

# AEROSOL JET™ HIGH DENSITY PRINTED ELECTRONICS

*New Generation of In-line Digitally Driven Dispense Systems  
for Advanced Packaging & Assembly*

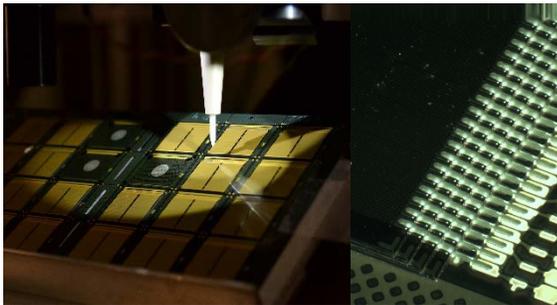
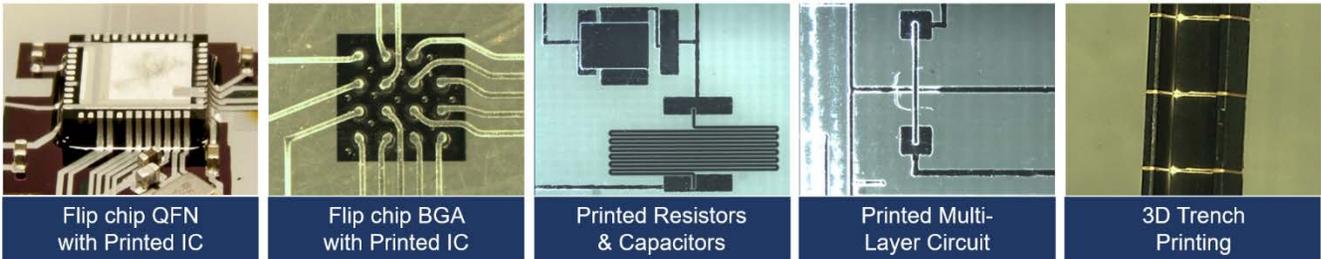
Available in 20um, 50um and 100um configurations



*A High-Resolution Dispensing & Electronics Printing Platform*

## ENABLING A NEW GENERATION IN ADVANCED PACKAGING & ASSEMBLY

From printed 3D Interconnects and RDLs, to embedded passives and fine feature attach, the HD Series in-line high density deposition system is a flexible platform that meets today's most demanding application challenges.

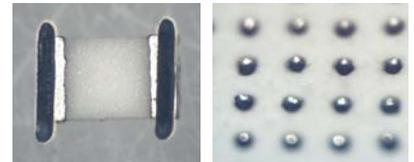


### PRINTED 3D INTERCONNECTS

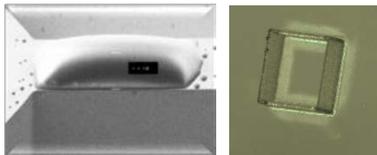
Direct printing of conformal 3D interconnects as an alternative to wire-bonding provides wide-ranging benefits, including smaller footprint, lower package height, reduced crosstalk and improved mechanical reliability. The Aerosol Jet solution can produce interconnect traces as narrow as 25-micron to support pad pitches down to 50-micron, and the solution is applicable to direct die attach and die stack applications, ie: combining dedicated memory with processor.

### COMPONENT AND DIE ATTACH

With its unique ability to print fine features with high viscosity inks, the Aerosol Jet HD platform can produce high resolution adhesive pads with features as small as 25-micron. This supports conductive attach of today's smallest die and components, without the need for manual re-work increasing overall throughput and eliminating wasteful end-of-line clean-up steps.



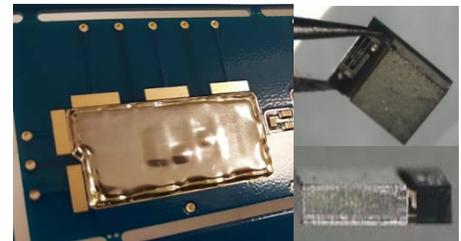
### PRINTED DIELECTRICS, INSULATORS AND ADHESIVES



In addition to conductive materials, the Aerosol Jet HD platform performs high resolution printing of a wide range of common non-conductive electronics materials. Applications include MEMS bonding, seal rings, local passivation, and insulative overcoats. When coupled with conductor printing, the system can produce high density cross-over and multi-layer circuitry.

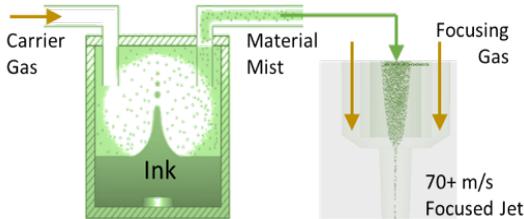
### CHIP AND BOARD LEVEL SHIELDING APPLICATIONS

The Aerosol Jet HD platform is capable of producing precision conformal coatings on non-planar surfaces, enabling chip and board level EMI shielding that are requisite for today's mobile devices. Larger nozzles enable single pass printing of coatings measuring from millimeters to centimeters in width, while maintaining uniform layer thickness from 100nm to 10's of microns. Couple this capability with the HD's fine feature printing and edge coatings of complex packages, and selective exposure to contacts and ground planes are now possible.



## Aerosol Jet Technology Basics

Optomec's patented Aerosol Jet technology is a fine-feature material deposition solution used to directly deposit functional electronic materials onto planar & non-planar substrates without the need for masks, screens or subtractive post-processing. The process utilizes an innovative aerodynamic focusing technique to collimate a dense mist of micro droplets into a tightly controlled beam of material that can print features <20 microns to millimeters in size.



This aerosol-based approach is flexible in its ability to support a wide viscosity range of inks, produce both thin & thick layers, and print both small & large features. Its non-contact process can tolerate a variable stand-off distance (1-5mm) and variable angle of incidence (up to  $\pm 22.5$  degrees from normal) making the process readily suited for printing on non-planar and 3-dimensional substrates.

## AEROSOL JET HD SERIES IN-LINE DIGITAL DISPENSE SYSTEMS

### *Equipment and solutions for digital additive manufacturing*

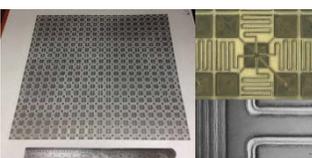
Optomec's Aerosol Jet HD Series of in-line digital dispense systems, with its compact design and seamless fit in today's production lines, brings digital dispensing to a whole new level. The HD Series high resolution printing capabilities meets advanced packaging production gaps.

#### **FLEXIBLE**

The HD series handles a variety of substrate sizes and compositions to meet specific process requirements. Applications from dot dispense, to advanced coatings, to 3D interconnects leveraging advanced features such as print head tilting, contact and non-contact heating, and in-situ material curing are all possible.

#### **COST-EFFICIENT**

The system features compact machine dimensions, high accuracy stages, precise material deposition, low material waste, and a streamlined mechanical design enabling the system to maximize run-times with reduced maintenance



#### **ADVANCED DISPENSE CAPABILITIES**

The HD Series leverages Aerosol Jet production proven dispense technology used in 24x7 manufacturing of Smartphone antenna, printing strain sensors onto 3D gas turbine blades, printed specialty coatings used by Mil-Aero manufacturers, and printed fine-feature redistribution circuits in semiconductor applications.

#### **HD SERIES DISPENSE DIFFERENCE**

With its digital driven print process and precise high-resolution print capabilities, Aerosol Jet HD print solutions are filling gaps in current production manufacturing lines. Whether its smaller package footprints found in the manufacture of BGA or stacked die packages or shielding applications requiring precise material deposition, Aerosol Jet print solutions are meeting these ever-increasing density and resolution challenges.

#### **SCALABLE PRODUCTION PROCESSES**

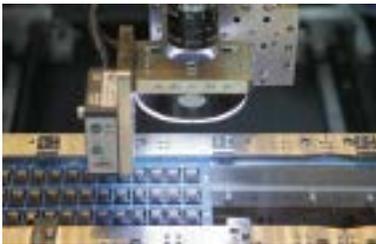
The HD Series print capabilities start with a standard 100  $\mu\text{m}$  print process. The processes can be further scaled to 50  $\mu\text{m}$  and 20  $\mu\text{m}$  high resolution printed features. Wider features from 100  $\mu\text{m}$  to > 2.5 mm can be further scaled via additional print heads and process control configurations.

# Aerosol Jet HD Series Advanced System Features



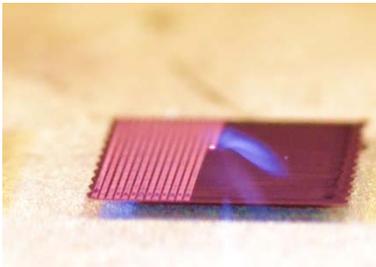
## CONFIGURABLE CONVEYOR STATIONS

Edge clamps, vacuum blocks, vacuum heating and non-contact heating modules offer all the potential material handling options for efficient dispensing.



## BODY RECOGNITION FUNCTION

Body recognition is used instead of fiducial search for better accuracy on high precision applications such as odd shaped PCBs or when dispensing on very small components.



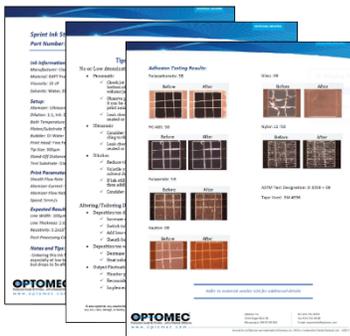
## OPTIONAL IN-SITU LASER CURING

The IR Laser Module is a compact, stand-alone, Class IV, laser material processing unit specifically designed to process thin films of nanoparticle, colloidal, or precursor inks. The laser radiation is delivered through an optical fiber, capable of providing >1.0 W of focused infrared laser radiation at a wavelength of 830 nm.



## OPTIONAL IN-SITU UV CURING

The Light-Curing Spot Lamp Module emits energy in the UVA and visible portion of the spectrum (300-450 nm) for light curing of adhesives, coatings, and encapsulants. Ideally suited for inline processes.



## AEROSOL JET PROCESS RECIPES

Process recipes enable customers to save time and speed development of new printed electronic processes and applications. Developed by Optomec applications engineers, each recipe provides detailed dispense and cure instructions including substrate preparation, equipment set-up, printing parameters, and in-situ or post-processing curing procedures. Expected print results are given for a particular nozzle type and print speed. If applicable, expected electrical and environmental performance data is provided.

# AEROSOL JET HD IN-LINE SYSTEM SPECIFICATIONS

## DISPENSING/PRINTING CAPABILITY

|                         |                                      |
|-------------------------|--------------------------------------|
| Printed Feature Sizes   | 20, 50 and 100 micron configurations |
| Feature Size Tolerances | +/- 10%                              |
| Single-Pass Thickness   | 100nm to ~5um                        |
| Minimum Spot Size       | 25um (configuration dependent)       |
| Print Speed             | 1 to 50 mm/s                         |

*Note: Print Performance is Material, Substrate and Application Dependent*

## MATERIAL SUPPORT

|                        |   |
|------------------------|---|
| Conductors             | Ag, Cu, Au, Pt, Ni, Al, etc.  |
| Conductor Performance  | ca. 2-3X Bulk (200C); 3-5X Bulk (120C)                                    |
| Conductive Adhesives   | Silver-Epoxies, Loctite   |
| Transparent Conductors | PEDOT, CNT, Graphene, etc.  |
| Dielectrics/Insulators | Polyimide, Teflon, SU-8   |
| Adhesives              | Epoxies and Urethanes   |
| Other                  | Resistors, Ceramics, Biomaterials   |
| Ink Formulation        | Nanoparticle suspensions, Solutions-based, diluted screen printing pastes |
| Ink Requirements       | Particle Size: 5 to 500nm<br>Viscosity: 1 to 500 cP                       |

## STANDARD FEATURES

|   |
|---|
| Single lane Conveyor                                  |
| Vision module   |
| CCD vision system                                     |
| Audible alarm   |
| Dispensing software                                   |
| X,Y,Z fiducial calibration platform                   |
| IPC   |
| Barcode reading function module (with barcode reader) |

## OPTIONAL FEATURES

|   |
|---|
| Dual lane Conveyor                            |
| Decathlon ultrasonic cassette                 |
| Decathlon pneumatic cassette                  |
| 830 nm IR laser module                        |
| UV cure module                                |
| Automated print head tilt                     |
| Barcode reading function module (with camera) |
| Left-right, right-left conveyor               |

## MOTION SYSTEM

|                       |  |
|-----------------------|--|
| Printing Area         | XY: 300mm x 450mm  |
| Positioning accuracy  | XY: $\pm 30 \mu\text{m}$ @ $3 \sigma$ Z: $\pm 30 \mu\text{m}$ @ $3 \sigma$ |
| X, Y, Z Repeatability | XY: $\pm 10 \mu\text{m}$ @ $3 \sigma$ Z: $\pm 25 \mu\text{m}$ @ $3 \sigma$ |
| Max speed             | 1000 mm/s (X,Y)  |
| Acceleration          | 1.3g   |
| Resolution            | 640 x 480 px (30 W) ?  |
| Drive system          | Linear motor   |

## SUBSTRATE MATERIAL HANDLING

|                               |           |
|-------------------------------|-----------|
| Conveyor type                 | Belt      |
| Tool payload capacity         | 3 kg      |
| Min. substrate/carrier width  | 50 mm     |
| Max. substrate/carrier width  | 500 mm    |
| Min. substrate/carrier length | 50 mm     |
| Max. substrate/carrier length | 350 mm    |
| Operating system              | Windows 7 |
| Substrate thickness range     | 0.5~6 mm  |
| Communication protocol        | SMEMA     |

## FACILITIES REQUIREMENTS

|                     |                                  |
|---------------------|----------------------------------|
| Power               | 220V, 2KW, 10A, 60 Hz            |
| Air supply          | 90 psi (6 bar)                   |
| Nitrogen supply     | 550 to 880 kPa.                  |
| System dimension    | 880 x 1290 x 1450 mm (W x D x H) |
| System weight       | 900 kg                           |
| Standard compliance | CE                               |

## Contact Optomec

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## About Optomec

Optomec is the world leading provider of additive manufacturing systems for high-performance application in the Electronics, Biomedical, Photovoltaic, and Aerospace & Defense markets. These systems utilize Optomec's patented Aerosol Jet Printed Electronics technology and LENS power-metal fabrication technology.