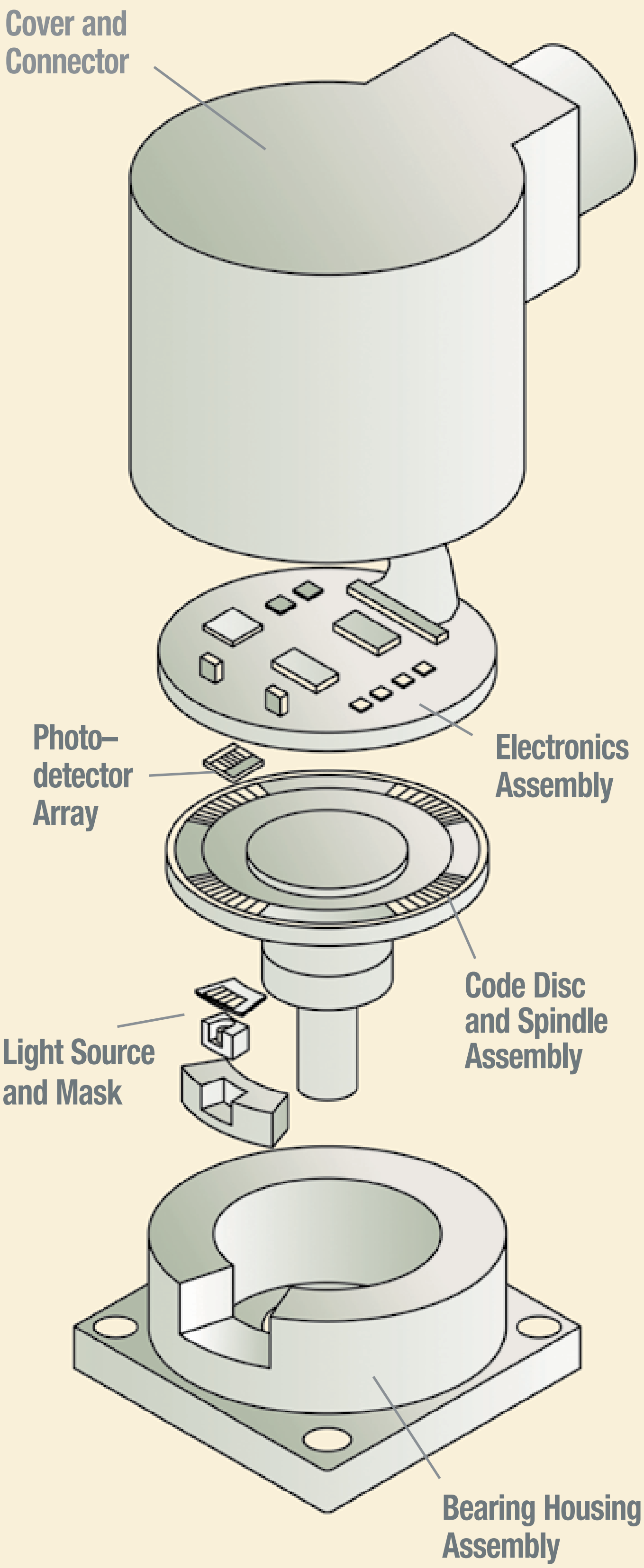


Incremental Encoders

An incremental encoder produces a series of square waves as it rotates. The number of square wave cycles produced per one turn of the shaft is called the encoder resolution. Incremental encoders work by rotating a code disc in the path of a light source (see figure at left); with the code disc acting like a shutter to alternately shut off or transmit the light to a photodetector. Thus, the resolution of the encoder is the same as the number of lines on the code disc. A resolution of 360 means that the encoder code disc will have 360 lines on it and one turn of the encoder shaft will produce 360 complete square wave cycles, each cycle indicating one degree of shaft rotation.

Since the resolution is "hard coded" on the code disc, optical encoders are inherently very repeatable and, when well constructed, very accurate. They also have no error accumulation as you might experience with analog sensors, and the square wave output is inherently easy for digital signal processing techniques to handle.

BEI provides incremental resolutions up to 288,000 counts per turn through a combination of direct read on the code disc and various multiplication techniques (see quadrature detection on next page).

Generally, incremental encoders provide more resolution at a lower cost than their absolute encoder cousins. They also have a simpler interface because they have fewer output lines. In a simple form, an incremental encoder would have 4 lines: 2 quadrature (A & B) signals, and power and ground lines.

A 12 bit absolute encoder, by contrast, would use 12 output wires plus a power and ground line.

Questions?

Call **1-800-ENCODER** and ask for **Applications Assistance**

Tel: 805-968-0782 / 800-350-2727 | Fax: 805-968-3154 / 800-960-2726
7230 Hollister Ave., Goleta, CA 93117-2807 | **www.beisensors.com**

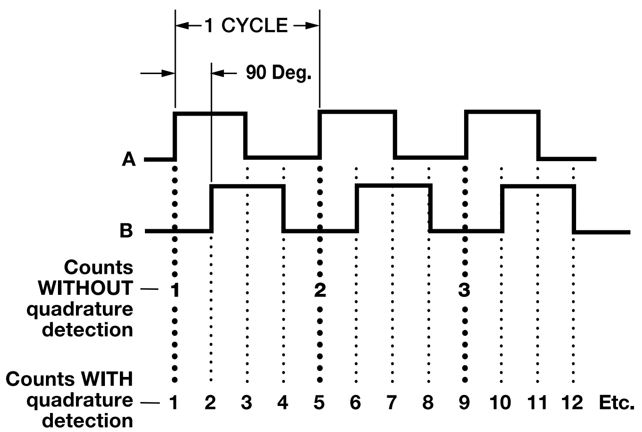
Quadrature Detection (Edge Counting)

Incremental encoders are usually supplied with two channels (A & B) that are offset from one another by 1/4 of a cycle (90 degrees). This signal pattern is referred to as quadrature and allows the user to determine not only the speed of rotation but its direction as well. By examining the phase relationship between the A and B channels, one can determine if the encoder is turning clockwise (B leads A) or counterclockwise (A leads B).

Many counter and controller manufacturers include a quadrature detection circuit as part of their electronics. This allows the use of a two-channel quadrature input without further conditioning.

With quadrature detection the controller can derive 1X, 2X or 4X the basic code disc resolution. 10,000 counts per turn can be generated from a 2500 cycle, two-channel encoder by detecting the Up and Down transitions on both the A and B channels. With a quality disc and properly phased encoder, this 4X signal will be accurate to better than 1/2 count (see diagram below).

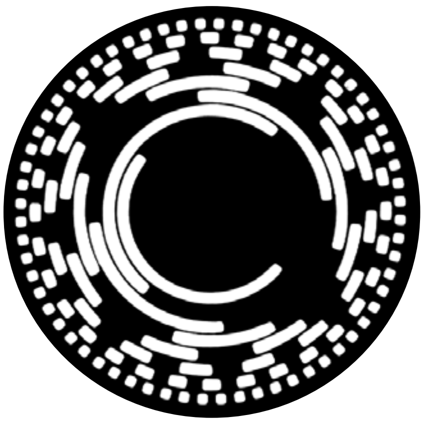
Another means of increasing resolution, interpolation, electronically subdivides the base resolution. Interpolation is achieved through the use of internal electronics acting on the raw encoder signal. This interpolated signal can be further multiplied through the quadrature detection method mentioned above. Interpolative multipliers of 2, 3, 4, 5, 8, 10, 12, 16 and 20 are readily available. More detail is available on pages 36 and 37.



Absolute Encoders

By contrast to incremental encoders, absolute encoders provide a "whole word" output with a unique code pattern representing each position. This code is derived from independent tracks on the encoder disc (one for each "bit" of resolution) corresponding to individual photodetectors. The output from these detectors is HI or LO depending on the code disc pattern for that particular position.

Absolute encoders are used in applications where a device is inactive for long periods of time or moves at a slow rate, such as flood gate control, telescopes, cranes, valves, etc. They are also recommended in systems that must retain position information through a power outage.



8 Bit Gray Code Absolute Disc