TRACKER™ NSE-5310

Miniature position sensor improves autofocus and zoom in digital still cameras

The TRACKER™ NSE-5310 miniature position sensor allows designers to quickly and easily improve autofocus and zoom mechanisms in existing digital still camera, video camera and similar product designs. Use this sensor to:

- **upgrade** open-loop stepper motor systems by adding closed-loop feedback control.
- **replace** existing optical encoders with a smaller, higher-resolution solution.

In both cases, adding the TRACKER will reduce power use and enable faster, more precise focus and/or zoom. This higher precision can allow you to use smaller optics, as well, further reducing your system size.

This application note describes the benefits and use of TRACKER position sensors in miniature camera lens systems.

How the TRACKER™ position sensor improves camera designs

- **Faster, more precise focus and/or zoom**
  
  The TRACKER enables high-resolution direct linear closed-loop control. With better resolution than open-loop systems or optical encoders, the lens moves more quickly to a more exact position.

- **Less waiting to take a picture**
  
  The TRACKER provides absolute position information over a 2 mm distance. This means that there is no need to reinitialize to reestablish a zero reference on power up. There is less waiting for the camera to be focused and ready.

- **Lower power use saves batteries**
  
  Faster ready time means less power is used on power up. The TRACKER also uses less power to maintain position, and can be powered off completely in standby mode.

- **Enables smaller cameras**
  
  With the TRACKER you can eliminate the external zero reference sensor. And because it enables more precise focus, you can achieve superior results with smaller optics.

What is the TRACKER™ position sensor?

The TRACKER position sensor is a magnetic sensor array with 0.5 µm resolution and integrated on-chip digital encoding. Less than 1.5 mm thick and 3.9 x 2.5 mm (in chip-scale packaging), it fits in the smallest digital cameras. It delivers absolute positioning in a 2 mm range. Unlike optical encoders or stepper motors, it does not require a separate zero-reference sensor.
To use the TRACKER in an optical system, a magnetic strip with alternate north-south poles is mounted on the moving optics mount and positioned above the sensor (Figure 2). The magnet should have pole length of 1 mm and pole pair length of 2 mm. A half pole is required at each end of the strip. The length of the strip determines the maximum measured stroke.

The TRACKER has a Hall sensor array on the chip. This array measures the spatially-varying magnetic field produced by the moving magnetic strip. An integrated digital encoder on the chip provides direct digital output of the absolute linear position within a 2 mm pole pair on the magnet. By counting pole pair crossings, a system processor can determine absolute position along the length of the magnet.

The absolute magnitude of the magnetic field intensity is used to detect the end of the magnetic strip and serves as a built-in zero reference. Standard I²C protocol enables simple integration into the system processor.

Advantages over open-loop stepper motor designs

In a stepper motor system, a known position is reached by moving a set number of steps from the reference sensor. Each direction change requires a position offset to correct for backlash – typically about 10 µm (Figure 3a). Backlash can change over time, making the factory offset inexact and limiting precision of focus or zoom.

The TRACKER, on the other hand, provides actual position information with a resolution of 0.5 µm and bi-directional repeatability of better than 2 µm. Focus is faster and more precise (Figure 3b).

Another drawback to open-loop stepper motor systems is that the position information is lost on power down: The motor must return to the zero reference sensor upon power up and then re-focus. This means a longer ready time and more power use. In contrast, the TRACKER’s built-in zero reference provides rapid absolute position reading on power up. (User-provided flash memory stores the pole count information on power-down.) This allows you to power off the system or put it into sleep mode to conserve power – the sensor returns absolute position on power-up without the need to reinitialize, for nearly instant ready time with less power use.

* Consider replacing the stepper motor and lead screw mechanism with a miniature piezo SQUIGGLE® motor for even greater precision, smaller size and lower power use.

Figure 2: The TRACKER position sensor measures the spatially varying magnetic field produced by the moving magnetic strip on the lens mount.

Figure 3: Providing actual position feedback, the TRACKER position sensor eliminates need for inexact backlash offset setting and improves precision.
Advantages over optical sensors

The TRACKER position sensor offers distinct advantages over miniature optical encoders in digital cameras. Because it is a magnetic sensor, it does not require a light source – eliminating that potential source of image degradation.

The TRACKER offers four times better resolution for more precise focus and zoom. In addition to giving your users better performance, this higher precision can allow you to use smaller optics, further reducing your system size.

The TRACKER uses less than one tenth the operating power of optical encoders when the lens is being moved. Furthermore, the TRACKER can be powered off when the lens is not moving, reducing power use even more. This can have a significant impact on camera battery life.

Optical encoders are incremental encoders and must hunt for a zero position on power-up. As described in the previous section, this results in a longer wait before the camera is ready to take a picture, and also in increased power use. The TRACKER is an absolute encoder and returns position information immediately on power up for faster focus.

The TRACKER is much smaller than optical encoder solutions. Optical encoders require a separate zero-reference sensor, with the encoder and reference sensor taking up about twice the volume of the TRACKER with its built-in zero reference.

Packaging

The TRACKER NSE-5310 is available in custom wafer-level chip scale packaging as small as 3.9 x 2.5 x 0.6 mm and in chip-on-board packaging measuring 5.4 x 4.2 x 0.6 mm (Figure 3).

New Scale offers an evaluation kit for easy handling during evaluation and system development. In this kit, the TRACKER NSE-5310 is packaged in a TSSOP 20 and mounted on a PCB with flex cable (Figure 4). The kit includes a suitable linear magnetic strip, along with an MC-31MB interface card and New Scale Pathway™ software with intuitive user interface to facilitate evaluation.

For more information

Please refer to our product data sheets for additional specifications and ordering information, or contact New Scale at +1 585 924-4450, email sales@newscaletech.com.