

QNP2 Series

Two-Axis, Parallel Kinematic, XY Piezo Nanopositioning Stages

Travels to 240 μm x 240 μm

Large square clear aperture up to 70 mm x 70 mm

Superior multi-axis accuracy via parallel-kinematic design

High stiffness and dynamics resulting in high process throughput

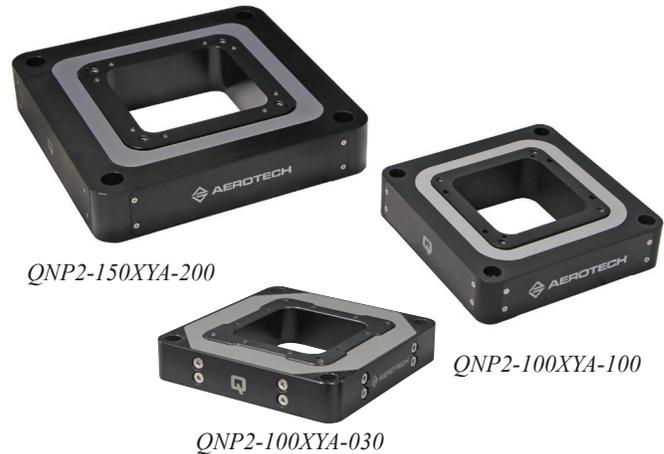
High-precision, frictionless flexure guidance

Patent pending design provides unmatched geometric performance

Long device lifetime

Superior positioning resolution and linearity with direct-metrology capacitive sensor option

Open-loop and vacuum versions



Sub-Nanometer Performance

All QNP2 piezo stages are available with closed-loop feedback (-C) or open-loop (no feedback). The unique capacitive sensor parallel-metrology design measures the output of the positioning carriage, directly enabling sub-nanometer resolution, linearity errors below 0.01%, and single-digit nanometer repeatability.

Ultra-Precision Control

When coupled with Aerotech's Q-series controllers and drives, the QNP2 stages demonstrate sub-nanometer positioning resolution, in-position stability (jitter), and high-positioning bandwidth. Software options such as Aerotech's Dynamic Controls Toolbox and Motion Designer packages provide a host of advanced yet easy-to-use tools such as Learning Control, Harmonic Cancellation, and Command Shaping, providing improved tracking errors and faster step-and-settle times. OEM drive options are also available. Aerotech's controller architecture easily enables high-speed, tightly-controlled coordinated motion between piezo stages, servos, steppers, and galvos.

Design Options

An optional mounting plate provides direct mounting to English or metric breadboard optical tables. A solid tabletop option is also available. QNP2 piezo stages are available in custom materials and vacuum-prepared versions upon request.

Aerotech's QNP2 series XY, parallel-kinematic, piezo positioning stages combine sub-nanometer resolution, high dynamics, and excellent geometric performance in a compact, low-profile package. The QNP2-series piezo stages come standard with a large, clear aperture with closed-loop travels up to 200 μm x 200 μm (open-loop travels to 240 μm x 240 μm). The design is ideal for optical microscopy, scanning probe microscopy, x-ray transmission microscopy, or other inspection or manufacturing applications where two-sided part access is required.

Precision Parallel-Kinematic Design

The QNP2 piezo stages employ a parallel-kinematic flexure and metrology design that ensures the highest levels of multi-axis accuracy. Guided by precision flexures which are FEA-optimized to ensure high-stiffness and long device life, the QNP2 stages offer best-in-class stiffness and resonant frequency, enabling high process throughput and fast closed-loop response.

Using a patent-pending drive design, yaw errors are minimized while still maintaining an Abbe-compliant metrology system. This design results in unmatched positioning performance over the entire XY travel space.

QNP2 SPECIFICATIONS

| Mechanical Specifications | | QNP2-100XYA-030 | QNP2-100XYA-100 | QNP2-150XYA-200 |
|---|-------------|----------------------------------|----------------------------------|----------------------------------|
| Closed-Loop Travel (X x Y) | | 30 µm x 30 µm | 100 µm x 100 µm | 200 µm x 200 µm |
| Open-Loop Travel, -30 to +150 V ⁽¹⁾ | | 36 µm x 36 µm | 120 µm x 120 µm | 240 µm x 240 µm |
| Resolution ⁽²⁾ | Closed-Loop | 0.1 nm | 0.30 nm | 0.40 nm |
| | Open-Loop | 0.03 nm | 0.15 nm | 0.20 nm |
| Linearity ^(3,4) | | 0.02% | 0.01% | 0.01% |
| Bidirectional Repeatability ⁽⁵⁾ | | 4 nm | 1 nm | 1 nm |
| Straightness | | 25 nm | 10 nm | 10 nm |
| 2D Flatness (Over Full XY Travel) | | 15 nm | 5 nm | 15 nm |
| Pitch | | 5 µrad (1 arc sec) | 1.5 µrad (0.3 arc sec) | 1.5 µrad (0.3 arc sec) |
| Yaw | | 5 µrad (1 arc sec) | 12 µrad (2.5 arc sec) | 20 µrad (4 arc sec) |
| Stiffness (In Direction of Motion) ⁽⁶⁾ | | 33 N/µm | 2.1 N/µm | 1.7 N/µm |
| Unloaded Resonant Frequency ⁽⁶⁾ | | 2400 Hz | 565 Hz | 375 Hz |
| Resonant Frequency (200 gram load) ⁽⁶⁾ | | 1725 Hz | 380 Hz | 290 Hz |
| Max Payload ⁽⁷⁾ | | 1 kg | 1 kg | 3 kg |
| Maximum Acceleration (Unloaded) ⁽⁸⁾ | | 400 m/s ² | 170 m/s ² | 40 m/s ² |
| Moving Mass (Unloaded) | | 0.14 kg | 0.14 kg | 0.5 kg |
| Stage Mass | | 0.36 kg | 0.48 kg | 1.2 kg |
| Material | | Anodized aluminum ⁽⁹⁾ | Anodized aluminum ⁽⁹⁾ | Anodized aluminum ⁽⁹⁾ |
| MTBF (Mean Time Between Failure) | | 30,000 hours | 30,000 hours | 30,000 hours |

Notes:

- Value ±10%.
- See Piezo Engineering Reference section 4.2 for description of resolution.
- Certified with each stage (closed-loop feedback models only).
- Measured approximately 15 mm above the carriage by an external metrology device. See Piezo Engineering Reference section 4.1 for description of linearity specifications.
- Specified as a 1 sigma (standard deviation) value (closed-loop feedback models only). See Piezo Engineering Reference section 4.3 for description of bidirectional repeatability.
- Values ±20%.
- On-axis loading listed.
- Max acceleration listed is the stage mechanical limitation. Achievable acceleration is a function of amplifier selection and move parameters.
- External elements are anodized aluminum. Some stainless steel components are used in the internal construction. Other materials upon request.
- Specifications listed are per axis unless specified.

| Electrical Specifications | QNP2-100XYA-030 | QNP2-100XYA-100 | QNP2-150XYA-200 |
|--|-----------------------------------|-------------------|-------------------|
| Drive System | Piezo Multi-Layer Stack Actuator | | |
| Feedback | CL: Capacitive Sensor OL: None | | |
| Voltage Range | -30 V to +150 V | | |
| Piezo Stack Capacitance ⁽¹⁾ | 4.6 µF (per axis) | 3.2 µF (per axis) | 6.4 µF (per axis) |

Note:

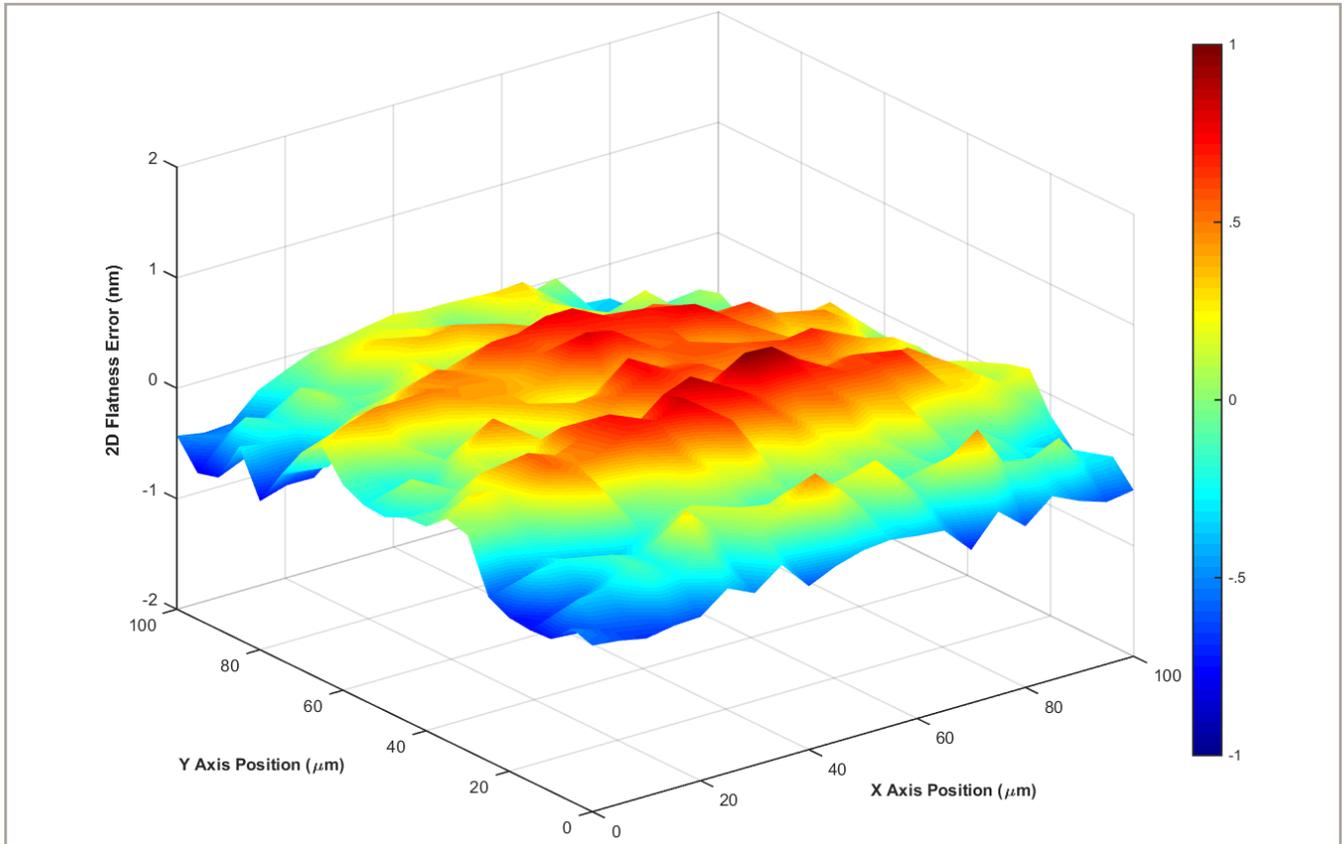
- Value ±20%

| Recommended Controller | |
|------------------------|---|
| Ensemble | Ensemble QLAB Ensemble QDe Ensemble QLe Ensemble QL ⁽¹⁾ |
| A3200 | Ndrive QLe Ndrive QL ⁽¹⁾ |

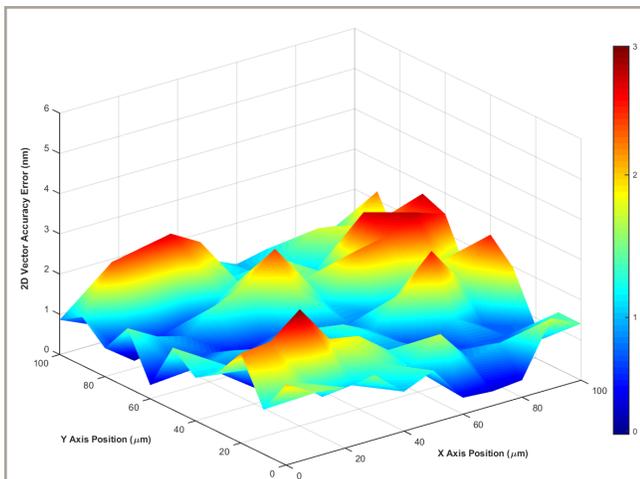
Notes:

- Unless noted, the QLAB, QDe, or QLe drives are required to achieve the listed specifications. Contact Aerotech for specifications when used with the QL drives.

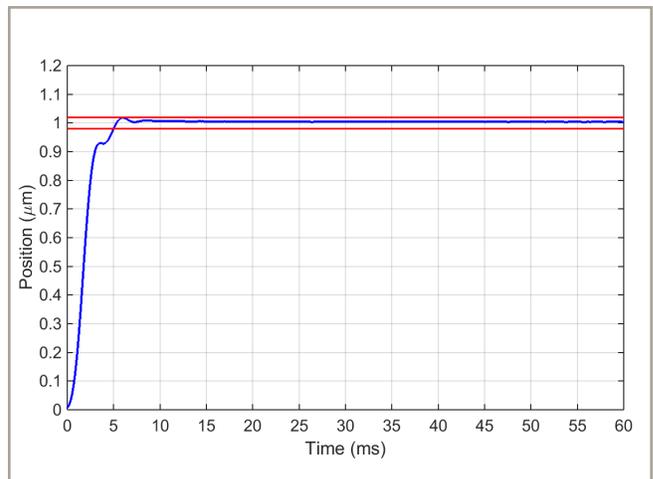
QNP2 Series DESCRIPTION



QNP2-100XYA-100-C two-dimensional flatness of 1.5 nm over the full XY travel. The results show the outstanding geometric performance of the QNP2 series.

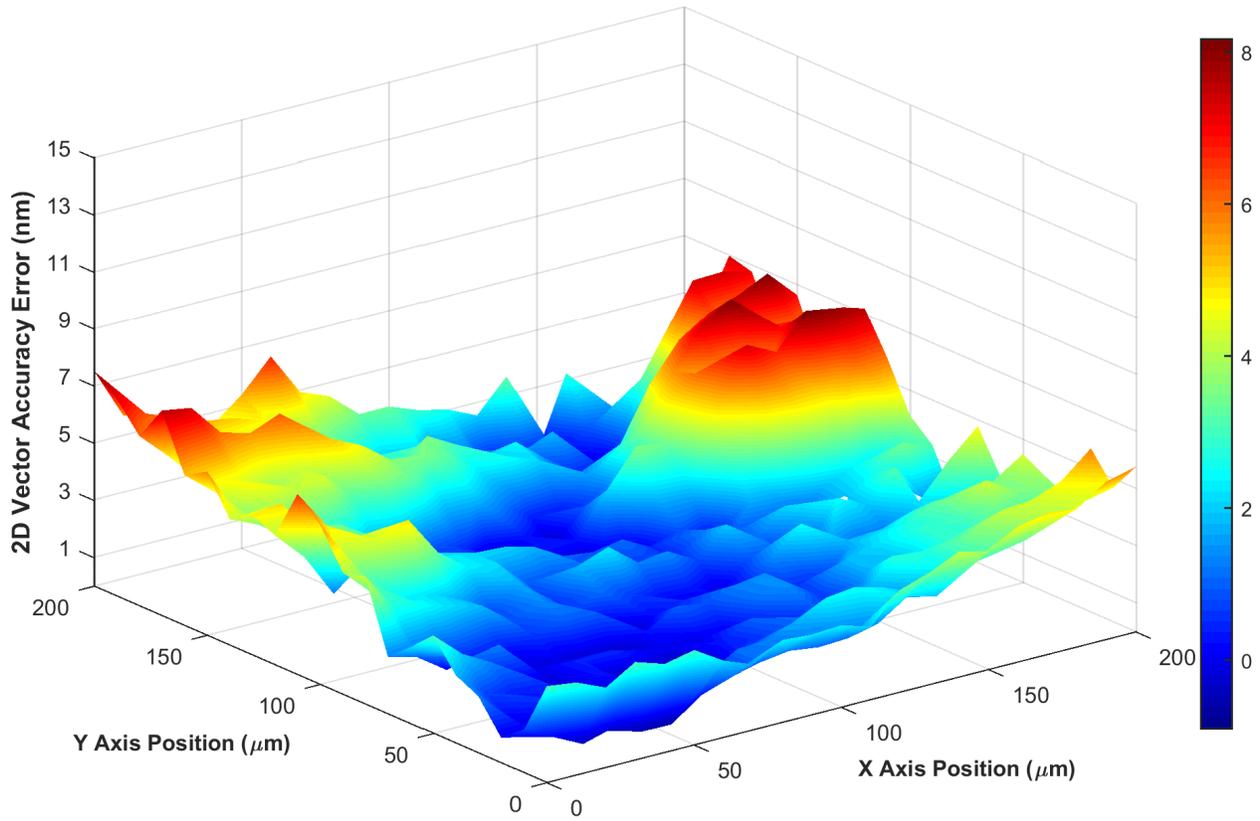


QNP2-100XYA-100-C two-dimensional accuracy error measured with an external laser interferometer targeting a two-sided optical square. The results show the nanometer-level positioning performance capability of the QNP2 series over the complete XY travel.

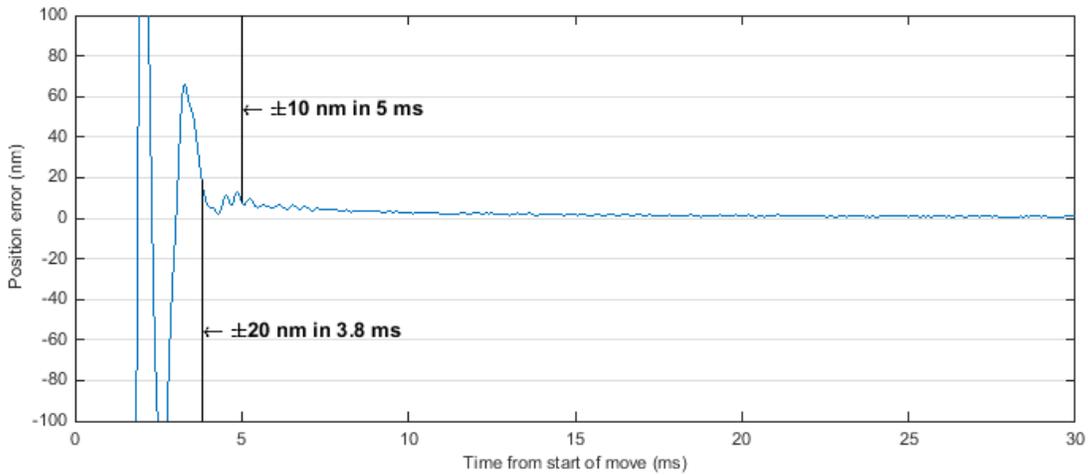


QNP2-100XYA-100-C single-axis move-and-settle plot of 5.1 ms for a 1 μm move with a 120 gram load and ±20 nm settle window illustrating the high-throughput capability of the QNP2 series.

QNP2 SERIES DESCRIPTION

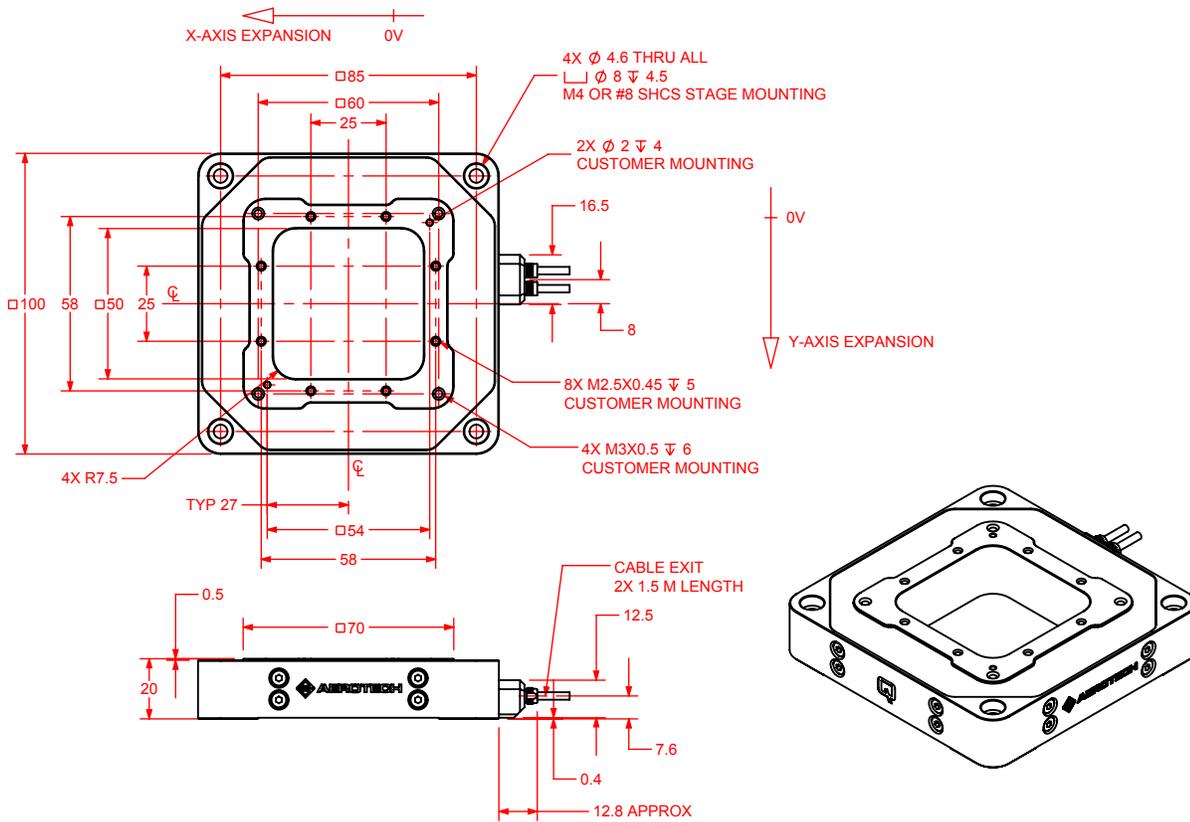


QNP2-150XYA-200-C two-dimensional vector accuracy of 7.7 nm over the full 200 um x 200 um XY travel. This result demonstrates the unmatched 2D positioning accuracy of the QNP2 series over a large travel range.

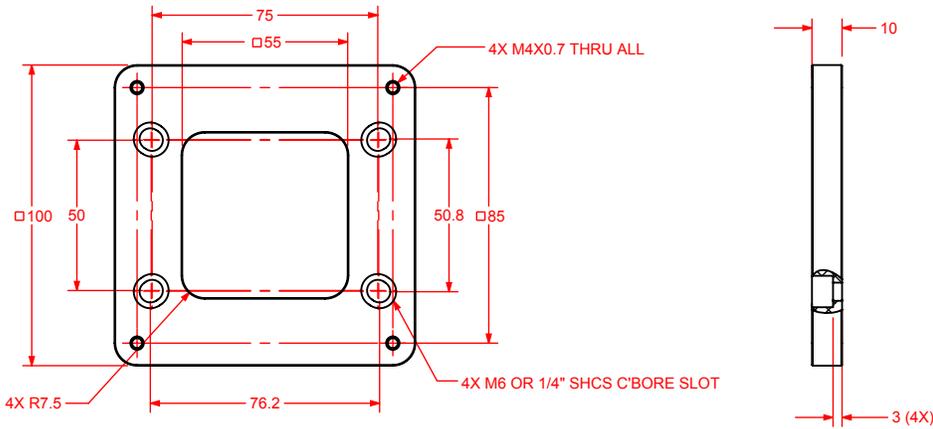


QNP2-100XYA-030 single-axis move-and-settle performance for a 10 um move (no-load condition), settling to within +/- 20 nm in 3.8 ms and to +/- 10 nm in 5 ms. This result illustrates the extreme dynamic performance capabilities of the QNP2.

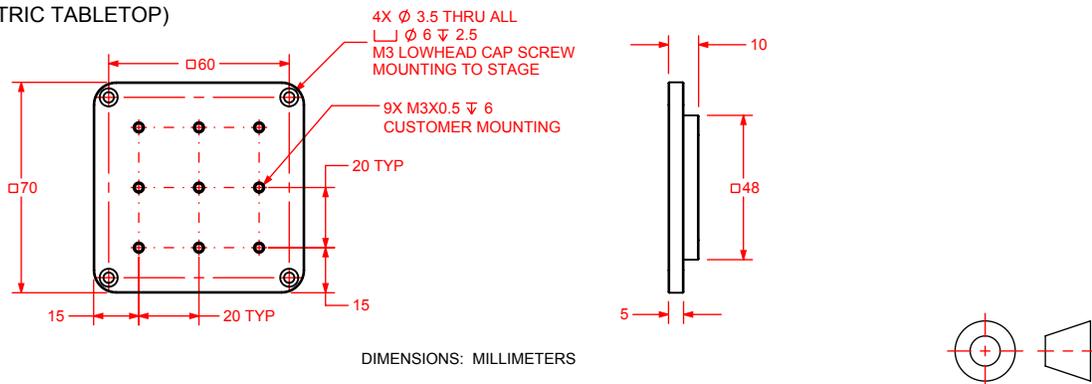
QNP2-100XYA-030 DIMENSIONS



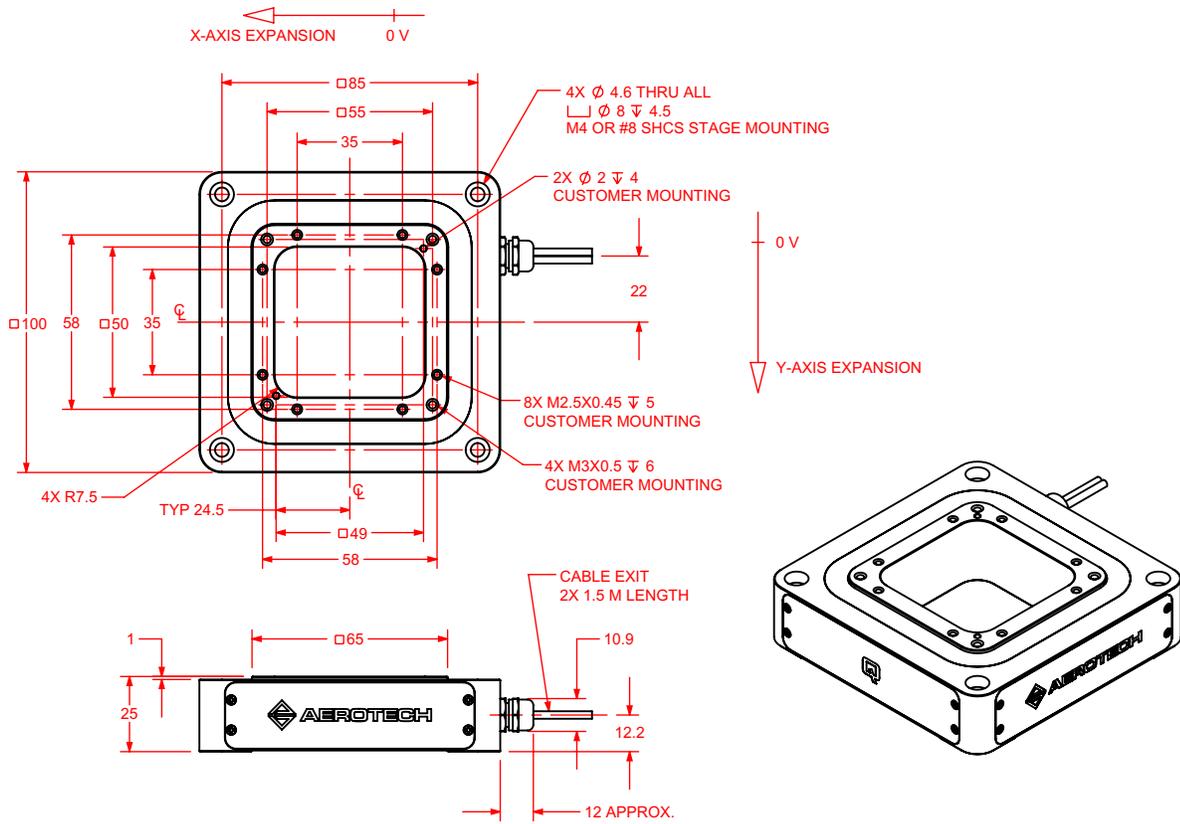
-MP (MOUNTING PLATE, BREADBOARD)



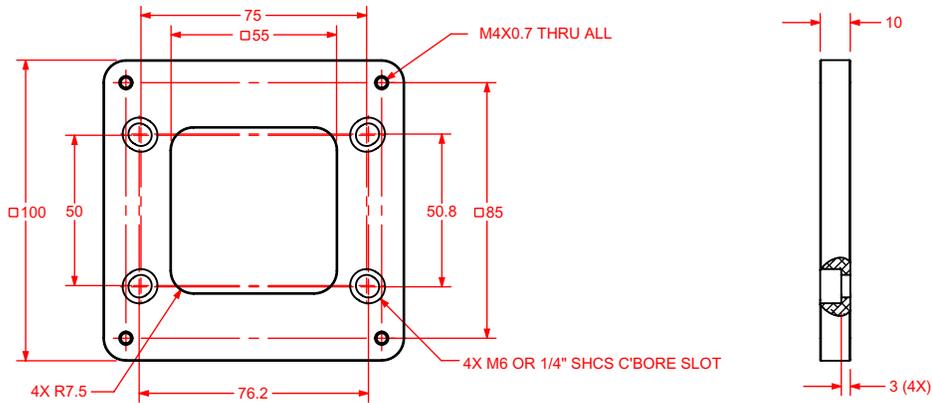
-TT1 (METRIC TABLETOP)



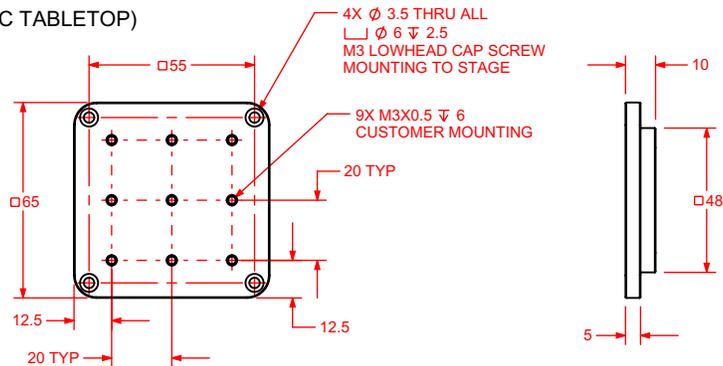
QNP2-100-XYA-100 DIMENSIONS



-MP (MOUNTING PLATE, BREADBOARD)

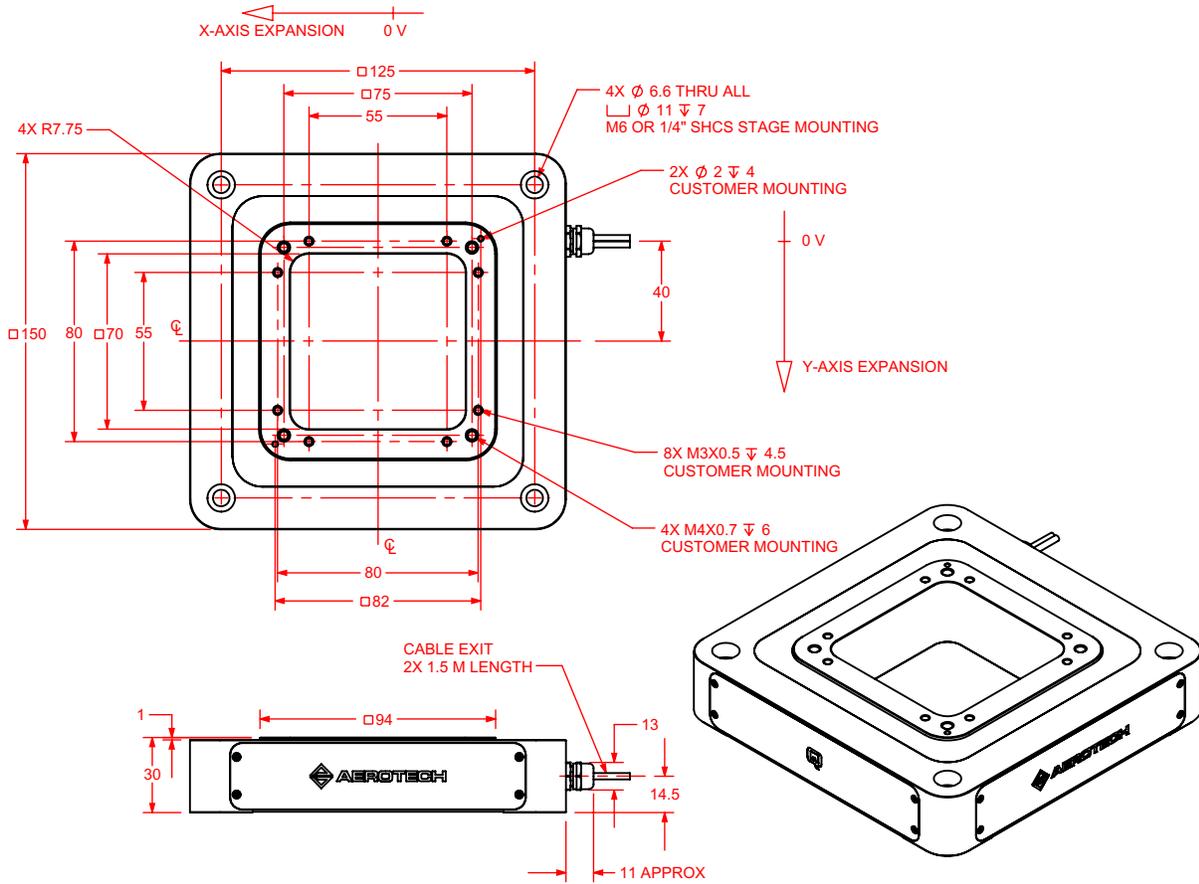


-TT1 (METRIC TABLETOP)

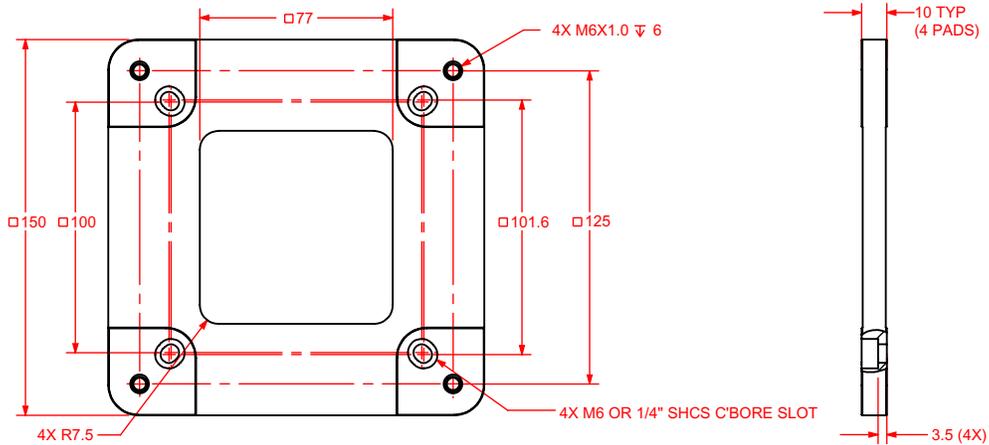


DIMENSIONS: MILLIMETERS

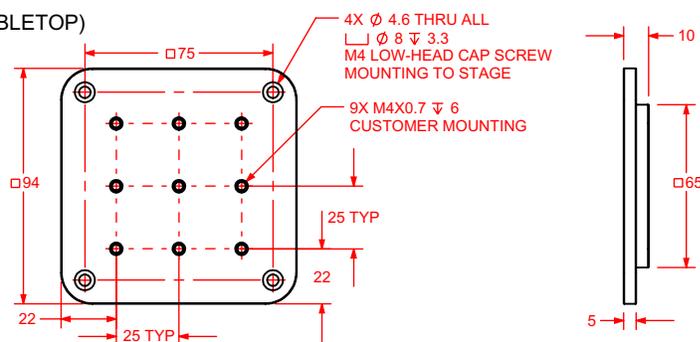
QNP2-150XYA-200 DIMENSIONS



-MP (MOUNTING PLATE, BREADBOARD)



-TT1 (METRIC TABLETOP)



DIMENSIONS: MILLIMETERS

QNP2 Series ORDERING INFORMATION

Model (Required)

| | |
|-----------------|--|
| QNP2-100XYA-030 | QNP2 two-axis XY piezo nan positioning stage, 30 μm x 30 μm closed-loop travel |
| QNP2-100XYA-100 | QNP2 two-axis XY piezo nan positioning stage, 100 μm x 100 μm closed-loop travel |
| QNP2-150XYA-200 | QNP2 two-axis XY piezo nan positioning stage, 200 μm x 200 μm closed-loop travel |

Feedback (Optional)

| | |
|----|-----------------------------|
| -C | Capacitance sensor feedback |
|----|-----------------------------|

Mounting Plate (Optional)

| | |
|-----|---|
| -MP | Mounting plate for English and metric optical breadboard tables |
|-----|---|

Tabletop (Optional)

| | |
|------|--|
| -TT1 | Solid metric tabletop, covers aperture |
|------|--|

Integration (Required)

Aerotech offers both standard and custom integration services to help you get your system fully operational as quickly as possible. The following standard integration options are available for this system. Please consult Aerotech if you are unsure what level of integration is required, or if you desire custom integration support with your system.

-TAS

Integration - Test as system

Testing, integration, and documentation of a group of components as a complete system that will be used together (ex: drive, controller, and stage). This includes parameter file generation, system tuning, and documentation of the system configuration.

-TAC

Integration - Test as components

Testing and integration of individual items as discrete components that ship together. This is typically used for spare parts, replacement parts, or items that will not be used together. These components may or may not be part of a larger system.