High-Accuracy and High-Throughput Placement Systems

GSMxs™ Small Footprint and GSMx™ Linear Motor Platform

Advanced Semiconductor Assembly Division of Universal Instruments
Automation in Electronic Assembly
Universal Instruments is a global provider of innovative electronic circuit assembly technology and equipment, integrated systems solutions, and process expertise. Universal serves the top manufacturers in every category of the electronics industry worldwide through more than 65 sales, service, product training, and parts distribution centers in more than 30 countries.

Universal has an installed base of more than 18,000 machines worldwide — including surface mount, through hole, odd form, advanced semiconductor assembly, and board handling equipment — and certification to the ISO 9001 and the QS-9000/TE quality standards. Universal is well positioned to offer the service and expertise that only a truly innovative and global organization can support.

Universal Instruments
www.uic.com
E-Mail: Universal@uic.com

USA Corporate Headquarters
Tel: +1-800-432-2607
+1-607-786-8104

European Headquarters
Germany
Tel: +49-621-845-5158

Asian Headquarters
Hong Kong
Tel: +852-2723-2800
Accuracy, Throughput, and Flexibility

Variable Reluctance Motor™ Technology Brings New Levels of Accuracy and Efficiency to the GSM® Platform

The accuracy you need...
The GSMxs and GSMx are built to provide accuracy of ±18 microns @ ±6 sigma.*
• Patented Variable Reluctance Motor Technology
• High performance vision systems
• 1 micron resolution (0.000039”)

The throughput you expect...
Universal’s linear motor assembly platforms are built to perform at 1,500-4,700 placements per hour.**
• Gang processing ability
• Vision-on-the-fly technology
• Large field of view with the high resolution MegaView™ Camera

The flexibility to configure application-specific solutions
Get various modular options that you can configure on site to be up and running today. Four high-accuracy placement spindles and seven high-speed FlexJet® spindles give you the accuracy you need and the throughput you want, while our process expertise provides answers designed to optimize your line.

The chart to the right shows the significant productivity improvement obtained when using mixed head configuration, compared to that obtained with standard single head configuration. In this case, the mixed head GSMxs Platform was configured with a high-accuracy head for placing a flip chip IC and a high-throughput head for the 5-10 passive components assembled on a typical flex circuit.

Linear Motor Platforms
The GSMx Platform gives you the best of both worlds—the accuracy required for placing flip chips and the feeder capacity necessary for placing standard components. This is the machine of choice for assemblies with flip chip devices placed alongside active discretes and passive components.

The GSMxs Platform is perfect for advanced semiconductor assembly. It has a footprint 40% smaller than the GSMx and Class 1000 clean room compatibility.

*Specification for a four-spindle Flex Head configuration. Accuracy is measured by Universal’s standard method, using glass slugs and glass slides.
**Actual throughputs are application dependent. Estimates available upon application review.
Patented Variable Reluctance Motor Technology

Linear motors offer many benefits over lead-screw systems, but they are not new to the field of automated electronic assembly. What is new, however, is the Variable Reluctance Motor Technology, introduced and patented by Universal. Variable Reluctance Motor Technology allows for higher precision placement, even at faster speeds.

Competitive Advantages
- Class 1000 clean room compatibility
- High accuracy with high speed
- Superior thermal performance
- Advanced stability and repeatability
- Increased reliability

Thermal Performance
- Non-permanent magnet system brings 20%* reduction in power dissipation
- Reduced power dissipation lowers core operating temperature**
- Reduced core operating temperatures eliminate the need for cooling and calibration
- No thermal compensation requirements (frame fiducials, thermal coupling)

Repeatability and Reliability
- Dual-drive Y-axis improves positioning accuracy and settle times
- Settle times reduced to <30 milliseconds @ ±10 microns
- Settle times reduced to <100 milliseconds @ ±1 micron
- Fewer piece parts reduce friction and maintenance, lowering operating costs

Accuracy

How Universal’s High Accuracy Placement Works

Dual-Drive Y-Axis
Linear scale encoders provide 1-micron resolution on both the X and Y-axis.

The Linear Motor Module
Laminated E-core utilizes alternating currents to control movement along the stator bar in minute increments for maximum precision.

* Percentage is based on a comparison to permanent magnetic motors.
** Internal temperature rises just 1° C over ambient temperature.
**THROUGHPUT**

How We Achieve Speed

**High Accuracy with High Speed**
Achieving volume production of advanced assemblies without sacrificing quality has been a continuous challenge throughout the industry. Universal offers the options necessary to achieve the highest throughput for your specific application.

**Gang Processing**
The GSMxs and GSMx Platforms enable you to achieve volume production of flip chip assemblies through a combination of the multiple-spindle head, gang picking and gang dipping capabilities.
- Pick four components simultaneously with the four-spindle head technology
- Dip four components in flux simultaneously with the Linear Thin Film Applicator

**MegaView™ Camera**
Improve throughput by imaging large components only once with the MegaView camera’s large field of view. The MegaView family of cameras are Universal’s new high-resolution vision inspection systems for semiconductor assembly. The large field of view is a significant improvement over current technology.

**Key Benefits**
- On-the-fly vision for die sizes up to 18 mm and bump diameters down to 50 microns
- Up to 60% improvement in tact time for flip chips larger than 13.97 mm x 10.8 mm
- Digital 640 vision system provides up to 30% improvement in assembly time over analog systems

<table>
<thead>
<tr>
<th>The MegaView Camera Advantage</th>
<th>.000&quot; per Pixel</th>
<th>Number of Pixels</th>
<th>Minimum Bump Size</th>
<th>Field of View (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Camera Attributes</td>
<td>0.5</td>
<td>512 x 512</td>
<td>50 µ (”.002”)</td>
<td>5 mm (0.2”)</td>
</tr>
<tr>
<td>MegaView Camera</td>
<td>0.8</td>
<td>1,024 x 1,024</td>
<td>80 µ (”.002”)</td>
<td>20 mm (0.787”)</td>
</tr>
<tr>
<td></td>
<td>0.4</td>
<td>1,025 x 1,024</td>
<td>40 µ (”.0016”)</td>
<td>10 mm (0.393”)</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>1,026 x 1,024</td>
<td>20 µ (”.0008”)</td>
<td>5 mm (0.2”)</td>
</tr>
</tbody>
</table>

The MegaView Camera Advantage
Flexibility
How We Provide Application-Specific Solutions

Options for the GSMxs and GSMx Platforms
Production lines are no longer dedicated to a single product. New products are always being introduced and high product mix is often the norm. As a result, adaptability of assembly equipment is critical to permit maximum flexibility, optimum cost of ownership and long-term investment protection. With a wide range of options, the GSMxs or GSMx Platforms can be configured for the task at hand, both today and in the future.

Wafer Feeder
Universal has developed an integrated wafer feeder with on-line wafer processing and shuttle delivery of die to the linear motor platforms for processing. The wafer feeder has designed flexibility to adapt to wafers up to 300 mm since. (Most of today’s wafers are 200 mm (8”) and larger wafers are on the immediate horizon.)
- Standard cassette input (up to 25 wafers)
- Single part number or multi-part number
- Pre-stretched wafers
- Up to 300 mm wafers
- Wafer map input or ink dot identification
- Tact time of 1 die/sec.
- Flip Chip capability: selectable by wafer
- Die size: 1 mm - 25 mm
- Bar code identification/tracking of wafers
- Small footprint (< 4 ft²)

Other Die Feeding Options
- Precision Slide-Top Feeder locates multiple waffle packs in pick-up area
- SurfTape™ provides an open carrier for surface mount devices packages in tape and reel
- TrayStak™ Feeder stacks up to 45 50 mm x 50 mm (1.968” x 1.968") waffle packs for automatic feeding
- Jedec Trays

Placement Heads
- Pressure Enhanced Head delivers a placement force range of 150 to 2,500 grams
- Low Force Option delivers a placement force as low as 20 grams
- Nozzle Kits and Custom Nozzles cater to special needs applications
- Mixed head offering
- Dispensing
**Vision/Lighting**
- MegaView Camera enlarges field of view to 1,024 x 1,024 pixels while maintaining high resolution
- Pad Site Find goes beyond global and local fiducials, using the circuitry itself for pattern recognition
- Universalight™ illumination module uses blue or red lighting to provide high-contrast imaging of low-contrast substrates
- Look-before-pick or blind pick selectable at the component level
- On-axis lighting options for both PEC and upward looking cameras

**Fluxing/Dispensing**
- Linear Thin Film Applicator reduces space required for flux application while increasing surface area for gang dipping four components simultaneously
- Rotary Thin Film Applicator provides reliable flux thickness control while enabling high throughput by dip fluxing three components simultaneously
- Micro Dispense II precisely dispenses low solids flux onto the center of the placement site
- Archimedes Metering Valve used to dispense solder paste, silver epoxy, and other adhesives

**Substrate Handling**
- Precision Board Lifter provides precise registration of the substrate when presenting singulated substrates for placement
- Custom Board Supports and Pallets designed to each application to secure singulated substrates during placement

**Precision Board Lifter**
- Precision board lifter accommodates varying substrate thicknesses and presents singulated assemblies for pick-and-place.
**Configuration Solutions**

*How We Put It All Together*

**Application-Specific Configuration Examples**

Universal’s continuous analysis of industry trends and advances in technology has led to an emphasis on designing flexibility into our equipment. We’ve developed a wide range of options to ensure ongoing adaptation to ever changing semiconductor and optoelectronics assembly processes. Universal Application Engineers will help you decide which configuration will produce the best accuracy and throughput for your specific application. Here are a few examples of configurations we recommend for flip chip on flex, flip chip in package, hybrid, and optoelectronics assemblies.

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**Obscure details of flexible circuit substrates (top) are enhanced (bottom) by the blue UniversaLight™ illumination module.**

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**Flip Chip on Flex**

The GSMxS and GSMx Platforms can handle your entire flip chip on flex assembly on one machine, including capacitors and connectors. While giving you this flexibility, we’ve also developed solutions for improved accuracy, yield and throughput.

**Flip Chip on Flex Challenges**

- Low-contrast substrates pose imaging problems
- Substrates can be difficult to accurately secure
- Difficult to achieve entire assembly with one machine

**Key Options for Machine Configuration**

- Blue UniveraLight illumination module to clearly see low-contrast copper-on-polyimide traces
- Custom pallets designed to secure the flexible substrate
- Capability of placing passive components, connectors and bumped devices on one machine. FlexJet Head as an optional second head for high throughput placement of passives.

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**Standards Lighting**

**Blue UniveraLight Illumination Module**

Obscure details of flexible circuit substrates (top) are enhanced (bottom) by the blue UniversaLight™ illumination module.
Flip Chip in Package

Flip chip ball grid array and chip scale packages require high-accuracy and high-speed placement of the most advanced flip chip devices. The small footprint GSMxs Platform configured with flip chip options is a perfect fit.

Flip Chip in Package Challenges
- Achieving high throughput without sacrificing quality
- Meeting advanced precision requirements for die placement
- Ensuring die stability prior to curing or reflow

Key Options for Machine Configuration
- A MegaView camera and a 640 Vision System for large die processing
- Specific vision algorithms for flip chip such as Pad Site Find
- Both dip fluxing and flux dispensing capabilities
- Ability to handle both singulated substrates as well as strips

<table>
<thead>
<tr>
<th>Flip Chip Machine Configuration: Specifications</th>
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<tbody>
<tr>
<td>Die Size</td>
</tr>
<tr>
<td>Minimum Bump Pitch</td>
</tr>
<tr>
<td>Minimum Bump Diameter</td>
</tr>
<tr>
<td>Fluxing Techniques Supported</td>
</tr>
</tbody>
</table>
Hybrid Assemblies

High volume telecommunications and automotive applications require the placement of active and passive components on advanced hybrid circuits. Universal offers options for the GSMxs and GSMx Platforms that address both the accuracy and throughput issues of these challenging applications.

Hybrid Assembly Challenges

- Precisely securing and presenting singulated substrates for placement
- Handling of fragile Gallium Arsenide components
- Placing the required range of components with one machine
- Achieving volume production of high-accuracy assemblies

Key Options for Optoelectronics

- Eutectic die attach station
- Low force for fragile Gallium Arsenide or Indium Phosphide devices down to 20 grams
- Look-before-pick vision
- Placement relative to previous placement
- In-situ UV curing
- Solder preform feeders

GSMxs Opto Platform Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
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<tbody>
<tr>
<td>Accuracy</td>
<td>±1.8 µ @ 6 σ</td>
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<tr>
<td>Die Size</td>
<td>0.3 mm – 25 mm</td>
</tr>
<tr>
<td>Placement Rate</td>
<td>1,500 to 4,700 cph</td>
</tr>
<tr>
<td>Placement Force Range</td>
<td>20 grams – 2,500 grams</td>
</tr>
</tbody>
</table>
### Specifications

**Linear Motor Platforms**

#### Component Capabilities

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Standard active SM packages</th>
<th>Bare Die</th>
<th>Flip Chip</th>
<th>CSP</th>
<th>Passives</th>
<th>Shields</th>
<th>Connectors</th>
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<td>Passives</td>
<td>Shields</td>
<td>Connectors</td>
</tr>
</tbody>
</table>

#### Components Characteristics

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare Die / Flip Chip</td>
<td>0.30 mm (0.012&quot;)</td>
<td>25 mm (0.98&quot;)***</td>
<td>0.30 mm (0.012&quot;)</td>
<td>25 mm (0.98&quot;)***</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>0.30 mm (0.012&quot;)</td>
<td>25 mm (0.98&quot;)***</td>
<td>0.30 mm (0.012&quot;)</td>
<td>25 mm (0.98&quot;)***</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>0.10 mm (0.004&quot;) —</td>
<td>—</td>
<td>0.10 mm (0.004&quot;) —</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Bump Pitch</td>
<td>100 µ</td>
<td>—</td>
<td>100 µ</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Bump Diameter</td>
<td>50 µ</td>
<td>—</td>
<td>50 µ</td>
<td>—</td>
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</table>

#### General Surface Mount Components

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>1.016 mm (0.04&quot;)</td>
<td>63.5 mm (2.50&quot;)</td>
<td>1.016 mm (0.04&quot;)</td>
<td>63.5 mm (2.50&quot;)</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>0.50 mm (0.02&quot;)</td>
<td>50.8 mm (2.00&quot;)</td>
<td>0.50 mm (0.02&quot;)</td>
<td>50.8 mm (2.00&quot;)</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>0.50 mm (0.02&quot;)</td>
<td>12.7 mm (0.50&quot;)</td>
<td>0.50 mm (0.02&quot;)</td>
<td>12.7 mm (0.50&quot;)</td>
<td></td>
</tr>
</tbody>
</table>

#### Component Feeding Options

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Waffle Packs</th>
<th>Wafer</th>
<th>Tape and Reel</th>
<th>JEDEC Trays</th>
<th>SurfTape™</th>
<th>Tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSMx</td>
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<td>JEDEC Trays</td>
<td>SurfTape™</td>
<td>Tubes</td>
</tr>
</tbody>
</table>

#### Board/Substrate Characteristics

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width¹</td>
<td>50.8 mm (2.00&quot;)</td>
<td>254.0 mm (10.00&quot;)</td>
<td>50.8 mm (2.00&quot;)</td>
<td>457.2 mm (18.00&quot;)</td>
<td></td>
</tr>
<tr>
<td>Length¹</td>
<td>50.8 mm (2.00&quot;)</td>
<td>330.2 mm (13.00&quot;)</td>
<td>50.8 mm (2.00&quot;)</td>
<td>508.0 mm (20.00&quot;)</td>
<td></td>
</tr>
<tr>
<td>Thickness²</td>
<td>0.50 mm (0.02&quot;)</td>
<td>12.7 mm (0.50&quot;)</td>
<td>0.50 mm (0.02&quot;)</td>
<td>5.08 mm (0.20&quot;)</td>
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</tr>
<tr>
<td>Weight³</td>
<td>2.72kg (6 lbs.)</td>
<td>—</td>
<td>2.72kg (6 lbs.)</td>
<td>—</td>
<td></td>
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</tbody>
</table>

#### Fluxing Techniques

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Linear Thin Film Applicator</th>
<th>Rotary Thin Film Applicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSMx</td>
<td>Linear Thin Film Applicator</td>
<td>Rotary Thin Film Applicator</td>
</tr>
</tbody>
</table>

#### Component Placement Force

<table>
<thead>
<tr>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
<th>GSMx</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Force Range</td>
<td>20 to 150 grams</td>
<td>150 to 2,500 grams</td>
<td></td>
<td></td>
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<tr>
<td>Intrinsic Availability</td>
<td>98%</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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¹ Boards and substrates below minimum specification require application review.
² Boards and substrates thicker than maximum specification require application review.
³ Placement forces below or above stated range require application review.
* Actual throughputs are application dependent. Estimates available upon application review.
** Specification for a four-spindle Flex Head configuration. Accuracy is measured by Universal's standard method, using glass slugs and glass slides.
*** Bare Die/Flip Chip above or below minimum stated, consult application team.