Flip Chip: Technologies & Market Trends
Biography & contact

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WHAT IS NEW?

• Updated market capacity and wafer forecast from 2014 to 2020

• Flip Chip players and 2014 ranking.

• Recent M&A

• Technology roadmap for Flip Chip bumping

• Updated information for Flip Chip on devices and applications

• Focus on LEDs and CMOS image sensors
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REPORT OBJECTIVES

The objectives of this report are:

• To provide analysis and understanding of Flip Chip markets, player dynamics and key trends

• To provide market data on Flip Chip capacity forecasts in wafer starts and $M for 2014–2020.

• To identify future Flip Chip strategy evolution and opportunities

• To provide an overview of Flip Chip technology and trends
COMPANIES CITED IN THE REPORT

AMD, AMKOR TECHNOLOGY, APPLE, ASE, GROUP, ATP, AT&S, CARSEM, CHINA WLCSP, CHIPBOND, CHIPMOS, CITIZEN, COWELL, CREE, E-SILICON, EDISEN-OPTO, ELEC-TECH, EPILED, EPISTAR, EVERLIGHT, FIRST LEVEL INC, FLIP CHIP INTERNATIONAL, FORMOSA EPITAXY, FREESCALE, GENESIS PHOTONICS, GLOBALFOUNDRIES, HC SEMITEK, HONGLITRONICS, IBIDEN, IBM, ILIJN LED, INARI TECHNOLOGY, INTEL, IPDIA, J-DEVICES, JCET, KUNSHAN HUATIAN, LBSEMIC, LEXTAR, LG INNOTEK, LUMENS, LUMILED, LUMEX, MICRON, MURATA, NEPES, NICHLIA, NYPCB, OPEN-SILICON, OPTOCAP, ORIENT SEMICONDUCTOR, OSRAM, PACTECH, PANASONIC CORPORATION, POWERTECH TECHNOLOGY, PRIMAX, QUALCOMM, QUIK-PAK, RENESAS, SAMSUNG ELECTRONICS, SANAN, SEMCO, SEMCO-WISOL, SEMILEDS, SHARP, SHINKO, SIGNETICS, SK HYNIX, SMIC, SONY, SPIL, STATCHIPPAC, STMICROELECTRONICS, TAIYO YUDEN, TEKCORE, TEXAS INSTRUMENTS, THEIL, TRIQUINT, TSMC, UNIMICRON, UNISEM… and more
WHO SHOULD BE INTERESTED IN THIS REPORT?

- **OSAT, IDMs, foundries companies:**
  - To have a broad overview Flip Chip applications & markets
  - To identify new markets
  - To monitor and benchmark potential competitors

- **Financial & Strategic investors:**
  - To understand the potential for Flip Chip technology.
  - To know the latest M&A
  - To get a list of Flip Chip players and their activities

- **R&D players:**
  - To understand new technical challenges in Flip Chip technology

- **Equipment & Material suppliers:**
  - To understand the technical evolution of Flip chip bumps.
  - To identify business opportunities and prospects

- **OEMs & Integrators:**
  - To evaluate benefits of using Flip chip technology in systems
The semiconductor industry is facing a new era:

- FEOL transistor scaling and cost reduction will not continue on the same path they followed for the past few decades, with Moore's law in its foundation.
- Advanced technology nodes do not bring the desired cost benefit anymore and R&D investments in new lithography solutions and devices below 10 nm nodes are rising substantially.

New market shifts are expected in due time, with “Internet of Things” getting ready to take over pole market driver position from mobile.

Why Advanced Packaging?

- While FEOL scaling options remain uncertain and IoT promises application diversification, the spotlight is now turned to advanced packages for:
  - Cost reduction
  - Performance boost
  - Functionality boost
- In order to answer market demands, the advanced packaging segment focuses on integration and wafer level packages.

Advanced packaging is transitioning to high-performance, high-density, low-cost collective wafer level packaging techniques.
Bridging the Gap Between Si and PCB Processing Capabilities

Feature sizes of PCBs

Increase in Packaging Technology Solutions

Flip Chip is a key Technology

Microelectronics Package Evolution

Gap Features Si vs PCB


Through hole DIP, PGA

Surface Mount SOP, QFP, PLCC

Ball grid arrays SiPs

Fan-in WLP FC BGA PoP More SiPs

Interposers 3D IC TSV FO WLP

Feature sizes CMOS

Packaging technology evolution

1980

Feature sizes of PCBs

1970

1990

2000

2010

Today

Transistor scaling and cost reduction will not continue on the same path – reaching sub 10nm grey zone.

**WHAT ARE THE OPTIONS?**

- Continue with development of advanced technology nodes *(follow Moore’s Law)*
- Develop new alternative technologies/packages *(More than Moore)* to meet the market requirements.
FLIP CHIP MARKET DRIVERS

CPUs / GPUs/chipsets, the earlier adopters of flip chip packaging, continue to grow at steady rate

- Almost all central processor units (CPUs), graphical processor units (GPUs) and chipsets are packaged using flip-chip. e.g., all CPUs & GPUs Intel, AMD & Nvidia

- CPUs and chipsets are mainly packaged in fcLGA (land grid array) and GPUs in fcBGA format.

- The main benefit that drive the use of flip chip for these devices are high I/Os, large chip to package area, superior electrical and thermal performance.
Flip chip assembly technology provide various benefits such as high I/Os, fine pitch interconnection, superior electrical and thermal performance which drives its applications across specific segments as seen below.

<table>
<thead>
<tr>
<th>High I/O density</th>
<th>Large chip to package area</th>
<th>Fine pitch interconnection</th>
<th>Electrical performance</th>
<th>Thermal dissipation</th>
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</tr>
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More details in the report

- DD is display driver
- CIS is CMOS image sensor
- BB is baseband processor
- PMU is power management unit
PACKAGING TRENDS

From standard package types to advanced packages

With the number of I/O constantly increasing, Flip Chip is a key Technology!
FLIP CHIP TECHNOLOGY ROADMAP

Silicon node:
- ≤ 32nm
- 28nm
- 14nm
- 10nm

Metallurgy:
- Sn-Pb
- Lead free
- Cu Pillar
- Au bump

Pitch:
- >150um
- 40-150um
- <40um

Bump Height:
- Solder
- Cu pillar

More details in the report

Current 2016 2017 2018 2019 2020
Cu Pillar will take market share from the others flip chip technology

Wafer capacity forecast will increase from 16M in 2014 up to 26M in 2020

9% CAGR expected for bumping capacity

Note: CIS and LED not included
FLIP CHIP TECHNOLOGY

Across different Market Segment

Consumer
- Laptops
- Tablets
- Smartphones
- UHD TV
- Game Station

Computing
- Desktop PC
- Set-up Box

Mobile/wireless

Medical
- Ultrasonic Handler

Automotive
- Cars

Industrial
- Servers

...And much more!
SAMSUNG GALAXY S6
Processor Package Teardown

Solder Bumping used for flip chip of the process in the Samsung Galaxy S6

Samsung Exynos 7420 + K3RG3G30MM-DGCH

Solder bump used to stack the processor onto the organic substrate
FLIP CHIP BUMP CAPACITY

Breakdown by Business Models including all type for Flip Chip Bumps

- OSATs are the leading business model for flip chip bumps with 36% of the wafer capacity followed by bumping houses and IDMs with respectively 27% and 26%.

- IC foundry business model has the smallest percentage with only 11% of the wafer capacity.

- OSATs will continue to grow up to 41% in wafer capacity in 2020 whereas IC foundry and bumping houses will decrease in wafer capacity.

- IDMs will also continue to gain share in wafer capacity up to 28% in 2020.
Key Players Identified

Majority of players are located in Asia (Taiwan, Korea & China)

- Lumileds, Lumex, CREE
- Osram
- Nichia, Citizen
- Genesis Photonics, Everlight, Epistar, Formosa Epitaxy, Lextar, Epileds, TSMC, Edison Opto, Tekcore, SemiLEDs

During our analysis, we were not able to identify any involvement from Sharp, Optogan or Citizen Electronics in Flip Chip product development and/or commercialization.

- Osram use its UX:3 thin-film flip-chip manufacturing platform however the technology is much more similar to vertical LED technology than Flip Chip LED technology.
- Formosa Epitaxy was acquired by Epistar in July 2014.
CIS: IPHONE6 CAMERA MODULE TEARDOWN

- Stacked gold stud bumps are deposited on the CIS and the circuit is assembled by flip chip on the ceramic package.

Au stud bump on ceramic substrate!
TOP PLAYERS IN 2014

- **Bumping & Assembly location**
  - TAIWAN

- **Cu pillar bumping**
  - INTEL

- **Advanced Underfill**
  - HENKEL

- **Gold bumping**
  - ChipBOND

- **Flip chip bonder**
  - BESI

- **Solder ECD bumping**
  - SPIL

Flip chip assembly #1 players
Yole Développement

From Technologies to Market
Yole Développement’s 30 analysts operate in the following areas:

- Imaging
- Photonics
- MEMS & Sensors
- Compound Semi.
- LED
- Power Electronics
- PV
- MedTech
- Manufacturing
- Advanced Packaging
4 BUSINESS MODELS

- Consulting and Analysis
  - Market data & research, marketing analysis
  - Technology analysis
  - Strategy consulting
  - Reverse engineering & costing
  - Patent analysis

- Reports
  - Market & Technology reports
  - Patent Investigation and patent infringement risk analysis
  - Teardowns & Reverse Costing Analysis
  - Cost Simulation Tool

- Media
  - i-Micronews.com website
  - @Micronews e-newsletter
  - Technology magazines
  - Communication & webcast services
  - Events

- Financial services
  - M&A (buying and selling)
  - Due diligence
  - Fundraising
  - Maturation of companies
  - IP portfolio management & optimization
40% of our business is in EU countries
30% of our business is in Asia
30% of our business is in North America
SERVING THE ENTIRE SUPPLY CHAIN

Integrators and end-users

Device makers

Suppliers: material, equipment, OSAT, foundries...

Financial investors, R&D centers

Our analysts provide market analysis, technology evaluation, and business plan along the entire supply chain.
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