

Optical Angular Resolvers

Small Pitches in Low Cost Technology

Angular resolvers are used in many industrial and automotive applications for the detection of the angular position of rotary motions. Traditional optical angular resolvers usually show the disadvantage that high resolution is hard to combine with low manufacturing costs. Therefore a new concept for low cost high resolution optical angular resolvers is developed at Hahn-Schickard.

The fundamental idea of the sensor is to use a micro structured plastic disc with a reflective coating, known from the compact disc (CD) or digital versatile disc (DVD) technology, as solid measure. With the well known manufacturing processes for CDs or DVDs, it is possible to fabricate a high precise solid measure in high quantities at very low manufacturing costs.

Fig. 1 compares the bits and bytes of a data or audio compact disc with the geometrically positioned microstructures of a test disc for the optical angular resolver. Consisting of longish cavities with a wavelength dependent depth, the micro patterned areas work like diffractive phase gratings. Structures for incremental (2) and absolute (3) encoding have been investigated.

The detection of the solid measure results in optical interference. Optical sampling of the solid measure is done by a focused beam of a laser diode, which is reflected by the back-side of the solid measure onto a photo diode as indicated in Fig. 2. The stiff arrangement of laser diode, lens and photo diode forms the reading unit of the angular resolver.

Functional prototypes of an 8-bit absolute encoded angular resolver as well as an incremental angular resolver were designed and assembled using precision mechanics (see Fig. 3). The optical units of the devices include a 650 nm laser diode, an aspheric lens, a suitable optical

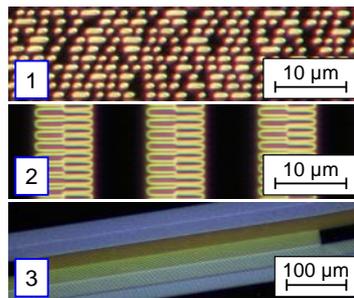


Fig. 1: Bits/Bytes (1), solid measures for incremental (2) & absolute angular resolver (3)

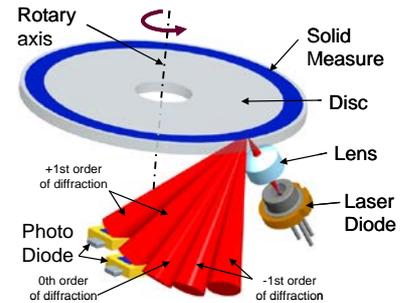


Fig. 2: Optical reading unit of an incremental angular resolver

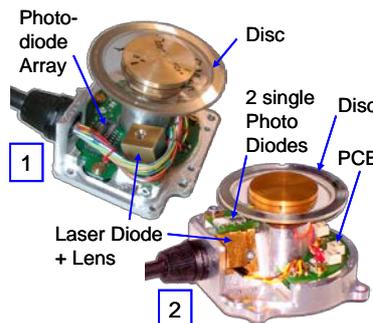


Fig. 3: Absolute encoded (1) & incremental (2) resolver

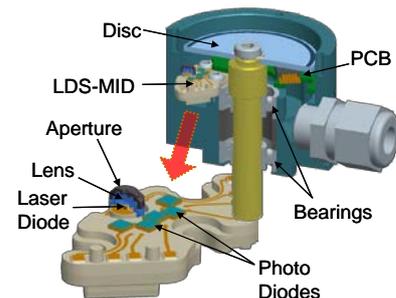


Fig. 4: Low cost assembly concept using MID-Technology

Characteristics

- High precise, low cost solid measure manufactured by CD-/DVD-technology
- Incremental or absolute encoding
- Simple, robust and stiff optical reading unit

measure and a photodiode array resp. two single photo diodes. Digitalization of the output signals is realized directly on the PCB inside the resolver. With the incremental angular resolver a resolution of 0.01° can be reached.

Fig. 4 shows a low cost assembly concept for an incremental angular resolver using MID-Technology. The optical unit of the resolver only con-

Applications

- Industrial applications:
 - Automation engineering
 - Drive systems and components
- Automotive applications:
 - Steering angle
- Consumer and office products
- Medical applications

sists of components which can be produced by injection molding with very small tolerances. Therefore all components just have to be plugged together and the resolver works without further alignment.

The results show the enormous capability and the large potential of this approach for an angular resolver that can be adapted and optimized to various applications.