

Queensgate Nano have decades of experience providing nanopositioning solutions for use in beamline science. Queensgate provides solutions for piezo-driven nanopositioning systems and capacitive sensors for use in vacuum from 10^{-2} Torr to 10^{-9} Torr, including radiation-hard options.



Image courtesy Diamond Light Source - the UK national synchrotron

Material selection for UHV prepared products

Providing product to operate in UHV, potentially at cryogenic temperatures and needing to be rad hard, requires that we select materials carefully. The higher the vacuum, the more important it is to source materials that have low outgassing. This often means that we avoid materials such as brass, zinc or lead as they are not suitable for UHV. Polymers must also have low outgassing, so our standard air-side PVC wiring is replaced with Kapton-insulated wires, and all bonding agents are selected using the NASA outgassing database.

Vacuum preparation

Preparation of materials and the components is also important because the manufacturing process can introduce chemicals that would cause a problem under vacuum. Parts designated for use in UHV are ultrasonically cleaned to remove oils and carbon residue from any metalwork. Prior to installation we recommend a bake-out to remove any solvent residues.

- UHV option guarantees performance down to 10^{-9} Torr
- Ultrasonic cleaning processes
- No trapped voids or volumes
- Low out-gassing materials
- 4 individual Kapton cables with SMA or Sub-D bulkhead connection
- Plug and play interchangeability with full calibration allowing easy controller replacement once installed in a vacuum.
- Radiation prepared variants available
- Calibrated systems comprise a closed-loop piezo-driven actuator, airside extension cable, vacuum feedthrough (optional) and selected controller.

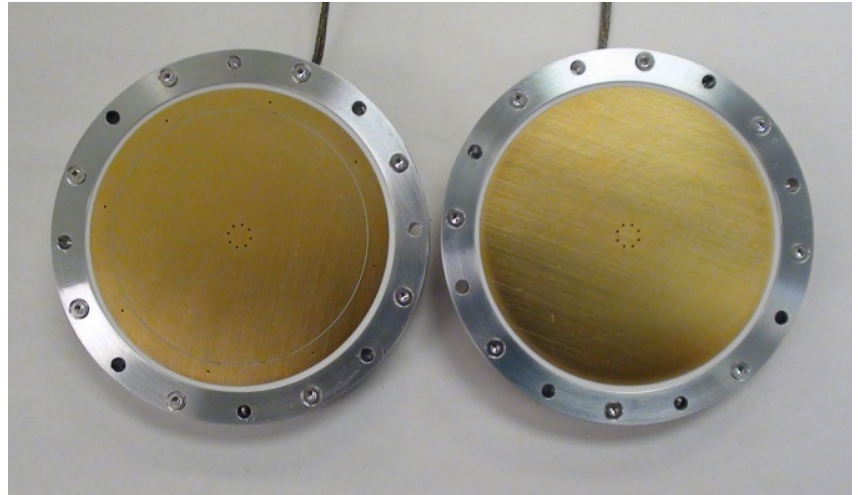
Applications: Synchrotron solutions

Diversity of applications

Synchrotron solutions provide a diversity of applications and often require bespoke solutions to meet a scientific challenge. Queensgate offers an extensive choice of accessories, interfaces and UVAC compatible options. Over 70% of our sales are custom solutions of performance-critical components.

Positioning accuracy and vibration measurement

The NanoSensor[®] is a non-contact position measuring system based on the principle of capacitance micrometry. They are non self-heating and maintain their zero position when powered down. Resolutions as small as 7 picometres (RMS) can be achieved. Measurement ranges from 20 μ m up to 11mm are available as standard with frequency responses up to 5kHz and linearity down to 0.02%.



Custom sensors for use within an insertion device at 10⁻⁹ Torr.

NanoSensor are used in beamlines to provide metrological measurements but also can be used to measure the relative pitch vibrations within a monochromator.[1]

The NC NanoSensor is a new series of high resolution capacitive sensors developed specifically for UHV to 10⁻¹⁰ Torr. Their ceramic gold construction has removed all adhesive bonding agents and their construction also means they can be baked out at higher temperatures and used in high radiation environments.

Single and multichannel sensor electronics are available. Single channel controllers can be synchronised to prevent noise due to electrical interference. Choice of controller is impacted by the operating bandwidth required and the length of in vacuum cable and the need for synchronisation

Piezo Actuators

The DPT ranges of actuators are designed with capacitive feedback control to give precise positioning and are capable of moving loads of up to 60 kg over the full travel range with low electronic noise, high linearity and fast settle time provides positioning with subnanometre levels of precision. High thermal stability super invar versions give superior positional stability with UHV compatibility to 10⁻⁹ Torr.

Soft X-ray Monochromator 2 DPT-D-20UHV Actuators

30 μ m travel range
30kg per actuator
Stable operation at fast setting
400Hz bandwidth



Used for fine tilting of grating to compensate for background vibration

Applications: Synchrotron solutions

Piezo Stages

Vacuum compatible versions of Queensgate flexure-guided piezo-actuated stages are available and assembled using kapton wiring. The stages can be used to position optics with sub nanometre precision.

Bending of Silicon Crystal at 80°K UHV

Solution:

NPS-Z-500A

Range > 80µm at 80°K

NC - Sensors to measure crystal bending.

Many Queensgate stages can be produced as vacuum-compatible systems, from our high-speed, high-precision, single-axis systems to our multi-axis XYZ and tip-tilt stages. As part of a vacuum nanopositioning/nano-sensing solution, feedthroughs and airside cables are required. Suitable feedthroughs can be provided by Queensgate or sent to be calibrated as part of complete system calibration.



'Works well, we are happy with it.'

'It is stable, doesn't vibrate or shake and is happy working in a high radiation environment.'

Quotes from Principal Beamline Scientist

Advanced control techniques developed by Queensgate provide a command resolution of 24 bits.

Single and multichannel variants are available.

Special features include:

- Standalone single, dual or triple - axis digital controller for NanoMechanisms and DPTs.
- 4th order linearization algorithm for high positional accuracy.
- Digital PID control loop for ease of setting up.
- Fast 20µs control loop update.
- Supports NanoMechanism EEPROM calibration data storage for automatic setup.
- Low noise floor offers precise imaging and focussing.
- Easy to interface with OEM software using supplied DLL (Dynamic Link Library).
- Examples of software in C/C++, Python and LabVIEW® provided.
- Front panel LEDs to provide instant operational status.
- Analogue input/output for external analogue control of NanoMechanism position.
- USB and Ethernet interfaces.



Applications: **Synchrotron solutions**

- Analogue command and analogue position monitors.
- Function playback, where pre-programmed waveforms can be downloaded into the controller and played back, triggered on command from the USB, Ethernet or TTL inputs. This would be useful for raster scanning or other repeatable scan patterns. Playback may be independent for each channel, or may be synchronised for multi-axis control.
- Programmable TTL trigger output based on the function playback. The trigger points can be programmed at any point(s) within the function playback waveform, allowing other equipment to be triggered accurately at locations in a scan pattern.
- In-position TTL output, per channel, to indicate that the stage/actuator position is within a pre-programmed tolerance from the commanded position. This signal is also available via the USB and Ethernet interfaces.
- Tuneable low-pass and notch filters per channel for improved stability and reduced noise.
- Synchronisation allowing multiple controllers to be used together.

[1] Vibration Measurements of High Heatload Monochromators for DESY PETRA III Extension P. Kristiansen¹, J. Horbach², R. Döhrmann² and J. Heuer² FMB Oxford Ltd, Unit 1 Ferry Mills, Oxford OX2 0ES, United Kingdom and DESY, Deutsches Elektronen-Synchrotron Hamburg, Notkestraße 85, 22607 Hamburg, Germany December 14, 2014).

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