# IC PACKAGE PITCH, LEADFRAME PLATING, AND SUBSTRATE MARKETS

**2013 EDITION**

**Copyright © 2013**

**New Venture Research Corp.**
**337 Clay Street, Suite 101**
**Nevada City, CA 95959**
**(Tel) 530-265-2004**
**(Fax) 530-265-1998**

**All rights reserved**

## ABOUT THE AUTHOR

**Sandra L. Winkler** has been an industry analyst starting in 1988, and from 1995 has been a staff member of Electronic Trend Publications, now New Venture Research Corporation. She has produced numerous off-the-shelf and custom reports throughout her career. She began her analyst career in the telecommunications industry, with Frost and Sullivan, and since 1995 has focused on the semiconductor packaging industry, authoring more than 30 widely cited reports on the topic, most notably *The Worldwide IC Packaging Market, Advanced IC Packaging Markets and Trends*, and *IC Packaging Materials*. She is a contributing editor and writer for Chip Scale Review magazine, Global SMT & Packaging News, and contributes to the IEEE/CPMT newsletter and other media. Ms. Winkler earned an MBA from Santa Clara University and is on the executive planning committee of the IEEE/CPMT Santa Clara Valley chapter, serving as Luncheon Program Chair.


© 2013 New Venture Research Corp.

## ABOUT NEW VENTURE RESEARCH CORPORATION

New Venture Research (NVR) was formed in 1988 to assist industry executives in their decision making. We began as an independent consultancy and have recently evolved into a publisher of off-the-shelf market research reports in key areas of the electronics industry. The reports are written by a team of staff analysts and independent consultants. We also offer consulting services when our clients need information not found in our reports.

The backbone of each report is based upon primary market research information. Our market information originates from direct interviews with vendors, users, and other industry participants. We use secondary research to test for reasonableness, technical backgrounds, and, in some cases, for top-level forecasts. We distill the research into coherent forecasts and recommendations.

We are dedicated to providing our customers with accurate reporting on our targeted markets. One of our reports can save our customers months or years of research. The reports enable executives to make decisions in a structured manner. Our customers tell us these reports are excellent tools for building consensus regarding their company's real market opportunities.

**NEW VENTURE RESEARCH**

337 Clay Street, Suite 101
Nevada City, California 95959

Tel: (530) 265-2004 • Fax: (530) 265-1998
www.newventureresearch.com


© 2013 New Venture Research Corp.

## DISCLAIMER

The author and publisher have used their best efforts to assure the accuracy of the material used in preparing this report.

The author and publisher make no warranty of any kind, expressed or implied, with regard to the information contained in this report. The author and publisher shall not be liable in any event for incidental or consequential damages in connection with, or arising from, the information contained in this report.

Any reference to particular products or manufacturers to illustrate points made in this report should not be construed as an endorsement of said products or manufacturers.

The opinions contained herein are those of the author and are based upon published and unpublished information obtained from a variety of sources, telephone and personal interviews with industry participants, and many years of experience.


© 2013 New Venture Research Corp.

**SOFTWARE LICENSE AGREEMENT**

This report is provided in PDF electronic file format. For considerations received, New Venture Research Corp. (NVR) hereby licenses this electronic copy of the report as described in this License Agreement to “You” the corporate or individual licensee. This License Agreement applies to all electronic file copies of the report for which you have purchased or otherwise been granted a license by NVR. Any use of the electronic file copy of the report indicates your acceptance of these terms.

The report and all electronic copies thereof are protected by both United States copyright law and international treaty provisions. You may not distribute any portion of the report. Unless otherwise specified in your purchase agreement with NVR, the electronic file copy of the report may be freely moved from one computer location to another, but may not be used by more than one (1) person simultaneously.


© 2013 New Venture Research Corp.

# IC PACKAGE PITCH, LEADFRAME PLATING, AND SUBSTRATE MARKETS, 2013 EDITION

## Table of Contents


Chapter 1 INTRODUCTION ........ 1

1.1 Background ........ 1

1.2 Scope ........ 1

1.3 Organization ........ 1

1.4 Methodology ........ 3

Chapter 2 EXECUTIVE SUMMARY ........ 4

2.1 Overview ........ 4

2.2 Package Pitch ........ 4

2.3 Leadframe Plating ........ 7

2.4 Substrates ........ 8

Chapter 3 TECHNICAL TRENDS ........ 10

3.1 World and Semiconductor Overview ........ 10

3.2 Not All Economies Recovering Equally; Unrest Remains ........ 10

3.3 World GDP ........ 11

3.4 Global Electronics Market ........ 16

3.5 Electronics Industry Summary Forecast ........ 18

3.5.1 Communications ........ 19

3.5.1.1 Cellular Handsets ........ 21

3.5.1.2 Cellular Infrastructure ........ 22

3.5.1.3 Other Phones ........ 23

3.5.1.4 Enterprise LANs ........ 23

3.5.1.5 Wireless LANs ........ 23

3.5.1.6 DSL and Cable Modems ........ 24

3.5.1.7 PBX/Other CPE ........ 24





© 2013 New Venture Research Corp.

3.5.1.8 Carrier-Class Equipment ........ 25
3.5.2 Computers ........ 25
3.5.2.1 Personal Computers ........ 28
3.5.2.2 Tablets ........ 28
3.5.2.3 Servers ........ 28
3.5.2.4 Workstations ........ 29
3.5.2.5 Enterprise Storage Systems ........ 29
3.5.2.6 Flash Drives ........ 29
3.5.2.7 Monitors ........ 30
3.5.2.8 Printers ........ 30
3.5.2.9 E-Readers ........ 31
3.5.3 Consumer ........ 31
3.5.3.1 Televisions ........ 34
3.5.3.2 Set-Top Boxes ........ 34
3.5.3.3 DVD Players/Recorders ........ 35
3.5.3.4 Digital Cameras ........ 35
3.5.3.5 Console Video Games ........ 36
3.5.3.6 MP3 Players ........ 36
3.5.3.7 Personal Navigation Devices ........ 36
3.5.3.8 Memory Cards ........ 36
3.5.4 Industrial ........ 37
3.5.5 Medical ........ 38
3.5.6 Automotive ........ 40
3.5.7 Commercial Aviation, Defense, and Other Transportation ........ 41
Chapter 4 IC PACKAGE PITCH BY MAJOR PACKAGE FAMILY AND I/O COUNT RANGE ........ 44
4.1 Overview ........ 44
4.2 DIP and Other Small Through-Hole Packages ........ 44
4.3 SOT ........ 45
4.4 SO ........ 45
4.5 TSOP ........ 45


© 2013 New Venture Research Corp.

4.6 DFN ........ 46
4.7 CC ........ 46
4.8 QFP ........ 47
4.9 QFN ........ 47
4.10 PGA ........ 47
4.11 BGA ........ 48
4.12 FBGA ........ 49
4.13 WLP ........ 49
4.13.1 Fan-Out WLPs ........ 51
4.14 IC Package Pitch Forecasts ........ 51
4.14.1 DIP ........ 51
4.14.2 SOT ........ 54
4.14.3 SO ........ 56
4.14.4 TSOP ........ 60
4.14.5 DFN ........ 64
4.14.6 CC ........ 67
4.14.7 QFP ........ 70
4.14.8 QFN ........ 73
4.14.9 PGA ........ 78
4.14.10 BGA ........ 81
4.14.11 FBGA ........ 85
4.14.12 WLP ........ 92
4.14.13 Total IC Package Pitch Forecast ........ 98
Chapter 5 LEADFRAME PLATING OPTIONS AND LEAD-FREE ISSUES ........ 100
5.2 Plating Finishes ........ 101
5.2.1 Preplated Finishes ........ 102
5.2.2 Postplate Finishes ........ 103
5.2.3 Issues with Lead Free: Tin Whiskers ........ 105
5.2.4 Plating Baths for Leadframes ........ 114
5.3 New Product Introductions ........ 115


© 2013 New Venture Research Corp.

5.3.1 Lockheed Martin Space Systems Company ........ 115
5.4 IC Package Plating Forecast ........ 117
Chapter 6 SUBSTRATES ........ 129
6.1 Overview ........ 129
6.2 Ceramic ........ 129
6.3 Laminate ........ 131
6.4 HDIS ........ 132
6.4.1 Microvia Structures ........ 133
6.4.2 Creating Microvias ........ 134
6.5 Coreless Substrates ........ 136
6.6 Flex Tape ........ 138
6.7 Embedded Passives ........ 139
6.8 Thermal Substrates ........ 140
6.9 New Product Introductions ........ 140
6.9.1 Fujitsu Components America, Inc. ........ 140
6.9.2 Intel Corporation ........ 140
6.9.3 Shinko Electric Industries Co., Ltd. ........ 141
6.9.4 Siliconware Precision Industries Co., Ltd. ........ 143
6.10 Forecasts ........ 148
6.10.1 Units by Pitch ........ 148
6.10.1.1 PGA ........ 148
6.10.1.2 BGA ........ 148
6.10.1.3 FBGA ........ 149
6.10.2 Substrate Units ........ 150
6.10.2.1 PGA ........ 150
6.10.2.2 BGA ........ 152
6.10.2.3 FBGA ........ 154
6.10.2.4 Substrate Unit Summary ........ 155
6.10.3 Substrate Area ........ 156
6.10.4 Substrate Revenue ........ 159




© 2013 New Venture Research Corp.

Appendix A WEBSITE ADDRESS GUIDE ........ 167
Appendix B GLOSSARY ........ 174


© 2013 New Venture Research Corp.

# Chapter 1
# INTRODUCTION

## 1.1 Background

IC packaging has taken a prominent role in enabling the advancement of mobile computing and meeting the requirements of high bandwidth. Because IC packaging holds the footprint to the printed circuit board (PCB), the size of the package is a large factor in the size of today's electronic gadgets. With Moore's Law nearly reaching its physical limitations, it is the ability to shorten the electrical signal path of the packaging of the integrated circuit (IC) that in turn enables faster signal propagation, thus allowing for meeting the higher bandwidth requirements.

Reducing the pitch of the package is one method of reducing the package size and shortening the electrical path. This report contains information on pitch, substrates, and plating finish, and is a continuation of the full coverage on the topic of IC packaging in this year's IC packaging series.

## 1.2 Scope

This report covers these basic topics:

- IC package pitch
- Leadframe finish
- IC package substrates for array packages

## 1.3 Organization

This report is divided into six chapters and two appendices. They are as follows:

**Chapter 1, Introduction**: This chapter outlines the background, scope, organization, and methodology of the report.


© 2013 New Venture Research Corp.

**Chapter 2, Executive Summary**: This chapter provides summary forecasts and information.

**Chapter 3, Economic Outlook and Worldwide Electronics Industry Forecast,** is an overview of the state of the overall economy and semiconductor industry.

**Chapter 4, IC Package Pitch by Major Package Family and I/O Count Range.**

The major package families include:

- Dual in-line package (DIP)
- Small outline transistor (SOT)
- Small outline (SO)
- Thin small outline package (TSOP)
- Dual flat pack no lead (DFN)
- Chip carrier (CC)
- Quad flat pack (QFP)
- Quad flat pack no lead (QFN)
- Pin grid array (PGA)
- Ball grid array (BGA)
- Fine-pitched ball grid array (FBGA)
- Wafer-level package (WLP)

The pitch forecasts are given for the I/O ranges of 3–18, 20–32, 34–100, 102–304, 308–999, and 1,000 and up. The global figures for the package families come from NVR's ***The Worldwide IC Packaging Market, 2013 Edition***, the first report in this four-report series of 2013. Those figures are built up from the package options of all IC device types, such as MPU, DRAM, the various analog chips, etc.

**Chapter 5, Leadframe Plating Options and Lead-Free Issues**, presents the forecasts for the leadframe plating options of the major leadframe package families of DIP, SO, SOT, TSOP, DFN, QFP, and QFN, and discusses the issues and solutions surrounding lead-free electronics.

**Chapter 6, Substrates**, forecasts the substrate options for the major packaging families of PGA, BGA, and FBGA. Forecasts of the various substrate options are presented by package family, substrate units, substrate area, and substrate revenue.


© 2013 New Venture Research Corp.

**Appendix A, Website Address Guide**: This appendix contains the Internet addresses of the companies presented in this report, plus the OSAT companies that serve the IC packaging industry.

**Appendix B, Glossary**: This appendix contains a general glossary of terms used in the IC packaging industry.

## 1.4 Methodology

Information was obtained from both primary and secondary sources to complete this report. Information was gathered by telephone, e-mail, at trade shows, from speakers at seminars, conferences, luncheons, and dinners, and by visiting companies in the industry. Secondary sources of information included company literature, trade magazines, seminar proceedings, and the Internet, and often led to further primary contact.

Hundreds of individuals were contacted for information for this report. They included key people within all of the major semiconductor fabrication companies and IC package foundries around the globe. Information was obtained using standard surveys and is printed only in the aggregate. The survey questions were designed to determine the size of the market and likely growth patterns and to elicit responses about issues and developments in this particular area of the packaging industry. Discussions with those in the industry also played a key part in gathering information for this report.

A wide assortment of companies providing products and services for this market was contacted as well. Information was gathered in person when possible; company literature and white papers from seminars and proceedings were also heavily utilized.


© 2013 New Venture Research Corp.