QNP$_{HD}$ Series

Single-Axis, High-Dynamic Piezo Nanopositioning Stages

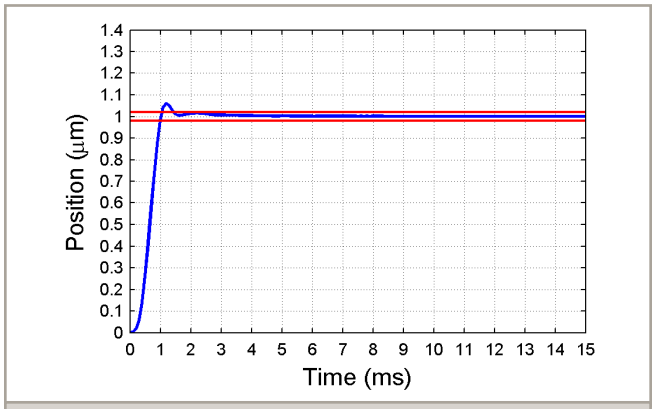
- Closed-loop travels from 10 µm to 40 µm
- Direct-drive actuation enables fast response times and higher-throughput processes
- High-precision, frictionless flexure guidance
- Long device lifetime
- Superior positioning resolution and linearity with direct-metrology capacitive sensor option
- Open-loop and vacuum versions

Aerotech's QNP$_{HD}$ piezo nanopositioning stages provide the benefits of both a stage and actuator in one compact, high-stiffness package. With a direct-metrology, capacitive sensor feedback option, high resonant frequencies and high load capacity, the QNP$_{HD}$ is ideal for a wide range of high-speed and high-precision applications such as scanning probe microscopy, disc-drive testing, or semiconductor wafer articulation.

Fast Response with Exacting Precision

The QNP$_{HD}$ employs a direct-drive actuation design and an optimized structure enabling millisecond-level response and move-and-settle times.

Guided by precision flexures that are optimized using finite element analysis to ensure high-stiffness and long device life, the QNP$_{HD}$ provides high-dynamics while maintaining excellent geometric performance (straightness and angular errors) for critical nanopositioning applications.



QNPHD30L-25-C move-and-settle plot for a 1 µm step, 200 gram payload and a settle window of ± 20 nm. All QNP$_{HD}$ exhibit excellent dynamic performance enabling higher-throughput processes.

The QNP$_{HD}$ stages are available in three closed-loop travel options.

High-Resolution and Positioning Accuracy

The QNP$_{HD}$ has the option of closed-loop feedback (-C) using a unique capacitive sensor design that allows for sub-nanometer resolution and single-digit nanometer linearity errors. 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$_{HD}$ demonstrates sub-nanometer positioning resolution 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.

Mounting Flexibility

The QNP$_{HD}$ is available with rear and side cable exit options along with mounting features for both horizontal and vertical orientations. This flexibility allows the user to orient and package the stage for the most optimal arrangement without designing various adapter plates and brackets that increase size and design complexity.

An optional mounting plate provides direct mounting to English or metric optical breadboard tables. Custom designs and vacuum-prepared versions are available upon request.

QNP$_{HD}$ Series SPECIFICATIONS

Mechanical Specifications		QNP$_{HD}$30L-10	QNP$_{HD}$30L-25	QNP$_{HD}$30L-40
Closed-Loop Travel		10 µm	25 µm	40 µm
Open-Loop Travel, -30 to +150 V(1)		12 µm	32 µm	50 µm
Resolution(2)	**Closed-Loop**	0.05 nm	0.10 nm	0.10 nm
	Open-Loop	0.02 nm	0.03 nm	0.05 nm
Linearity(3,4)		0.02%	0.02%	0.02%
Bidirectional Repeatability(5)		1 nm	1 nm	2 nm
Pitch/Yaw		5 µrad (1.0 arc sec)	5 µrad (1.0 arc sec)	7.5 µrad (1.5 arc sec)
Stiffness (in direction of motion)(6)		60 N/µm	31 N/µm	29 N/µm
Unloaded Resonant Frequency(6)		7000 Hz	4100 Hz	3500 Hz
Resonant Frequency (200 g load)(6)		2500 Hz	1900 Hz	1700 Hz
Max Payload(7)	**Horizontal**	2 kg	2 kg	2 kg
	Vertical	7 kg	10 kg	10 kg
Maximum Acceleration (Unloaded)(8)		2250 m/s^2	1250 m/s^2	750 m/s^2
Moving Mass (Unloaded)		39 g	54 g	77 g
Stage Mass		0.11 kg	0.15 kg	0.20 kg
Material		Stainless Steel		
MTBF (Mean Time Between Failure)		30,000 Hours		

Notes:
1. Value ±10%
2. See Piezo Engineering reference section 4.2 for description of resolution.
3. Certified with each stage (closed-loop feedback models only).
4. Measured approximately 15 mm above the carriage by an external metrology device. See Piezo Engineering reference section 4.1 for description of linearity specifications.
5. Specified as a 1 sigma (standard deviation) value. See Piezo Engineering reference section 4.3 for description of bidirectional repeatability.
6. Values ±20%.
7. On-axis loading listed.
8. Requires the selection of an appropriate amplifier to achieve the listed values.

Electrical Specifications	QNP$_{HD}$30L-10	QNP$_{HD}$30L-25	QNP$_{HD}$30L-40
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(1)	0.7 µF	2.3 µF	3.4 µF

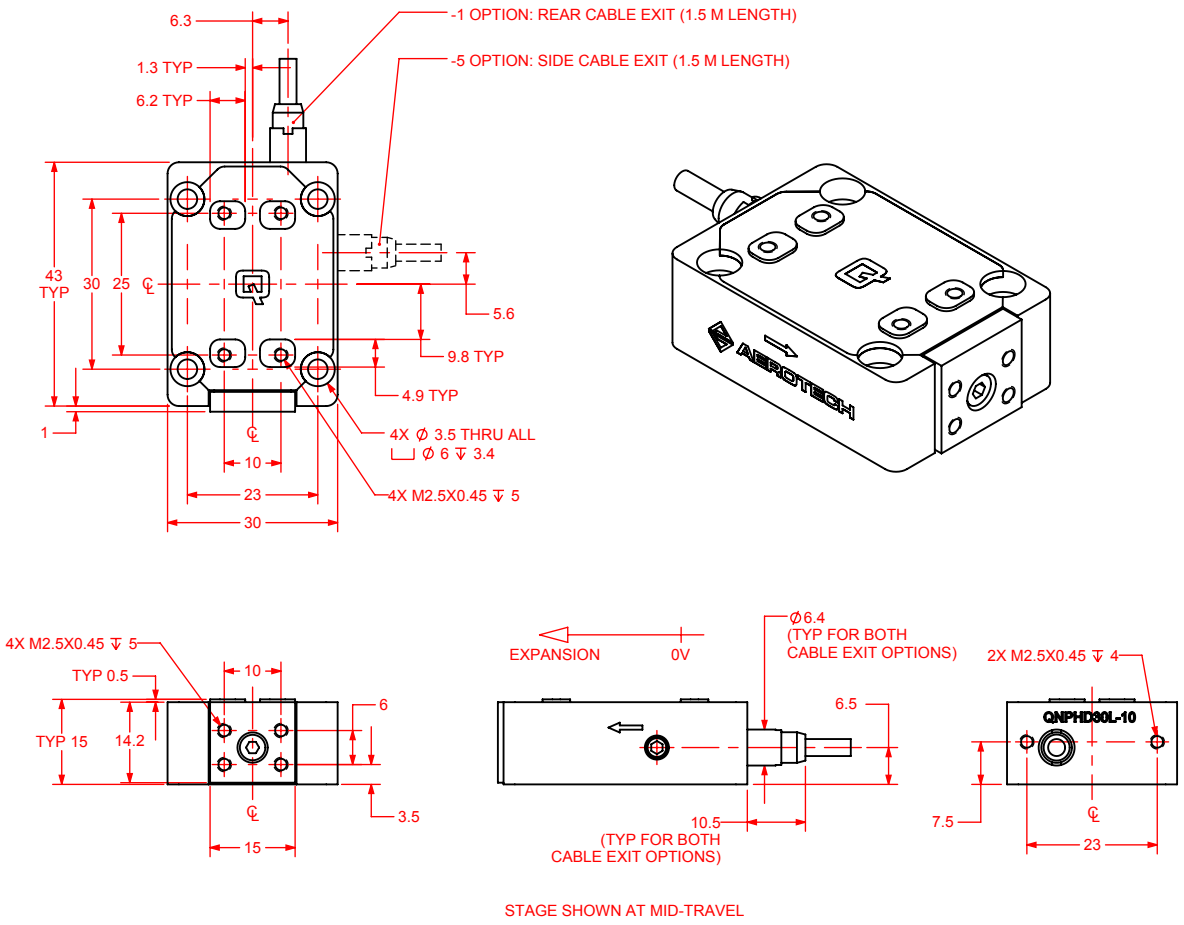
1. Value ±20%.

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

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.

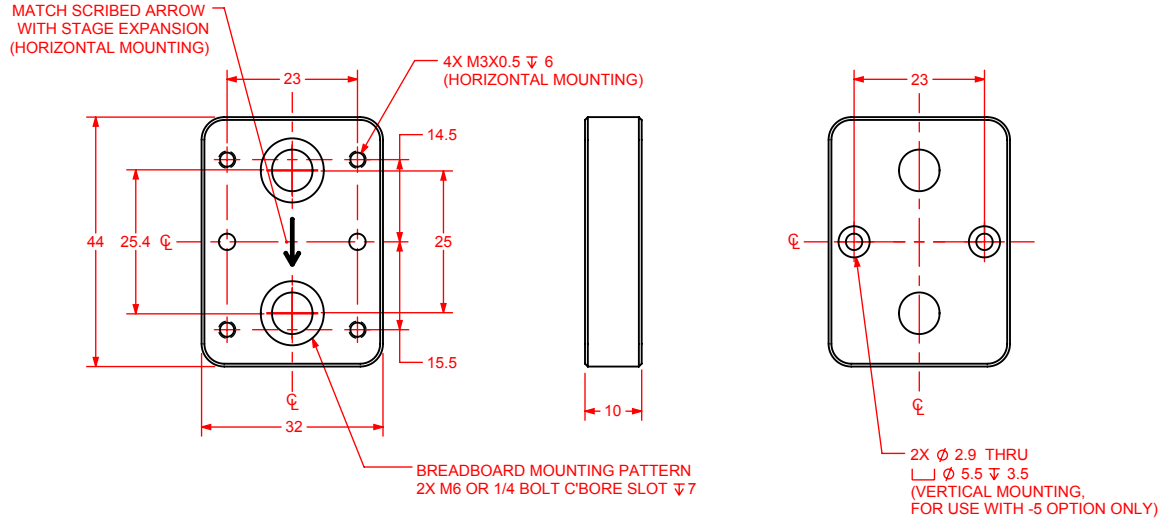
QNP$_{HD}$ Series DIMENSIONS

QNPHD-30-10L



STAGE SHOWN AT MID-TRAVEL

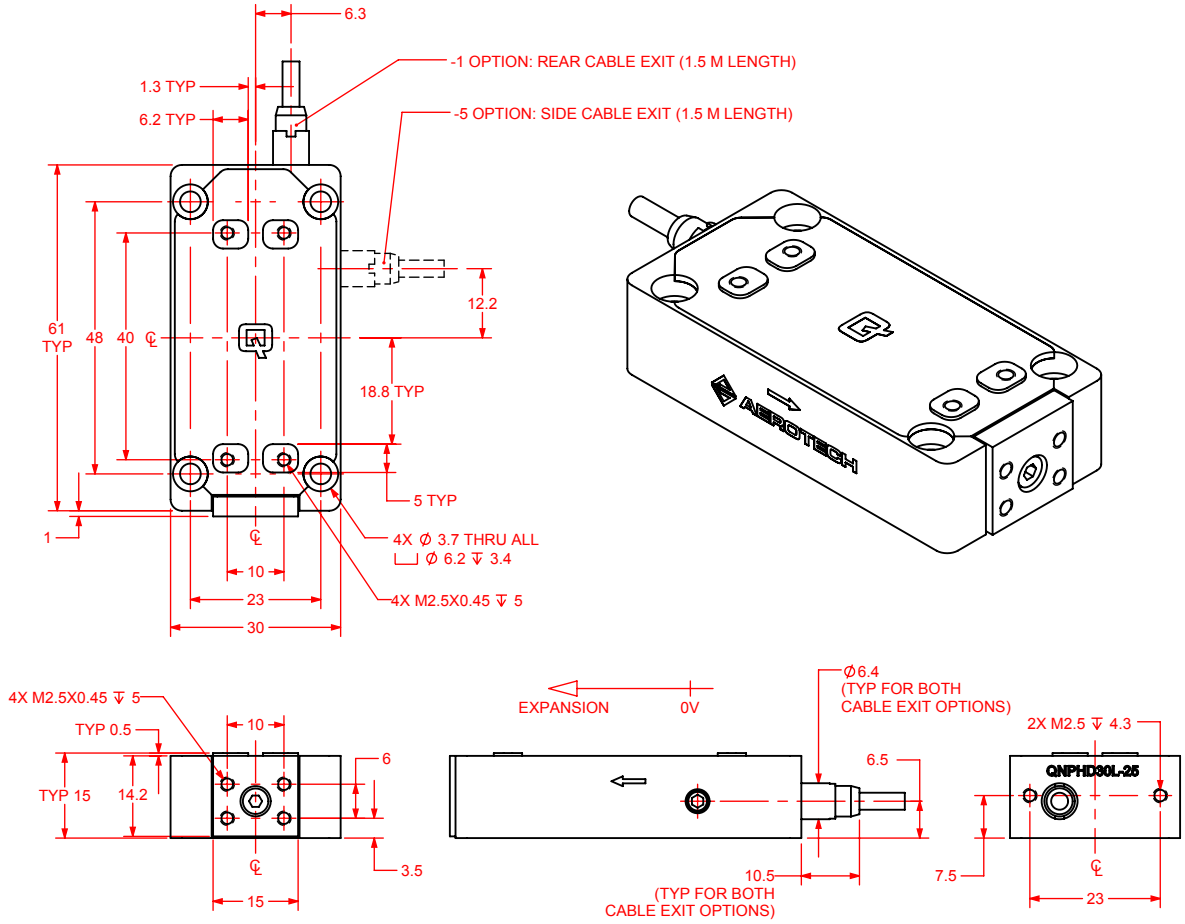
-MP (MOUNTING PLATE, BREADBOARD)
MATERIAL: STAINLESS STEEL



DIMENSIONS: MILLIMETERS

QNP$_{HD}$ Series DIMENSIONS

QNPHD-30-25L



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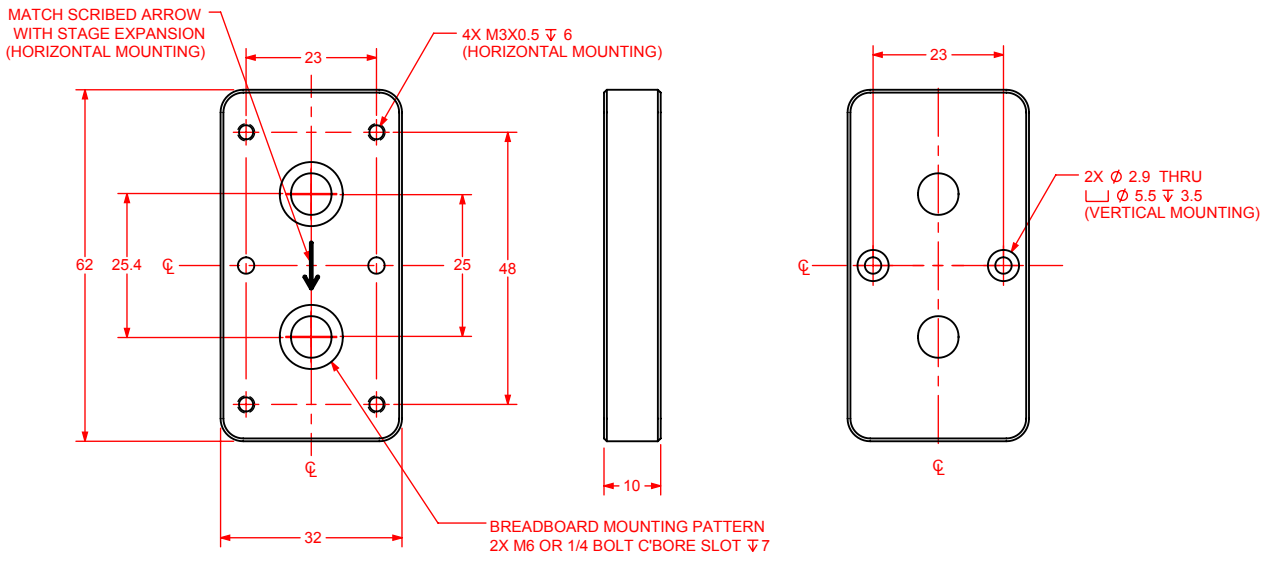
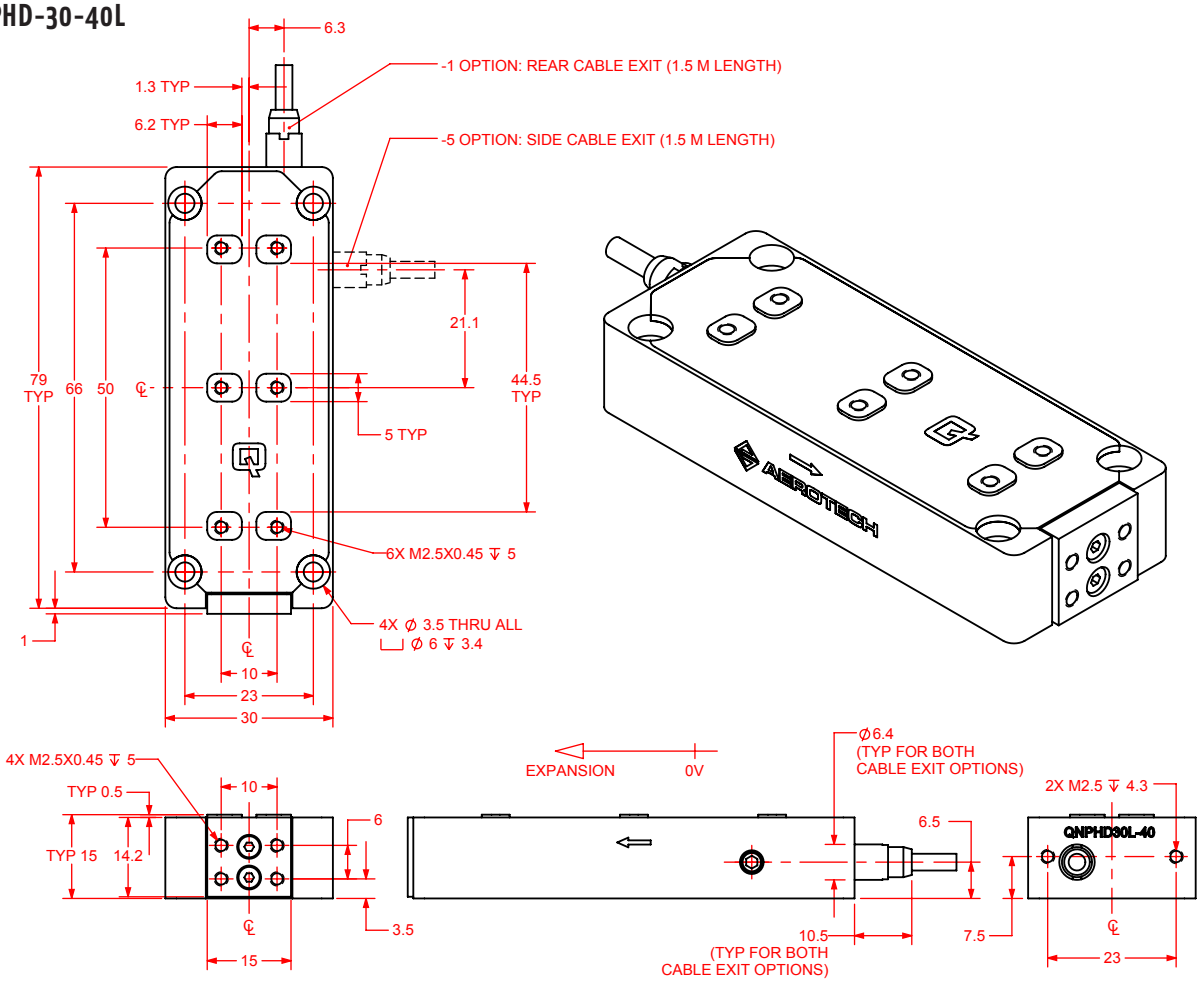


DIMENSIONS: MILLIMETERS

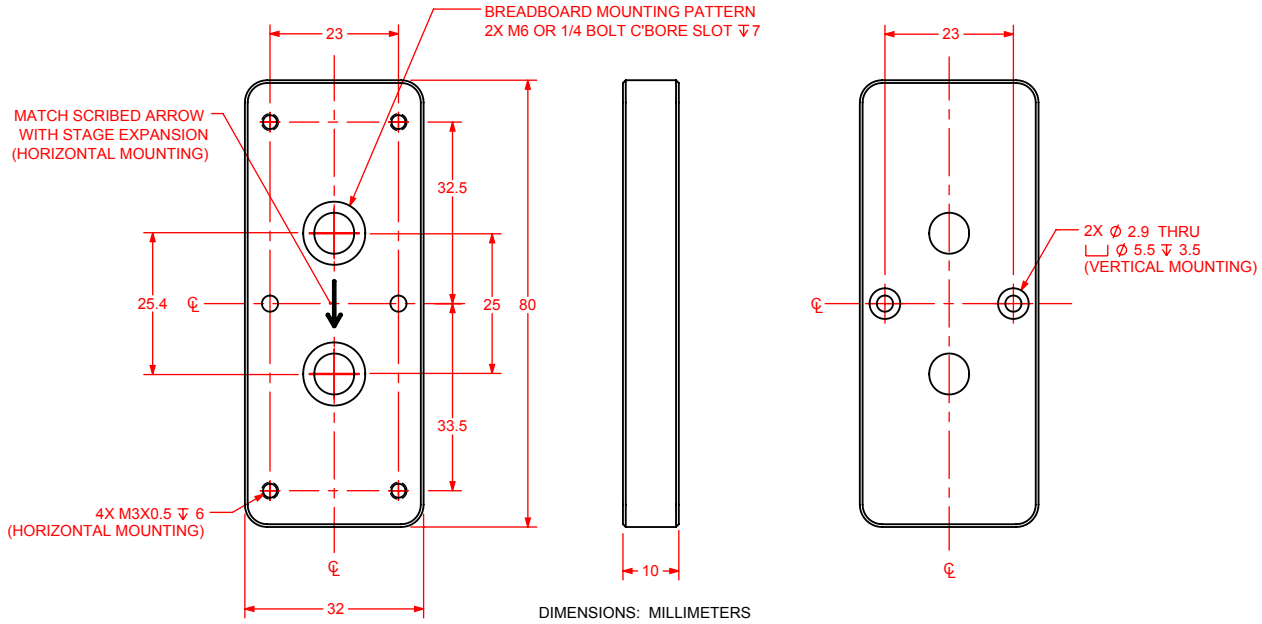
QNP$_{HD}$ Series DIMENSIONS

QNPHD-30-40L



STAGE SHOWN AT MID-TRAVEL

-MP (MOUNTING PLATE, BREADBOARD)
MATERIAL: STAINLESS STEEL



DIMENSIONS: MILLIMETERS

QNP$_{HD}$ Series ORDERING INFORMATION

QNPHD30L Single-Axis, High-Dynamic Piezo Nanopositioning Stages

Travel (Required)

-10	10 µm closed-loop travel, 12 µm open-loop travel
-25	25 µm closed-loop travel, 32 µm open-loop travel
-40	40 µm closed-loop travel, 50 µm open-loop travel

Feedback (Optional)

-C	Capacitance sensor feedback

Cable Exit (Required)

-1	Rear cable exit
-5	Left side cable exit

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 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.

Rear mounting holes and side cable exit option allow for easy vertical mounting