APPENDIX C

Integrated Circuit Package Types

Overview

With the ever-increasing levels of integration, packing more circuitry into ever smaller packages, electronic systems now rely on semiconductor devices. Anything from a few circuit components (transistors, resistors, and capacitors) to complete computer systems can be placed on a single silicon die.

An integrated circuit is a package containing a single silicon (silicon germanium for RF circuits, or gallium arsenide for microwave frequency circuits) that forms either part of a larger electronic circuit or system or is a complete electronic system in its own right. When the IC forms a complete electronic system, it is commonly referred to as a system on a chip (SoC). Modern communications ICs are SoC designs.

An extension to the IC is the multichip module (MCM), which contains multiple dies; for example, when sensors and circuits are to be housed in a single package but which cannot be fabricated on a single die. Originally referred to as a hybrid circuit, the MCM consists of two or more ICs and passive components on a common circuit base that are interconnected by conductors fabricated within that base. The MCM helps with size reduction problem and helps alleviate signal degradation.

An extension to the MCM is the system in a package (SiP), on which devices are stacked vertically. Wire bonding to the substrate is common.

An extension to the SiP is the package on a package (PoP).

IC Package Types

The package that the IC uses is either a through-hole package or a surface mount package, made of either plastic or ceramic. Plastic packages are cheaper to manufacture, but ceramic packages have superior heat dissipation and environmental protection (from moisture creeping into the package). The following list identifies the more commonly used package types among the many that are available.

Through-Hole Device Package Types

CERQUAD, ceramic quadruple side
DIMM, dual in-line memory module
DIL or **DIP**, dual in-line package:
- **CERDIP**, ceramic DIP
- **HDIP**, hermetic DIP
- **PDIL** or **PDIP**, plastic DIP

SIP, single in-line package
ZIP, zig-zag in-line package
PGA, pin grid array:
- **CPGA**, ceramic PGA
- **PPGA**, plastic PGA
- **SPGA**, staggered PGA

TO, transistor outline package (single transistor)

Surface Mount Device Package Types

BGA, ball grid array:
- **CBGA**, ceramic BGA
- **FBGA** or **FPBGA**, fine pitch BGA
- **PBGA**, plastic BGA
- **µBGA**, micro-BGA

CGA, column grid array
LCC, leadless chip carrier*:
- **CLCC**, ceramic LCC
- **PLCC**, plastic LCC

LCC, leaded chip carrier*:
- **JLCC**, J-LCC
- **CLCC**, ceramic LCC
- **PLCC**, plastic LCC

QFP, quad flat pack:
- **CQFP**, ceramic QFP
- **PQFP**, plastic QFP
- **QFJ**, QFP (with J-lead)
- **SQFP**, small QFP
- **TQFP**, thin QFP
- **VQFP**, very thin QFP

SOIC, small outline integrated circuit:
- **CSOIC**, ceramic SOIC

SOP, small outline package:
- **MSOP**, mini-SOP
- **PSOP**, plastic SOP
- **QSOP**, quarter-sized SOP
- **SOJ**, small outline (package, with J-lead)
- **SSOP**, shrink SOP
- **TSOP**, thin SOP
- **TSSOP**, thin shrink SOP
- **TVSOP**, thin very SOP

* The leaded and leadless chip carriers are identified by the same abbreviation (LCC) and can be easily confused.

Packaging Standards

Packages are defined by the following standards:

Military Standards

- **MIL-STD-1835 D**, Electronic Component Case Outlines
- **MIL-HDBK-6100**, Case Details for Discrete Semiconductor Devices
- **MIL-STD-2073-1D**, Packaging of Microcircuits (Military Packaging)

- **MIL-STD-1285D**, Marking of Electrical and Electronic Parts
- **MIL-M-38510**, General Specification for Microcircuits
- **MIL-STD-883**, Test Methods and Procedures for Microelectronics
- **MIL-STD-750**, Test Methods for Semiconductor Devices

EIAJ Standards

- **ED-7311**, Standards for integrated circuits package