

TECHNICAL BRIEF

In-Process Linear Motion: Three Things Your Supplier Must Have to Maximize Performance for Your Fab

INTRODUCTION

To meet colossal competitive pressures amid exponential market growth, semiconductor makers must constantly pursue improvements, from ultra-miniaturized circuitry to ever-more-advanced device architectures.

The systems that provide linear motion within the process are critical components for all this. But at the high end today, the specifications for those components are so extreme that only a handful of companies can supply them. How do semiconductor producers identify a linear motion supplier that can take their fabs to the next level?

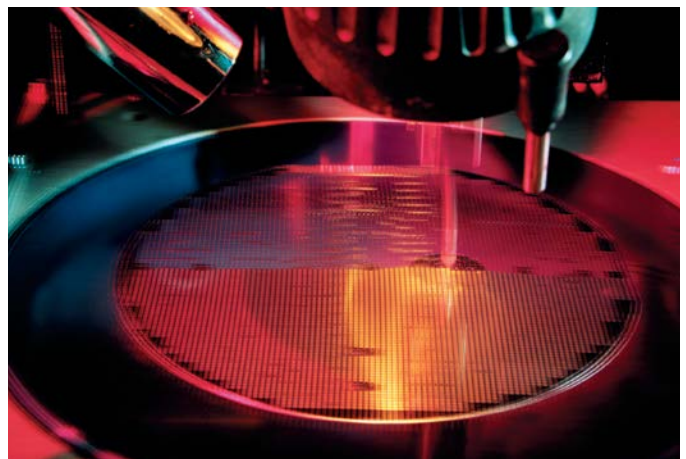
Here are three key characteristics your next-generation linear motion supplier must have — to position your process for what's next.

1. Integrated Manufacturing

Semiconductor engineering managers, engineering directors, and CTOs worldwide report that reliable linear motion is an absolute operational necessity.

The stakes are huge. A single failure of a linear motion component or system — anywhere in the process, including metrology, wire or die-bonding, wafer dicing and scribing, or packaging — can cost a fab hundreds of thousands of dollars (or even a great deal more) in downtime.

However, some suppliers provide components and systems that may be designed by one party, made by another, and mass-produced by a third. Even some high-end systems manufacturers don't make their own linear bearings or cross rollers. Instead, they simply assemble purchased components. Shortfalls in reliability seem almost inevitable.



Wafer inspection.

The solution: integrated manufacturing. Look for one of the few global suppliers that can control their own quality, almost every step of the way. Besides ensured QC, keeping design and manufacturing under one roof creates a synergy that's essential for the highest levels of product performance.

Often, only customized offerings can meet your fab's specific, edge-of-the-envelope requirements. Only a few linear motion product manufacturers provide true "spec-sheet-to-prototype-build" capabilities. Yet intelligent customization is often vital to anticipating and eliminating product shortcomings, and avoiding potential roadblocks in at-fab integration.

Specify products with the precise size, shape, coating, or material your job demands. And insist on solutions that meet your unique targets for accuracy, speed, flatness, preloading (to increase stiffness by eliminating internal clearances), service life, maintenance levels, and price.

At the highest levels of reliability, look for suppliers that integrate, not just their production, but their offerings. For example, a leading supplier may furnish a complete metrology solution, from the floor up to the point of measurement. Besides highest-performance cross roller bearings to provide extremely smoothness and speed, such a solution would take "ownership" of the entire assembly: not just the stage, but the frame it mounts to — along with state-of-the-art active dampening technology. So you get rock-solid control of both control component movement and any ancillary vibration.

2. Proven Innovation

When your fab production must push the envelope, make sure your linear motion can do the same. Seek out solutions with nanometer-scale stability and microsecond step-and-settle times. Look for suppliers that can handle typical high-end semiconductor linear motion specifications like these:

Configuration	XYZT or + Z
Travel	up to 600 x 750 mm (450 mm wafer)
Accuracy	≤ 1 µm over total indicated runout (TIR), mapped
Repeatability	≤ 0.1 µm
Stability	≤ 2 nm (within 1 s point-to-point)
Step & Settle	< 100 ms for 25 mm
Constant Velocity	< 0.01% at < 100 mm/s
Straightness	< 5 µm over TIR
Flatness	< 5 µm over TIR



Wedged designed Z-axis for E-beam application.

State-of-the-art linear motion solutions could include advanced positioning and motion systems with the integration of linear bearings and profiled linear guideways. In addition, fabs worldwide are reaching for higher levels of performance with newer developments like these:

Carbon fiber construction. Innovations in materials can meet multiple customer constraints. For example, in the right places, carbon fiber components provide reduced weight and thickness — while improving structural strength, stiffness, and stability.

Different guiding solutions. Different applications and specifications could require different linear guide approaches. While most may fall into the use of traditional mechanical-style bearings, others may require the ultra-smooth motion of air-bearings. And in some cases, the ideal solution could be a combination of both — or a HYBRID guide solution.

Improved controllers. Controllers are an important element in pushing the limits of linear motion performance in the fab. The latest models boast increased speed and new diagnostics. Avoid proprietary systems that lock you into one controller type. Look for a supplier whose system works with the controller that best fits your application requirements.

Ultra-high-speed positioning systems. The innovative SCHNEEBERGER Double-Gantry system demonstrates the potential to double positioning speed in semiconductor metrology. Advantages: Uncoupled X and Y axis for extremely fast settling times • Carbon fiber cross-member for increased stiffness and lighter mass • Accelerations up to 5 g with 0.5 µm positioning accuracy.

3. Solid Experience

Semiconductor manufacturing is not an industry that treats latecomers gently. That includes linear motion makers.

Fortunately, you can find specialized suppliers with literally decades of experience providing linear motion components and systems for semiconductor makers across the globe. Search out a supplier that's ready, able, and willing to realize manufacturing and performance improvements as well as cost efficiencies. That kind of partner can collaborate on long-term business/technological roadmaps for your mutual benefit.

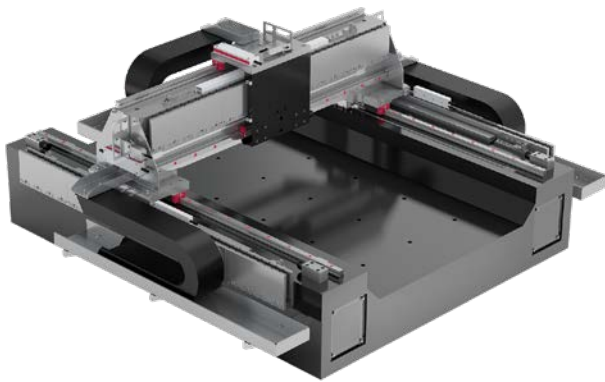
Besides overarching issues of purposeful design and quality assurance, an experienced linear motion supplier knows how to choose platings and coatings to resist corrosion; pre-clean oils and residue off all parts; pre-bake components

when needed to prevent later outgassing; and assemble all required elements in the supplier's dedicated clean-room manufacturing space.

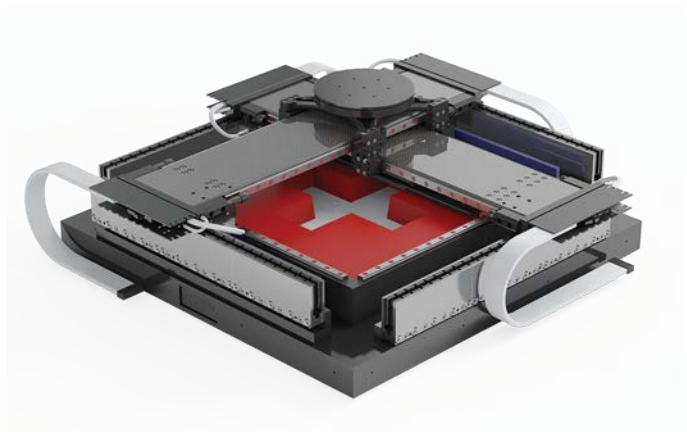
Experience teaches that even the smallest detail can make a difference. Examples: For some hard-to-access process locations, ceramic bearings can offer complete freedom from lubrication. And where appropriate, a leading linear motion supplier can assemble elements using vented screws, to avoid trapping tiny, possibly contaminated air pockets at the screw tip.

The right linear motion supplier can overcome every obstacle to help deliver the unquestioned reliability and next-level performance your fab has got to have.

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