PariPoser fabric does not compress under load but moves elastically allowing the contact pads to make intimate contact with the BallWire columns. Space must be provided for the silicone to move into. This space is provided by the PariPoser surface roughness and the interstitial space between the contact pads. When a PariPoser connector is compressed between an LGA device and board, the PariPoser material conforms to the surface tending to fill all the voids providing a stable, gasket like interconnection. Little additional vertical motion will occur with load or time. The result is a very stable, environmentally protected interconnection.

PariPoser interconnection materials are formulated to optimize both insulation resistance and through resistance. Our standard design process is to require a gap between any adjacent conductors be at least 40% of the pitch. Hence when using our 1.0 mm pitch material, all spaces between any adjacent conductors must be at least 0.4 mm. When traces pass between pads can be contacted by the PariPoser fabric, the gap between the trace edge and the pad defines the required formulation. For this reason, Paricon recommends that no traces be placed on the surface layer in the pad field.

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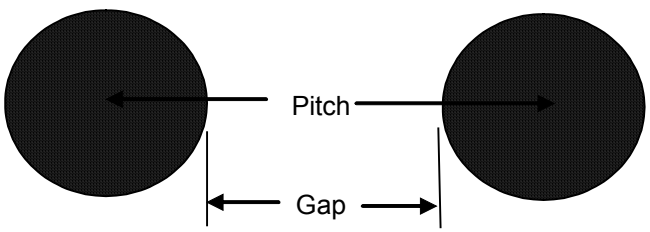
Design Rules

The following design rules will provide optimum performance when using PariPoser technology. Deviations from these rules should be reviewed with Paricon for input on the impact on performance. The following table summarizes the design rules.

Contact Design Rules

Contact Pitch (mm)	Minimum Gap[1] (mm)	Minimum Pad Area[3] $(mm)^2$	Minimum Pad Height[2] (inches)	Sheet Thickness (inches)
1.27	0.51	0.46	0.0030	0.0150
1.00	0.40	0.28	0.0030	0.0100
0.80	0.32	0.18	0.0030	0.0090
0.50	0.20	0.071	0.0020	0.0065
0.40	0.16	0.045	0.0020	0.0053
0.10	0.04	0.0028	0.0014	0.0025

1- Gap applies to pads on both surfaces.
2 - Pad height includes total height of opposing pads
3 - Area is projected interconnection area between opposing pads



PC Board

- Pads can be of any shape but gaps between adjacent pads/ traces must be at least 40% of the defined pitch.
- Traces between pads are not recommended.
- Large ground pads should be segmented to allow flow of the silicone.
- No solder mask should be used in pad field or under contactor.
- Although solder plated pads have been demonstrated to be effective, Paricon recommends the use of gold plated pads for the best performance.
- The use of filled via technology has been demonstrated to provide increased pad area and, as would be expected, lower contact resistance.

LGA Device

- Pads can be of any shape but gaps between adjacent pads / traces must be at least 40% of the defined pitch. Board pads and Device Pads must be considered together when defining the 40% gap.
- Traces between pads are not recommended.
- Solder mask is permitted as long as the pads on the board has no solder mask and the depth of the well created by the solder mask is no more than ~5% of the pad diameter. (A .025″ diameter pad on 1mm pitch can be recessed 0.0012″ from the plane of the solder mask.
- Solder plated pads can be used but the best performance for repeated insertions as seen in test and burn-in are obtained with gold plated systems.

BGA Device

- In general, direct contact between a BGA device and the PariPoser material will tend to splay the columns and not provide as high a quality of performance as found with an LGA. Paricon has developed a unique flex circuit interposer which contacts the solder ball at the periphery, provides wipe, and protects its bottom from mechanical damage. It also provides a flat pad interface to the PariPoser for optimum performance. Contact Paricon for more details.

Kelvin Contactor

- Kelvin contactor capability is provided by using the 0.1 mm PariPoser fabric in the contactor. The pad pairs on the board should follow the design rules of the 0.1 mm material. Hence the gap should be greater than 0.04 mm or 0.0016″. A practical gap dimension is >0.0025″ .

Loading

- A uniform load of 40–50 grams per contact (for 1 mm pitch applications) over the contact surface is recommended for optimum performance.
- A backing plate that prevents the PC board from moving more than 0.002″ is recommended.
- An external spring member that maintains a constant load should be used.
- A uniform load spread over the entire device is preferred but not required except for devices that are very thin. Successful applications have been designed for ceramic packages using only a small portion of the edge of the package to apply the load.
- Load levelers such as silicone pads are very effective.

Durability

- The PariPoser material is quite durable and can be used for several hundred thousand cycles in test applications. No cleaning is necessary under normal usage. Any loose debris that is on the PariPoser material can be blown off with compressed air (canned air). Alcohol can also be used to rinse debris from the PariPoser surface. Excess scrubbing of the surface is not recommended, as it can loosen the nickel particles causing a loss of conductivity. Removal of surface nickel particles is the key failure mechanism noted.

- The amount of set that the PariPoser material takes is slight and temperature dependent. Little permanent deformation is noted. The PariPoser material will conform to the pad geometry and an impression can be seen when the connector is disassembled. This is small and tends to fully recover in a short time. This phenomenon is not a "set" but is perhaps better described as being damped or viscous elasticity.

Performance Characteristics

Paricon has developed many products and formulations to address a wide variety of applications. Specific data sheets and connector application support is available upon request.

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