

# 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

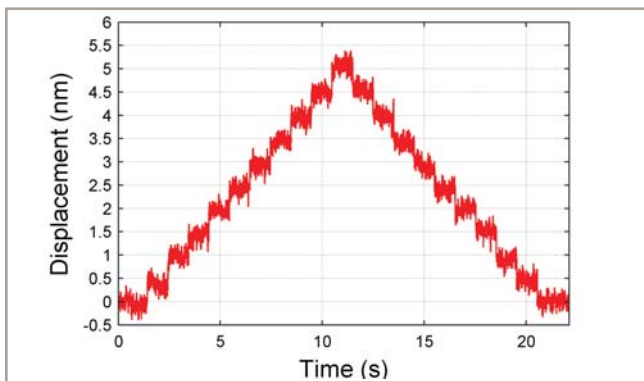
Mounting compatibility with other QNP-series piezo nanopositioners

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.



QNP-40-100L 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 of 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		QNP-40-100L	QNP-50-250L	QNP-60-500L
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
Push/Pull Capacity (In Direction of Motion) <sup>(7)</sup>		10 N		
Max Payload <sup>(8)</sup>		1 kg		
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:

- Value  $\pm 10\%$ .
- 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. See Piezo Engineering Reference section 4.3 for description of bidirectional repeatability.
- Values  $\pm 20\%$ .
- See Piezo Engineering Reference section 4.6 for description of piezo stage load ratings.
- On-axis loading listed.
- External elements are anodized aluminum. Some internal components are stainless steel. Other materials upon request.

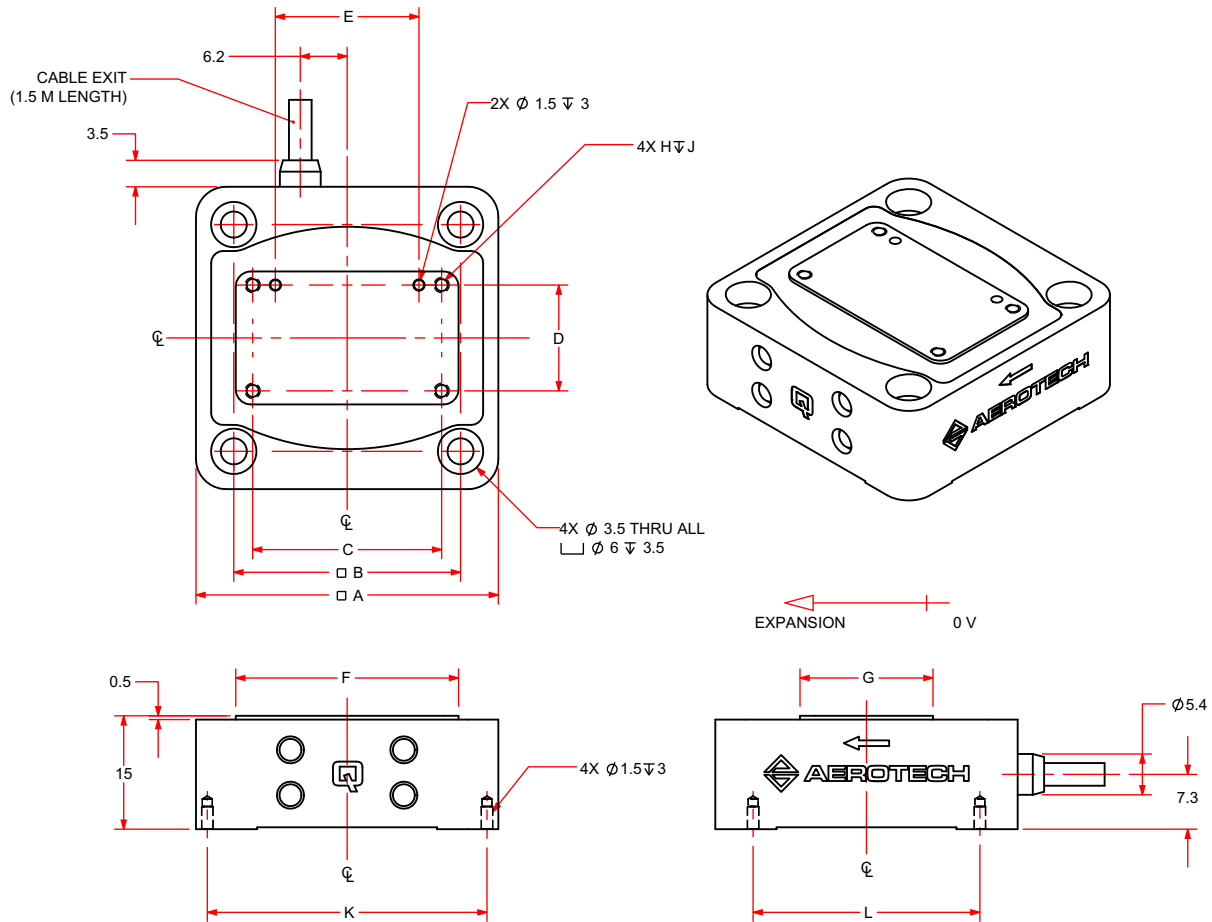
Electrical Specifications	QNP-40-100L	QNP-50-250L	QNP-60-500L
Drive System	Piezo Multi-Layer Stack Actuator		
Feedback	Closed Loop: Integrated Capacitive Sensor (-C) Open Loop: None (-)		
Max Voltage	-30 V to +150 V		
Piezo Stack Capacitance <sup>(1)</sup>	1.6 $\mu\text{F}$	2.3 $\mu\text{F}$	6.4 $\mu\text{F}$

Notes:

- Value  $\pm 20\%$ .

Recommended Controller		QNP-40-100L	QNP-50-250L	QNP-60-500L
Multi-Axis	Ensemble	QLAB (1-4 Axes Available)		
Single Axis				

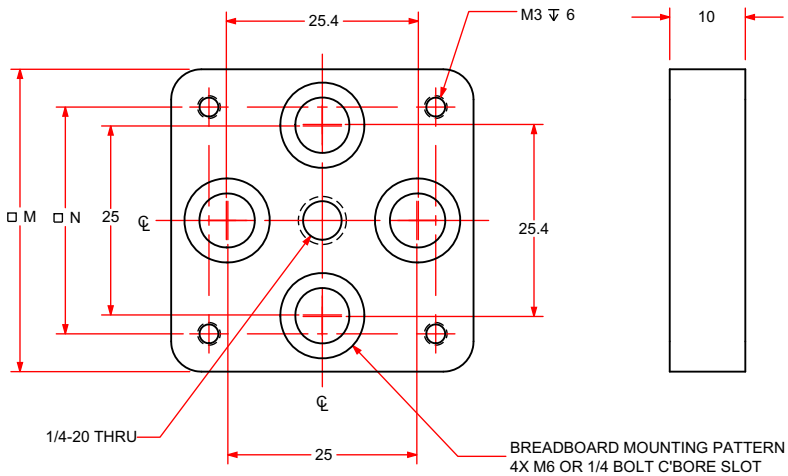
# QNP-L Series DIMENSIONS



(STAGE SHOWN AT MID-TRAVEL)

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

## -MP (MOUNTING PLATE, BREADBOARD)

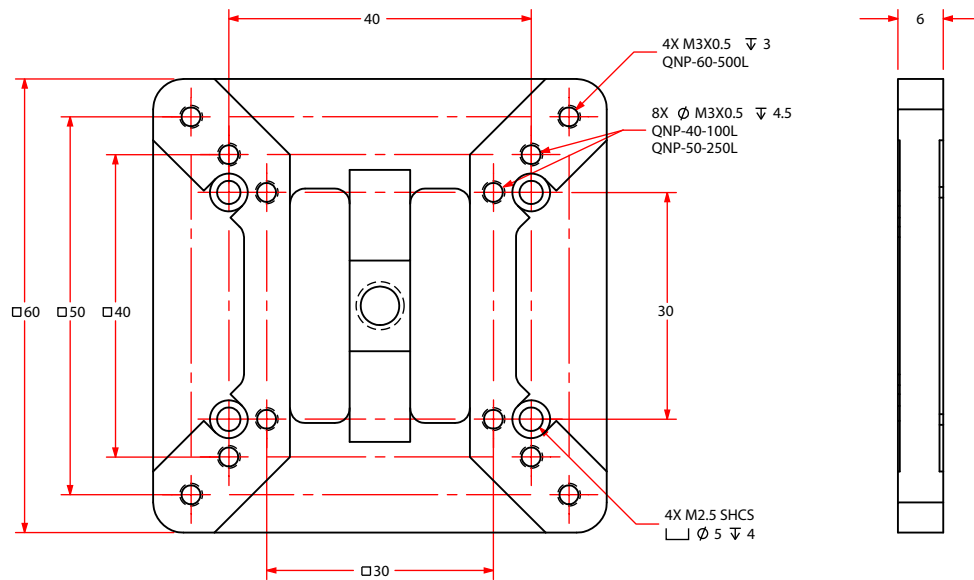
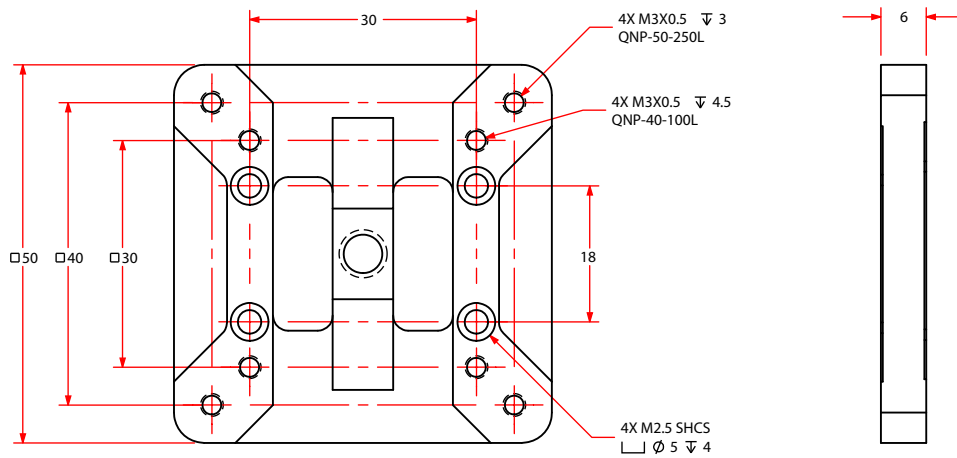
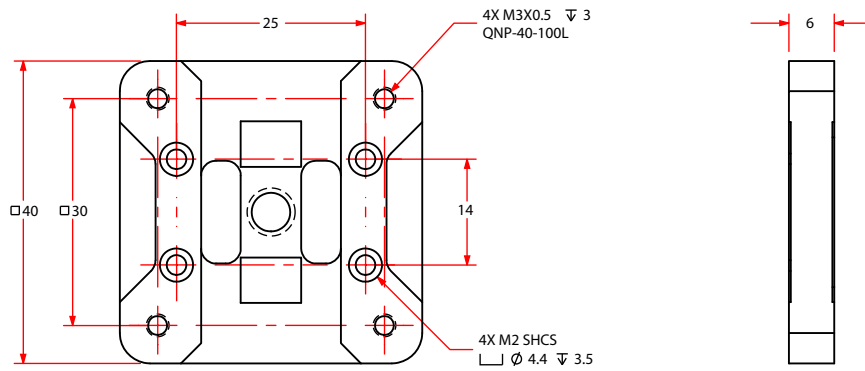


STAGE	M	N
QNP-40-100L	40	30
QNP-50-250L	50	40
QNP-60-500L	60	50

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

QNP-40-100L	QNP-L series open-loop nanopositioner, 40 mm wide, 120 $\mu\text{m}$ open-loop travel
QNP-40-100L-C	QNP-L series closed-loop nanopositioner with capacitive sensor feedback, 40 mm wide, 100 $\mu\text{m}$ closed-loop travel (120 $\mu\text{m}$ open-loop travel)
QNP-50-250L	QNP-L series open-loop nanopositioner, 50 mm wide and 300 $\mu\text{m}$ open-loop travel
QNP-50-250L-C	QNP-L series closed-loop nanopositioner with capacitive sensor feedback, 50 mm wide, 250 $\mu\text{m}$ closed-loop travel (300 $\mu\text{m}$ open-loop travel)
QNP-60-500L	QNP-L series open-loop nanopositioner, 60 mm wide, 600 $\mu\text{m}$ open-loop travel
QNP-60-500L-C	QNP-L series closed-loop nanopositioner with capacitive sensor feedback, 60 mm wide, 500 $\mu\text{m}$ closed-loop travel (600 $\mu\text{m}$ open-loop travel)

### Options

-MP	Mounting plate for English and metric optical breadboard tables
-AP	Adapter plate kit for customer mounting of multi-axis QNP stages; AP-QNP-40-100 mounts 100L upper-axis to 100L lower-axis; AP-QNP-50-250 mounts 100L/250L upper-axis to 250L lower-axis; AP-QNP-60-500 mounts 100L/250L/500L upper-axis to 500L lower-axis

Two QNP-40-100L stages in an XY arrangement using the AP-QNP-40-100 adapter plate.



A QNP-50-250L and QNP-40-100L in an XY arrangement using the AP-QNP-50-250 adapter plate.

