

TECHNICAL NOTES: OPTICAL TECHNOLOGIES



VeraPathTM

Optical Encoder Technology

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Medical | Industrial | Scientific | Microelectronics

The Challenge

MicroE's PurePrecision technology has enabled designers of precision motion control systems in medical, semiconductor, advanced industrial and scientific applications to design smaller, lighter and more energy efficient machines and instruments. PurePrecision technology is particularly well suited for applications where the encoder is installed in controlled environments that require compact sensor size, small overall footprint and high accuracy associated with glass gratings.

To achieve higher levels of performance in their equipment and in the face of continued pressure to make machines smaller, lighter and more energy efficient so they can be deployed in more flexible and mobile configurations, our customers often need to measure their payload position directly. This commonly requires that the encoder be installed out in the open where it is subject to contamination (dust, oil, et al) and the normal wear and tear exposure associated with operating in 24/7/365 manufacturing environments.

The Solution: VeraPath™ Technology

We are excited to introduce new VeraPath™ optical technology to the market because it enables us to solve a significantly broader range of precision feedback applications for our customers.

VeraPath technology is engineered with advanced optical filtering and state-of-the-art signal processing and electronics, ensuring reliable performance in a wide range of operating conditions where the encoder is exposed to a degree of contamination. VeraPath technology is designed to filter out signal disturbances caused by scale contamination, scratches, and typical variations of metal scale flatness, which allows our customers to achieve high levels of accuracy with metal scales as well as glass gratings.

This is especially beneficial in advanced industrial applications, when the customers' motion control system requires a precision optical encoder on a long linear stage or actuator where metal tape scales are the preferred solution. With VeraPath technology, Celera Motion is able to offer the dirt immunity, reliability, and accuracy with metal tape scales, where the encoder may be exposed to contaminated environments.



How VeraPath™ Works

Encoders sense the relative position between a sensor and a scale. Celera Motion produces MicroE non-contact optical “kit encoders”, where the sensor and scale are individually installed into a machine element with a pre-existing bearing structure. The sensor head emits an optical beam which reflects off the scale and illuminates a detector array also in the sensor head. The resulting signals are then processed to provide position and speed information.

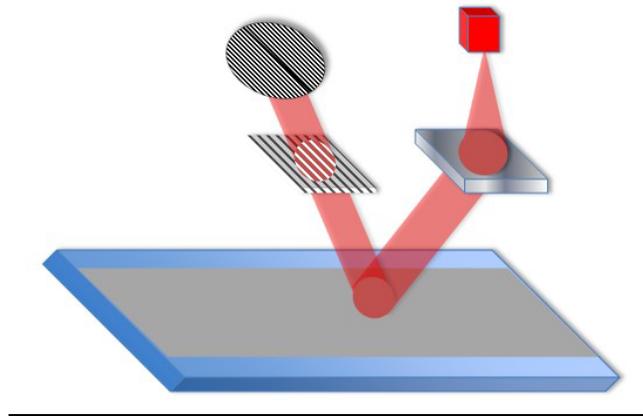


Figure 1

Position Track

The VeraPath optical system uses a low coherence LED as its light source. As shown in Figure 1, a diffractive lens collimates this light and directs the beam out of the sensor head at an angle toward the multi-track pattern on the scale. Reflection and diffraction from the periodic structure on the scale cause a beam of multiple diffraction orders to re-enter the sensor head and pass through the optic which re-diffracts the incoming light forming interference fringes on the detector.

By diffracting off the scale’s grating and re-diffracting through the optic – and by using a low coherence light source – filtering is achieved such that the 20µm period interference fringes at the detector are relatively free of distortion even in the presence of scale contamination. The detector’s interleaved photodiode array samples the fringes over a wide area, with this averaging further adding to VeraPath’s contamination tolerance. The resulting push/pull signals from the array provide highly accurate position information when fully processed.



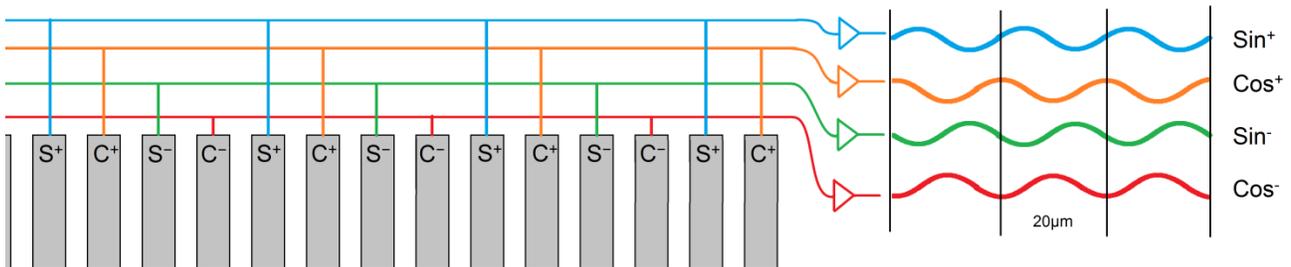


Figure 2

Index Track

Verapath uses multiple identical index tracks interleaved with the position tracks on the scale as shown in Figure 3. Each index track contains an index pattern of dark and light regions so that push/pull processing can be employed for excellent robustness, eliminating occurrences of false or missing index pulses. By interleaving the main and index tracks, proper phasing of the index with respect to the sine and cosine signals is maintained even through theta-z rotational misalignments.

In the analog version of Veratus, the 20µm wide index window is centered on the positive sine/cosine crossing while the digital model provides a 1 LSB index centered on the index window where quadrature signals A+ and B+ are both in a high state. The optics for filtering the index tracks function differently than the position track sensing optics do; so the index and position detector arrays effectively “see” only the optical signals from their respective tracks.

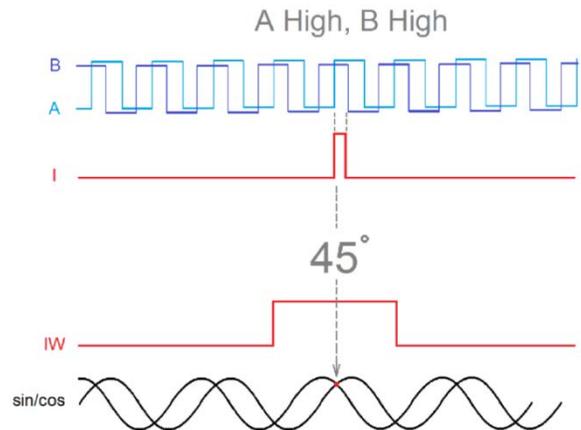


Figure 3



Scale contamination resistance is achieved with the large beam cross-section and large detector array averaging a generous amount of the scale. Plus the low coherence of the LED light source minimizes the spatial noise from scatter/diffraction off of contaminants.

Though it results in a slightly large sensor head (yet still smaller than comparable competitive products) and slightly reduced tolerances to misalignment than encoders built with PurePrecision™ technology (see Technical Note TN-101), the optical technology of VeraPath offers improved long range accuracy and contamination robustness

The benefits of VeraPath technology, coupled with our 20+ years of expertise designing miniature precision encoders, has enabled us to solve a new set of customer application needs with the industry's smallest precision optical encoders.

VeraPath is the technology behind the **Veratus™** Series of encoders.

