

New differential measurement configuration for vacuum applications

New, differential measurement configuration provides a fibre optic launched interferometer solution for precision motion applications in vacuum or other controlled environments.

The introduction of Renishaw's RLE system in 2001 revolutionised interferometer system architecture, reducing a complex scientific instrument to a simple production tool.

Key in this transformation was the use of fibre optics to deliver the laser light directly to the measurement axes, eliminating the requirement for multiple remote beam splitters, benders and adjustable mounts.

The new differential measurement capability extends the RLE system's specification, to provide a solution suitable for many 'front-end' semiconductor processing applications that utilise precision motion systems in a vacuum, or other controlled processing environments.

All components of Renishaw's RLE laser interferometer encoder system have been designed with simplicity of installation and operation in mind, and the new differential interferometer is no exception. When used in applications involving a controlled environment process chamber, the differential interferometer is positioned via three simple location pins on the exterior of the chamber, with the laser beams entering through a suitably positioned, anti-reflection coated, view-port.

Integral beam steerers, providing independent $\pm 1^\circ$ pitch and yaw adjustment for the measurement and reference beams further simplify system alignment, resulting in rapid initial installation and minimal downtime resulting from in-field machine service.

Systems comprising a standard RLU laser unit and the new differential interferometer produce

digital quadrature output with resolutions to 10 nm, or 1 Vpp sine / cosine analogue signals. However, the addition of an optional RGE interpolator or the new RPI20 parallel interface enhance system resolution to 0.39 nanometres and 40 picometres respectively.

The configuration of the differential interferometer is such that it offers a number of significant advantages over other solutions. Commonality between measurement and reference beams facilitates the previously mentioned external mounting capability in addition to:

- Removal of errors due to thermal translation of the interferometer mounting position
- Minimisation of the effects of laser frequency instability as the differential path length (between measurement and reference beams) is reduced
- Removal of common mode environment effects

Overall, the RLE system offers OEMs and end-users alike a simple to install, simple to use, interferometer based encoder solution. The available range of fully compatible components allows system specific feedback solutions to be configured for each individual application requirement.

As with other Renishaw detector heads, the differential head contains interferometer optics, a unique, multi-channel fringe detection scheme and laser steerers, connecting to a (remotely) mounted RLU laser unit via a 3 m fibre umbilical. The full range of interchangeable system components allows flexible system configurations to suit linear and X-Y motion applications. The comprehensive range of flexible interferometer solutions is further enhanced by a 24-month warranty.