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Application note

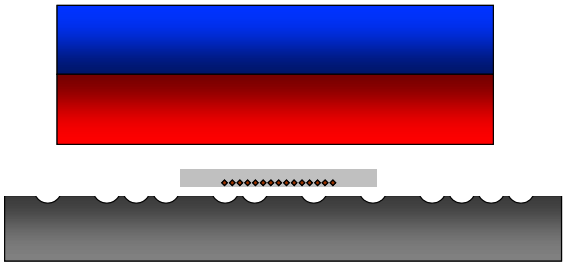
Using InAxis™ technology for measuring absolute position of linear actuators

In today's world, the field of use of linear actuators is infinitely diverse.

They can be used in almost any automation application; from electric pushers performing only single movement, to more complex systems where many joint actuators perform well coordinated and controlled motion.

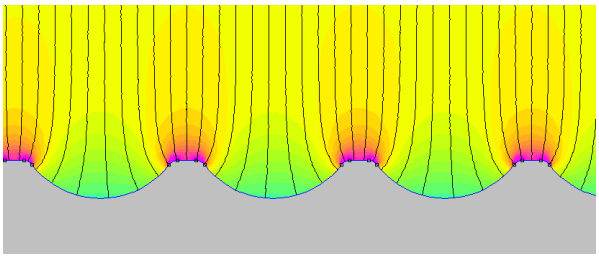
In order to control the motion using closed control loops it is important **to know the exact position of every actuator**. There are many possibilities to add position encoders to linear actuators: rotary encoders mounted to the back of a stepper motor, linear encoders mounted parallel to actuators, etc. Rather than mounting an encoder outside or next to the actuator it is desirable to **integrate the encoder as part of the actuator**. For example, if the rod of the actuator is modified so it measures directly in the axis of movement which the readhead can interpret as position, we get a perfect solution. Other mechanical properties of the rod must remain the same.

The core of the InAxis™ technology is the new MIS53 ASIC chip based magnetic sensor.



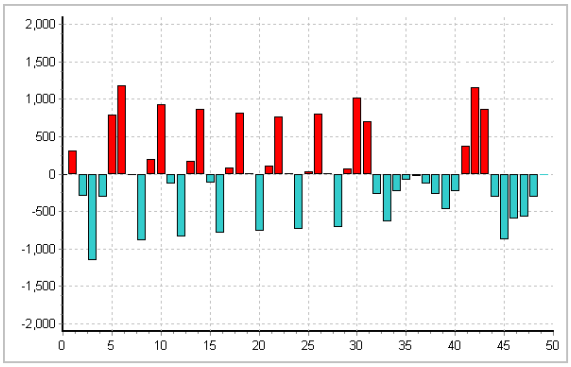
Permanent magnet, MIS53 chip and metal scale (schematic drawing)

Since the MIS53 chip can **detect small distortions** of the magnetic field caused by cut grooves on the surface of the metal rod, it can be used to build a position encoder integrated in the actuator. The MIS53 has a linear array of more than 50 Hall-effect sensors integrated on the same silicon die. It operates in two modes: the bipolar mode offers detection of small magnetic fields, while the unipolar mode is used to measure changes of the magnetic field of a biasing permanent magnet caused by a metal object based in front of the magnet.



Modulation of magnetic field due to metal structures

The structure on the rod can be coded in a unique pattern. This **coded pattern** can be used for determining the absolute position. In this case the actual position of the actuator can be read immediately upon system start-up and no movement to a reference position is needed.



Reading of coded pattern

There are various ways to cover the structures to make the rod's surface smooth again, including filling the grooves with non-magnetic material and covering it e.g. with a thin layer of hard chrome. Such an encoder is **immune to dirt and fluids** making it ideal for use in many applications including outdoor machinery.

Resolutions of such integrated encoders are to 0.5 µm with a typical accuracy of ±5 µm. The serial interface protocols include SSI, CAN and Asynchronous serial interface.

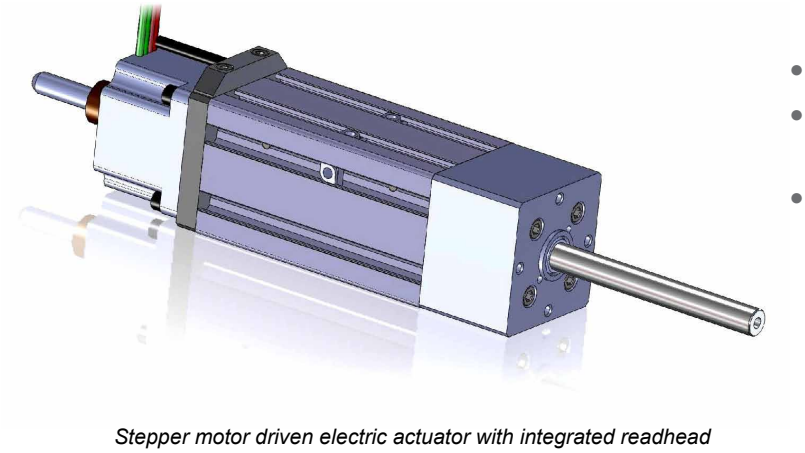
Suitable for electrical, as well as other linear actuators like hydraulic and pneumatic cylinders.

Features:

- Temperature range from -40 °C to +85 °C
- Various communication interfaces incl. CAN, SSI
- Self-monitoring for possible fault conditions
- Target system temperature monitoring

Typical applications

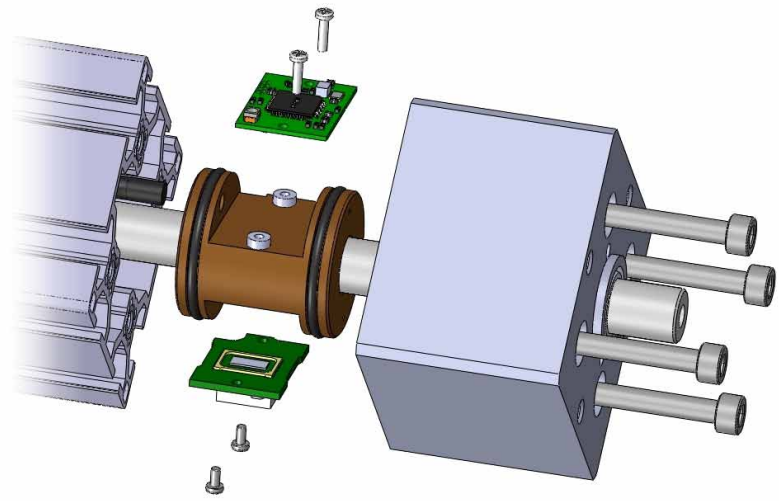
Integration into an electric linear actuator



- Encoder scale is integrated in the rod
- Readhead is incorporated in the sliding bushing
- Mechanical backlash does not affect position control

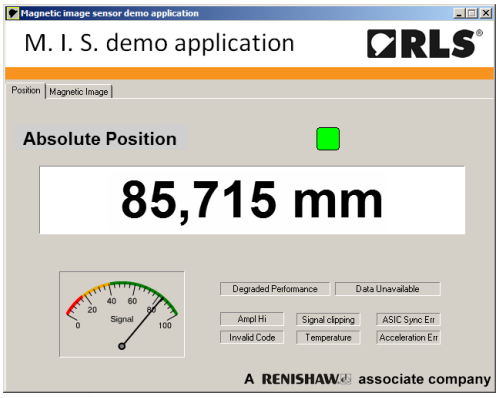
Stepper motor driven electric actuator with integrated readhead

Sliding bushing is a holder for the sensor module (MIS53 mounted as Chip-on-board on the bottom-side PCB) and the signal processing electronics that provides data interface to the motion-control electronics.



Readhead detail - exploded view

Integration into a two-tonne hydraulic cylinder



Readhead with IP68 connector mounted at the end of a cylinder