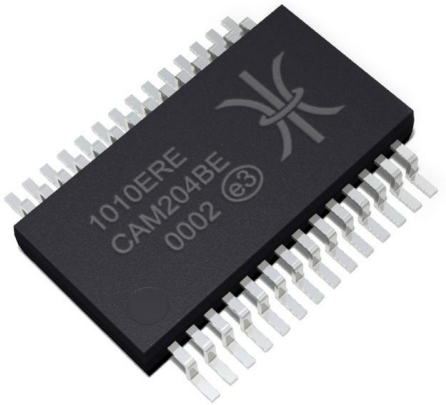
FEB 2013

# Resonant Inductive Technology from CambridgeIC

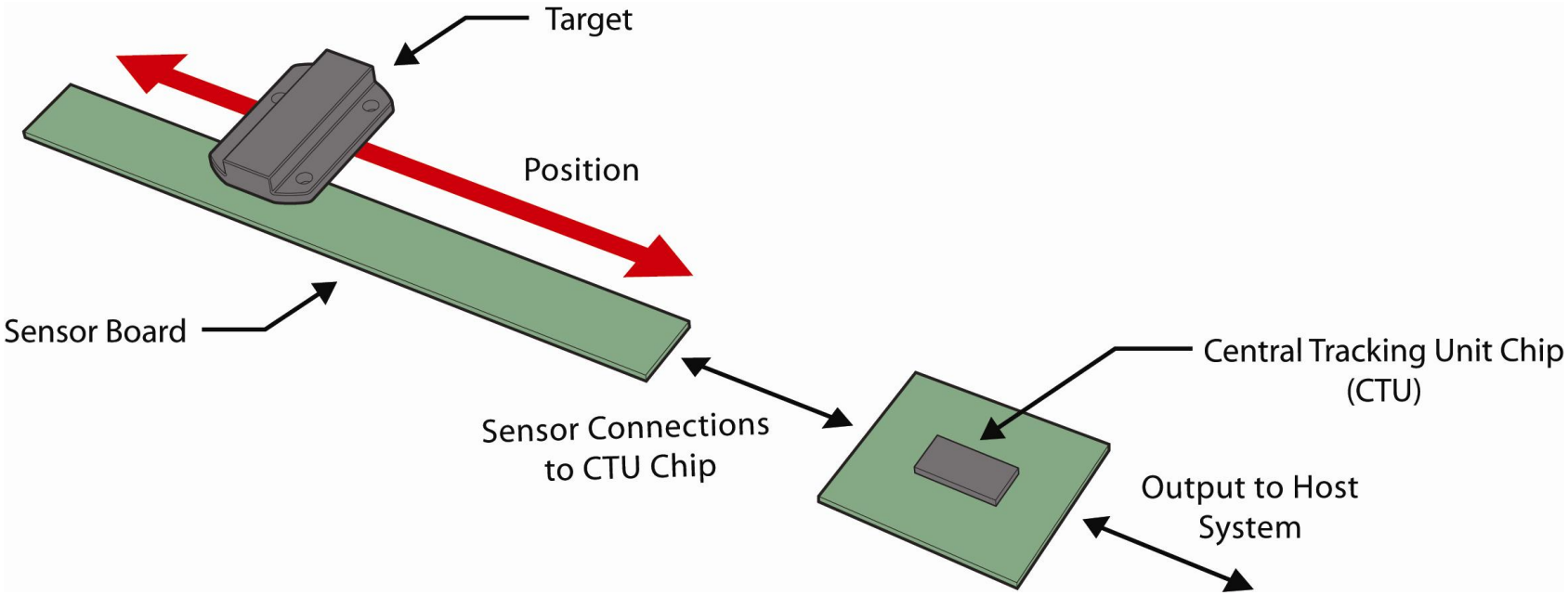

Simple, robust non-contact position measurement using PCBs as sensor

# Topics

- Technology
- Products
- Features & benefits
- Competition
- Applications
- About CambridgeIC
- Business model
- Forthcoming Products

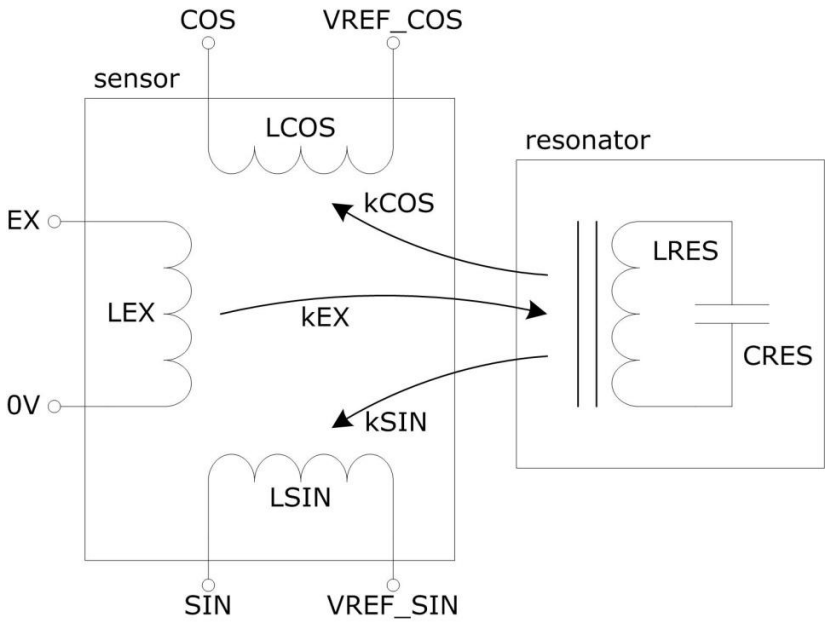


# Technology (1)



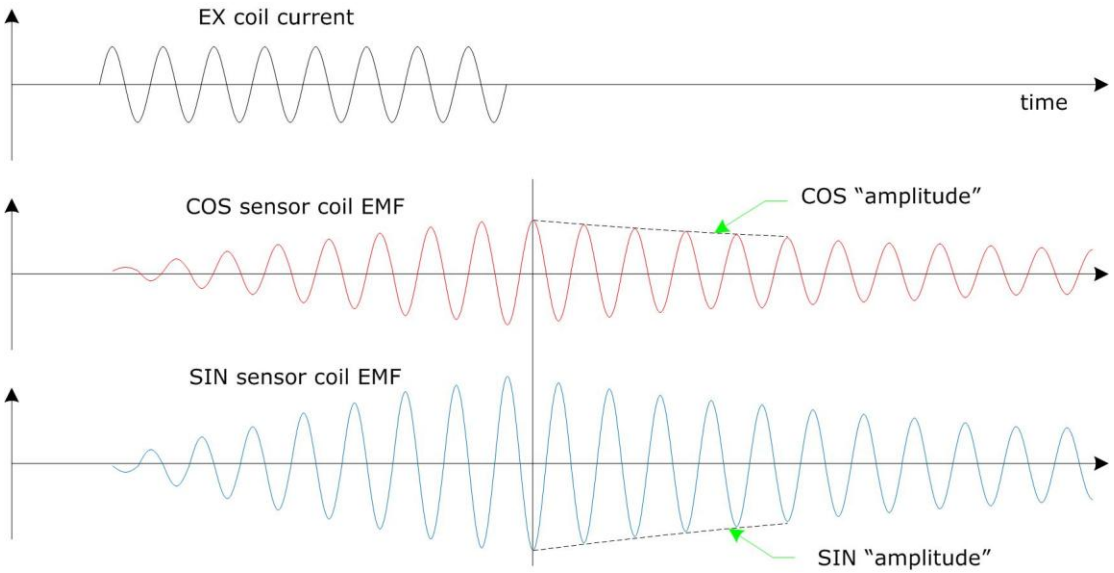
# Technology (2)

- Principle: inductive
- Sensor: coils on PCB
- Target: LC resonator



# Technology (3)

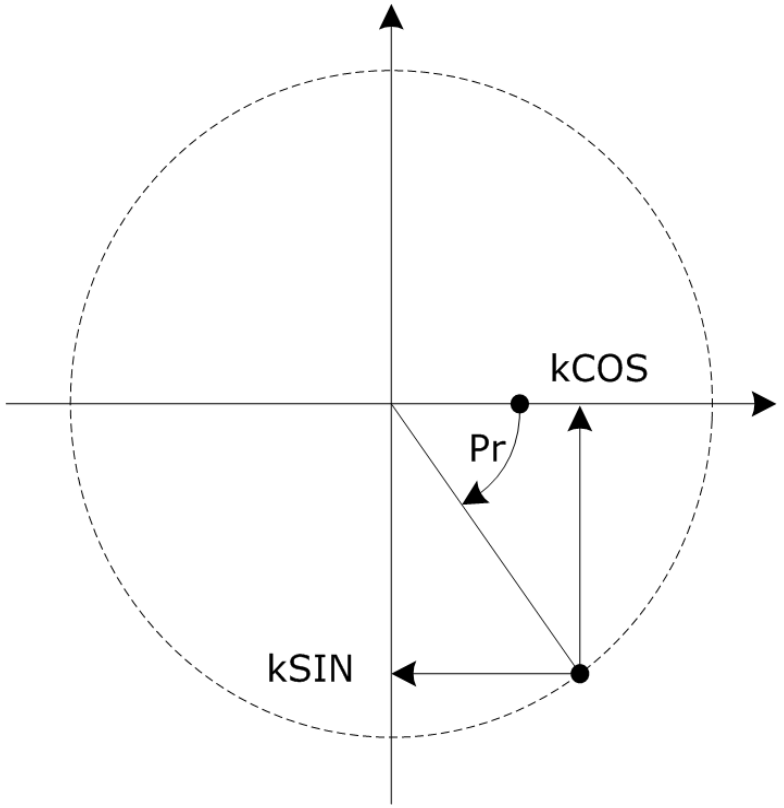
- CTU chip energises sensor EX coil
- Resonator in target oscillates
- CTU chip detects resonator signals



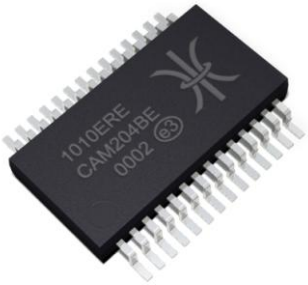
# Technology (4)

- Position calculation
  *4-quadrant atan*

- Some sensors use fine + coarse pitch for higher precision



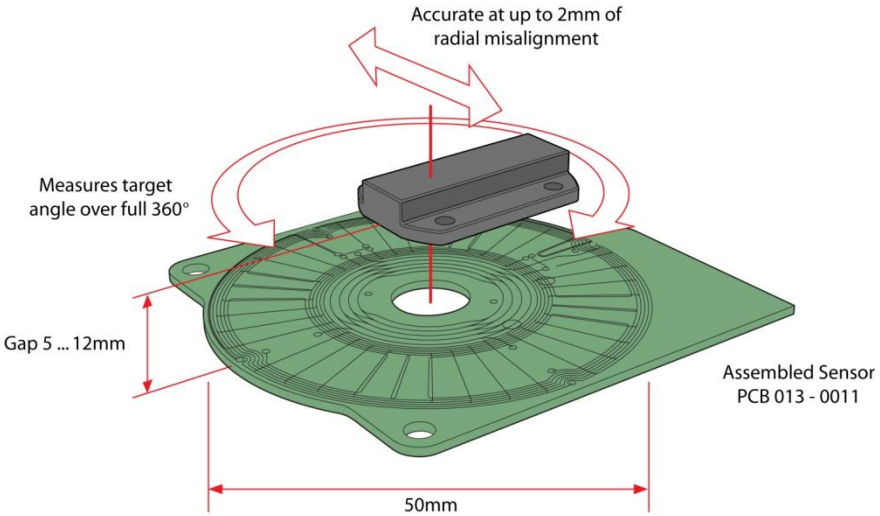
# Products (1)

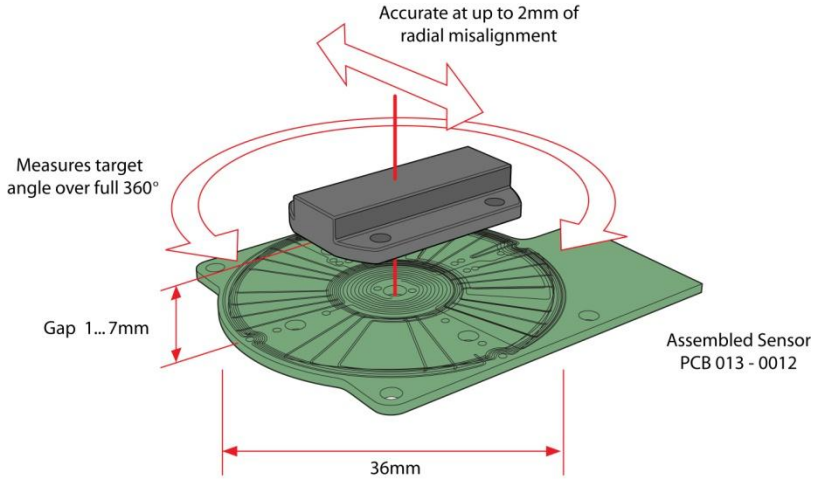


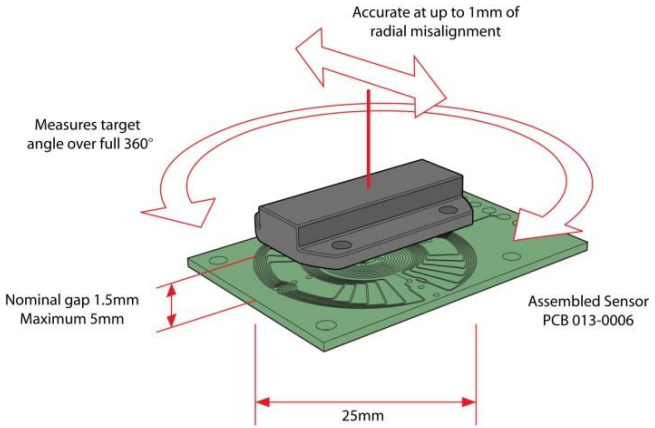

- CAM204BE CTU chip
  - Processes 4 Type 1 sensors
  - Precise, fully ratiometric measurement
  - 9 – 11 bit Noise Free Resolution Types 1&4
  - 13 – 16 bit Noise Free Resolution Type 6
  - -40°C … +125°C, extremely stable
  - 1000 measurements per second
  - 2.7V…3.6V supply, 5V tolerant Ios
  - 28-pin SSOP package
  - SPI interface

# Products (2)

- Rotary sensors
  - End-shaft
  - ~ ±0.5° accuracy (±1° when misaligned 1mm)

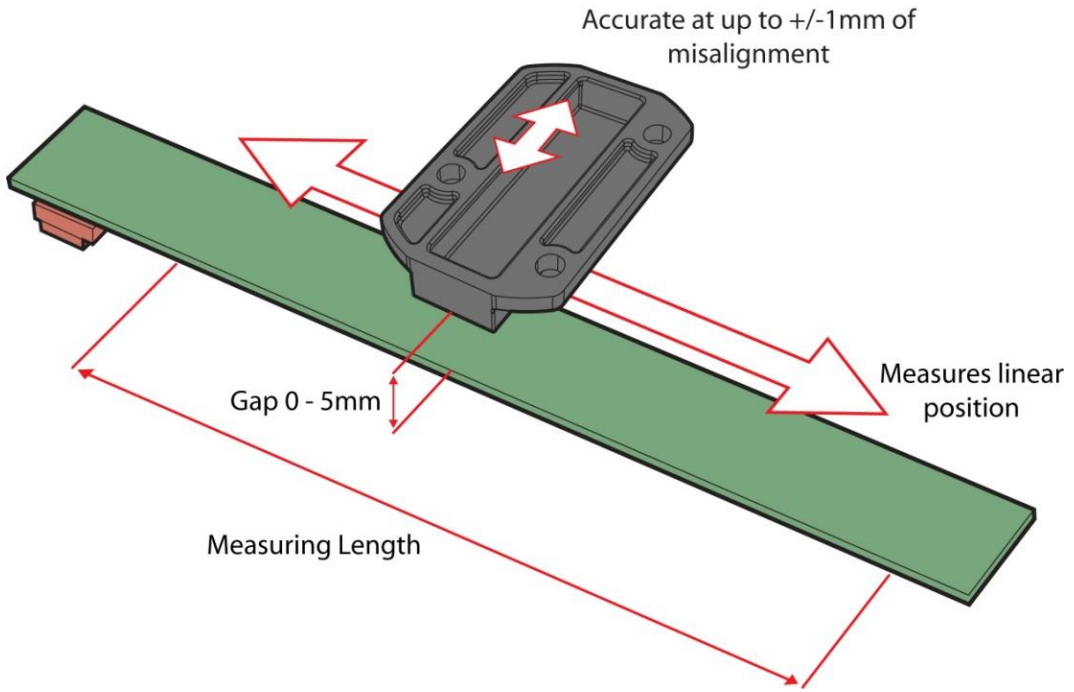


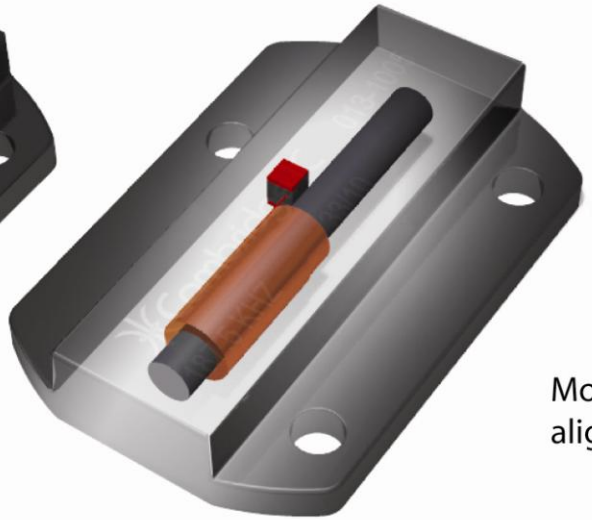
# Products (3)

- Linear sensors 25mm...300mm
- ~ ±0.25% Linearity Error at 1mm gap



# Products (4)

- Targets

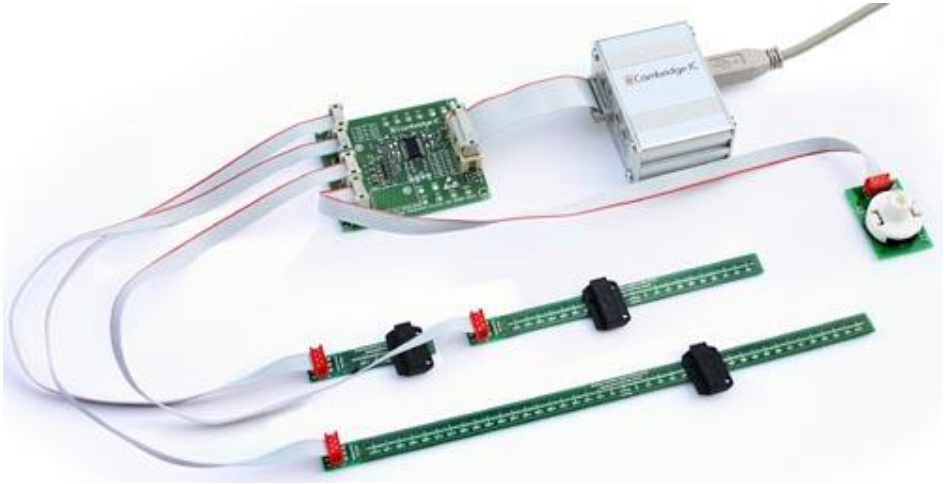



Resonator comprises a coil in parallel with capacitor mounted onto a ferrite rod

Mounting holes are accurately aligned with resonator

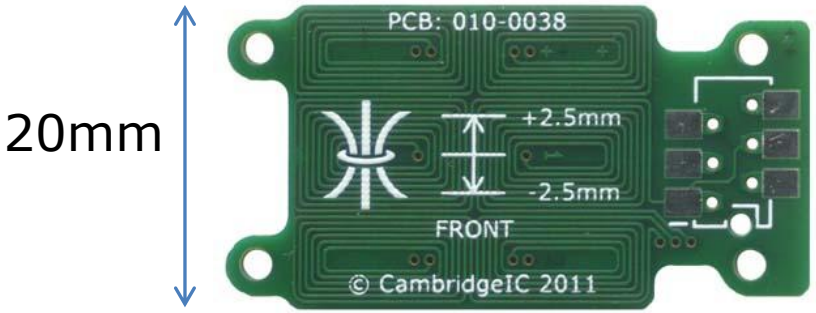
# Products (5)

- CTU Development Kit
  - Type 1 CAM204 Development Board
  - Selection of Type 1 sensors with targets
  - CTU Adapter for SPI to USB conversion
  - CambridgeIC CTU Software for PC



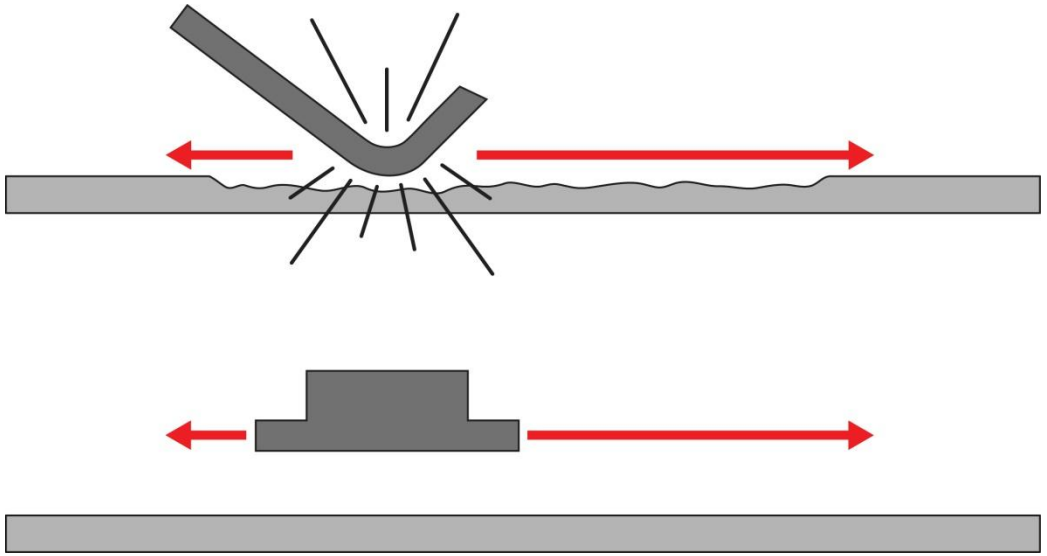
# Products (6)

- Short Stroke Linear Sensor
- ±0.25mm linearity over 5mm “accurate” Measuring Range
- >16mm range for VALID output



# Features & benefits (1)

- Non-contact

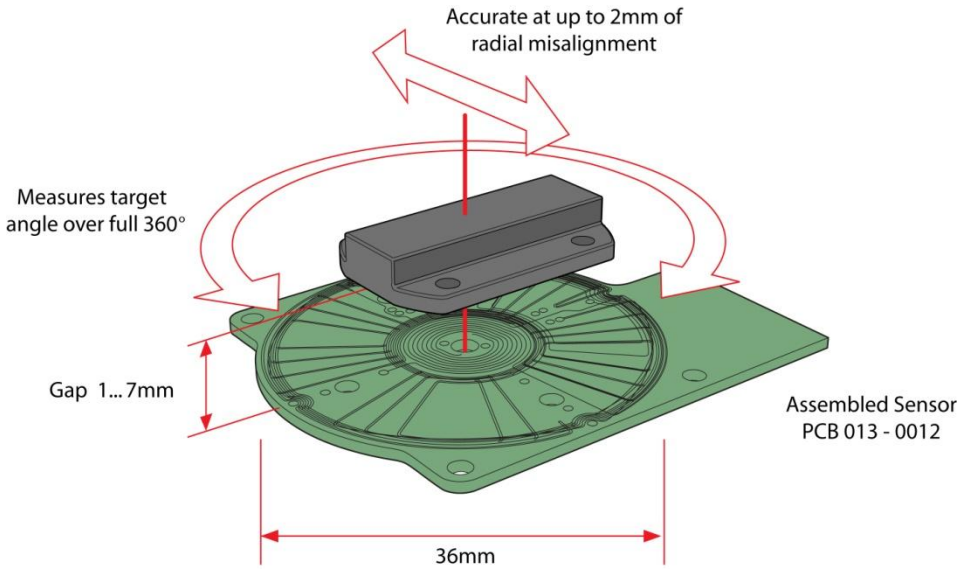


# Features & benefits (2)

- Works through
  - Dirt
  - Dust
  - Oil
  - Salt water
  - Metallic swarf
  - Cleaning fluids

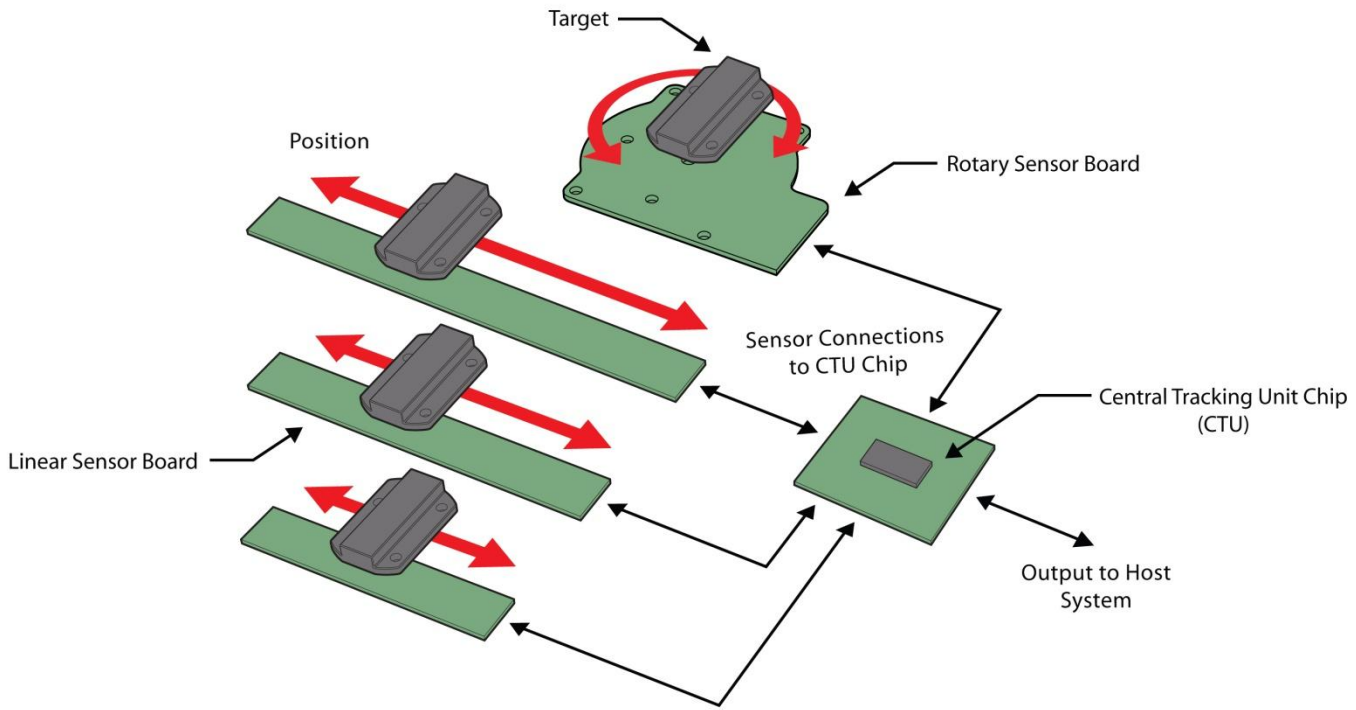
# Features & benefits (3)

- Tolerant of misalignment
- Large gaps possible



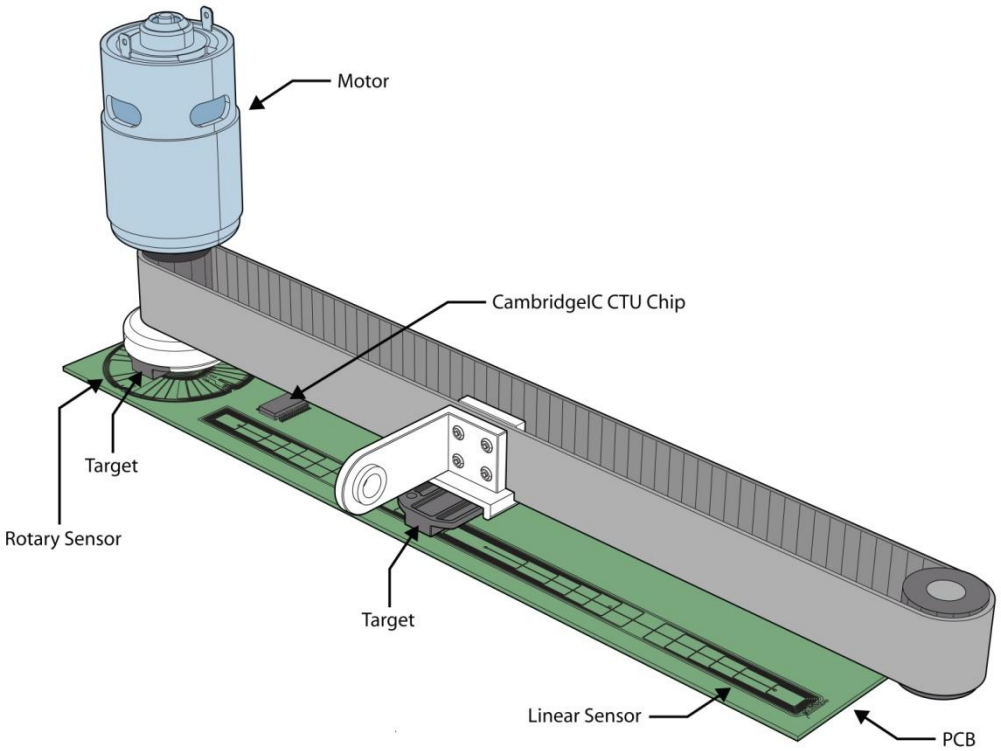
# Features & benefits (4)

- Multi-axis



# Features & benefits (5)

- Integrate sensors and electronics

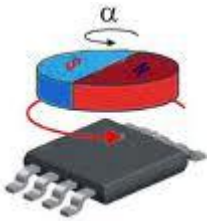


# Features & benefits (6)

- Stability from PCB technology
  - Reproducible sensor to sensor
  - Reproducible across temperature
- Precision from CTU chip
  - Immune to temperature, supply, component variation etc
  - Tracks resonator frequency
- High resolution
  - 10 ... 16 bits depending on gap & sensor
- High Q resonator means big signals back from sensor
  - Robust against EMI

# Competition

Magnetostrictive




Hall Effect

LVDT

Optical encoder

(replaces one or more on/off switches with continuous measurement)

Potentiometer

# Applications (1)

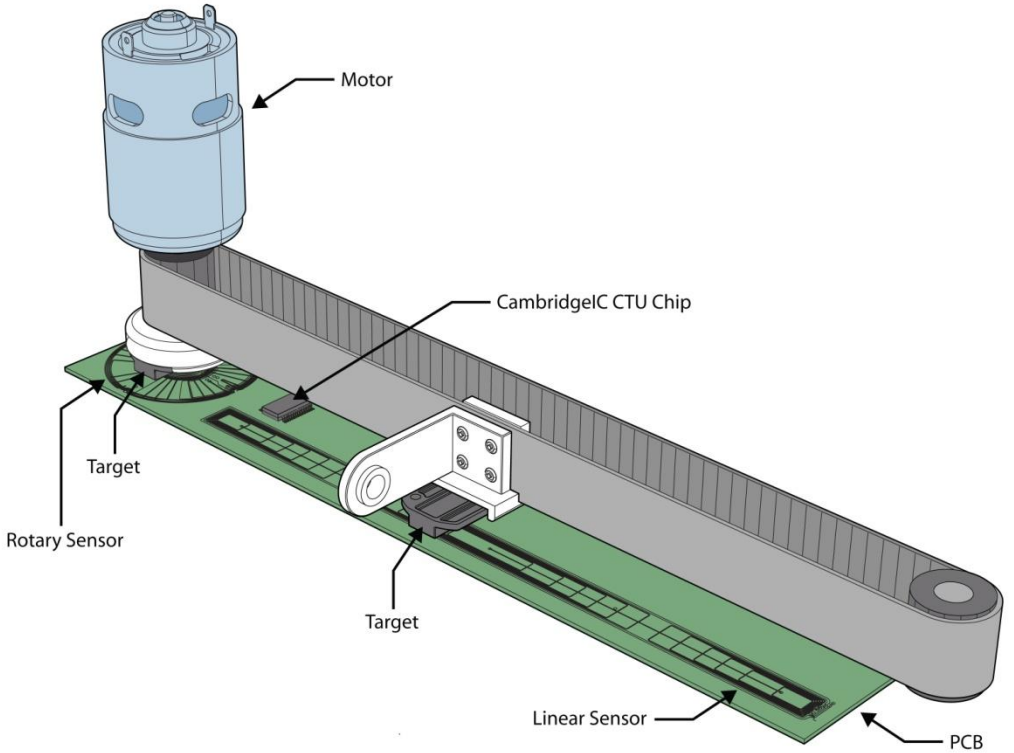
- Industrially housed sensors from TURCK

# TURCK Exclusivity Notice

- TURCK is CambridgeIC's exclusive partner
  - "for fixed location industrial automation applications (i.e. factory or other production process), where the relevant sensor parts are industrially housed (i.e. within a separate unit and thereby protected from damage during installation and use), and then physically incorporated into the production line"
- Exclusivity applies to release of Sensor Blueprints by CambridgeIC
- Sale of CambridgeIC products for use in exclusive applications is not prohibited, to enable distribution to function normally
- However it is strongly discouraged, because the customer will not be able to build their own sensors unless they have Sensor Blueprints

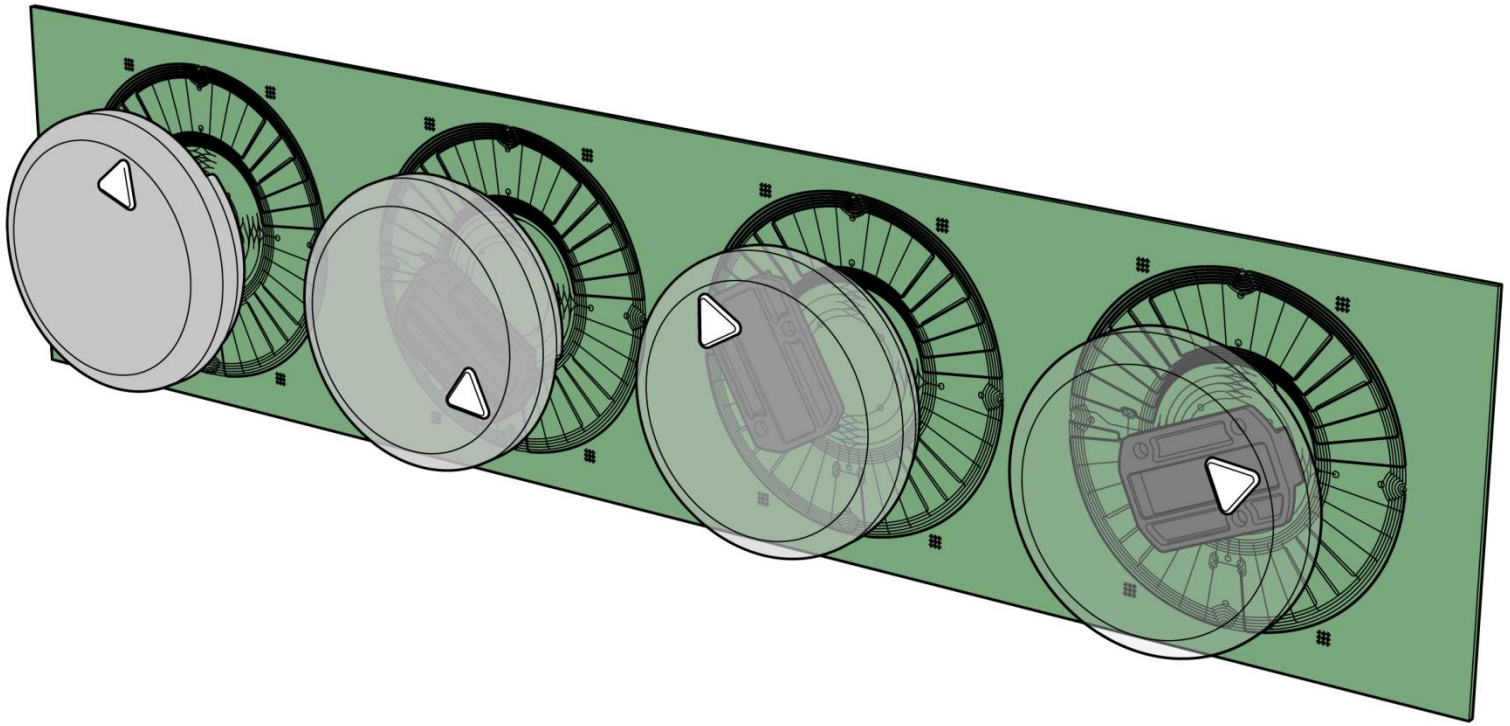
# Applications (2)

- Embedded actuator feedback



# Applications (3)

- Dial reading and control panels

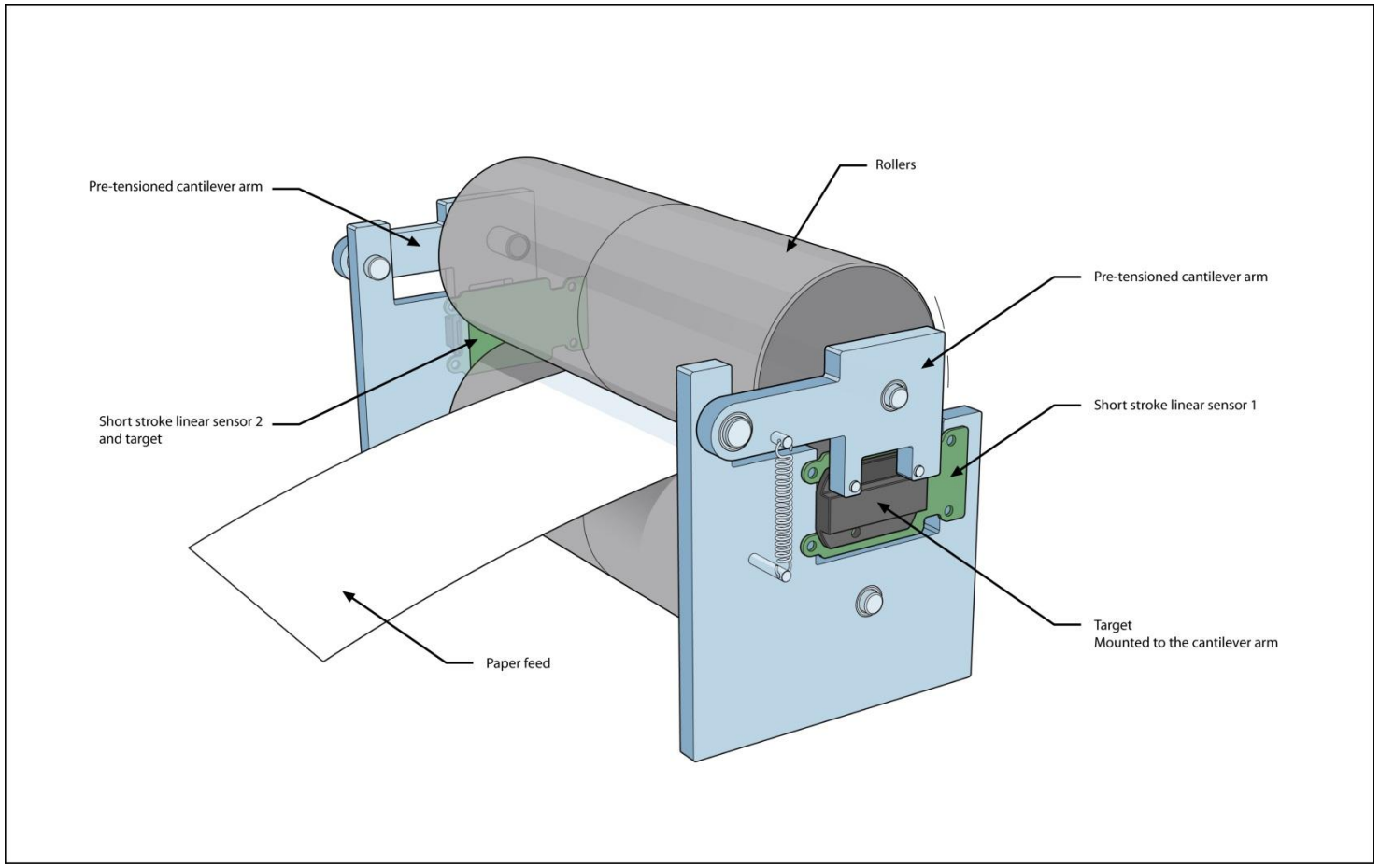


# Applications (4)

- Robotics
- Medical analysers
- Medical beds
- Carousels

# Applications (5)

- Thickness measurement



# Applications (6)

- Cash Dispensers

# NOT Applications

- Direct A/B/N encoder replacement
  - CAM204 interface is SPI not A/B/N
- Machine tools
  - Typical accuracy ≤10µm
  - Usually happy with incremental sensors
  - Usually happy to align sensor
  - Usually need A/B/N interface
- High-volume automotive
  - CAM204 requires several external components
  - Operates up to +125°C, not +150°C
  - Does not include 48V supply protection

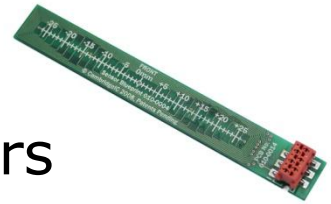
# About CambridgeIC

- Team invented resonant inductive 1994
- CambridgeIC founded 2007
  - To develop processor chips
  - To provide customers with complete solution
- Privately owned by founding team
- Funded from profits
- Business aims
  - Establish resonant inductive as technology of choice for embedded sensing inside machines requiring robust, precise position feedback
  - Maintain leadership of the technology

# Business Model

- CambridgeIC develops processor chips
  - Price includes use of Sensor Blueprints

- CambridgeIC develops sensor designs
  - Samples available for customer evaluation and low volumes
  - Sensor Blueprints available for customers to have manufactured themselves



- Targets are a commodity
  - Sold by CambridgeIC, TDK-EPC today

# Forthcoming Products (1)

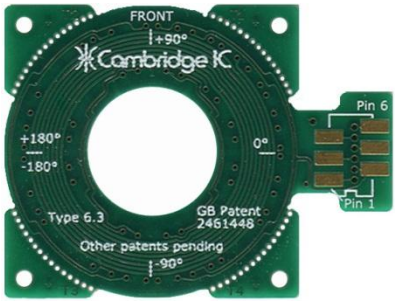
- CAM502 CTU Chip
  - For high-speed applications
  - Up to 5000 samples/s
  - 125µs Group Delay actual → reported
  - Processes one sensor
  - 6mm x 6mm QFN package
  - Otherwise similar to CAM204
  - Dev Boards Q2 2013

# Forthcoming Products (2)

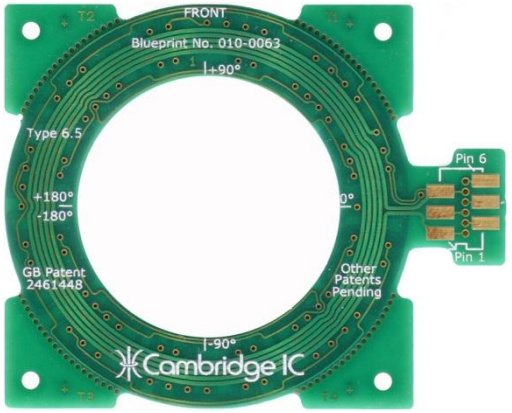
- CAM201 CTU Chip
  - Single axis version of CAM204
  - 5mm x 5mm QFN package
  - Otherwise similar to CAM204
  - Dev Boards ~ 2nd half 2013

# Forthcoming Products (3)

- Precision through-hole rotary sensors
- Absolute over full 360° (fine + coarse sensor coils)
- ~ 14 bits Noise Free Resolution
- CAM204 IC processes two sensors
- E.g. for antennae, surveillance cameras, heliostats




35mm Type 6.3
±0.2° linearity

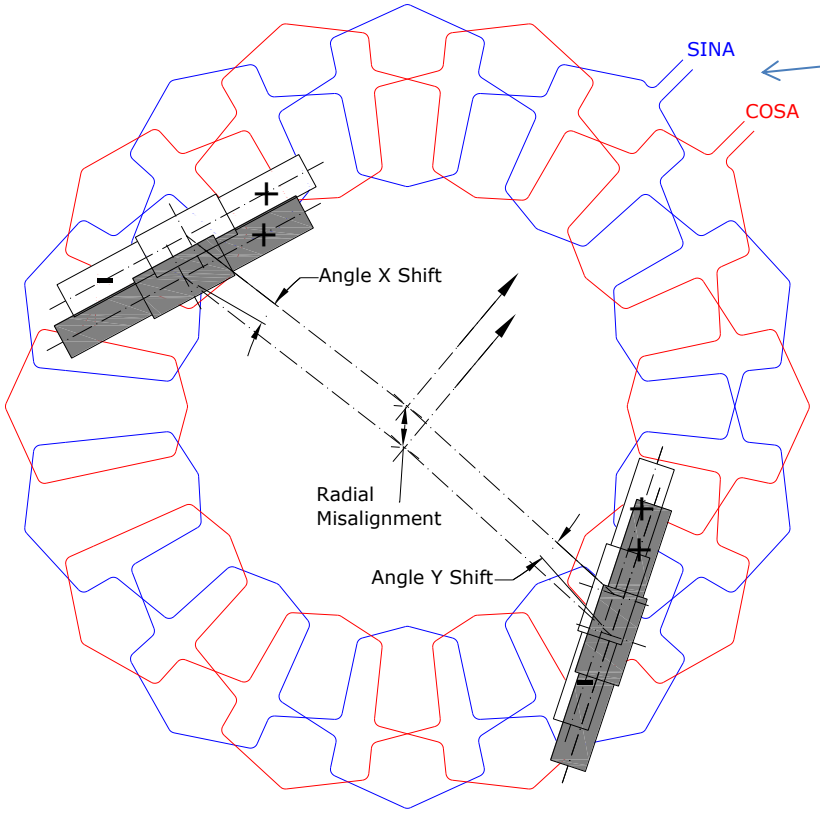



49mm Type 6.5
±0.15° linearity

Linearity figures are not "best case" – they are practical values with 0.5mm radial, ±0.5mm axial and ±0.3° angular misalignment

# Forthcoming Products (4)

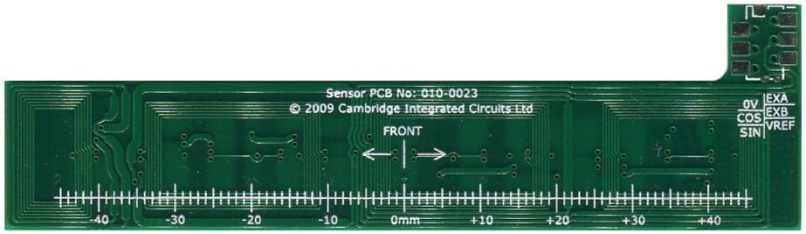
- Through-hole sensors use targets with twin wound ferrite rods on opposite side of axis for immunity to misalignment




Fine sensor coils

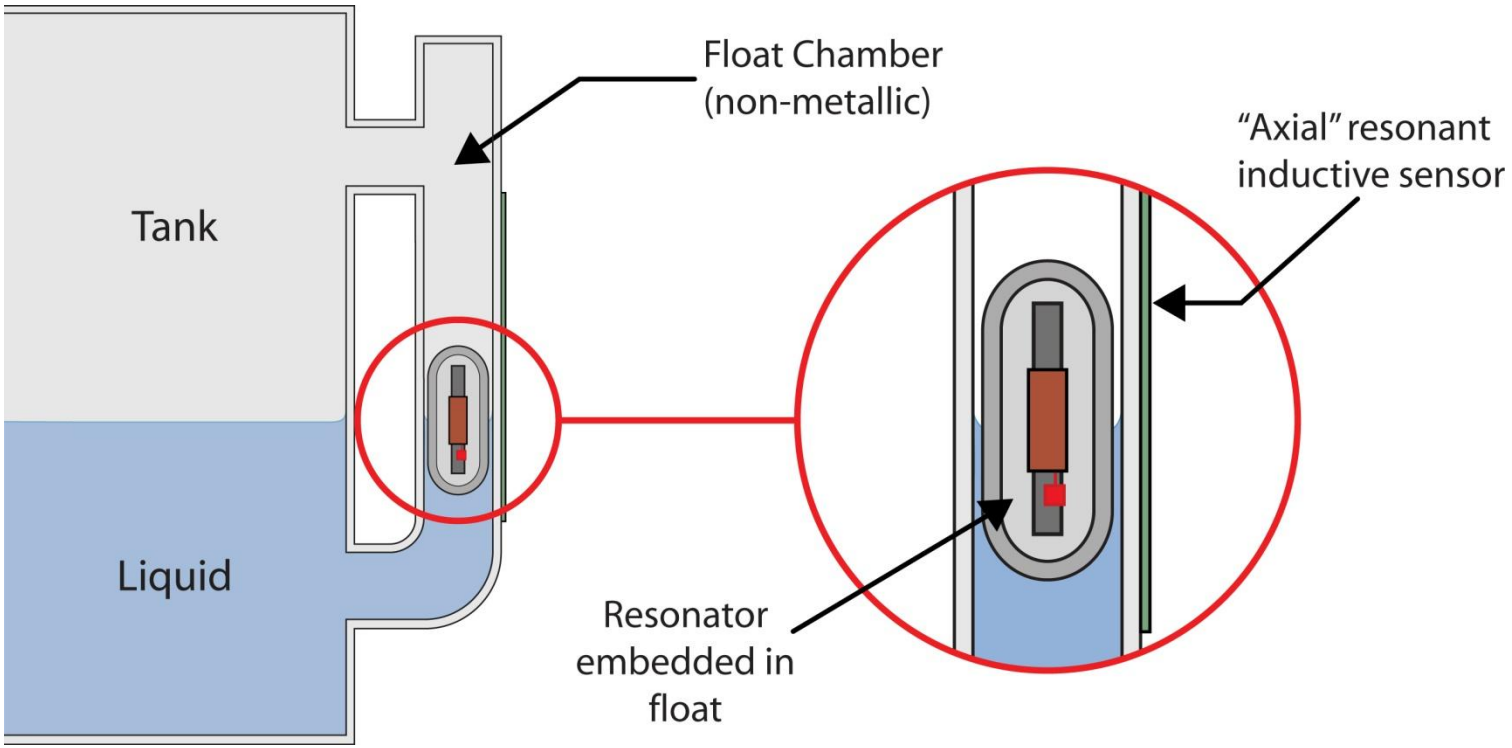
# Forthcoming Products (5)

- Type 3 Axial sensor
- Sensor's axis points along measuring direction
- Allows free rotating target...



# Forthcoming Products (6)

- Type 3 Axial Sensor for float level sensing

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