
The Worldwide Conventional and Advanced Packaging Market for IC Devices

2019 EDITION

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Chapter 1

Introduction

1.1 Report Overview

This report, *The Worldwide Conventional and Advanced Packaging Market for IC Devices, 2019 Edition*, examines the global marketplace of integrated circuits (ICs) and the many packaging designs developed for ICs. Published by New Venture Research (NVR), this comprehensive report presents detailed analysis of a vast and vibrant market that exceeded \$388 billion in 2018. The nearly 400-page report provides insightful analysis of major market trends affecting the semiconductor industry, and presents dozens of tables and figures quantifying both the integrated circuit devices and IC packaging markets. Specifically, this report examines 30 separate IC device types and 44 IC packaging market segments, providing extensive and detailed quantitative analysis of annual revenues, unit shipments, and average pricing. Virtually every table presents historical data for 2018, and five-year forecasts from 2019 through 2023. In addition, numerous graphical figures provide an alternative perspective for understanding the underlying data.

In addition to this introductory chapter, a brief Executive Summary, and a glossary of terms appended at the end, the report is arranged into four chapters each focused on a different aspect of IC packaging. First (Chapter 3) is an in-depth analysis of the many types of integrated circuits being manufactured today. They are segmented according to their principal function, as follows:

- Processors: Microprocessors (MPUs), microcontrollers (MCUs), and digital signal processors (DSPs)
- Memory: DRAM, SRAM, flash, ROM and EPROM, and EEPROM/other
- Logic devices: Digital bipolar, standard logic, gate array, display drivers and touch-screen controllers, and standard cells and PLDs
- Special-purpose logic devices: Consumer, computer, communications, automotive, and multipurpose/other
- Analog devices: Amplifiers and comparators, interfaces, data converters, and voltage regulators and references
- Application-specific analog devices: Consumer, computer, communications, automotive, and industrial/other

Naturally, there is a total market-level analysis, as well as an examination of the data in terms of device function and of major world regions—North America, Europe, China, Japan, and the rest of the world (ROW). The bulk of the chapter provides a detailed discussion of each device type, and because the overall focus of this report is on IC packaging, tables show unit shipments and revenues of each IC device type in terms of the packaging type into which they are mounted.

Chapter 4 examines the worldwide IC packaging market and provides the data that lies at the foundation of most of the quantitative analysis throughout the report. Briefly, IC packaging market segments consist of fourteen major categories, each further delineated according to the number of package I/Os, ranging from three-pin connectors to packages with more than 2,500 solder balls arrayed across the package surface. The fourteen major IC packaging “families” are:

- Transistor outline packages (TOs)
- Dual in-line packages (DIPs)
- Small outline transistors (SOTs)
- Small outline packages (SOs)
- Thin small outline packages (TSOPs)
- Chip carriers (CCs)
- Quad flat packs (QFPs)
- Dual flat pack no-lead packages (DFNs)
- Quad flat pack no-lead packages (QFNs)
- Pin grid arrays (PGAs)
- Ball grid arrays (BGAs)
- Fine-pitch ball grid arrays (FBGAs)
- Wafer-level packages (WLPs)
- Direct chip attached ICs (DCAs)

Altogether, in more than 60 separate tables, we discuss the 44 separate IC packaging market segments, with tables quantifying the specific IC devices mounted in the packaging type.

However, a composite examination of the many packaging families does not come near to describing the entire IC packaging market, because in addition to these “conventional” packaging types, the industry has developed a range of “advanced” packaging solutions

designed to solve the many issues presented by modern electronics design. Chapter 5 of the report examines a significant subset of the worldwide IC packaging market in terms of these advanced packaging types, which consist of both single-chip packages and complex multichip packages. Specifically, the products and technologies covered in this chapter include:

- Fan-out wafer-level packages (FOWLPs)—This recent advancement provides a reliable means of expanding the number of leads or connections beyond the range of standard wafer-level packages and is one of the hottest markets in the semiconductor industry today.
- Multi-row quad flat pack no-lead packages (MRQFNs)—This packaging technique has given new life to the mature QFN market segment by enabling manufacturers to greatly expand the number of contacts beyond what conventional single-row QFNs are capable of supporting.
- Stacked IC packages—These packages combine multiple ICs of a given type in vertical stacks that are then packaged as a single chip. Specific market segments that are analyzed include thin small outline packages (TSOPs), fine-pitch ball grid arrays (FBGAs), quad flat pack no-lead packages (QFNs), and wafer-level packages (WLPs).
- System-in-package solutions—These packages combine not just stacks of one type of device, but a variety of active memory, logic, or analog devices, as well as passive components. Examples of these advanced packages are package-in-packages (PiPs), package-on-packages (PoPs), and multichip modules (MCMs).

Finally, Chapter 6 discusses the interconnection technologies used within individual packages that allow ICs to communicate with the systems in which they are embedded. Under examination in this chapter are the traditional wire bond technique, which has been in widespread use since the very beginnings of the semiconductor industry, as well as the more advanced flip chip interconnection upon which much of the modern advanced packaging industry is founded. The chapter provides extensive data for the specific IC device types and their relevant packaging types that utilize flip chip interconnection. In addition, the chapter provides an analysis of a fairly new interconnection technique called through-silicon via (TSV), which holds much promise for enabling further advancement into the 3D integration of IC packaging.

1.2 Report Organization

This report is organized into six chapters plus an Appendix:

- Chapter 1 Introduction – Outlines the scope and organization of the report.
- Chapter 2 Executive Summary – Provides an overview of the worldwide IC packaging market and highlights of the various market segments covered in this report.
- Chapter 3 Integrated Circuit Device Market Analysis – Defines and analyzes 30 IC device categories based on total worldwide, functional, and world regional market segments. Provides in-depth analysis of ICs in terms of the major IC packaging types, as well as the number of I/Os for each packaging type.
- Chapter 4 IC Packaging Market Analysis – Defines and analyzes 14 IC packaging “families” with details focused on the number of I/Os in the package. Package I/O count is viewed in terms of six categories. Altogether, there are 44 distinct market segments covered, with each one referenced against the IC devices mounted in the various packaging types.
- Chapter 5 Advanced Packaging Markets – Describes the market and technology trends in advanced IC packaging products, as follows:
 - Fan-out wafer-level packaging (FOWLPs)
 - Multi-row QFNs (MRQFNs)
 - Stacked packages, specifically stacked TSOPs, stacked FBGAs, stacked QFNs, and stacked WLPs
 - System-in-packages (SiPs), specifically package-on-packages (PoPs), package-in-packages (PiPs), multichip modules (MCMs), and stacked WLPs used within SiPs
- Chapter 6 Interconnection Technologies and Solutions – Briefly describes the market and technology trends of wire bonding and the metals used with wire bonding. The major focus of the chapter is flip chip interconnection. Discussion covers the technology and major market trends for flip chip interconnection, with the market segmented by packaging types and IC devices used with flip chip. The final section of the chapter discusses through-silicon vias (TSVs).
- Appendix Glossary of IC Packaging Terms – Provides acronyms and short definitions of various terms used in the semiconductor and the IC packaging industries.

1.3 Methodology

The information presented in this report was gathered from a variety of primary and secondary sources. Both qualitative and quantitative data were provided by marketing and business development managers at IC packaging manufacturers and other semiconductor-related companies through responses to detailed surveys. In addition, extensive use was made of publicly available materials, including company Web sites and literature such as press releases and investment reports, as well as articles and white papers obtained through the Internet, online databases, and trade publications. We have utilized these varied resources to ascertain market trends and in preparing the tables and figures appearing throughout this report. However, the author and New Venture Research are the sole and exclusive originators of the specific historical and forecast data presented in this report, and are responsible for its content.