

Ultra-precision force measurement for low forces and nanometer displacements

Reliable verification of low forces remains a challenge in automated high-precision production systems. The ultra-precision force sensor range from IBS Precision Engineering is developed for robust inline force verification in the Newton range with mN resolution, combining high repeatability, easy integration and production-ready durability. Simultaneous nanometer-level displacement measurement is available for advanced analysis applications.

The IBS ultra-precision force sensor range consists of three variants: a 5 Newton, a 5 Newton damped and a 20 Newton version. They are designed for forces up to ± 5 N or ± 20 N and measure both force and axial displacement simultaneously. The force measurement is based on a mechanical system with a linearly defined stiffness, rather than a conventional strain gauge configuration. This approach enables both static measurements and dynamic loading with high stability. The force measurement has a resolution of 1 mN for the 5 N versions and 20 mN for the 20 N, while displacement is captured with nanometer resolution.



Figure 1: Left to right - 20 N, 5 N damped and 5 N

Independent of orientation and load position

An important practical advantage is that the sensors operate independently of orientation. Measurement accuracy is not affected by their orientation relative to gravity, making them suitable for complex test setups and machine integration. In addition, the sensors are tolerant to off-centre loading. Thanks to their mechanical design, measurement results remain stable when the force is not applied exactly at the centre, reflecting realistic conditions in many test and production environments.

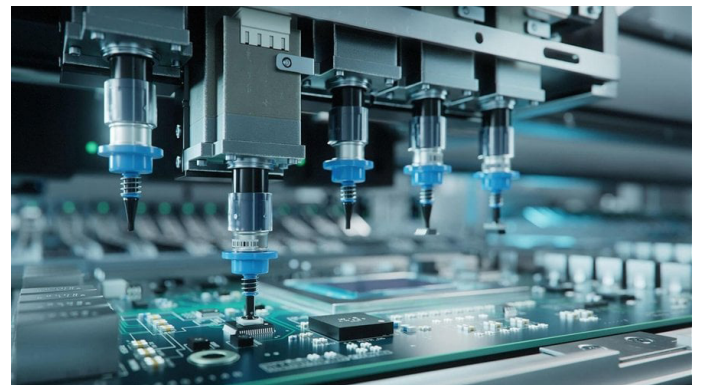


Figure 2: High-precision, dynamic applications

Dynamic behaviour and overload

The force sensor range is suitable for dynamic applications where forces vary rapidly, for example in pick-and-place systems or when analysing low impact and contact forces. Despite the low nominal measurement range, the sensors can withstand overloads up to approximately 30 N for the 5 N versions and 60 N for the 20 N version. Mechanical end stops provide overload protection, preventing permanent damage. This increases robustness during setup, testing or unintended peak loads.

High-frequency force measurements

The 5 N damped version integrates a dedicated damping mechanism to enable high-frequency force measurements. In applications where the sensor is repeatedly touched by a probe or nozzle, oscillations after each contact can affect throughput. The integrated damping suppresses these vibrations and shortens the settling time, allowing the sensor to return to a stable measurement state more quickly. This enables higher touch frequencies without compromising accuracy or repeatability, making it particularly suitable for inline force inspections and fast dynamic testing environments.

Adaptability

For different applications, interchangeable anvils (contact points) can be used. This allows the contact geometry to be adapted to the test object or wear to be compensated without replacing the entire sensor. Following anvil replacement, recalibration is required to maintain SI-traceability and measurement reproducibility.

Easy retrofit machine integration

The sensors are designed for easy integration into machines and production systems. A small mounting plate on either of two sides, allows fast installation without complex fixturing, while the gravity-independent measurement principle enables operation in any orientation. The compact design makes it possible to position the sensors close to the production area, even where installation space is limited. This allows force verification to be integrated directly into the machine, without interfering with machine movement, cycle time or accessibility.

Typical applications

The ultra-precision force sensors can be used in:

- Precision analysis of pick-and-place machines and other fast dynamic systems
- Verification of small forces in production lines and R&D laboratories
- Early-stage design and testing phases where accurate parameter determination is essential

Stable and repeatable low-force measurement

The ultra-precision force sensor range from IBS Precision Engineering is a specialised measurement solution for applications requiring low-force measurement, high resolution and repeatable performance. The combination of a robust mechanical design, orientation-independent operation and straightforward integration make the sensors suitable for production environments. Their stable measurement principle and SI-traceable calibration support reliable force verification in demanding R&D and industrial applications.

Read more

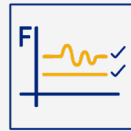
- [Ultra-precision force sensor webpage](#)

Benefits ultra-precision force sensors



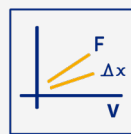
Bi-directional force measurement

Where forces alternate between tension (pulling) and compression (pushing).



For static and dynamic forces

Ideal for calibrating systems defining parameters such as motor current or positioning force.



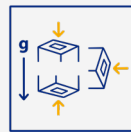
Simultaneous measurement of force and displacement

Real time results. This gives the option to analyse and compensate collision forces.



Hysteresis free measurement

Hysteresis free design ensures reliable, consistent and accurate measurements, regardless of how the input changes.



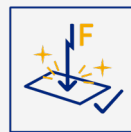
Capable of operating under any angle w.r.t. gravity

It can be applied at any angle. This offers flexibility in mounting and integration.



Replaceable contact surface

A replaceable anvil allows replacement after wear and extends the total lifespan and flexibility of the load cell.



Robust design against overload

The robust design allows for a large overload. This increases durability and prevents failure in unexpected situations.



Robust to off-center loading

The large touch surface enables off-center loading, improving accuracy in applications where ideal alignment is not always possible.



SI-traceable calibrated measurements

Making the result reliable, traceable, internationally recognized and ensuring compliance with industry standards.