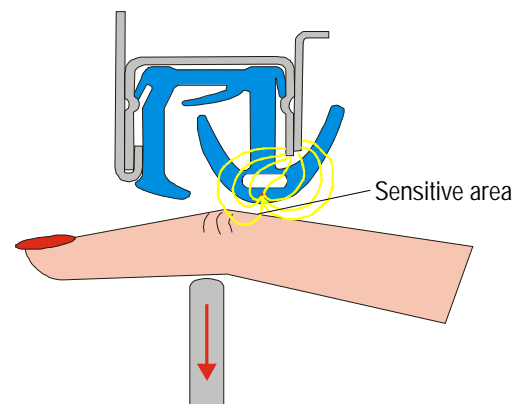


Window jam protection

Automatically operated windows are these days part of standard vehicle equipment. Increasingly sliding doors, tailgates and trunk lids are also electrically operated. However, there is a certain risk associated with this level of comfort: Anyone who has had a hand jammed in a closing window knows that this can be very painful. With sliding roofs or tailgates severe and even fatal injuries can be caused due to the greater mass. Consequently, the closing process must be monitored to prevent jamming. Today generally, contacting systems are used for this: These systems monitor, for example, the motor torque and switch off when the torque becomes too high. Other systems have a tactile sensor in the profile strip in which a contact is closed when two integrated wires are pressed together. All these systems have however the disadvantage that despite this a force - in many cases quite substantial - must be exerted.

The solution is therefore a non-contacting monitoring system. Together with Metzeler and the Fraunhofer Gesellschaft, Micro-Epsilon has developed a non-contacting capacitive jam protection sensor. The sensor can be easily integrated into existing door or window profiles. With the contact systems mentioned above, the wires already present in the profile can even be used as sensor elements. These wires are part of a capacitive evaluation circuit which reacts to changes in the capacitance between the wires.



The electric field here also extends to the space outside of the wires to enable non-contacting detection. If an object with a dielectric constant $\gg 1$ enters the field, the capacitance changes and the circuit detects the proximity. Since the human body mainly consists of water with a dielectric constant of approximately 81, the jamming of body parts can be easily detected.

Application

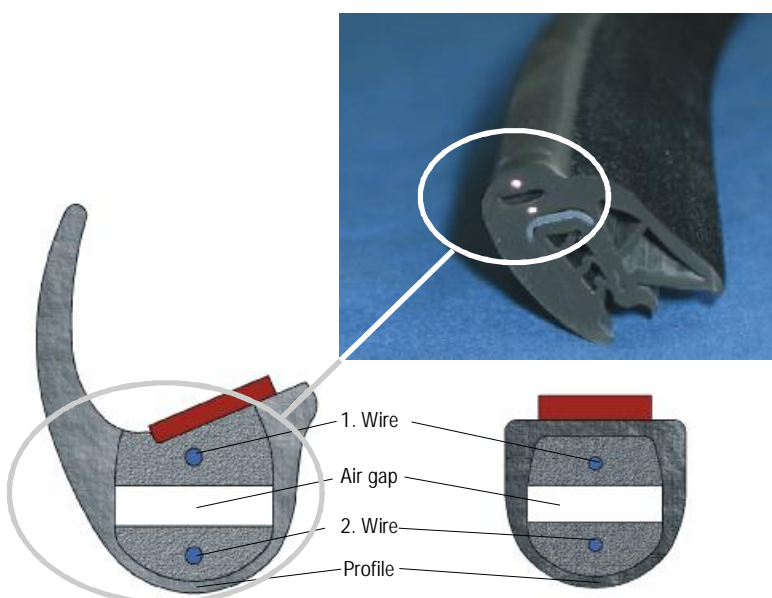
But what happens with rain or moisture, because here too water acts on the sensor? The engineers at Micro-Epsilon have been successful in developing a reliable so-called hand/water differentiation. Using a multi-frequency technique clear differentiation between body parts and liquid water is possible in the signal. Only now is application on vehicles possible. Additional safety is also provided in that the wires which act as the switch continue to be used, also providing a tactile signal. This is then necessary if objects other than body parts having a lower dielectric constant become jammed (e.g. wooden or plastic parts). Here however, the action of the force is not such a problem.

The evaluation circuit is miniaturized in the form of an ASIC, significantly reducing the installation space and presenting a cost-effective solution suitable for large-scale production.

System data:

- Capacitive sensor with two wires as electrodes
- Extruded in a rubber profile
- Redundant system with tactile signal
- Electronics with ASIC in plastic case in the plug.
- Measurement range 10 pF, offset up to 300 pF.
- Resolution < 50 fF
- Detection threshold for finger down to 3 mm, for hand down to 20 mm.
- Switching time capacitive < 7 ms, tactile < 5 μ s.
- Hand/water detection.
- Wire breakage detection, watchdog timer.
- Ready for operation 60 ms after switch-on.
- Supply voltage 7...18 Vdc, current consumption < 25 mA.
- Output signal logic level 5 V

Measurement principle



METZELER 
Automotive Profile Systems

This application was realized in co-operation with Metzeler Automotive Profile Systems.

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