

# QFOCUS QF-50

## Single-Axis, Microscope Objective, Piezo Nanopositioning Stage

400  $\mu\text{m}$  closed-loop travel; 450  $\mu\text{m}$  open-loop travel

Outstanding step-and-settle and scanning performance

Designed for use with larger, high-NA objectives

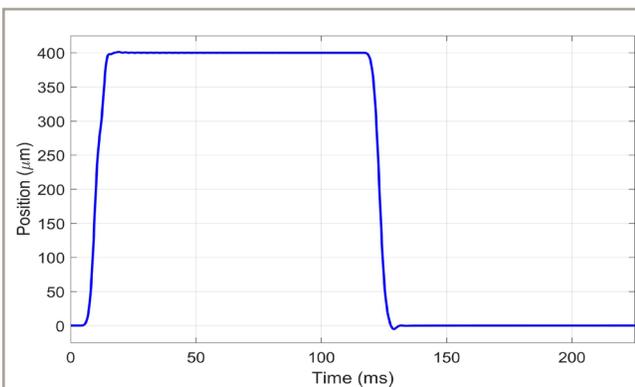
Superior positioning resolution and linearity

Mounting flexibility

29 mm diameter clear aperture

Aerotech's QFOCUS® QF50Z piezo nanopositioning stage enables microscope objective and optics positioning at a large travel (400  $\mu\text{m}$  CL, 450  $\mu\text{m}$  OL) without sacrificing speed or nanometer-level performance.

The QF50Z is designed to accommodate newer optical instruments and next-generation laser micromachining applications. Due to a high-stiffness mechanical design, the QF50Z can outperform competitive piezo scanner offerings with larger, higher numerical aperture (NA) objectives. The QF50Z is ideal for demanding optical positioning applications requiring high precision and throughput coupled with long travels.



*The QF50Z exhibits industry leading step-and-settle times. In this image, the QF50Z-400-C performs a 400  $\mu\text{m}$  step with a 1% settle window in 13 ms without a load. The QF50Z-400-C can perform the same step with a load of 150 g in just under 30 ms.*



*The QFOCUS QF50Z shown with a Michelson interferometry objective used in 3D optical surface profilers.*

### Precision Design

The QFOCUS QF50Z piezo stage is guided by precision flexures that are optimized using finite element analysis. The resulting design offers outstanding stiffness and resonant frequency enabling high process throughput and fast closed-loop response.

In addition to designing for high-dynamics, meticulous care was taken in the QF50Z flexure bearing design allowing for unrivaled geometric performance with straightness errors to 40 nm throughout the entire travel range.

### Direct Metrology Feedback

The QF50Z piezo stages have the option of closed-loop feedback (-C) using a unique capacitive sensor design that allows for sub-nanometer resolution and high linearity. Unlike foil strain gages or piezoresistive sensors, capacitive sensors provide a direct measurement of the positioning carriage enabling superior accuracy and repeatability.

### Flexible and Precise Control

When coupled with Aerotech's Q-series controllers and drives, the QF50Z demonstrates sub-nanometer positioning resolution and in-position stability (jitter) while maintaining high-positioning bandwidth. A host of software options (Dynamic Controls Toolbox and Motion Designer) provide many 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.

## QFOCUS QF50Z Series DESCRIPTION

### Mounting Flexibility

The QFOCUS QF50Z is available with threaded adapters to fit most microscopes and objectives. The microscope turret mounting allows fast and simple positioning of the QF50Z at any desired orientation. In addition, tapped

holes on the stage body provide alternative mounting for custom interfaces in machines or other optical instruments. The QF50Z is available with a clear aperture of 29 mm as standard. Custom stage designs, travels, and threaded adapters are available.

## QFOCUS QF50Z Series SPECIFICATIONS

Mechanical Specifications		QF50Z-400
Closed-Loop Travel		400 $\mu$ m
Open-Loop Travel, -30 to +150 V <sup>(1)</sup>		450 $\mu$ m
Resolution <sup>(2)</sup>	Closed-Loop	0.9 nm
	Open-Loop	0.4 nm
Linearity <sup>(3,4)</sup>		0.01%
Bidirectional Repeatability <sup>(5)</sup>		4 nm
Pitch		15 $\mu$ rad (3 arc sec)
Yaw		15 $\mu$ rad (3 arc sec)
Straightness (X, Y)		40 nm
Stiffness (in direction of motion) <sup>(6)</sup>		0.41 N/ $\mu$ m
Unloaded Resonant Frequency <sup>(6)</sup>		400 Hz
Resonant Frequency (150 g load) <sup>(6,7)</sup>		180 Hz
Max Payload <sup>(8)</sup>		1 kg
Maximum Acceleration (Unloaded) <sup>(9)</sup>		235 m/s <sup>2</sup>
Moving Mass (No Objective)		75 g
Stage Mass <sup>(10)</sup>		0.21 kg
Material		Anodized Aluminum/Brass <sup>(11)</sup>
MTBF (Mean Time Between Failure)		30,000 Hours

Notes:

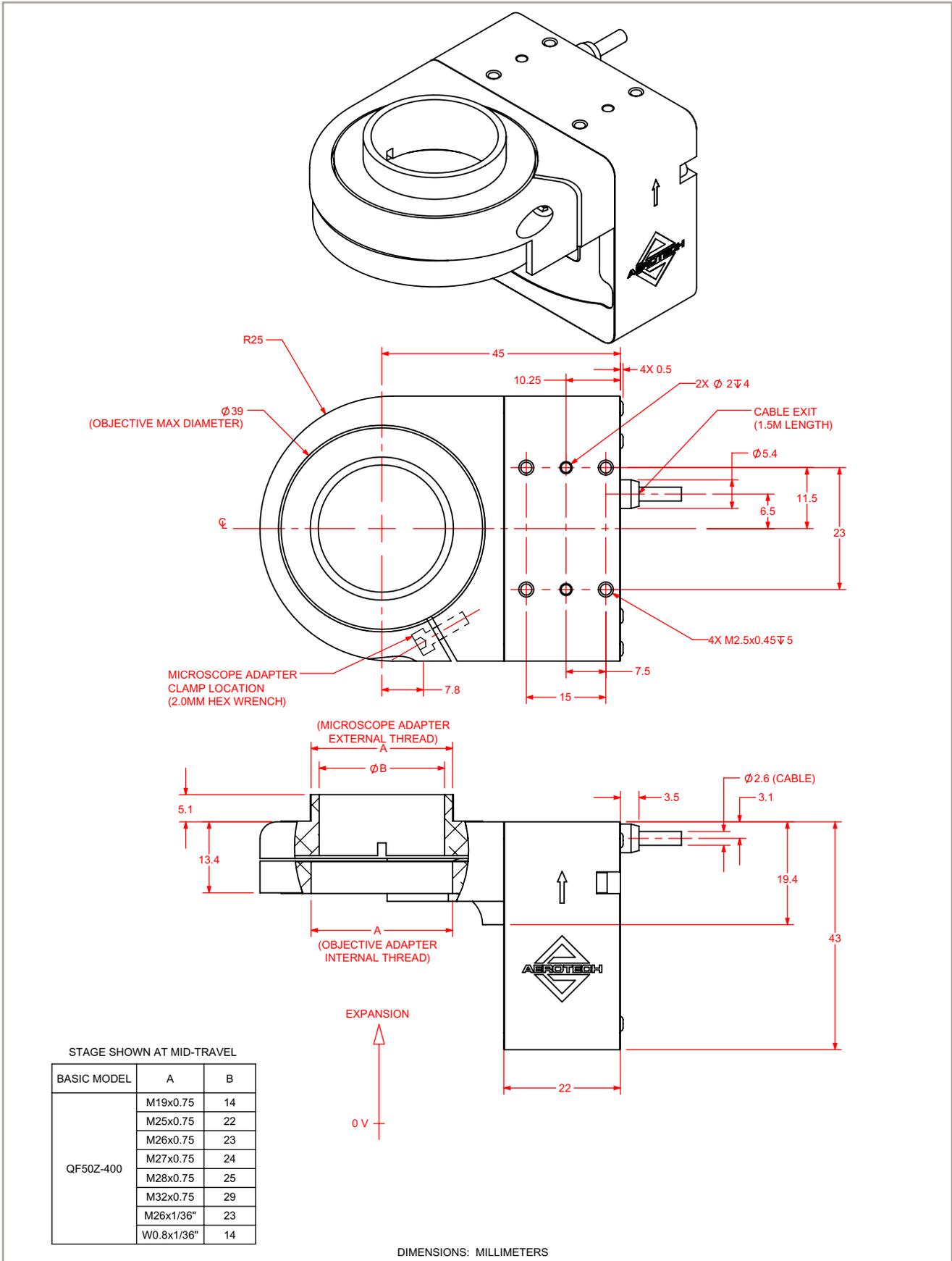
- Value  $\pm$ 10%.
- See Piezo Engineering reference section 4.2 for description of resolution.
- Certified with each stage (closed-loop feedback models only).
- See Piezo Engineering reference section 4.1 for description of linearity and accuracy specifications.
- Specified as a 1 sigma (standard deviation) value (closed-loop feedback models only). See Piezo Engineering reference section 4.3 for description of bidirectional repeatability.
- Values  $\pm$ 20%.
- Loaded resonance can vary as a function of objective size/geometry.
- On-axis loading listed.
- Max acceleration listed is the stage mechanical limitation. Achievable acceleration is a function of amplifier selection and move parameters.
- Stage mass includes microscope adapter (-MA1) and objective adapter (-OA1).
- External elements are anodized aluminum. Brass used for threaded adapters. Some stainless steel components are used in the internal construction. Other materials upon request.

Electrical Specifications	QF-50-400Z
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>	6.8 $\mu$ F

1. Value  $\pm$ 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 are required to achieve the listed specifications. Contact Aerotech for specifications when used with the QL drives.



## QFOCUS QF50Z ORDERING INFORMATION

### Travel (Required)

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-400                      400  $\mu$ m closed-loop travel, 460  $\mu$ m open-loop travel

### Feedback (Optional)

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-C                          Capacitance sensor feedback

### Microscope Adapter (Optional)

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-MA1                      W0.8 x 1/36" microscope adapter  
 -MA2                      M19 x 0.75 microscope adapter  
 -MA3                      M25 x 0.75 microscope adapter  
 -MA4                      M26 x 0.75 microscope adapter  
 -MA5                      M27 x 0.75 microscope adapter  
 -MA6                      M28 x 0.75 microscope adapter  
 -MA7                      M32 x 0.75 microscope adapter  
 -MA8                      M26 x 1/36" microscope adapter

### Objective Adapter (Optional)

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-OA1                      W0.8 x 1/36" objective adapter  
 -OA2                      M19 x 0.75 objective adapter  
 -OA3                      M25 x 0.75 objective adapter  
 -OA4                      M26 x 0.75 objective adapter  
 -OA5                      M27 x 0.75 objective adapter  
 -OA6                      M28 x 0.75 objective adapter  
 -OA7                      M32 x 0.75 objective adapter  
 -OA8                      M26 x 1/36" objective adapter

### Integration (Required)

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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.

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-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.