

**Integrated quality
assurance: the key
to success**



Optimized semiconductor production

Measurement technology from Kistler boosts process reliability



Semiconductor products such as processors for computers or smartphones are becoming more powerful, but also more compact – so quality assurance systems have to meet demanding requirements

Quality is the overriding priority

The semiconductor industry has developed complex and highly interconnected value chains that span the globe, almost without parallel in any other sector. To coordinate research and development, assembly, testing and logistics, the distance between the Americas and Asia has to be bridged not just once, but many times over.

Solutions to meet growing requirements

The latest megatrends, such as autonomous driving, 5G and the Internet of Things (IoT) are continuing to ramp up this process. These developments require microelectronic products such as semiconductor memories and integrated circuits (ICs), as well as, MEMS and sensors utilized for the implement intelligent functions such as crash prevention, blind spot detection and brake assist systems.

Applications such as these make it essential for Smart Manufacturing to ensure the quality of semiconductor products: absolutely reliable production processes are a must for chip fabricators. Manufacturers of safety applications who supply the automotive industry are not the only ones who must meet this requirement: more and more end customers who purchase semiconductor products also expect fabrication processes to be fully traceable.

Comprehensive monitoring, control and documentation

Measurement technology from Kistler boosts productivity, reduces scrap and machine downtime, and ensures end-to-end traceability and transparency. Thanks to piezoelectric force sensors and the related monitoring systems, highly dynamic applications can be monitored precisely and controlled as necessary – with full documentary backup. By offering these benefits, solutions from Kistler deliver real added value for the complex production processes in the semiconductor industry.

Benefits for machine manufacturers

- Enhanced process reliability
- Increased productivity
- Process monitoring and documentation

Benefits for semiconductor manufacturers

- Improved product quality
- Reduced quality costs
- Traceability and transparency

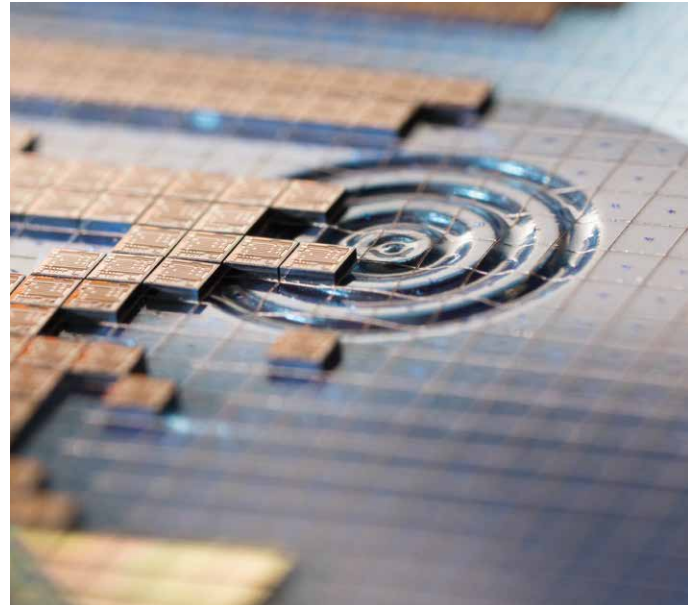
Integrated measurement technology optimizes production

New technologies and applications require more powerful semiconductors. Although their architecture is more complex, they are becoming even smaller and their design is focused specifically on customized solutions. For manufacturers, this means that force – as the critical process variable – must be controlled and monitored throughout production.

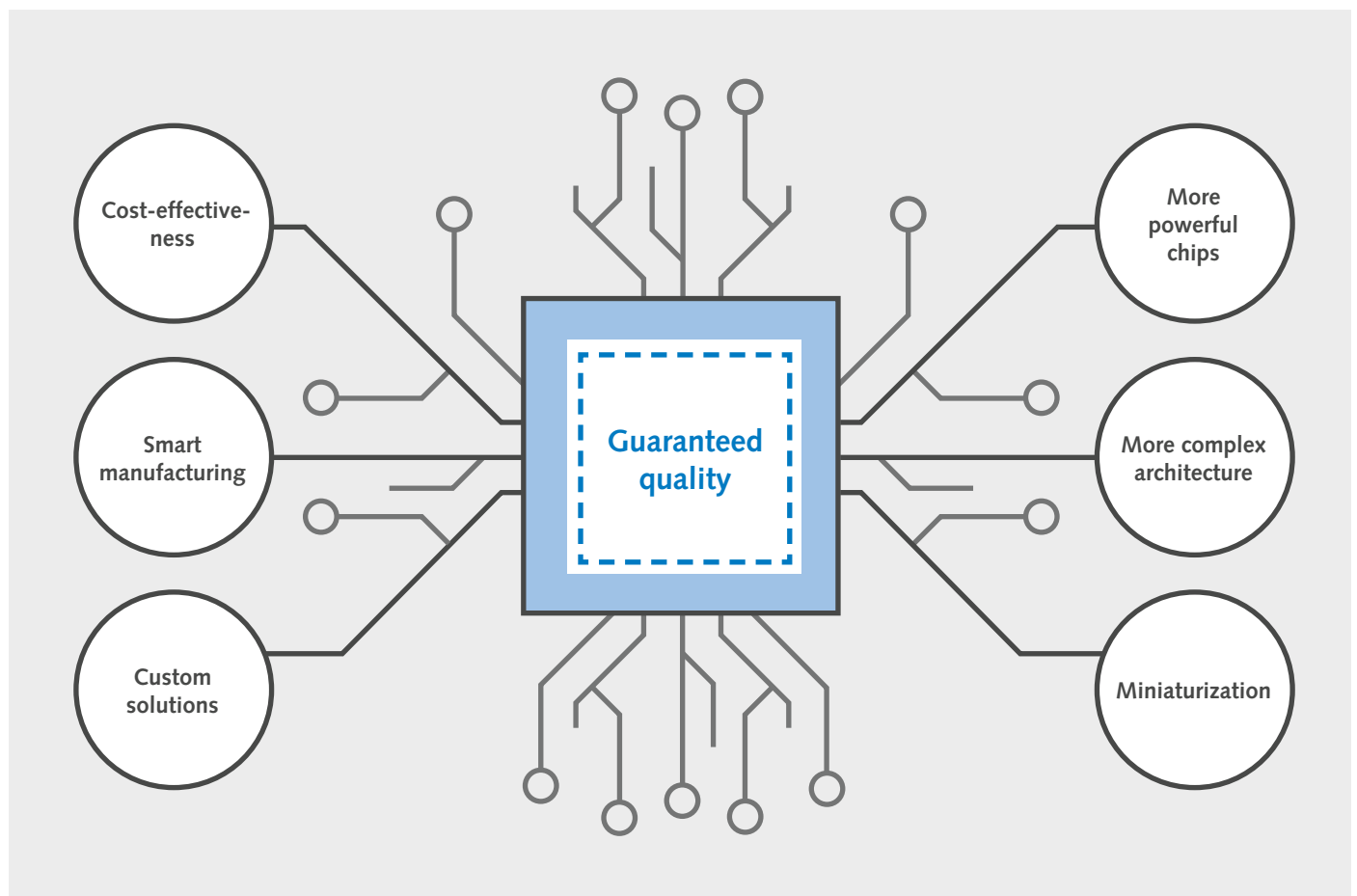
Unless force measurement technology is integrated in the machine, it will be virtually impossible to meet these challenges. Measurement technology from Kistler enables continuous quality monitoring in real time, based on accurate measurement data – opening the way for manufacturers to implement sustainable improvements to their production processes.

Experience pays dividends

Thanks to over 60 years of experience with piezoelectric measurement technology, we can provide exactly the support that machinery manufacturers and fabrication companies require. As a global partner for the industry, we provide integrated quality monitoring as the key to optimizing semiconductor production.



Only as much force as necessary: semiconductor products are delicate and sensitive





Kistler's diverse product portfolio includes the right piezoelectric quartz force link for every application

Step by step to the required solution

Machinery manufacturers rely on quality and innovation. Measurement technology from Kistler helps companies to achieve both objectives so they can stand out from the competition: integrated sensor technology and process monitoring give our customers the innovative edge.

Our support for customers already begins in the machine development phase. Our experts draw on their in-depth knowledge of viable measurement systems to offer advice on choosing a suitable solution. Throughout the entire process, they contribute their experience of dealing with complex measurement technology.

Semiconductor manufacturers are increasingly reliant on solutions from Kistler that provide dependable quality assurance for their production processes. Deviations in wafer and chip fabrication are detected while the process is still taking place, so appropriate action can be taken in response.

Minimizing scrap leads to significant savings on costs. And as an added benefit, process monitoring and control systems open the way to increased productivity. The acquired measurement data can be utilized to optimize processes and boost the efficiency of chip production.

Kistler provides local and global support for customers in the semiconductor industry throughout all four phases of the plant's life cycle: machine development, testing and commissioning, operation and optimization, and retrofit.

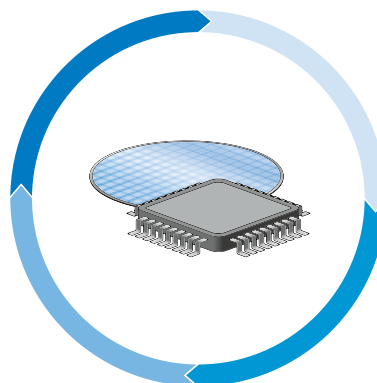
Traceability is a critical requirement for semiconductor fabricators, and machinery manufacturers must also bear this factor in mind. Comprehensive documentation is needed so that the manufacturing process for each individual product can be clearly traced. Solutions from Kistler supply this data in ready-processed form.

Retrofit

- Machine analysis
- Customized advice
- Installation of measuring chain
- Commissioning

Operation and optimization

- Analysis of measurement results
- Plant optimization
- Sensor calibration



Machine development

- Application advice on feasibility and product selection
- Development support
- Sensor installation

Testing and commissioning

- Integration of measurement equipment
- Commissioning
- Training

Take the lead – with piezoelectric sensors

Kistler is the world's leading provider of sensors based on piezoelectric technology – the solution of choice for the highly dynamic production processes in the semiconductor industry.

Benefits of piezo sensors:

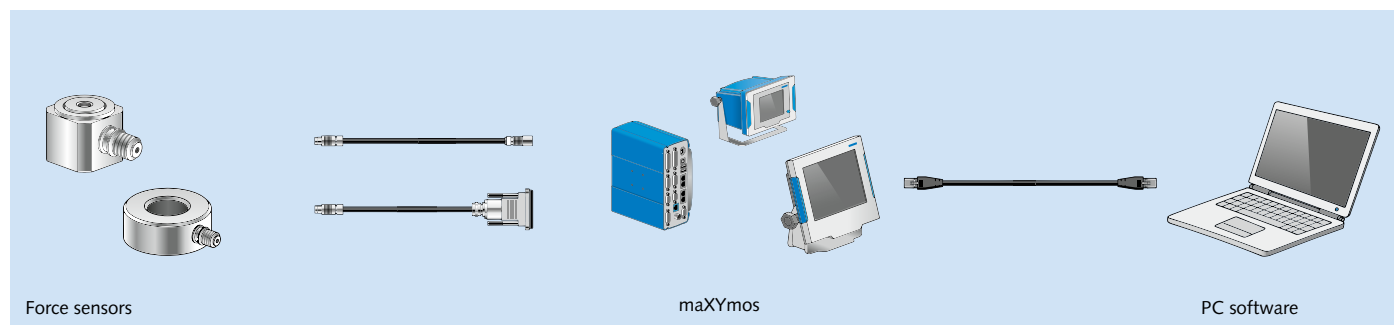
- Highly dynamic measurement for ultra-high cycle rates
- Excellent rigidity
- Very wide measuring range (mN to kN)
- High repeat accuracy
- Rugged and resilient
- Compact design
- Consistent performance throughout long lifetimes



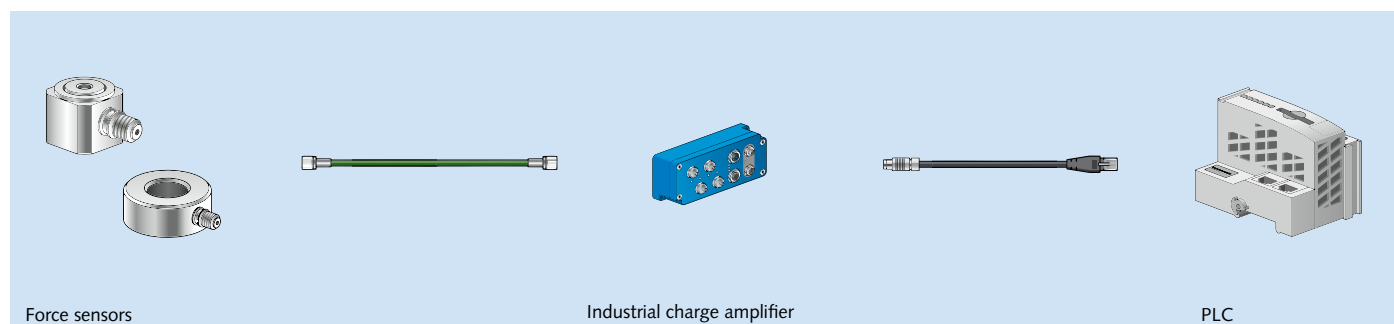
Continuous research work enables Kistler to develop crystals with outstanding properties for piezoelectric sensors

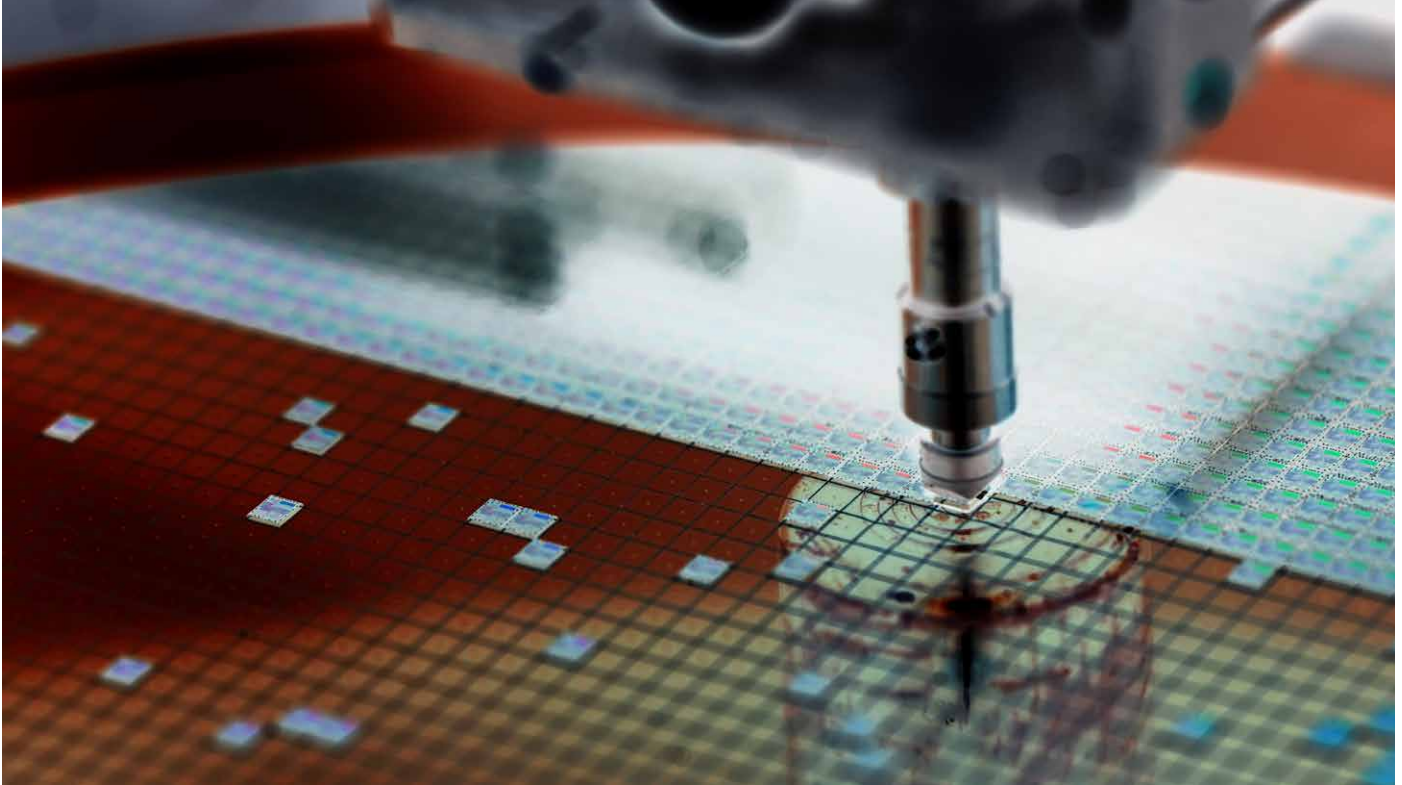
Expertise across the entire measuring chain

Measure Connect Monitor and control Document and analyze



Measure Connect Amplify Connect Monitor and control





The chip extractor removes the finished semiconductors individually from the wafer – with high-precision monitoring by force sensors

Quality assurance – directly in the process

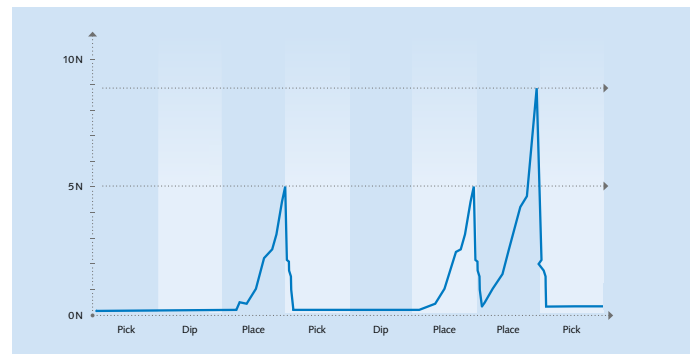
Force measurement technology from Kistler guarantees quality in the many different processes involved in chip fabrication:

- Die sorting
- Thermocompression bonding
- Wafer grinding/polishing
- Flip-chip
- Wire bonding
- Force calibration
- Panel bonding

Reliable pick-and-place

Fabrication often involves pick-and-place steps, when a part is picked up and moved by a robot. Examples include processes such as die sorting, test handling and flip-chip. Any excessive impact or tensile forces to the die must be avoided during these steps. Consequently, force control and the force data encountered during the pickup and placement process are critical.

Measurement and control are also essential when the semiconductor is separated. The values obtained here can be adjusted to improve production output. Precise control of the forces prevents damage to the chip, so quality costs are cut. And last but not least, continuous monitoring ensures traceability of every fabrication step for each individual product.



Graphic view of a pick- and-place application showing the force curve for removing and placing the dies

Bonding – it has to be right!

The process of bonding substrates or wafers with the help of chemical and physical processes presents complex challenges. Deviations in the parameter setpoint will influence the condition of the semiconductor, substrate and solder bumps – potentially resulting in a variety of defects. For example: the bond head guides the semiconductor to the substrate and is lowered. When the semiconductor contacts the substrate, a constant force is required until heat reaches the required temperature, in this way bonding can continue. The force data – as the critical variable – is monitored throughout the process and adjusted as necessary.

The right solution for every application

Semiconductor production combines many processing steps. This is why Kistler offers solutions of varying depth for different applications and customer requirements.

Integrated force testing and control

The measured force data is used for regulation and control – for example, during wafer processing and in the bonding process. Constant and precise application of force ensures that damage is prevented. Kistler measurement technology is integrated in the production line and supports process optimization and traceability.

Continuous monitoring

Many applications require constant monitoring and testing, but they do not need continuous control. It is sufficient to halt the process if there is a defined deviation from the setpoint. Integrated process monitoring based on force testing supplies accurate measurement data, so users can identify the causes of faults and optimize the process.

Periodic calibration

This cost-effective form of force testing makes use of calibration kits. They can be used for large numbers of identical machines. This approach is ideal if applications do not require continuous measurement and machine axis force values are verified at regular intervals.



Quality assurance with Kistler – just contact us!

Are you ready to take the next step, and move your machines or your entire production up to a new level of quality? Our experienced sales engineers will be glad to advise you and provide support throughout your project.

Force measurement technology in the chip fabrication process

	Applications	Continuous testing and control	Continuous testing	Periodic calibration
Wafer fabrication	Grinding, dicing and polishing equipment	•		•
	Chemical-mechanical planarization (CMP) equipment	•		•
Assembly and packing	Dicer	•	•	•
	Die sorter	•	•	•
	Die bonder	•	•	•
	Wire bonder	•	•	•
	Flip-chip bonder	•	•	•
	Molding and sealing equipment	•	•	•
Testing	Bond pull strength tester		•	•
	Pick-and-place handlers	•	•	•
	Turret handlers	•	•	•
	Sorting and tape equipment	•	•	•











Kraftsensoren
Transducer technology for precise force and pressure measurement.



Ladungsverstärker
Charge amplifier for precise signal processing.



Prozessüberwachungssysteme
Process monitoring systems for quality control.



Find out more about our applications:
www.kistler.com/applications

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