QNP-Z Series

Single-Axis, Z Piezo Nanopositioning Stages

- **Travel ranges from 100 µm to 600 µm available**

- **Long device lifetime**

- **High-precision, frictionless flexure guidance system**

- **Superior positioning resolution and linearity to 0.007% with direct-metrology capacitive sensor options**

- **Mounting compatibility with other QNP-series piezo nanopositioners**

- **Open-loop and vacuum versions**

Aerotech's QNP™-series of piezo nanopositioning stages offers nanometer-level performance in a compact, high-stiffness package. A variety of travel (100 µm to 600 µm) and feedback options make this the ideal solution for applications ranging from microscopy to optics alignment.

Aerotech's QNP-Z series of piezo nanopositioners offer closed-loop travel options of 100, 250 and 500 µm.

High Quality in a Compact Package

The QNP piezo stages are guided by precision flexures that are optimized using finite element analysis to ensure high-stiffness and long device life. The resulting design offers outstanding stiffness and resonant frequency enabling high process throughput and fast closed-loop response. Furthermore, these stages have been designed to provide excellent geometric performance (straightness and angular errors) while at the same time minimizing the overall stage package size.
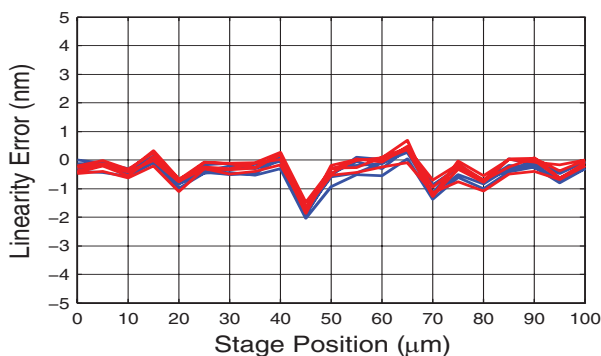
QNP40Z-100 linearity error plot measured with a laser interferometer over multiple bidirectional runs. The measured linearity is less than 0.002% and measured repeatability is less than 1 nm pk-pk.

High-Resolution and Positioning Accuracy

All of the QNP piezo stages have the option of closed-loop feedback using a unique capacitive sensor design that allows for sub-nanometer resolution and high linearity. The capacitive sensors measure the output of the positioning carriage directly, enabling superior accuracy and repeatability.

Ultra-Precision Control

When coupled with Aerotech's Q-series controllers and drives, the QNP piezo nanopositioning stages demonstrate sub-nanometer positioning resolution and 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.

Automatic parameter and calibration identification is accomplished using Aerotech's FlashConfig feature. The stage is automatically identified and all operational parameters including axis calibration data are uploaded into the controller ensuring safe, accurate and true "plug-and-play" operation.

Design Flexibility

Aerotech's QNP piezo stages are available with capacitance sensor feedback or without feedback (open-loop). Open-loop provides a cost-effective option for applications where compact size, high-dynamics, and sub-nanometer positioning resolution are required, but absolute positioning accuracy and repeatability are not required. Open-loop designs can also be used where the piezo position is controlled via an external feedback source (interferometer, vision system, photodetector, etc.).

An optional mounting plate provides direct mounting to English or metric breadboard optical tables. The QNP-series also includes the -L and -XY stages in which common travels mount together with adapter plates.

All QNP piezo stages are available in vacuum-prepared versions upon request.

QNP-Z SPECIFICATIONS

Mechanical Specifications[1]		QNP40Z-100	QNP50Z-250	QNP60Z-500
Closed-Loop Travel		100 μm	250 μm	500 μm
Open-Loop Travel, -30 to +150 V[2]		140 μm	300 μm	600 μm
Resolution[3]	Closed-Loop	0.30 nm	0.50 nm	0.90 nm
	Open-Loop	0.15 nm	0.20 nm	0.40 nm
Linearity[4,5]		0.01%	0.01%	0.007%
Bidirectional Repeatability[6]		1 nm	1 nm	3 nm
Pitch/Roll/Yaw		15 μrad (3 arc sec)	25 μrad (5 arc sec)	39 μrad (8 arc sec)
Stiffness (in direction of motion)[7]		0.96 N/μm	0.40 N/μm	0.42 N/μm
Unloaded Resonant Frequency[7]		1050 Hz	510 Hz	310 Hz
Resonant Frequency (50 gram load)[7]		620 Hz	340 Hz	260 Hz
Maximum Acceleration (Unloaded)[8]		530m/s^2	260m/s^2	220m/s^2
Moving Mass (Unloaded)		53 g	83 g	234 g
Max Payload[7]		1 kg	0.8 kg	1 kg
Stage Mass		0.08 kg	0.13 kg	0.31 kg
Material		Anodized aluminum[10]		
MTBF (Mean Time Between Failure)		30,000 Hours		

Notes:
1. All specifications, unless noted, are measured centered over the output carriage.
2. Value ±10%.
3. See Piezo Engineering reference section 4.2 for description of resolution.
4. Certified with each stage (closed-loop feedback models only).
5. See Piezo Engineering reference section 4.1 for description of linearity and accuracy specifications.
6. 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.
7. Values ±20%
8. On-axis loading listed
9. Requires selection of an appropriate amplifier to achieve listed values.
10. External elements are anodized aluminum. Some stainless steel components are used in the internal construction. Other materials upon request.

Electrical Specifications	QNP40Z-100	QNP50Z-250	QNP60Z-500
Drive System	Piezo Multi-Layer Stack Actuator		
Feedback	Closed Loop: Capacitive Sensor (-C) Open Loop: None (-)		
Maximum Voltage	-30 V to +150 V		
Piezo Stack Capacitance[1]	1.6 μF	2.3 μF	13.2 μF

Note:
1. Value ±20%

Recommended Controller	
Ensemble	Ensemble QLAB
	Ensemble QDe
	Ensemble QLe
	Ensemble QL
A3200	Ndrive QLe
	Ndrive QL

Note:
1. 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.

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QNP-Z Series DIMENSIONS

CABLE EXIT
(1.5 M LENGTH)

3.5

E
TYP

2X Ø1.5 ⌵ 3

D
TYP

□ A

CUSTOMER MOUNTING
4X M3 ⌵ 4.5
(THRU ACCESS FOR 2 MM WRENCH)

□ C

0.3

B

EXPANSION

0 V

Ø5.4

6

4X T-SLOTS FOR M3 X 8 LOW HEAD SHCS (PROVIDED)
CONCENTRIC WITH M3 CUSTOMER MOUNTING HOLES

2X Ø1.5 ⌵ 3
CONCENTRIC WITH TOP
LOCATING PIN HOLES
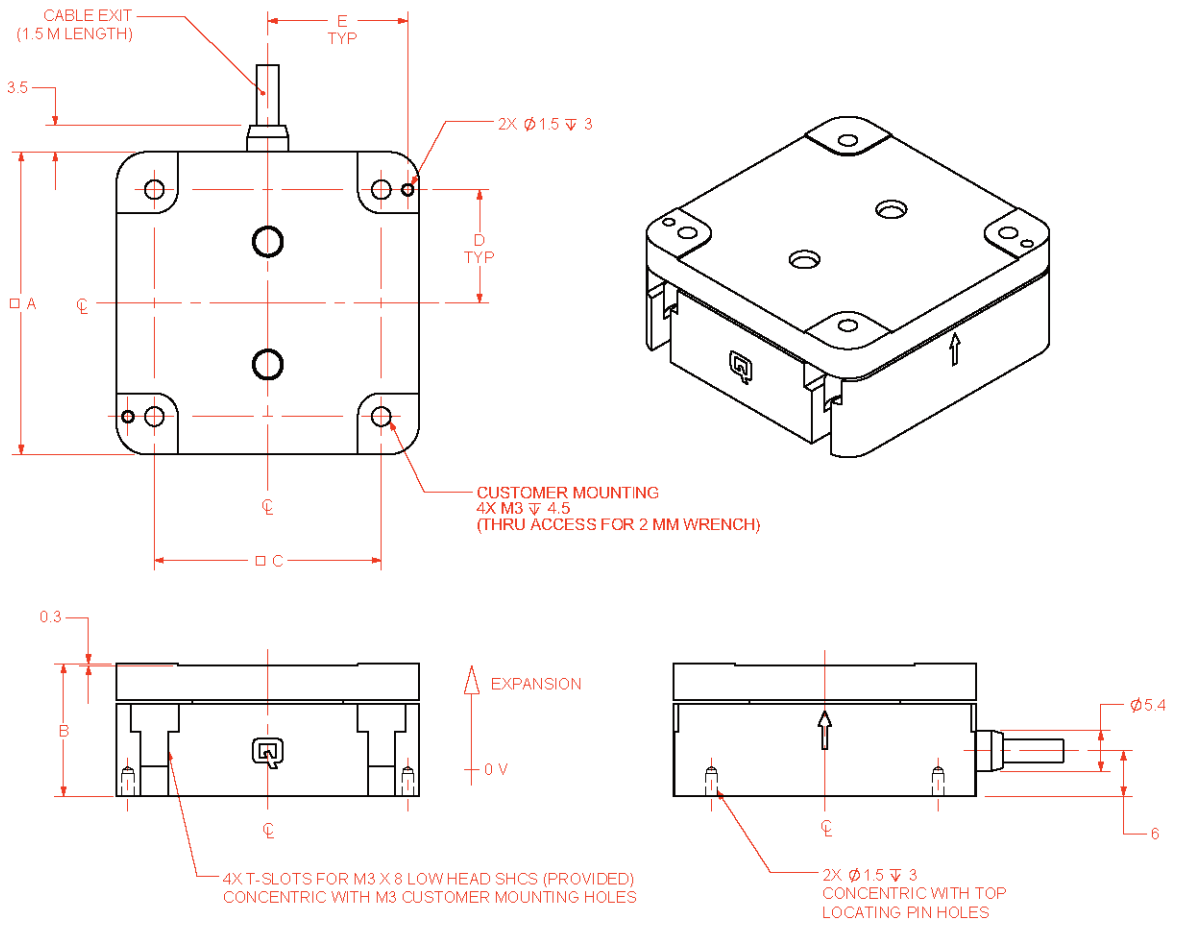
(STAGE SHOWN AT 0 V POSITION)

STAGE	A	B	C	D	E
QNP40Z-100	40	17.5	30	15	18.5
QNP50Z-250	50	17.5	40	20	23.5
QNP60Z-500	60	25	50	25	28.5

-MP (MOUNTING PLATE, BREADBOARD)

25.4

M3 ⌵ 6

10

25

25.4

□ F □ G
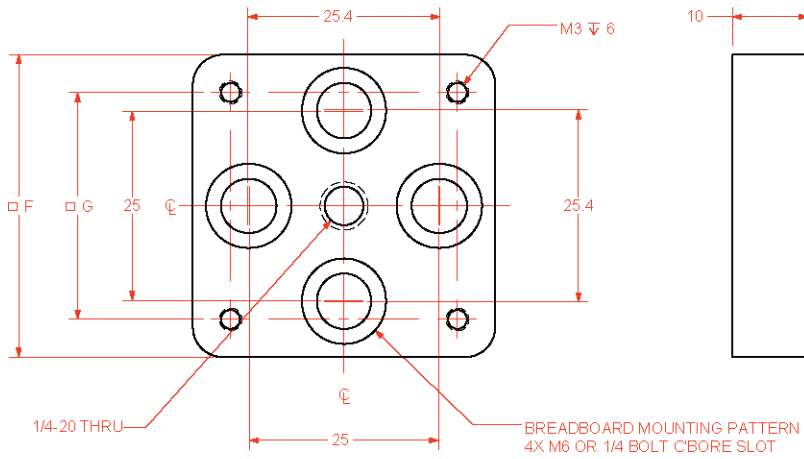
STAGE	F	G
QNP40Z-100	40	30
QNP50Z-250	50	40
QNP60Z-500	60	50

1/4-20 THRU

25

BREADBOARD MOUNTING PATTERN
4X M6 OR 1/4 BOLT C'BORE SLOT

DIMENSIONS: MILLIMETERS

QNP-Z Series DIMENSIONS

–AP (Adapter Plate)

-AP-QNP-250XY-100Z
(MOUNTS QNP40Z-100 ONTO QNP50XY-250)

4X M3 SHCS
⌴ 6 ⍌ 3.5
QNP-50-250XY

□40
□30
□50

6

4x M3x0.5 ⍌ 4.5
QNP-40-100Z
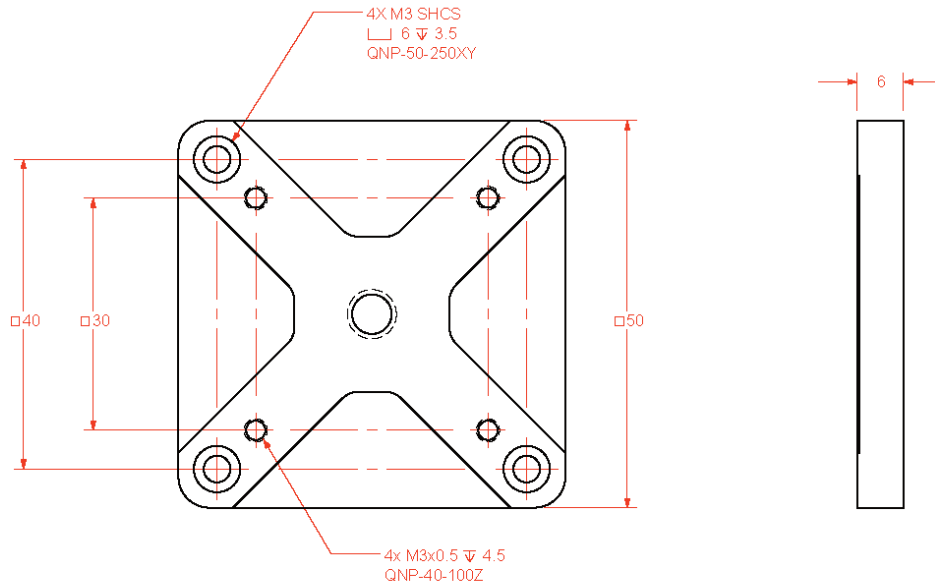
-AP-QNP-500XY-100Z-250Z
(MOUNTS QNP40Z-100 OR QNP50Z-250 ONTO QNP60XY-500)

4X M3 SHCS
⌴ 6 ⍌ 3.5
QNP-60-500XY

□50
□40
□30
□60

6

4x M3x0.5 ⍌ 4.5
QNP-40-100Z

4x M3x0.5 ⍌ 4.5
QNP-50-250Z
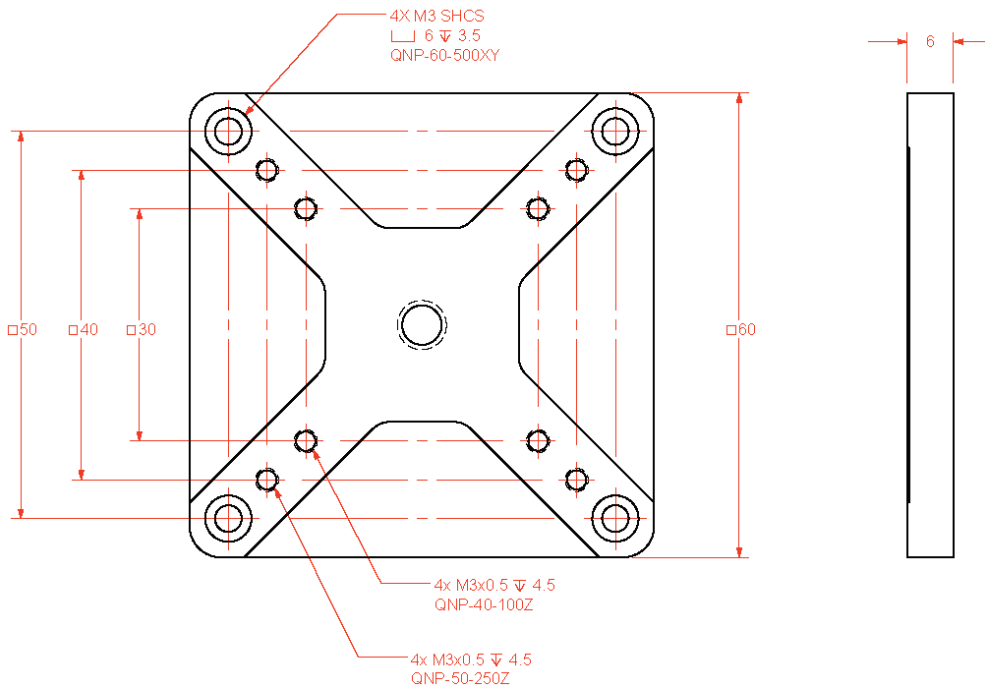
DIMENSIONS: MILLIMETERS

QNP-Z Series ORDERING INFORMATION

QNP-Z Single-Axis Z Piezo Nanopositioning Stages

QNP40Z-100	QNP40Z-100 single-axis, Z piezo nanopositioning stage, 100 µm CL travel
QNP50Z-250	QNP40Z-250 single-axis, Z piezo nanopositioning stage, 250 µm CL travel
QNP60Z-500	QNP60Z-500 single-axis, Z piezo nanopositioning stage, 500 µm CL travel

Feedback (Optional)

-C	Capacitance sensor feedback

Mounting Plate (Optional)

-MP	Mounting plate for English and metric optical breadboard tables

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. This is typically used for spare parts, replacement parts, or items that will not be used or shipped together (ex: stage only). These components may or may not be part of a larger system.

Adapter Plates (to be ordered as a separate line item)

AP-QNP250XY-100Z	Adapter plate, lower: QNP250XY, upper: QNP100Z
AP-QNP500XY-100Z-250Z	Adapter plate, lower: QNP500XY, upper: QNP100Z/250Z