Lowering the Cost of Advanced Packaging

Achieving the most direct connection to silicon – miniaturising package dimensions and maximising IC performance – defines the leading edge of chip-scale package design.

Assembling chip-scale packages demands accurate and precise back-end processes for depositing materials such as solder paste, solder spheres, flux, and adhesives. Precision printing is known to deliver the high levels of control, repeatability and productivity necessary to build today’s most advanced packages – and to solve the next challenges now visible on the technology horizon.

Moreover, as package outlines and interconnect dimensions continue to shrink, the boundaries between back-end package processes and board-level assembly using the most advanced surface-mount packages are progressively blurring. To secure the most advanced capability and highest productivity, leading to untouchable productivity and the lowest cost per unit when assembling packages at wafer and substrate level, it makes sense to choose the technology & process partner with the leading position in precision printing in both the packaging and assembly markets.

“High accuracy deposition of materials to support advanced semiconductor packaging processes”
Move forward with us

At DEK, we have built our reputation as the leading global supplier of pre-placement equipment and solutions for high-speed, high-efficiency electronic assembly, supporting the world’s foremost manufacturers for over 40 years.

Our installed base totals over 14,000 automated in-line printers; located across four continents and spanning the surface-mount technology spectrum from high-volume ultra cost-sensitive assembly to precision placement of the latest chip-scale packages.

Building on this capability, our semiconductor packaging technologies are used by leading chipmakers and advanced packaging specialists to perform processes such as solder ball attachment; achieving six-sigma process capability at the smallest ball diameter and pitch dimensions in mainstream use. In the meantime, our labs are working towards future generations of packaging requirements; we have already demonstrated solder ball placement at 70µm diameter and 150µm pitch.

Our solutions for key back-end processes maximise the printer’s value as a true multi-purpose platform, supporting rapid reconfiguration for high-accuracy processes at wafer and substrate levels, using a wide range of electronic materials. Find out more about DEK’s semiconductor process technologies for wafer-level and substrate-level processes on the following pages.
Advanced Technologies and Processes

Printing Adhesives, and More, at Wafer Level

The stable foundation of a world-class screen printer proves an extremely cost-effective platform for wafer-level processes at the heart of new and emerging packaging technologies.

Precision Wafer Bumping

Growing use of flip-chip and chip-scale packages in next-generation and products is driving demand for accurate and efficient wafer bumping solutions. DEK is working with leading packaging specialists and chipmakers worldwide, delivering and supporting successful processes based on:

- 
- DirEKt Ball Placement
- Solder paste print and reflow
- In-situ mask processes such as Flip Chip International process

DirEKt Ball Placement, a breakthrough technology introduced in 2000, now has a substantial installed base and is routinely used in high-volume production to place solder balls from 1.2mm down to 0.2mm diameter. And we continue to move forward, developing new processes. Our research and development teams are demonstrating promising yields when placing 70µm balls on 150µm pitch.

Advanced Wafer-Level Coatings

Printing electronic materials such as adhesives directly onto wafers, before singulation, is critical to important emerging packages and device technologies, including wafer-level chip-scale packages, MEMS devices, RFID tags and high-power LEDs.

Our wafer-level applications solve package assembly challenges across a wide range of component technologies:

- WLCSP: B-stage epoxy, passivation, wafer-level underfills
- MEMS - Glass frit and adhesives
- Low-cost RFID - Printed silicon
- Advanced LEDs - Phosphors
- Wafer-level camera lenses

Printing Glass Frit For Wafer Level MEMS Assembly

Typical process specifications:

- 150mm and 200mm wafers
- Material deposit height approx 15µm
- Material deposit width approx 150µm
Several advanced options provide the key to successful precision printing at wafer level:

**Wafer Handling**

Fully automatic wafer handling, developed in conjunction with CHAD Industries and individually optimised for each application, boosts efficiency in high-volume production. All wafer sizes and thicknesses are supported. DEK and CHAD combined can offer specific expertise related to handling thinned wafers for all wafer-level packaging processes.

Semi-automatic wafer handling, developed in conjunction with Nutek to meet wide-ranging production and budget requirements, aids secure and accurate manual loading of each wafer.

**Precision Wafer Pallets**

DEK is a leader in tooling innovations for wafer-level printing.

Our precision-machined vacuum pallets for wafers from 100mm to 300mm diameter, and 0.075mm to 1.00mm thickness, promote optimal flatness and parallelism for high yield, high throughput and minimum variability.

We can also supply custom pallets for TAIKO DISCO™ wafers, and your own specific requirements on request.

**Dedicated Wafer Transport Solution**

A specialised transport solution optimised for the specific purpose of handling all wafers. This solution benefits from the responsive motion control and non-contact stopping system built into our machines for accurate and gentle handling of your high-value wafers. A recent process study has shown direct benefits to process capability via the use of this Wafer Transport Solution and Precision Wafer Pallet.

**Alignment**

DEK’s innovative wafer alignment solution enables fast, accurate and repeatable alignment – even for wafers having complex patterns and offering no truly unique features or fiducial markings. Proven alignment capability of 2Cpk @±12.5µm with the Galaxy print platform is ideally suited for all wafer-level bumping processes.

**DirEKt Ball Placement**

Our unique placement head is the key to successful wafer-level ball placement using solder spheres at the smallest sizes in production. The innovative head design ensures safe and secure placement of solder balls, achieving high throughput and high ball-yield rates.

**Roll Bar Squeegee**

DEK’s Roll Bar Squeegee, custom designed for wafer-level application of die-attach adhesive, is ultra rigid to outperform conventional squeegee blades when used with large stencil apertures and wafers up to 300mm diameter. Shown to deliver process capability of up to 2Cpk @±12.5µm for wafer-level coatings.

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**Final Package Assembly**

Precision print techniques can increase your total throughput and reduce costs for final package assembly, when depositing materials at the substrate level for flip-chip and chip-scale packages, BGAs, and System in Package (SIP) devices.

**Substrate Handling**

Key processes can be performed cost-effectively using DEK’s high-accuracy print platforms, where precision deposition is required for materials such as solder paste, solder balls, flux, die-attach adhesive, conductive ink, thermal interface material, and sealants for lidded packages.

Processes supported by DEK print solutions:
- Substrate bumping and solder ball placement
- Passive attach
- 3D printing with solder paste
- Fluxing for Controlled Collapse Chip Connection (C4)
- Die-attach adhesive for Window BGA (DRAM) and CSP
- Lid seal
- Thermal Interface Material deposition

**DEK’s innovations in handling and tooling, print head design and process-optimised stencil design maximise accuracy and repeatability when processing singulated substrates, strips, or leadframes.**

**Award-Winning Virtual Panel Tooling**

Virtual Panel Tooling – unique to DEK – interfaces directly with industry-standard carriers, and is capable of aligning multiple singulated substrates independently. Alignment is completed within the cycle time of the standard print process, achieving high throughput in terms of Units Per Hour (UPH).

**Singulation**

Single-Substrate Tooling, taking advantage of the platform’s vision-alignment capabilities, enables automated sequential processing of singulated parts where ultimate accuracy is required.

**Multi Award-Winning ProFlow®**

The leading enclosed print head technology enables a wide variety of electronic materials to be deposited accurately and preserved with minimal degradation and wastage over an extended period.
Building-in DEK technologies and solutions to your back-end packaging processes connects you to DEK’s world-class support infrastructure. Already proven in the fast-moving, global surface-mount assembly business, our support model puts the resources you need within easy and immediate reach.

Application engineers working at our specialised centres of excellence – with locations in the Americas, Europe and Asia – provide the expertise in process, materials and equipment you need to operate at the leading edge of technology and productivity. Our application support teams offer:

- Help to optimise your processes or equipment
- Resources to carry out trials and benchmarking exercises
- Streamlining the introduction of a new process, quickly, to your factory floor

At the same time, our development teams are constantly researching package technologies, to advance our knowledge at the leading edge and discover new and better construction techniques and processes. Respected within the industry as semiconductor packaging experts, our engineers regularly present papers at conferences and events, and contribute comprehensively to define the current state-of-the-art and future possibilities.

Connect with our extensive support network by discussing with your nearest representative how you can adopt DEK’s advanced processes and technologies within your back-end assembly activities.
Build an Enduring Lead

Partner with DEK, the leading developer of precision, automated screen printing for advanced, back-end packaging processes, at both wafer and final package levels.

The flexibility and configurability of our proven, world-class printing platforms provides the cost-effective foundation you need to establish a winning presence in your markets.

In addition, our comprehensive range of modular solutions, supporting a broad portfolio of processes for advanced packaging, delivers the flexible and future-proof capabilities you need to continuously adapt and improve your capabilities to meet your customers’ requirements going forward.

Combined with our stable equipment platforms and precision handling options, our proven processes give you the assurance that you can meet your immediate and medium-term goals.

For the longer term, you can trust our commitment to R&D to deliver the new technologies and process knowledge you will need to adopt emerging package technologies quickly and successfully. As package technologies continue to advance, progressively delivering performance increases as well as eliminating issues related to package overheads and shrinking dimensions, DEK can help you achieve best-in-class processes that deliver best-in-class performance with continuous cost down; keeping you at the forefront of your markets and firmly ahead of your competitors.

Find Out More

To discover how DEK technologies and capabilities can help you boost productivity, contact your nearest DEK representative directly or go to www.dek.com

“DEK IS COMMITTED TO PROVIDING LOW COST SEMICONDUCTOR PACKAGING SOLUTIONS FOR THIS RAPIDLY EVOLVING INDUSTRY”