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Investor Day

Encoder Product Division

15th May 2014

Presented by Dr Jim Henshaw

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Customer needs

- Initial market was metrology, exploiting Renishaw's contacts in the CMM market but later evolved into industrial automation.
- Many manufacturing businesses are adopting industrial automation to:
  - Increase capacity and flexibility
  - Improve product consistency and quality
  - Reduce manufacturing time & costs
- Automation requires rapid, reliable and accurate measurement of relative position between moving parts such as:
  - Linear distance moved
  - Angle moved

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Engineering solutions – what is a position encoder?

- A ‘position encoder’ converts position data into a ‘coded’ electrical signal. Consists essentially of 2 components:
  - *Scale* (a rule with accurate markings on it)
  - *Readhead* (a small device to read position information from the *Scale*)

- The *Scale* has positional information ‘encoded’ along its length

- The *Readhead* reads and interprets the scale’s positional information using optical, magnetic, inductive or capacitive techniques and outputs positional data as ‘coded’ electrical signals

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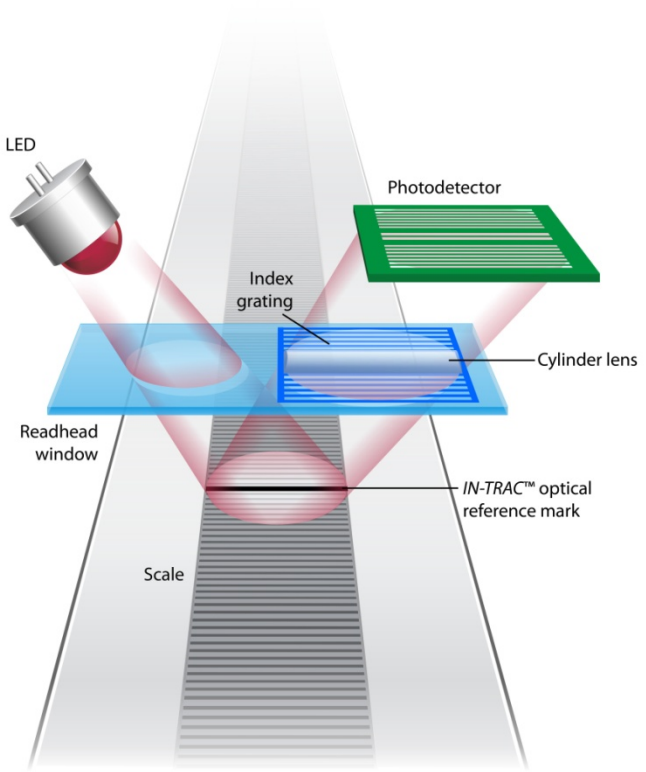
Engineering solutions – features of our encoders

- Non-contact
  - The readhead does not touch the scale
  - Position is sensed optically
  - No friction or wear

- Hence:
  - Rugged and easy to install
  - Innovate to give competitive advantage



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Engineering solutions – features of our encoders

- Linear – measure distance in a straight line…fixed, tracked…
- Rotary – measure angular rotation about an axis…ring, disc…
- Made in house – we own the processes

- Typical performance: resolve to 10’s nm (below thousandth of hair’s breadth), tenths of an arc second, lengths beyond 50 m, diameters up to 1.5 m

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Engineering solutions – features of our encoders

- **Incremental** and **absolute** measurement
  - **Incremental** reports relative position (how far have I moved?)
  - Conventional method…our early products

  - **Absolute** reports actual position (where am I?)
  - Newer…taking the innovative lead

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Successful outcomes – encoder applications

- Renishaw encoders are used in a wide variety of industries and applications
- Large and growing market with many opportunities but demand quality, reliability, service as well as performance and cost of ownership

Manufacturing Processes
Electronics
Semiconductor
Flat panel display
Motion control
Solar panel
Scientific

Products
Metrology
Machine tools
Aerospace
Robotics
Print
Medical

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Successful outcomes – Electronics manufacture

- Miniature electronic and optical components are positioned on boards and then bonded with glue or solder
- Amicra Mikrotechnologie develops and manufactures Micro Assembly Cells designed for this purpose.
- Amicra machines mount micro-components with an accuracy of up to ±0.5 µm
- Renishaw's RESOLUTE absolute encoders provide instant position information on power up with low noise and high stability

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Successful outcomes – Encoders in space!

- Part of European *Copernicus* Earth observation programme
- 1st of 5, Sentinel-1A launched 3 April ‘14
- 2 Renishaw rotary encoders on the Laser Communication Terminal for inter-satellite communication
- Targets telescope at long range, typically 5000 km
- Pointing accuracy <1 µrad
  i.e. hit a dinner plate at 1000 miles