

Advanced Lead Frame Services—  
From Design to Delivery



**Founded in 1982, QPL Limited** is a global supplier of lead frames for the semiconductor industry. With headquarters in Hong Kong and manufacturing in both Hong Kong and China, the company has sales offices throughout the United States and Asia Pacific.

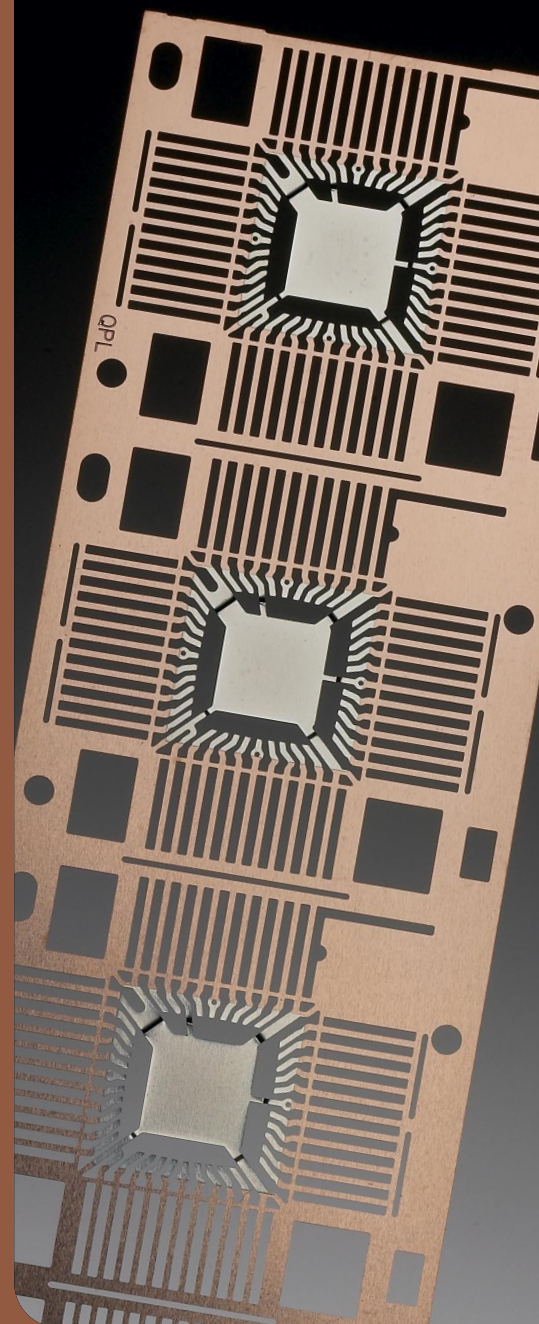
**At QPL Limited**, we are committed to delivering total customer satisfaction through product quality and service reliability. From lead frame design to delivery, QPL provides volume production while at the same time offering customers the customization they need for specific requirements. These may include reduced cycle times, customized specifications, thermally and electrically enhanced designs, special quantity orders and an inventory management service. Our flexible approach gives our customers the most reliable and cost-effective solution for sustaining an uninterrupted supply line.

To ensure total customer satisfaction, we maintain the highest standards of customer service. Through streamlined and flexible production standards and on-call customer service, QPL delivers products with industry-renowned quick turnaround times. In-house design teams also allow us to tailor our services to different customer requirements. In addition to customer design for etched lead frames, QPL provides a comprehensive range of standard products including SOIC (Small Outline Integrated Circuit), QFP (Quad Flat Package), TQFP (Thin Quad Flat Package), PDIP (Plastic Dual In-Line Package), PLCC (Plastic Leaded Chip Carrier) and TSOP (Thin Small Outline Package). For customers with a long-term need in lead frame supply, QPL has also developed a partnership program through which both companies work together to determine overall requirements while striving to reduce costs and increase service.

We're always looking to future development trends in the industry and the needs of our customers. As such, investing in new technology and equipment forms a vital part of QPL's business strategy. We continuously assess and evaluate how production processes and customer requirements can be refined and improved to increase levels of efficiency and quality. Investments are also being made in new technologies such as laser plotter systems, automatic etching machines, high-speed plating and automatic downset/taping equipment. In addition, we are dedicating resources to licensing technologies (pre-plated lead frames, NiPdAu (Nickel Palladium Gold), Stiffeners for TBGA (Tape Ball Grid Array) and Heatsinks for Thermal Enhanced Packages, etc.) as well as automatic inspection systems for everything from mask generation to final testing/inspection operations.

With our high-quality products, experienced personnel and continuous investment and improvement in new technology, QPL is committed to become the most preferred lead frame supplier in the world.

We offer a full range of process capabilities to meet all customer requirements. This makes QPL the partner of choice for one-source lead frame manufacturing, and provides customers with the flexibility they need to customize a design to meet their specific applications.



#### SURFACE CLEANING

QPL utilizes a conveyor-type cleaning process to remove surface contamination that occurs in the form of oils, greases, oxides, dirt and particulate contamination.

#### LAMINATION

This process consists of laminating photoresist on the surface of cleaned raw material, with coating being performed automatically through the use of a laminator. Both sides of a lead frame can be coated simultaneously using two separate rolls of photoresist. Photoresist offers a means of rendering substrates photosensitive, resisting the etchant by providing a protective coating which adheres firmly to the substrate surface. Finally, the substrate is slitted into panel form to prepare it for the next process.

#### EXPOSURE

The photoresist is then exposed to the required lead frame pattern with the aid of an ultraviolet source and a precision pattern glass/film photomask. Note: The photomask is generated by converting a customer drawing (artwork file) into a single-strip master mask or multi-strip production mask.

#### DEVELOPMENT

During development, areas to be retained as metal are coated with resists and the etched parts are kept free of the resist in the finished pattern. Development is achieved by spraying developer onto the imaged photoresist.

#### ETCHING

The etching process involves running the developed panels through a series of nozzles spraying etchant, after which the protective photoresist film is stripped from the finished lead frames. Etched panels are then singulated into strips to suit cut-strip form plating, taping and downset operation.

#### PLATING

QPL's capabilities include plating silver, NiPd, AuPdNi, nickel and gold onto lead frames. All of our plating operations are in strip or reel-to-reel to help facilitate quick turn-around and small lots. To ensure customer compliance, quality of the plated products is closely monitored.

#### TAPING

Taping is a process wherein the inner leads of the lead frames are taped using a thin polyimide material fed into the cutting die. A cut strip of a tape held at the tip of the punch by a vacuum is pushed directly downward to stick on the heated lead frame beneath the die. Different types of tape configurations are available to meet specific package needs. These include QFN taping in which the tape is applied to the back of the QFN lead frame strip, and Lead Lock taping in which the tape is applied to the lead tips on the top of the lead frame in order to maintain lead coplanarity. QPL is also capable of applying LOC (Lead on Chip) tape on Alloy 42 lead frames for memory packages.

#### DOWNSET

Downset is a process that depresses the tie bar of the die pad to obtain the required dimension for every unit of a strip.

#### 100% AUTO-INSPECTION

QPL performs auto-inspection on every lead frame for dimensional and surface-condition defects.

#### PACKING AND SHIPPING

QPL provides the highest level of care when packing and shipping lead frames, and will work with you to ensure that your lead frame order arrives safely and on time.

## PROCESS CAPABILITIES

### Process Flow—Etching

Photochemical etching is one of the most widely used methods for manufacturing lead frames. A high unit-cost process, it can be tooled with low costs and minimal time requirements.

Etched lead frames are manufactured in flat sheets, made of either copper or Alloy 42, on which both sides are coated with photoresist film. Next, surface cleaning is performed, followed by lamination. The

photoresist is then exposed to the required lead frame pattern with the aid of an ultraviolet source and a precision pattern glass/film. The areas to be retained as metal are coated with resists and etched parts are kept free of the resist in the finished pattern during development process. The final steps include running the material through a series of nozzles spraying an etchant, after which the protective photoresist film is stripped from the finished lead frames. Next, the etched panels are singulated into strips. The cut strips are cleaned and plated, usually with silver at the inner leads to facilitate wire bonding. The plated strips are then taped with lead lock tape and downset before the final inspection.



### Silver Plating

QPL offers up to 16 lines on one plating machine for faster cycle time, minimizing floor space and additional costs.

Lead frames are plated with standard spot/ring/full plating or multi-mini spot plating, with individual lines separately controlled to meet the customer's quality requirements.

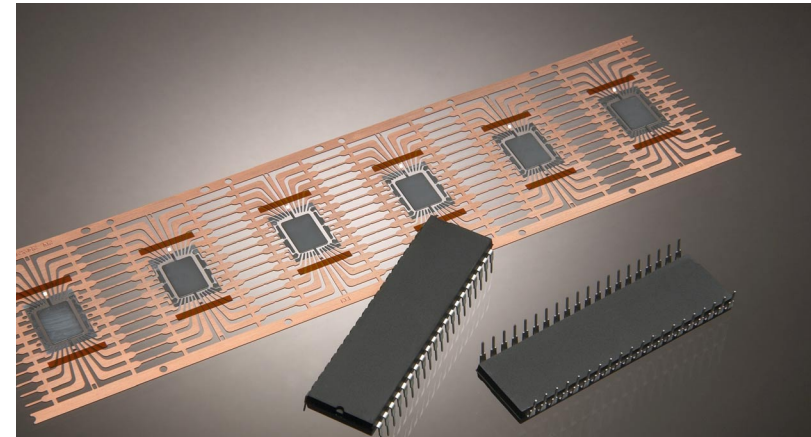


### NiPdAu Plating

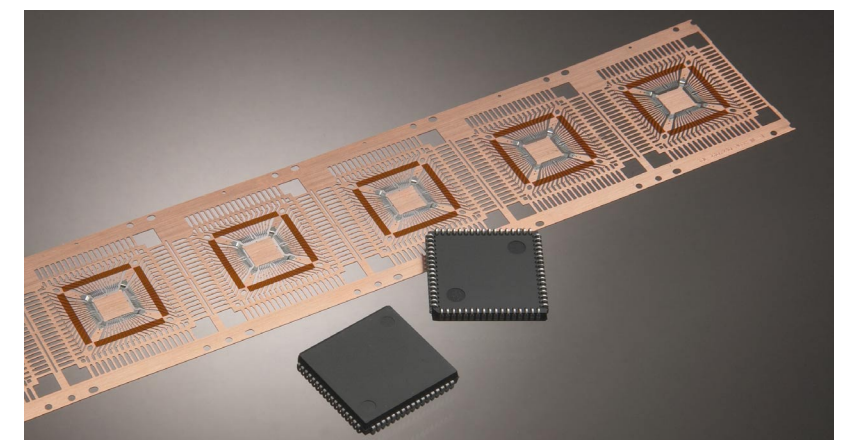
Through licenses obtained from Texas Instruments and Furukawa, QPL offers substantial advantages by using NiPdAu-ppf (NiPdAu pre-plated lead frames). These advantages include the elimination of selective plating, the completion of all wet processes prior to package assembly, and increases in both throughput and production yields. This process also enables significant quality

improvements, including enhanced coplanarity maintenance, the elimination of both solder bridging and the possibility of silver migration, and environmental benefits due to the elimination of Cyanide and Lead. Best of all, customers realize overall packaging cost reduction due to simplification of the plating process, the reduction of waste treatment, and the extension of their lead frame shelf-life.

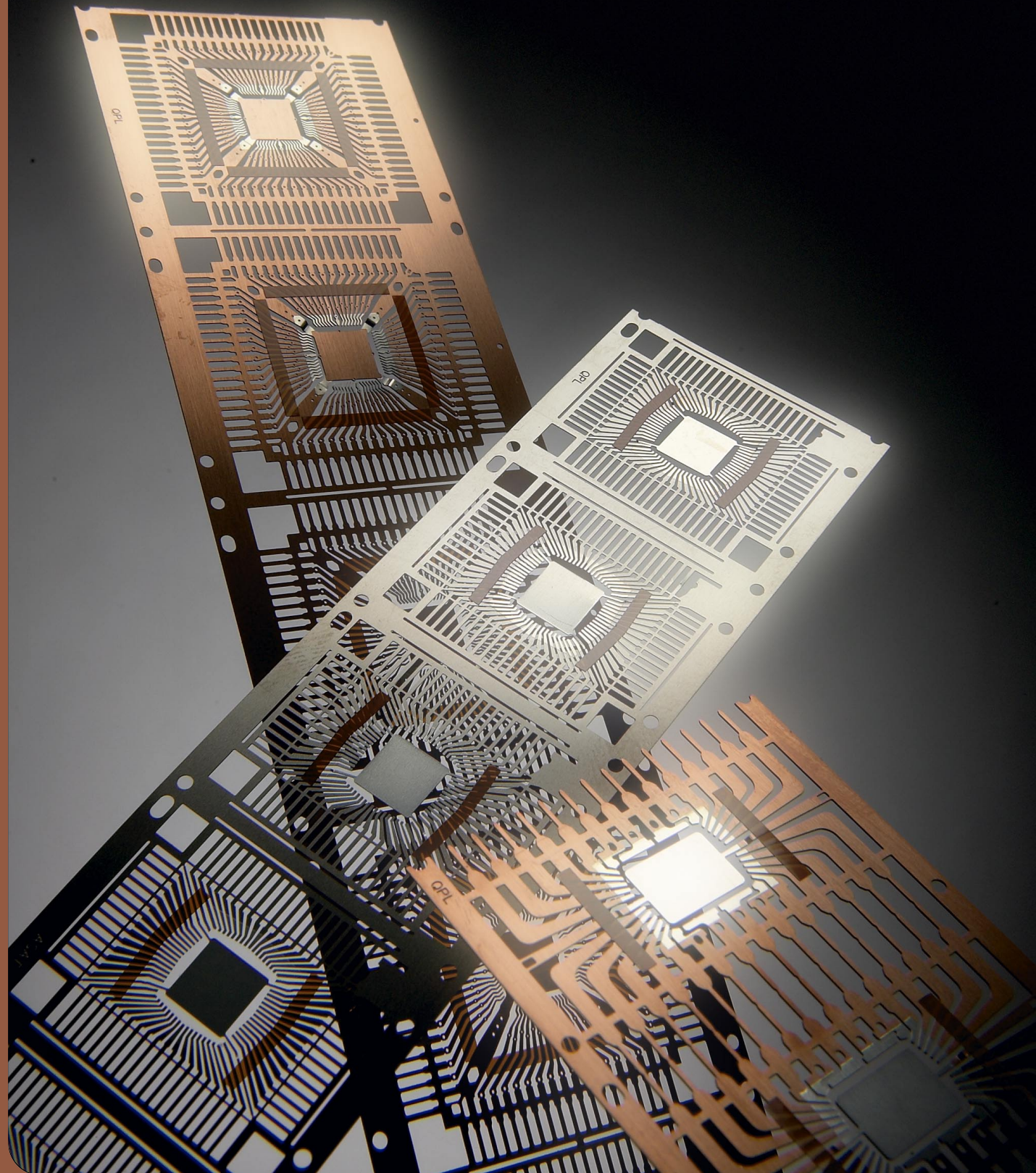


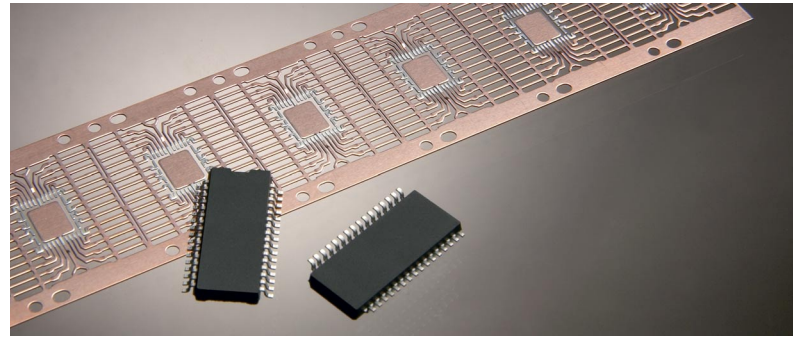


**PDIP/SPDIP** The Plastic Dual In-line Package/Shrink Plastic Dual In-line Package has a rectangular plastic body with two rows of leads that are bent up from the package body at a slight angle. Its most common use is through-hole insertion mounting in applications such as logic, processor and memory devices. QPL also delivers IDF (Interdigitated Frame) versions that enable more lead frames to be oriented along a strip, resulting in increased throughput in assembly.

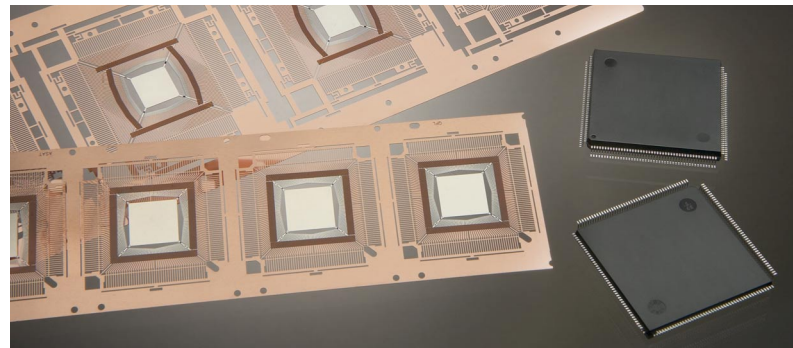


**PLCC** The Plastic Leaded Chip Carrier has leads on all four sides with J-shaped bends and is available with a variety of pad designs, such as dual-pad. Designs with fused leads promote better thermal performance, while those with a closed dambar reduce mold flash and improve the solder plating coverage.



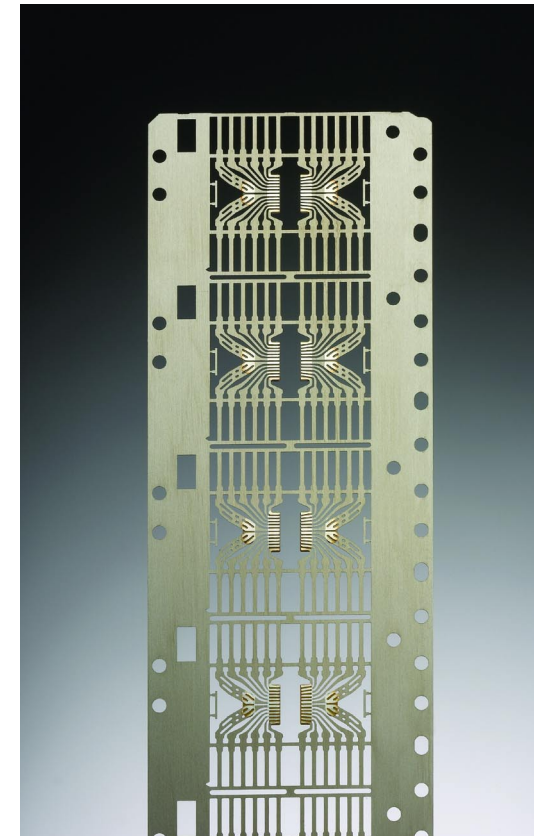
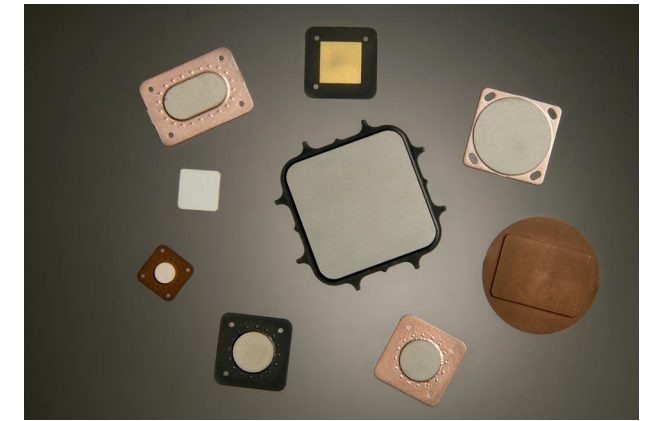
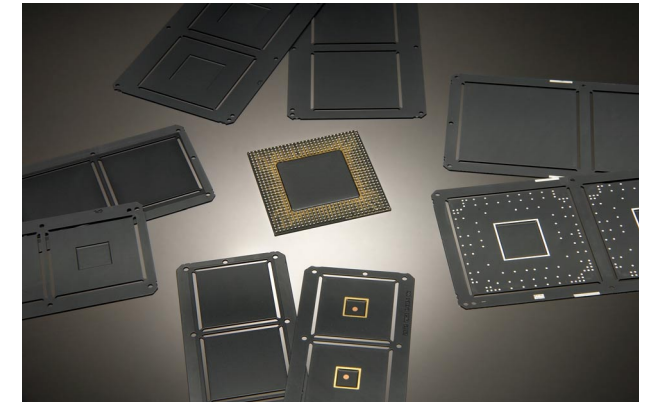


**SOIC** The Small Outline Integrated Circuit is available in a number of variations, including SOP (Small Outline Package), SSOP (Shrink Small Outline Package), SOJ (Small Outline J-Leaded), TSOP (Thin Small Outline Package), and TSSOP (Thin Shrink Small Outline Package). The SOIC package is desirable for its small footprint on the circuit board. SO lead frames are available in single-pad, dual-pad and matrix designs.

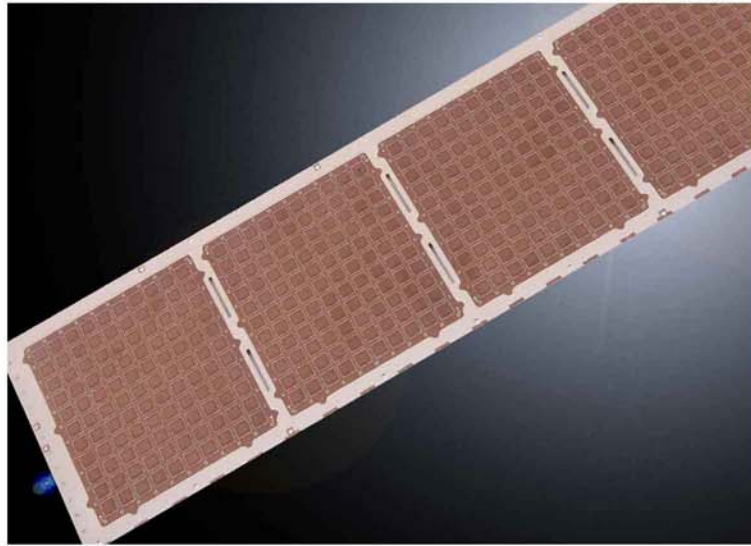


**QFP/TQFP** The Quad Flat Pack/Thin Quad Flat Pack is a plastic package with a square or rectangular body with leads on all four sides in a gull-wing configuration. Designs with “dimples” (half-etched holes) on the back side of the pad provide the mechanical adhesion to prevent delamination. Different pad designs exist to further enhance package reliability, while designs with a dual-pad lead frame are available to minimize cost.

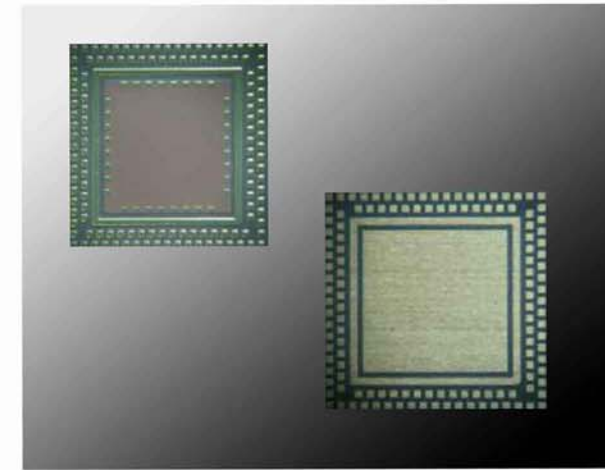
**TBGA** The Tape Ball Grid Array Stiffeners/Heatsinks deliver high performance while reducing the real estate required by QFP and PBGA (Plastic Ball Grid Array) packages. The TBGA Stiffener is the integral top layer of the package and is fabricated from thermally conductive sheet copper. Due to its strength, the stiffener is used for handling the package during assembly, test and reflow on the motherboard. The cavity where the IC chip is placed is etched and can be plated with a gold ring, which provides a wire bondable surface for ground bonds. QPL offers a wide range of TBGA stiffeners for high-performance applications, as well as both etched and stamped heatsinks (heat spreaders).



**LOC** The Lead On Chip features lead fingers that are attached directly to the surface of the chip using a double-sided adhesive tape. Since there is no die pad on the LOC lead frame, the package allows for higher density, enabling it to accommodate a larger IC chip and providing better reliability performance than traditional packages. These characteristics make LOC packaging a good choice for meeting the increasing capacity and density requirements of DRAM (Dynamic Random Access Memory) designs.



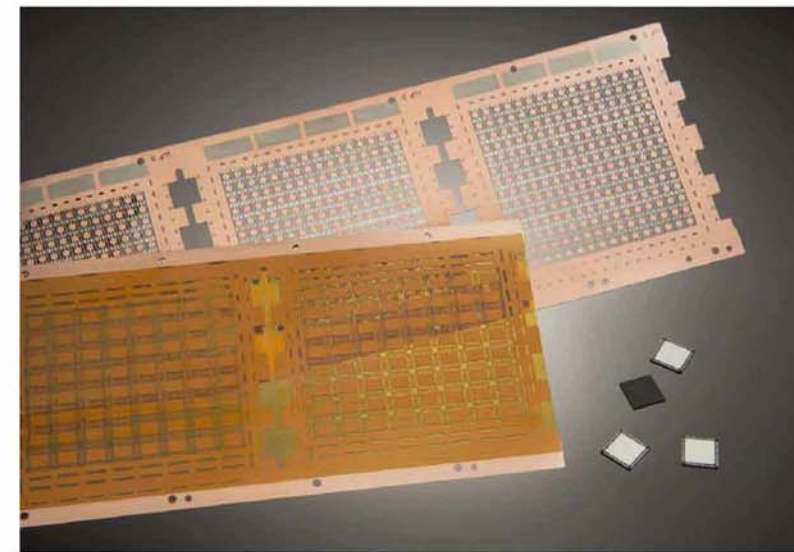
**HDL** The High Density Leadframe (HDL) is the latest innovation in the QFN (Quad Flat No-Lead ) packaging evolution that delivers the greatest number of leads per body size while delivering the highest performance at a lower cost. The HDL package and processes were invented and developed by Mr. Li Tung Lok (TL Li) of GPL Limited and uses high density leadframe routing to allow contacts to cover the total bottom area of the package. The HDL's unique two-step LF etching process allows the package to be designed around the die and application and results in the shortest wire bond lengths of any wire bonded technology. With outstanding electrical, thermal, and MSL level 1 performance, the HDL package is ideal for single die, MCM and SIP applications using either Flip Chip and/or Wire Bonding connections. The IC Packaging Technology of the future is here today with HDL solutions.



### HD-BU

"HD-BU", abbreviated from High Density Build Up, is an ultra thin, fine pitch package with exposed die attach pad feature for excellent electrical & thermal performance. "HD-BU" is a lead-free, multi-row, array package solution and provides a high flexibility for design for most of chip scale applications.

**QFN** The Quad Flat Non-Lead package type delivers the small footprint and low pin-count needed for today's portable devices and high-speed applications demanding high electrical performance in a constrained area. QFNs are miniaturized, low pin-count, perimeter-array packages that use a metallic lead frame for the die assembly and board interconnection. This design allows the use of standard die-attach, wire-bond and encapsulation technologies and equipment. QFN is a lead frame-base CSP (Chip Scale Package) type of package with a "leadless" element that enables superior thermal performance and the ability to view and contact leads after assembly. GPL has the capability to produce custom designs based on customer request. All parts are available with a standard plating option.





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