

# QNP-L Series

## Single-Axis Linear Piezo Nanopositioning Stages

Travel ranges from 100  $\mu\text{m}$  to 600  $\mu\text{m}$  available

Long device lifetime

High-precision, frictionless flexure guidance system

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

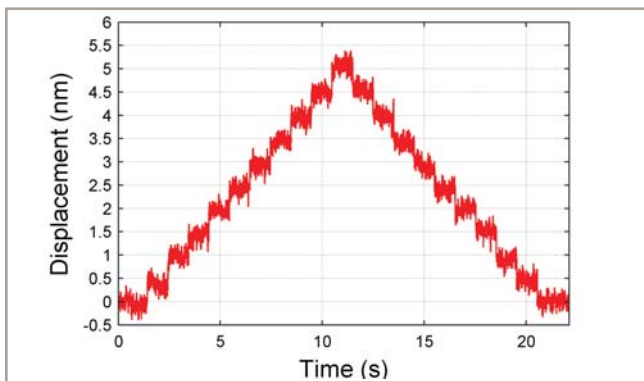
Mounting compatibility with other QNP-series piezo nanopositioners

Open-loop and vacuum versions

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

### 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.



*QNP40L-100-C 0.5 nm bidirectional step plot measured with an external ultra-precision capacitance sensor. All sizes of the QNP-L stage series offer exceptional sub-nm mechanical step capability.*



*Aerotech's QNP-L series of single-axis piezo nanopositioners offer closed-loop travel options of 100, 250 and 500  $\mu\text{m}$ .*

### 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 XY and Z stages in which common travels mount together with adapter plates.

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

## QNP-L SPECIFICATIONS

Mechanical Specifications		QNP40L-100	QNP50L-250	QNP60L-500
Closed-Loop Travel		100 $\mu\text{m}$	250 $\mu\text{m}$	500 $\mu\text{m}$
Open-Loop Travel, -30 to +150 V <sup>(1)</sup>		120 $\mu\text{m}$	300 $\mu\text{m}$	600 $\mu\text{m}$
Resolution <sup>(2)</sup>	Closed-Loop (Integrated Feedback)	0.30 nm	0.50 nm	0.90 nm
	Open-Loop	0.15 nm	0.20 nm	0.40 nm
Linearity <sup>(3)(4)</sup>		0.01%	0.01%	0.007%
Bidirectional Repeatability <sup>(5)</sup>		1 nm	1 nm	3 nm
Pitch/Yaw		6 $\mu\text{rad}$ (1.2 arc sec)	6 $\mu\text{rad}$ (1.2 arc sec)	12 $\mu\text{rad}$ (2.5 arc sec)
Stiffness (In Direction of Motion) <sup>(6)</sup>		1.25 N/ $\mu\text{m}$	0.40 N/ $\mu\text{m}$	0.27 N/ $\mu\text{m}$
Unloaded Resonant Frequency <sup>(6)</sup>		1300 Hz	475 Hz	350 Hz
Resonant Frequency (50 Gram Load) <sup>(6)</sup>		650 Hz	325 Hz	260 Hz
Max Payload <sup>(7)</sup>		1 kg		
Maximum Acceleration (Unloaded) <sup>(8)</sup>		900 m/s <sup>2</sup>	420 m/s <sup>2</sup>	210 m/s <sup>2</sup>
Moving Mass (Unloaded)		28 g	48 g	96 g
Stage Mass		0.06 kg	0.09 kg	0.14 kg
Material		Anodized Aluminum <sup>(9)</sup>		
MTBF (Mean Time Between Failure)		30,000 Hours		

Notes:

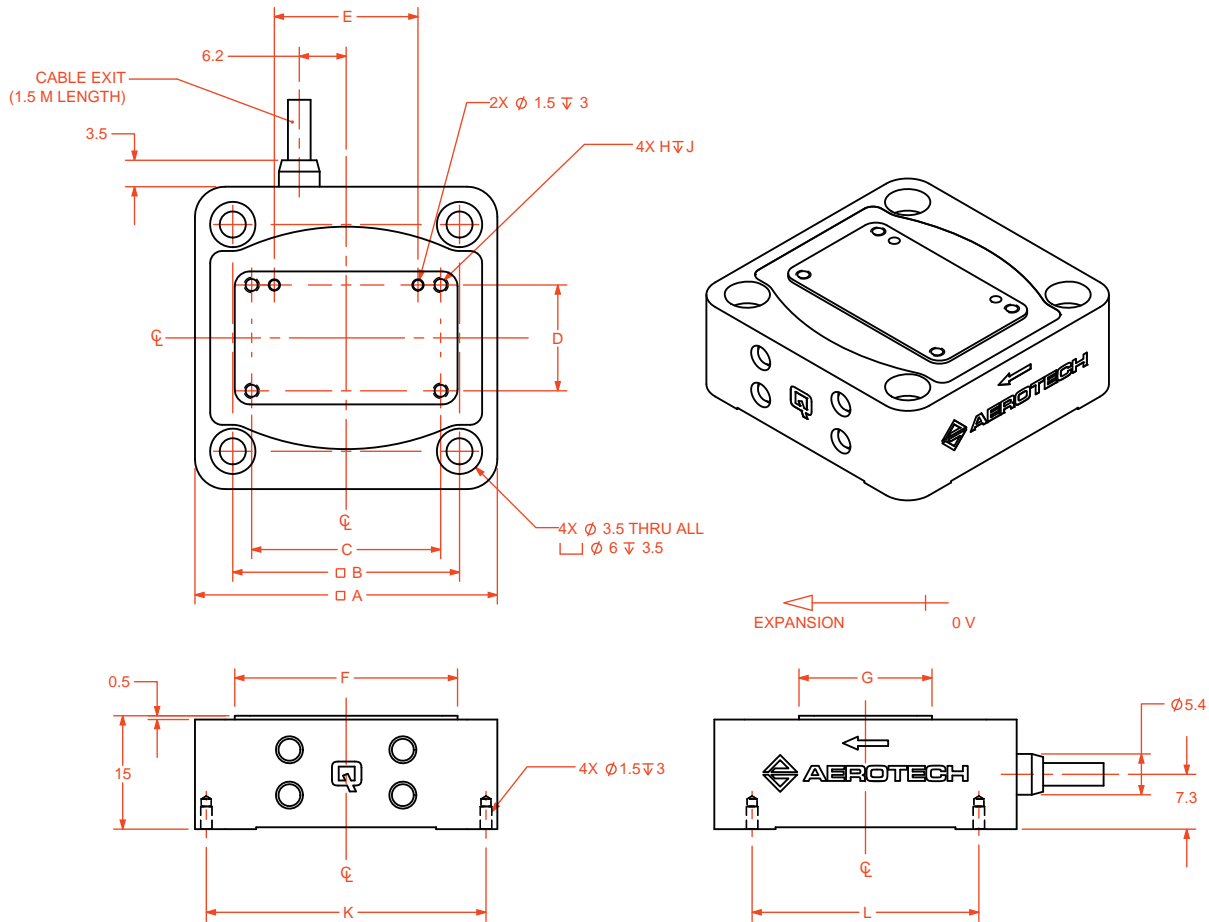
1. Value  $\pm 10\%$ .
2. See Piezo Engineering Reference section 4.2 for description of resolution.
3. Certified with each stage (closed-loop feedback models only).
4. See Piezo Engineering Reference section 4.1 for description of linearity specifications.
5. Specified as a 1 sigma (standard deviation) value (closed-loop feedback models only). See Piezo Engineering Reference section 4.3 for description of bidirectional repeatability.
6. Values  $\pm 20\%$ .
7. On-axis loading listed.
8. Requires selection of an appropriate amplifier to achieve listed values.
9. External elements are anodized aluminum. Some internal components are stainless steel. Other materials upon request.
10. Specifications are measured centered and at a height of approximately 15 mm above the output carriage.

Electrical Specifications	QNP40L-100	QNP50L-250	QNP60L-500
Drive System	Piezo Multi-Layer Stack Actuator		
Feedback	Closed Loop: Integrated Capacitive Sensor (-C) Open Loop: None (-)		
Voltage Range	-30 V to +150 V		
Piezo Stack Capacitance <sup>(1)</sup>	1.6 $\mu\text{F}$	2.3 $\mu\text{F}$	6.4 $\mu\text{F}$

Notes:

1. Value  $\pm 20\%$ .

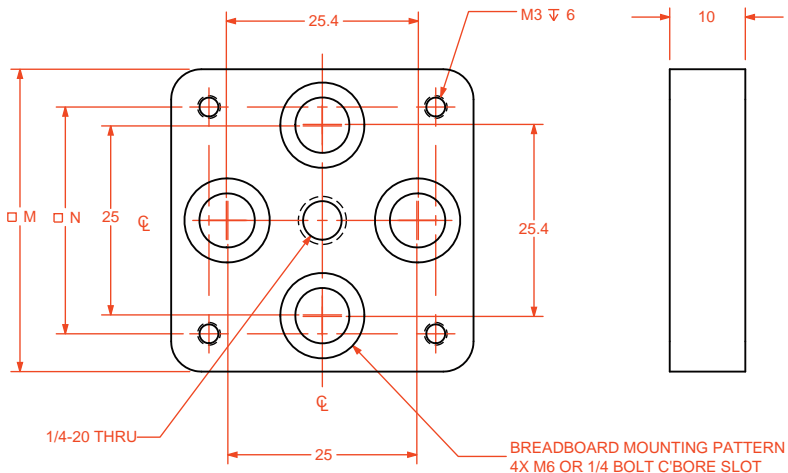
# QNP-L Series DIMENSIONS



(STAGE SHOWN AT MID-TRAVEL)

STAGE	A	B	C	D	E	F	G	H	J	K	L
QNP40L-100	40	30	25	14	19	29.5	17.6	M2	4	37	30
QNP50L-250	50	40	30	18	23	41.8	24.3	M2.5	5	47	40
QNP60L-500	60	50	40	30	33	51	35	M2.5	5	57	50

## -MP (MOUNTING PLATE, BREADBOARD)

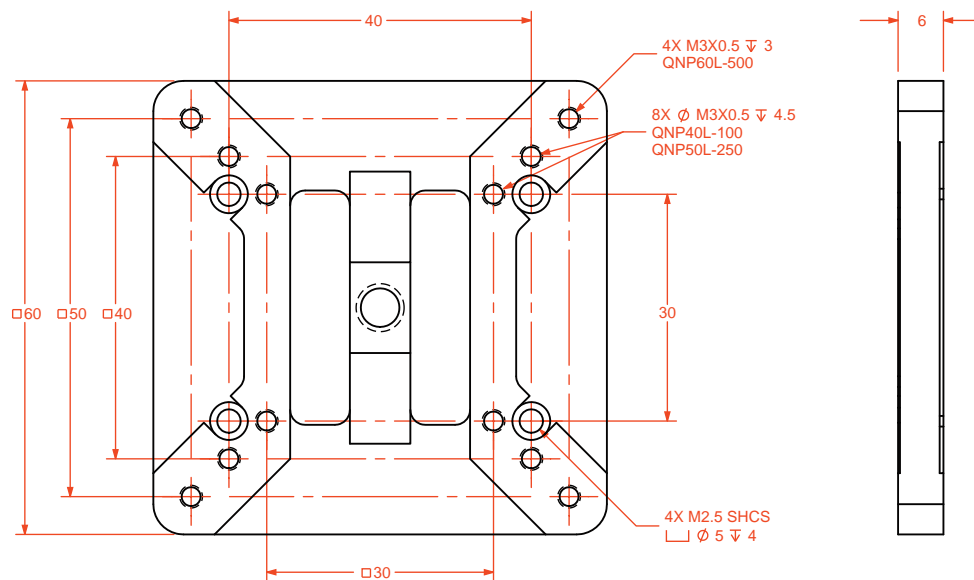
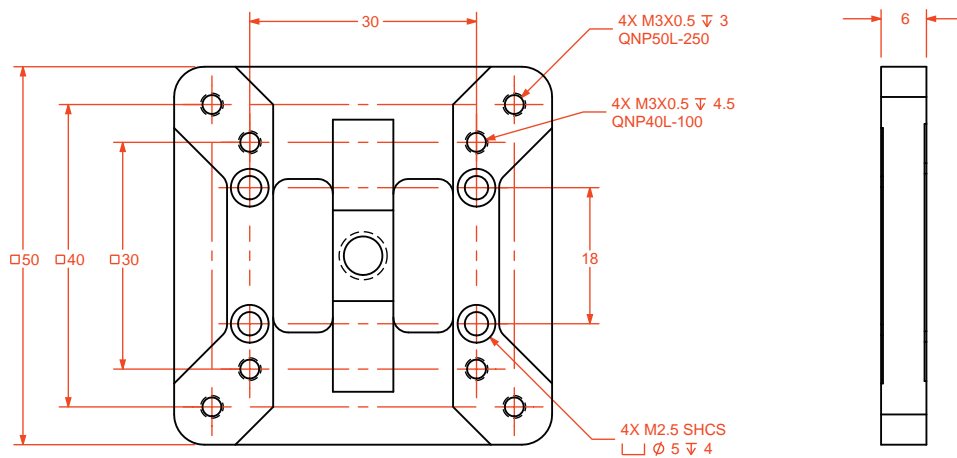
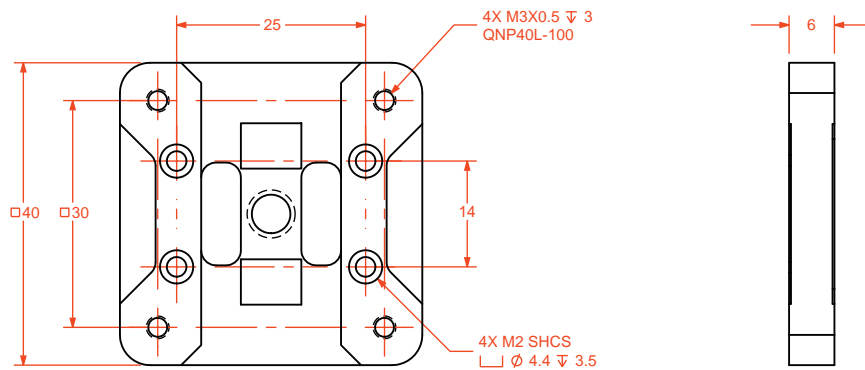


STAGE	M	N
QNP40L-100	40	30
QNP50L-250	50	40
QNP60L-500	60	50

DIMENSIONS: MILLIMETERS

## QNP-L Series Adapter Plate DIMENSIONS

-AP (ADAPTER PLATE)



DIMENSIONS: MILLIMETERS

## QNP-L Series ORDERING INFORMATION

### QNP-L Series Single-Axis Piezo Nanopositioning Stage

QNP40L-100	QNP40L-100 single-axis linear piezo nanopositioning stage, 100 $\mu\text{m}$ CL Travel
QNP50L-250	QNP50L-250 single-axis linear piezo nanopositioning stage, 250 $\mu\text{m}$ CL Travel
QNP60L-500	QNP60L-500 single-axis linear piezo nanopositioning stage, 500 $\mu\text{m}$ CL Travel

### Feedback (Optional)

-C	Capacitance sensor feedback
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### Mounting Plate (Optional)

-MP	Mounting plate for English and metric optical breadboard tables
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### 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	<p><b>Integration - Test as system</b></p> <p>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.</p>
-TAC	<p><b>Integration - Test as components</b></p> <p>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.</p>

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

AP-QNP40L-100	Adapter plate, QNP40L-100
AP-QNP50L-250	Adapter plate, QNP50L-250 to 40L-100/50L-250
AP-QNP60L-500	Adapter plate, QNP60L-500 to 40L-100/50L-250/60L-500

Two QNP40L-100 stages in an XY arrangement using the AP-QNP40L-100 adapter plate.



A QNP50L-250 and QNP40L-100 in an XY arrangement using the AP-QNP-50-250 adapter plate.

