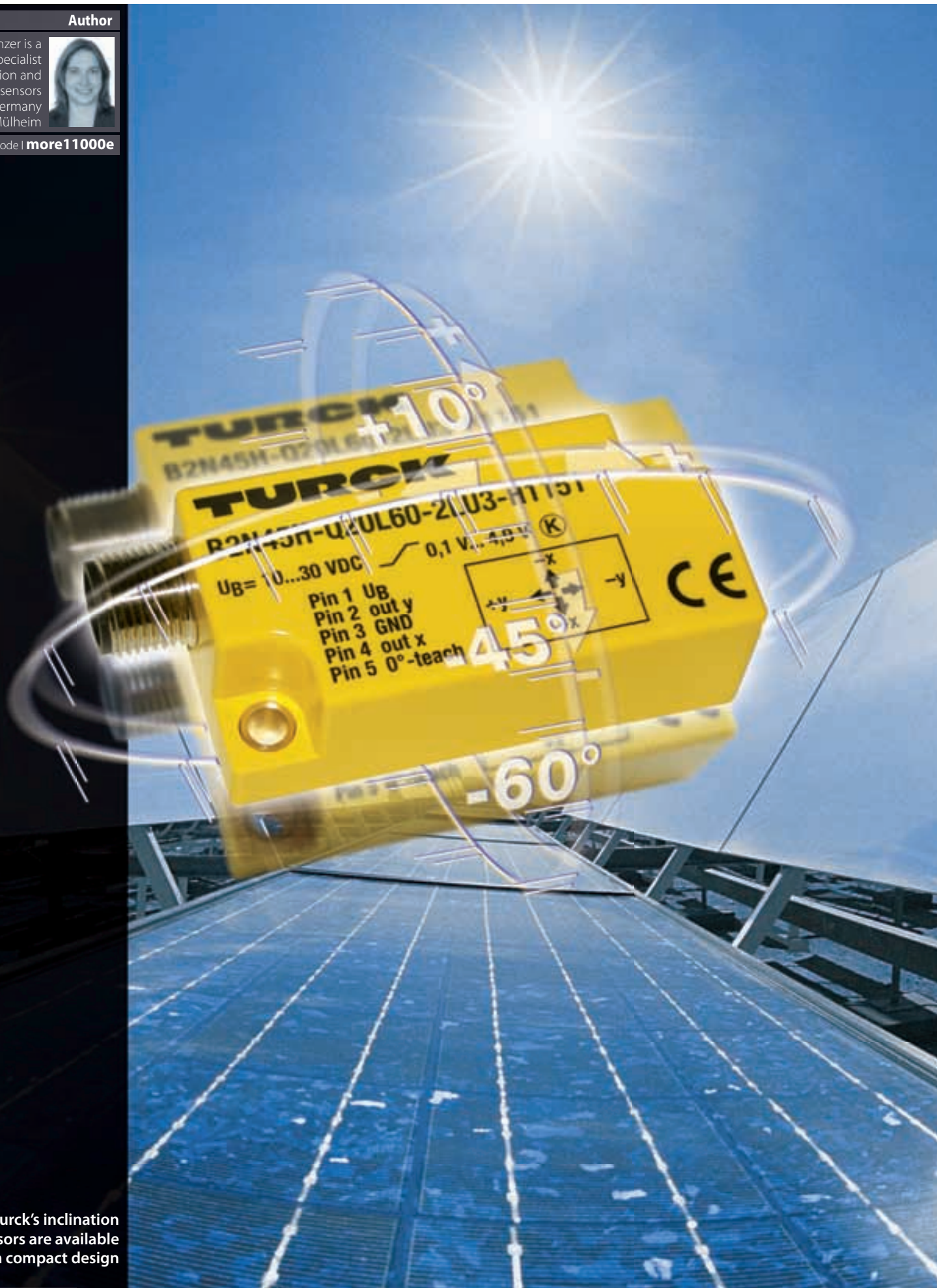


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Turck's inclination sensors are available in a compact design

# Get an Angle on it

Robust inclination sensors from Turck allow reliable inclination measurement up to 360 °

**W**hether for steering a harvester, an agricultural or a construction machine, for the surveillance of ships, vehicles or airplanes, or for the control of vending machines, robots or solar plants, sensors for measuring and surveying inclination angles make the operating procedures more safe and efficient. Since safety and efficiency are important competitive factors, the request for inclination sensors that are easy to operate is rising constantly. For the sensor specialist, Turck, this was a reason to develop a whole inclination sensor family whose members are able to measure nearly every inclination angle.

## The technology

An inclination is the relative position of a course, compared to the horizontal or to the vertical axis. Changes from this position can be measured fast and accurately with inclination sensors. As a reference for the measurement of the inclination angle, the gravitational acceleration is measured. This measuring principle equals the use of a plumb-line, where a mass orientates itself at the gravitational field.

The inclination sensors by Turck are based on the so called MEMS-technology (micro-electronic mechanical system). At the core of the construction is a micro-mechanical capacitive sensor element, consisting of two parallel horizontal plate-type capacitors. A plate-type capacitor consists of two parallel conductive plates. If a direct voltage is used with both plates, they charge until the electrode voltage is the same as the direct voltage. In doing so, the voltage of the capacitor is proportional to the direct voltage. The quotient from both values is the capacity.

Both plate-type capacitors from Turck's inclination sensor family use a shared middle plate, which forms a micro-mechanical pendulum. If the sensor is accelerated or brought out of its plumb position, the shared middle plate adjusts its position and the capacity of the conductive plates changes. This shared plate is constructed as an elastic pendulum. The sensors work as spring-mass system, whose springs are made of silicon



Inclination sensors are used for jet bridges, as well as ...



... for innumerable construction machines and other vehicles

### Quick read

Rising requirements for safety and efficiency for vehicles, machines and plants increases the demand for robust inclination sensors that are easy to handle. For Turck, this was the reason to introduce its new inclination sensor family whose members measure nearly every possible angle of inclination. There is a sensor for every situation – from the biaxial standard model to a sensor with a CANopen-interface.

In this washing and bleaching machine by Erbatech, the inclination sensor monitors a dancer bar that scans the tension



bars that are only  $\mu\text{m}$  wide; the mass is also made of silicon. Through the displacement between the spring-loaded part and a fixed reference electrode during the acceleration or the inclination, a change of the electric capacity can be measured.

### Robust packaging

Next to the measuring cell, the evaluation of the signals and the packaging of the electronics play a crucial role for the reliability and the functionality of the inclination sensors. The sensors have a repeat accuracy of 0.1 percent of the measurement range and a dissolution of up to 0.05 degrees, where the highest precision is needed. Due to the encapsulated electronics, the sensors are rated for IP68 environmental protection. This was proven through long term storage (24h) at -25 and 70 °C, seven days in a dip tank and ten thermal shocks from -25 and 70 °C.

The high reliability and the robust construction of the sensors are as important for the user as is the easy operation and administration. The 20 mm wide design of the Q20L60, and the cubical-shaped design of the Q42, work well in utility vehicles and agricultural machines, as well as in industrial crane technology and in industrial automation. Two diagonal, opposing drill holes in the Q20L60 and two drill holes on the side of the Q42 allow a fast and safe installation. The inclination sensors from Turck are also useful in systems that perform fast movements and are exposed to heavy impacts.

### The sensor family

The new inclination sensor family from Turck offers different designs for different fields of applications. The standard program contains the biaxial inclination sensors. They are available with an analog output for voltage, electricity and radiometric and cover an angular range from +10, +45 and +60 degrees. For special operational areas, the sensor family offers uniaxial models, which are able to cover the angular range of 360 degrees. With these models, the user can adjust the angular range within a few seconds. The uniaxial type is available with an analog output for voltage and electricity.

For the surveillance of critical values, Turck offers another 360 degree version with programmable switching points. With a few clicks on the teach-adaptor, the switching and the tripping points, as well as the hysteresis, can be programmed according to the requirements of the application. The LEDs on the sensors show the current switching status.

### Highlight with CANopen-interface

Turck's Q42 inclination sensor has a standard CANopen-interface (according to CiA DS-301/category after CiA DSP-410). These models offer baud rates of 10 kBit/s up to 1MBit/s, high sampling rates and bandwidth, as well as adjustable repression of vibrations. All the measured data and the parameters are accessible over the object index. The individual configurations can be saved with an internal EE-PROM non-volatile storage. ■