

MultiChip, Packages

Multi-Chip Packages



Literature Number: SNOA287

Multi-Chip Packages

"Multi-Chip Packages" or MCP is a terminology used within National Semiconductor Corp. Outsiders refer to the same type of packaging as "Few-Chip Packages" or FCP (proposed by MCC) or low-end Multi-Chip Modules (MCM).

MCP refers to a packaging configuration containing at most five (5) chips, connected via wirebonds to a multilayer circuit board, and protected by either a molded encapsulant or a low-cost ceramic package. In the simplest case, dies can be attached to a die paddle without a substrate, and inter-die communication is achieved through die-to-die wirebonding.

It is as if all the chips were integrated into one single die and packaged as such, since the same form factor and footprint are kept to facilitate subsequent board assembly operations. Thus, this quasi-integration of functions is transparent to the end-user who only sees the end-product as one single package. MCPs can also incorporate the use of passive components.

A key feature of MCP is the use of standard packages as a vehicle for low-end MCM applications. This allows the end user to readily incorporate MCP solutions since the test, handling, and mounting equipment already exist in the industry.

Being one version of the MCMs, MCPs benefit from the same advantages that MCMs offer, namely:

- **Improved Performance:** closer positioning of the dies on the substrate and shorter interconnection lengths should enhance system speed dramatically.
- **Higher Integration Density:** substituting several packages for one slightly larger but single package, should either free board real estate for other use or help reduce the board size.
- **Lower Power Consumption:** smaller drivers are needed resulting in lower power consumption.
- **Mixed Signal Applications:** MCP allows the integration of chips made from different technologies in one package.
- **Lower Cost:** cost savings result from fewer packages with a fewer number of leads, a simplified board layout,

and the feasibility of mixed technologies in the same package. Smaller risks are associated with MCPs compared to MCMs since existing package and board assembly equipment and technologies are used. For instance, the same CAD design software for board layout can be extended to MCP substrate design, standard pick-and-place tooling can be used for die placement, the same leadframe outline can be applied eliminating the needs for new molds or trim and form tooling, and test sockets and even shipping containers for MCPs fitting the form factor of single chip packages can be readily deployed.

- **Time-to-Market:** inserting several dies into the same package allows much faster introduction of the product into the market compared to integrating all the desired functions on a new single chip. The latter can still be achieved provided that the product needs and volume forecasted are warranted. Thus, MCP finds a special niche in packaging, acting as transitory stage between product needs and chip integration. The timely introduction is most important since the highest profit margins are always achieved in the early stages of the product life cycle.

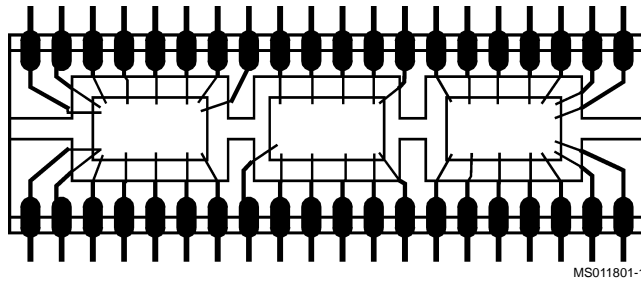
Aside from offering products in MCP configuration, National Semiconductor will also work with customers to design and manufacture their requirements using this technology.

Four types of MCPs are currently offered by NSC. The type numbers increase with the complexity of the package, and is summarized in *Figure 1*.

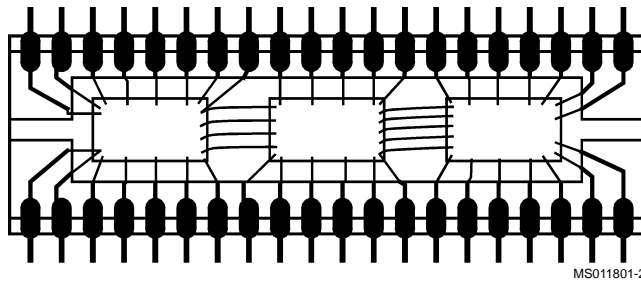
- **Type 1:** Multiple dies with die-to-leadframe bonding. No substrate.
- **Type 2:** Multiple dies with die-to-die bonding. No substrate.
- **Type 3:** Multiple dies with jumper chip. No substrate.
- **Type 4:** Multiple dies on substrate.

MCP Types

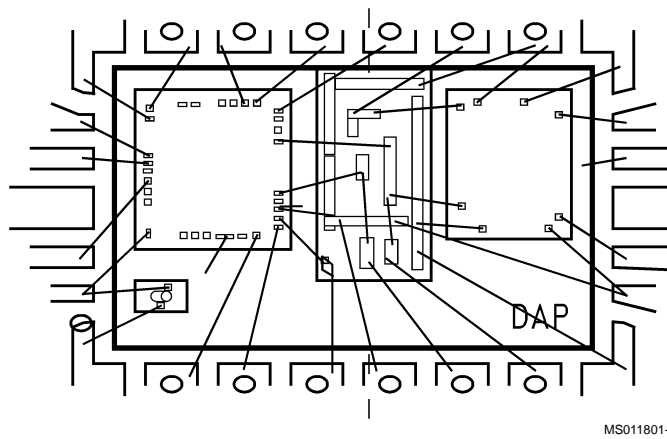
Type 1: Multiple Dies, No Substrate Die-to-L/F Wire Bonding



Type 2: Multiple Dies, No Substrate Die-to-Die Wire Bonding



Type 3: Multiple Dies, Jumper Chip



Type 4: Multiple Dies on Substrate

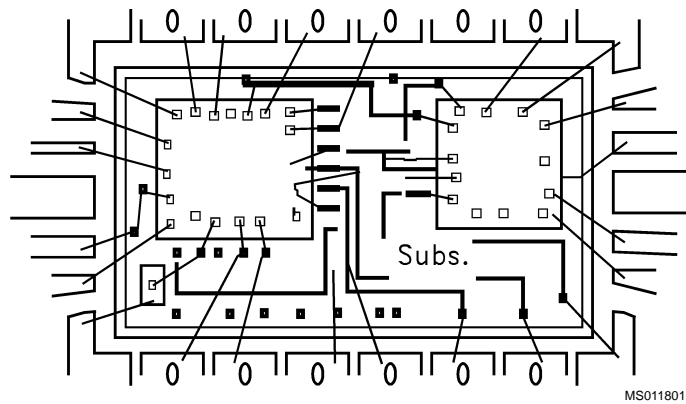


FIGURE 1. Schematic of the four types of MCPs offered by NSC. The MCPs can be obtained in a variety of packages.

MCP Types (Continued)

The MCP can be configured in the following eight classes of form factors with the relevant pin count:

1. Molded plastic thru-hole packages.
2. Molded plastic surface mount packages.
3. Molded thin packages.
4. Molded PGAs and LGAs.
5. Cavity packages (non-hermetic).
6. Ceramic thru-hole packages.
7. Ceramic surface mount packages.
8. Ceramic PGAs.

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