

Technical Report

# Inductive sensors: Can do more than expected

The (still) hidden talents among the all-rounders in automation

When thinking of smart automation solutions, inductive sensors most often do not come to mind. Without a good reason, as proved in the following examples of intelligent Baumer sensor solutions.



Figure 1

Figure 1: Is IO-Link the better analog interface? The IO-Link digital interface provides numerous benefits, including reduced costs and noise-free digital signals.

Inductive sensors are the proven standard when it comes to short-distance detection on metallic objects. They are cost-effective, their non-contact principle is free from wear and they available in an enormous variety. In factory and process automation, plenty of them are deployed for permanent operation, usually in object detection or presence checks at machines and installations. But inductive sensors can do much more, provided they outrun standard precision capabilities or come up with smart functions. The present technical report will present less known applications of the powerful Baumer inductive sensors.

## IO-Link, the better analog interface?

The inductive sensors from Baumer with fully integrated electronics are unrivalled in precision. They reliably measure distance down to micrometer accuracy and

this way open up entirely new application potential. For example, they cost-effectively measure force and strain at machines, systems and tools.

Likewise, such high-precision measurements require accurate and stable transmission of measurement signals. Most often, this is done via analog interface (current- or voltage-based). So far, the only alternative used to be serial or fieldbus interfaces either complex to integrate or only featured by larger-sized, more complex sensors.

Conventional analog outputs present other challenges: Due to their sensitivity (few V/mm or mA/mm) operation is often within the mV or  $\mu$ A range. Noise emitted by near electromagnetic fields or even a simple cable impact may significantly impair the measuring signal



Figure 2

quality. Consequently, this calls for more expensive shielded cables while in parallel the cable length should be kept to a minimum. Furthermore, controllers requires high-resolution analog converters which will reflect in the calculation of total cost.

Further to variants with analog interface, the Baumer inductive sensors with IO-Link interface are available in most varied designs. When it comes to distance measurements with micrometer precision, this digital interface is an interesting alternative at reduced effort and costs. IO-Link provides numerous benefits:

- Easily connected to controllers via IO-Link master - at less cost compared to high-resolution AD converter cards
- Easy integration via IODDs (IO Device Description)
- Up to 20 m length, no shielded cable required
- Noise-free digital transmission without additional conversions

Easy sensor parameterization via IO-Link. Appropriate filter settings achieve optimally harmonized response time and resolution. The freeware Baumer Sensor Suite is the intuitive tool for easy evaluation and parameterization of IO devices.

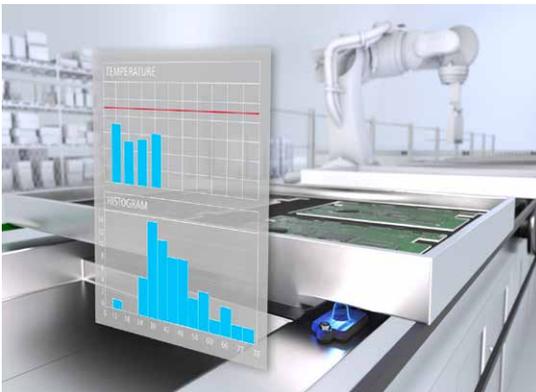


Figure 3

### Smart inductive sensors acting as speed monitor, frequency sensor or counter

Where rotating or vibrating machines and systems must be monitored and/or controlled, the Baumer inductive sensors with IO-Link open up new ways in terms of simplified implementation.

As an example, besides distance IO-Link provides also the frequency information for speed or vibration measurements up to 1.2 kHz. The measured value is delivered in Hz, where the speed information can be derived from. And, also parameterization of switching signals is based on frequency. In parallel to measured value transmission via IO-Link, switching signals can be transmitted to the digital output. In limit monitoring, the sensor can be parameterized to keep every switching operation within 100 to 120 Hz - even when not networked to the IO-Link interface.



Figure 4

Furthermore, within frequency measurements the sensor provides additional data such as signal amplitude (AC) and offset (DC) for monitoring the distance towards an object. This unique secondary data create added value for condition monitoring, for example monitoring wear at gearwheels.

Just likewise convenient, the sensor can be configured to counting switching cycles. Acting as a counter, the sensor would check batch sizes in running production or readout machine cycles for servicing.

Typically, such applications utilize standard inductive or Hall sensors; their output signals (switching pulses) must be correspondingly interpreted and converted. This entails integration effort and in parallel requires

Figure 2: Smart application: IO-Link inductive sensor IR12 also performs as a speed monitor.

Figure 4: The Baumer portfolio of inductive sensors offers every common format. A particular sensor specialty are the new compact but yet powerful ultra-flat sensors IF250 which allow for maximum design freedom.

Figure 3: IO-Link sensors ease machine monitoring and predictive maintenance by delivering important data on the condition of sensor or machine.

fast input polling. Using IO-Link, switching signal evaluation is completely in the smart sensor. Polling values therefore allows for longer intervals which takes processing effort off the controller.

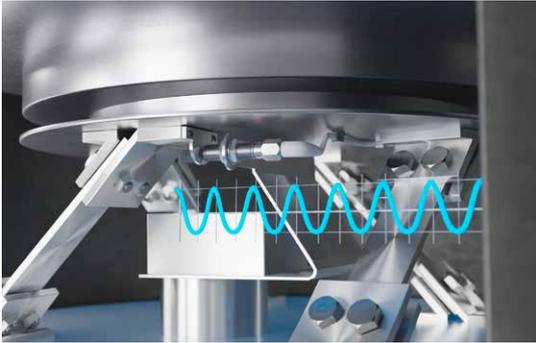


Figure 5

#### Diagnostic data optimize maintenance and reduce downtime

IO-Link sensors ease machine monitoring and preventive maintenance by providing important data on the condition of sensor or machine. Particularly inductive sensors are often close to the point of action, e.g. integrated in electronic spindles or gearboxes. Diagnostic data as the temperature information allow for early reactions to any negative trend (heating by wear/friction) and prevent failure. Such data may also serve for control tasks to keep the machine in the optimum working range or to compensate for ambient impacts. Further to other secondary data like power supply, operating time, number of machine cycles and others, the available histograms provide particular benefit. Both process and diagnostic data are continuously recorded and value-specifically assigned among 16 bins. Such histograms facilitate evaluation in the application or deliver information on the sensor's operating conditions in the event of service.

#### Compact performance sensors open up new application fields

The comprehensive Baumer portfolio of inductive sensors offers every common format for different application conditions (indoor, outdoor, hygienic). Compact yet powerful variants are a particular sensor specialty which allow machine design engineers smart solutions even in limited installation space. The product in the Sensor Solution Toolbox is ultra-flat IF250: Yet a mere 6 mm thin, IF250 will detect objects at up to 12 mm distance. Such performance is unrivalled in this class of housing dimensions and opens up new application fields where standard cylindrical sensors would not fit because of tight installation space.

#### Conclusion

These application examples demonstrate that inductive sensors with integrated electronics can do many more tasks than just object detection and presence checks. Powerful sensor variants ensure cost-efficient performance, particularly when exploiting the full potential of the data supplied via IO-Link interface. Intelligent solutions with inductive sensors are of ever-increasing importance on the way to the smart factory.

Further information at:  
[www.baumer.com/inductive-distance](http://www.baumer.com/inductive-distance)

Figure 5: Optimal control and monitoring of vibro-conveyors by measuring vibration frequency and stroke. The ultra-precise inductive sensors ensure process-reliable material feeding.



AUTOR  
Silvio Sprenger  
Product Manager  
Inductive Sensors,  
Baumer