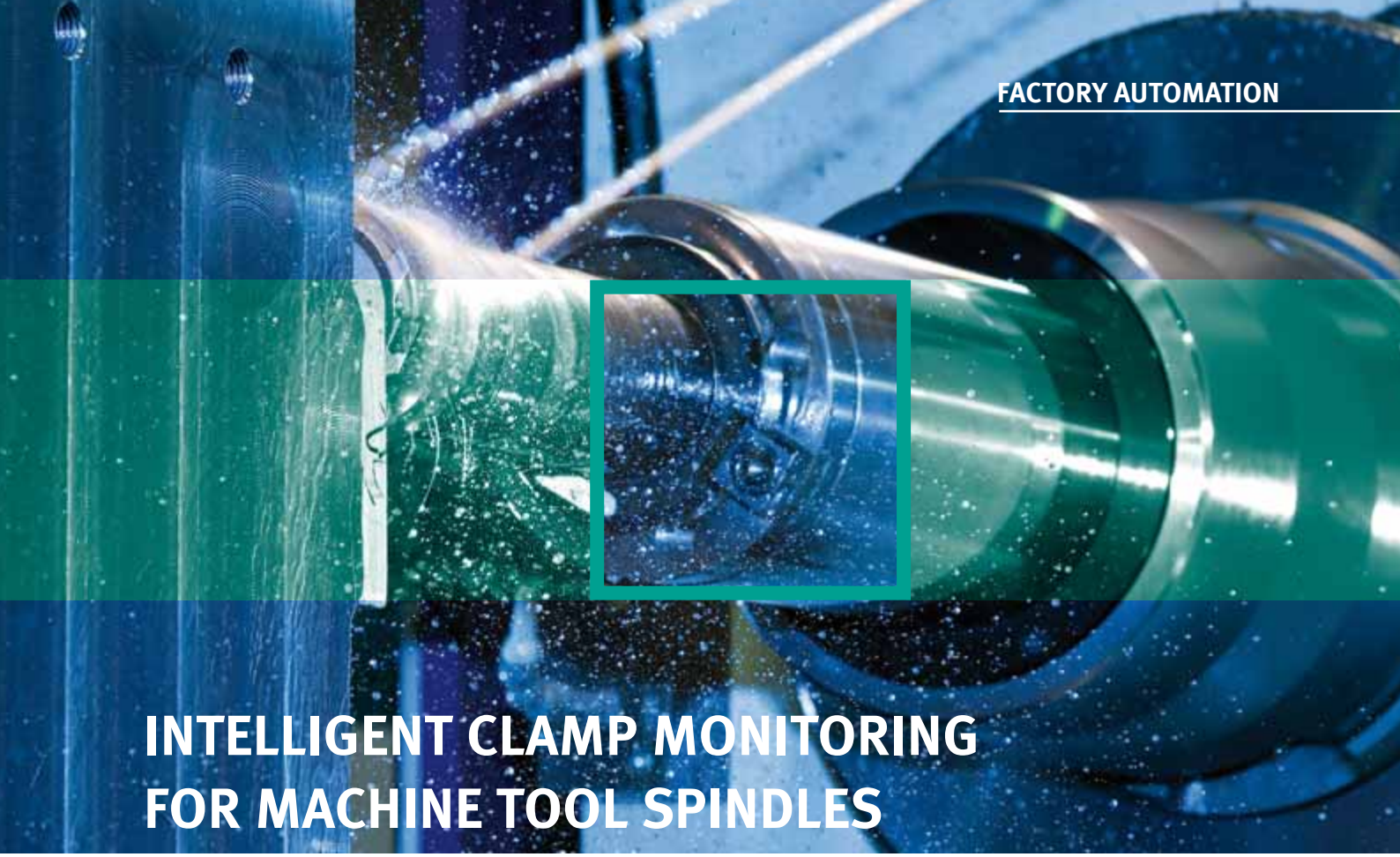
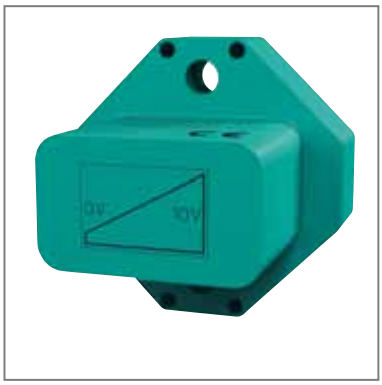


INTELLIGENT CLAMP MONITORING FOR MACHINE TOOL SPINDLES

WITH INDUCTIVE POSITIONING SYSTEMS



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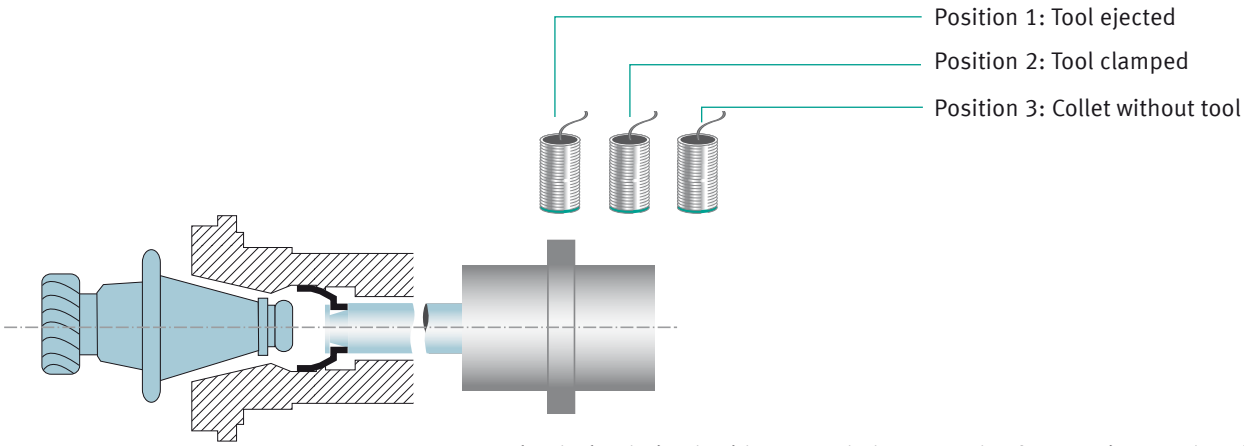
POSITION DETECTION FOR MACHINE TOOL CLAMP

OPTIMIZING THE TOOL CLAMPING PROCESS

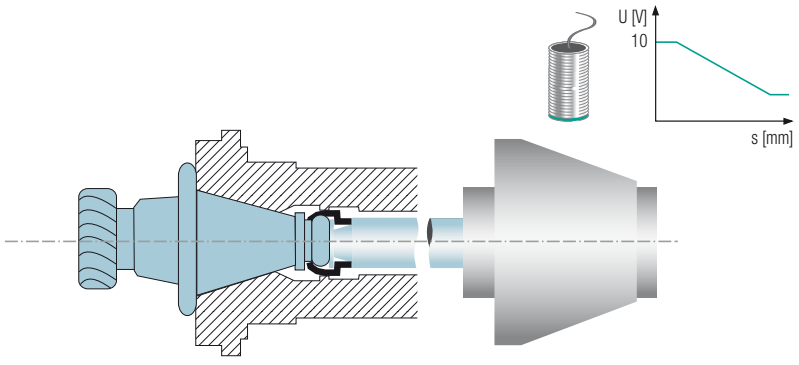
The core of a machining center is the tool spindle. While direct drive spindles are used on modern machine tools, classic milling, drilling and grinding spindles are operated indirectly via a central drive unit. The clamping/release device has the important task of consistently clamping the tool correctly, regardless of whether the spindle is driven directly or indirectly. In addition to speed and rate of advance, this is a crucial factor in ensuring that the surface of the workpiece is machined to a high quality.

The actual clamping state is calculated by measuring the axial displacement of the clamping cylinder. Three important clamping states must be detected here:



The three positions of the tool clamp are usually acquired using three discrete sensors.

A mechanical or inductive binary proximity sensor is often used to monitor the three clamping states. However, an analog signal that is proportional to the displacement and provides feedback relating to the clamping state is a much more valuable feature. This type of position feedback allows the clamping state to be monitored continuously and adjusted during the machining process. Continuous monitoring of the clamping state not only improves results on the actual machined workpiece, but also increases the reliability of the overall clamping system.



Clamp monitoring with an analog proximity sensor combined with a mechanical taper delivers a clamping signal proportional to the movement.

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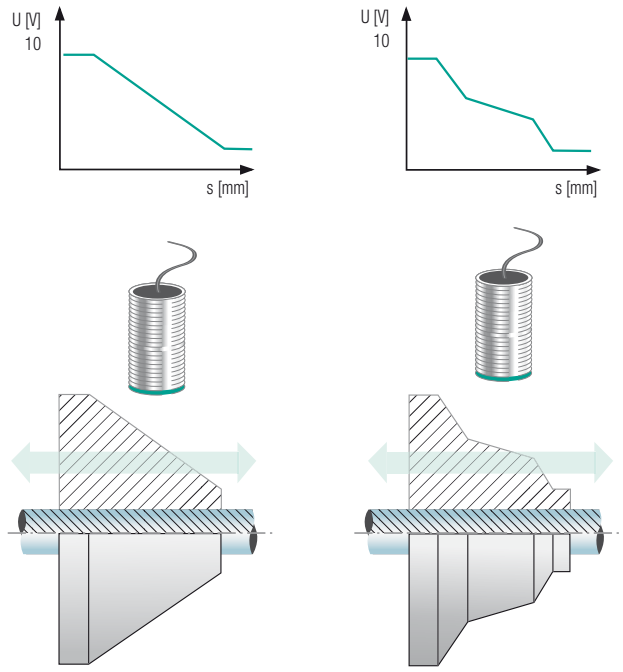
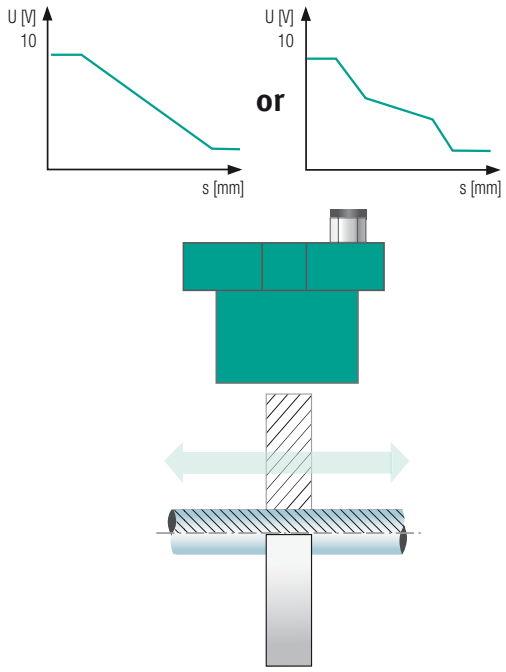
SENSOR REPLACES MECHANICAL CONTROL CAM

INTELLIGENT POSITION SENSOR GENERATES VARIOUS TYPES OF ELECTRONIC CLAMPING PROFILES

The PMI series sensors operate without making contact. Unlike analog-inductive proximity sensors, PMI sensors do not measure the changes in distance between the sensor and control cam (see illustration on left “Conventional analog sensor”), but the position of a moving steel disc. The sensors detect the axial position regardless of the distance between the sensor and the control cam (see illustration on right “Intelligent PMI sensor”). Position signals generated in this way are rotationally stable and free of signal jumps.



Conventional analog sensor;
Using an analog proximity sensor, the geometric shape of the control cam on a clamping/release unit produces the electronic clamping profile.



Intelligent PMI sensor;
Virtually any electronic clamping profile can be generated from a simple geometric control disc.

The PMI sensor incorporates a microcontroller, which allows the sensor to accurately measure position. As a result, the sensor provides an analog profile curve without relying on control cams with complicated shapes. The advantage of this kind of electrical output signal is clear: important clamping positions can be controlled more precisely and the machine controller can process positions more quickly, which saves valuable time and increases the efficiency of the clamping process.

ELECTRONIC TEACH-IN OF THE MEASURING RANGE ELIMINATES THE NEED TO ADJUST LIMIT SWITCHES MECHANICALLY

After the sensor is fitted to the tool clamp, the travel range of the clamping unit is taught in at the press of a button. The electrical output signal is then scaled to the required positions. The time-consuming adjustment of several position switches on the tool clamp is no longer necessary, which makes assembly and set-up of the entire spindle more efficient.

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ADVANTAGES AND SPECIFICATIONS

ADVANTAGES

- **Position detection independent of distance**
  provides an error-free measurement signal, even when the control cam is rotating
- **Scalable output signal via teach-in**
  eliminates the time-consuming adjustment of individual switches
- **Integral microprocessor**
  provides intelligence to adapt the output signal to the clamping state and increases the efficiency of the clamping
- **IO-Link command interface**
  gives access to important stored data and operating modes

TECHNICAL SPECIFICATIONS*

PMI14V-F112

PMI14V-F166

Technical specifications		■ Oil-resistant plastic housing ■ Scalable output ■ Available with IO-Link interface	■ Robust metal enclosure ■ Scalable output ■ Mechanical locking device secures installation position
Measurement	Measurement range Resolution Repeatability Linearity	0 mm … 14 mm 33 µm ± 50 µm ± 0.3 mm	0 mm … 14 mm 33 µm ± 50 µm ± 0.3 mm
Electrical	Operating voltage Signal output Load resistance No-load current	18 V … 30 V 0 V … 10 V ≥ 1000 Ω ≤ 20 mA	18 V … 30 V 0 V … 10 V ≥ 1000 Ω ≤ 20 mA
Mechanical	Ambient temperature Degree of protection	-10 °C … +70 °C IP67 Oil-resistant housing	-10 °C … +70 °C IP67 Oil-resistant housing

* For detailed information, refer to the technical product data sheets for the respective inductive positioning system: www.pepperl-fuchs.com

PMI-F112 WITH IO-LINK INTERFACE

IO-Link

In addition to an analog voltage output, the PMI-F112 is also equipped with a state-of-the-art IO-Link control interface. The IO-Link provides simple point-to-point communication between the sensor and controller. An IO-Link protocol communicates via the existing connections on the sensor. A complicated signal bus system on the sensor level is not required. The functionality of the sensor can be enhanced by providing the following:

Process data:
- Signal proportional to position
- Switching signal for triggering events relative to position

Parameter sets:
- Scaling of the sensor to match mechanical range
- Defined start and end point of clamp monitoring
- Definition of switching point position

Protocol data:
- Event counter for clamping cycles and operating hours
- Storage of spindle ID and installation date
- Temperature recorder
- Error condition signalling

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FACTORY AUTOMATION – SENSING YOUR NEEDS

Pepperl+Fuchs sets the standard in quality and innovative technology for the world of automation. Our expertise, dedication, and heritage of innovation have driven us to develop the largest and most versatile line of industrial sensor technologies and interface components in the world. With our global presence, reliable service, and flexible production facilities, Pepperl+Fuchs delivers complete solutions for your automation requirements – wherever you need us.

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