

9.8 Thermal Management Information

This section provides thermal management information for the ceramic ball grid array (CBGA) package for air-cooled applications. Proper thermal control design is primarily dependent on the system-level design—the heat sink, airflow, and thermal interface material. To reduce the die-junction temperature, heat sinks may be attached to the package by several methods—spring clip to holes in the printed-circuit board or package, and mounting clip and screw assembly (see Figure 27); however, due to the potential large mass of the heat sink, attachment through the printed-circuit board is suggested. If a spring clip is used, the spring force should not exceed 10 pounds.

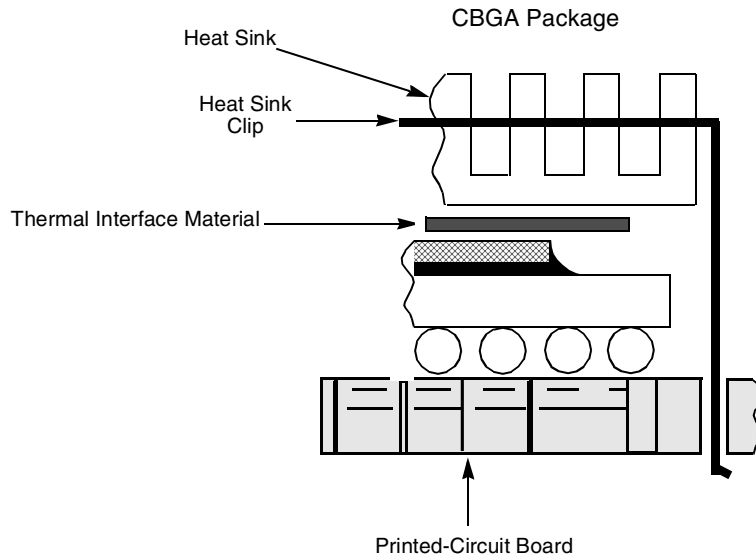


Figure 27. Package Exploded Cross-Sectional View with Several Heat Sink Options

The board designer can choose between several types of heat sinks to place on the MPC7455. There are several commercially available heat sinks for the MPC7455 provided by the following vendors:

Aavid Thermalloy 80 Commercial St. Concord, NH 03301 Internet: www.aavidthermalloy.com	603-224-9988
Alpha Novatech 473 Sapena Ct. #15 Santa Clara, CA 95054 Internet: www.alphanovatech.com	408-749-7601
International Electronic Research Corporation (IERC) 413 North Moss St. Burbank, CA 91502 Internet: www.ctscorp.com	818-842-7277
Tyco Electronics Chip Coolers™ P.O. Box 3668 Harrisburg, PA 17105-3668 Internet: www.chipcoolers.com	800-522-6752

Wakefield Engineering
 33 Bridge St.
 Pelham, NH 03076
 Internet: www.wakefield.com

603-635-5102

Ultimately, the final selection of an appropriate heat sink depends on many factors, such as thermal performance at a given air velocity, spatial volume, mass, attachment method, assembly, and cost.

9.8.1 Internal Package Conduction Resistance

For the exposed-die packaging technology, shown in [Table 3](#), the intrinsic conduction thermal resistance paths are as follows:

- The die junction-to-case (actually top-of-die since silicon die is exposed) thermal resistance
- The die junction-to-ball thermal resistance

[Figure 28](#) depicts the primary heat transfer path for a package with an attached heat sink mounted to a printed-circuit board.

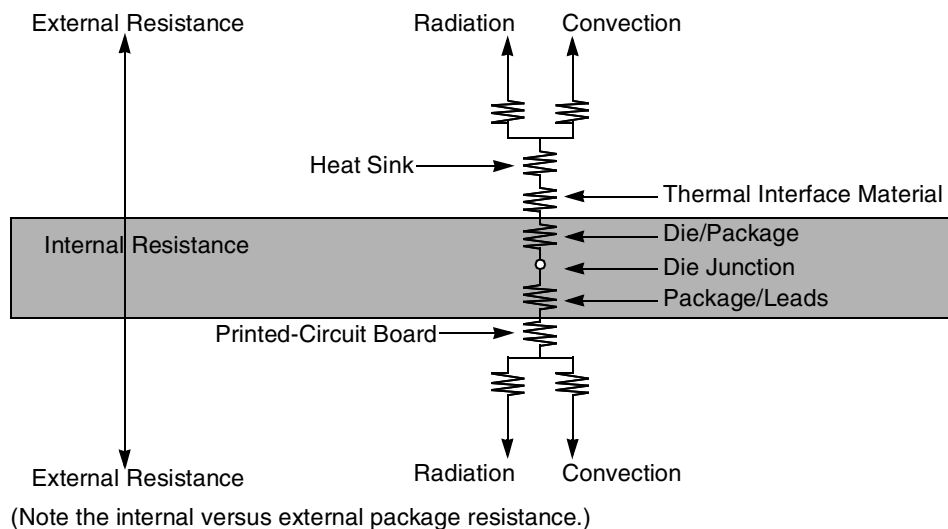


Figure 28. C4 Package with Heat Sink Mounted to a Printed-Circuit Board

Heat generated on the active side of the chip is conducted through the silicon, then through the heat sink attach material (or thermal interface material), and finally to the heat sink where it is removed by forced-air convection.

Because the silicon thermal resistance is quite small, for a first-order analysis, the temperature drop in the silicon may be neglected. Thus, the thermal interface material and the heat sink conduction/convective thermal resistances are the dominant terms.

9.8.2 Thermal Interface Materials

A thermal interface material is recommended at the package lid-to-heat sink interface to minimize the thermal contact resistance. For those applications where the heat sink is attached by spring clip mechanism, [Figure 29](#) shows the thermal performance of three thin-sheet thermal-interface materials (silicone, graphite/oil, fluoroether oil), a bare joint, and a joint with thermal grease as a function of contact pressure. As shown, the performance of these thermal interface materials improves with increasing contact pressure. The use of thermal grease significantly reduces the