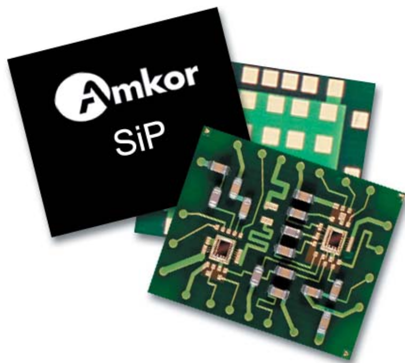
System in Package (SiP)

technology

SiP technology

solution



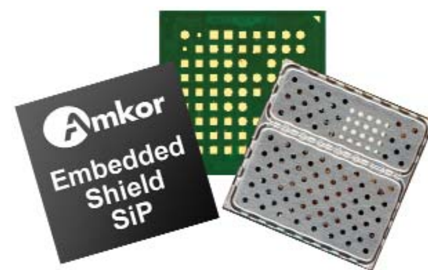
Semiconductor industry demands for higher levels of integration, lower costs, and a growing awareness of complete system configuration have continued to drive System in Package (SiP) solutions. Amkor Technology is committed to being a leader in providing the services necessary to make our customers successful with System in Package technologies.

What is System in Package?

System-in-Package (SiP) is more than an IC package containing multiple die. SiP products are fully functional systems or sub-systems in an IC package format. SiP may contain one or more IC chips (wire-bonded or flip chip) plus other components that are traditionally found on the system mother board such as:

Passive components:

- Discrete passives
- Integrated passive networks
- Passives embedded or patterned in the package substrate



Other typical components assembled on the system board:

- SAW/BAW filters
- EMI shields
- Pre-packaged ICs
- Connectors
- Mechanical parts

The power of SiP is the ability to bring together many IC and package assembly and test technologies to create highly integrated products with optimized cost, size and performance.

Total System in Package Solutions

In an SiP approach, one must consider not only the traditional elements of package assembly, but also design aspects relating to the overall system functional requirements and manufacturing process, as well as supply chain management and test.

System design becomes paramount to the overall success of developing a System in Package. Early in the overall system design, the customer and Amkor discuss and agree upon all elements of the system requirements to ensure success of the design. With this in mind, Amkor has significantly expanded our design capability to combine traditional layout expertise with digital and RF circuit design and system modeling. Amkor can also translate your reference designs for use in SiP development. Working closely with the customer, Amkor can model circuits electrically, mechanically and thermally, to reduce design iterations.

After modeling, Amkor can prototype the package using production-capable equipment to ensure ease of transfer into one of our high volume factory sites. Supply chain considerations play a major factor in the success of SiP product realization and impact both design and manufacturing. Amkor has expanded its traditional supply chain expertise into passive components, and other parts not traditionally found in the package assembly environment. Amkor can manage the supply chain to ensure successful SiP development and production.

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Markets for SiP

Existing market uses for SiP include RF and wireless devices (such as power amplifiers, switch/filter modules, GPS modules, cellular, Bluetooth™ solutions), digital baseband solutions for the wireless markets and controllers for hard drives in the storage market. SiP technology can also be used to enhance single component packages that require improved circuit performance and reduced board real estate. System in Package technology allows multiple advanced packaging technologies to be combined to create solutions customized to each end application.

Amkor is heavily involved in providing SiP solutions for RF and wireless applications such as digital cellular, Bluetooth®, 802.11 modems and GPS. We have RF design engineers on staff to assist customers in designing RF SiPs, including creating circuit elements (e.g., baluns and filters) in the substrate which may eliminate discrete components. Amkor is able to meet all design, material and manufacturing requirements for RF SiPs, including such items as wire length control and substrate materials (LTCC, laminate and others). We have successfully used our RF design and packaging capability to integrate shields and antennas directly into the SiP.

Amkor has developed expertise in RF testing including test system software/ hardware development and manufacturing test. We have an internally-developed, world class test platform that typically offers a 50% to 80% reduction in test time for common RF parts -- PAs, LNAs, & combinations in Integrated Front Ends (IFE).

System in Package Benefits

As with System on Chip (SoC), Amkor's SiP technology is an ideal solution in markets that demand smaller size with increased functionality. However, SiP has the added benefit of compatibility with die design changes and integration of various die technologies (e.g., Si, GaAs, SiGe, and MEMS) without the high cost and lead time associated with SoC development and manufacturing. Amkor Technology has leveraged its single chip assembly and test technology into SiP development.

- Smaller size solution than individually-packaged ICs
- Higher performance through shorter interconnect paths, better dimensional toleranceing and local shielding
- Lower overall cost of ownership
    - Eliminate packaging (multiple ICs now in one package)
    - Reduces system board complexity and layer count by moving to the SiP
    - Uses less system board space than individually packaged ICs
    - Reduced overhead for the customer (Amkor offers turnkey solutions for assembly, test, supply chain management and value-added services)
    - Known good modules
- Reduced time to market
    - Changes can be made to the SiP without changing the system board
    - Design flexibility and easy redesign versus complex System on Chip design
    - SiP allows plug-and-play insertion into one or multiple systems

System in Package is the modular design approach offering unprecedented flexibility in product development. The end user benefits from a faster time-to-market, reduced cycle times for system design, lower development risk as compared to SoC IC development, flexibility, tuned functional performance, and in the end, a lower overall cost of ownership.

Reliability/Manufacturing

With proper consideration to design, Amkor's SiP packages are capable of reaching L3/260 and passing Amkor's internal SQLb. Amkor currently has high-volume SiP manufacturing capability in its Philippines (P3) factory. We support production in ChipArray® package formats, as well as custom packages such as daughter cards, fingerprint sensors, etc.

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