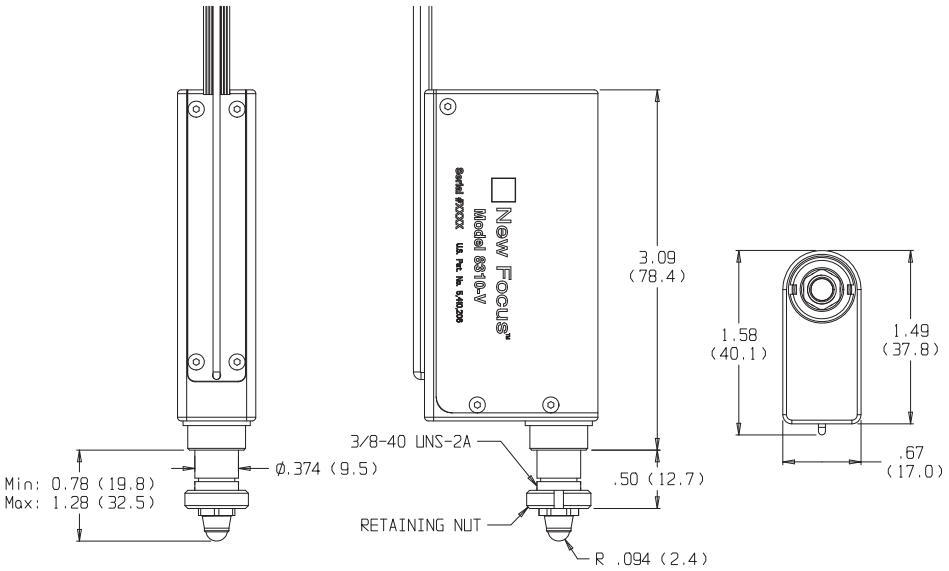
## Technical Support

For questions or concerns regarding the Model 8310-V vacuum-compatible closed-loop Picomotor actuator, please contact Technical Customer Service at 1-866 NUFOCUS (683-6287), or outside the US and Canada, 408-919-1500, or through e-mail at TechSupport@NewFocus.com.

## Warranty

All products are guaranteed to be free from defects in material and workmanship for a period of one year from date of shipment. At its option, New Focus will either replace, repair, or credit the item.





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# Vacuum-Compatible Closed-Loop Picomotor™ Actuator

## Model 8310-V


*U.S. Patent #5,394,049 & #5,410,206*


## Getting Started

The Model 8310-V vacuum-compatible closed-loop Picomotor™ actuator has two cables. One is an integral part of the Model 8310-V assembly. It is 19" long, vacuum compatible to $10^{-6}$ Torr, and is terminated in a 15-pin miniature sub-D connector for mating with a vacuum chamber feedthrough.* The second cable is not vacuum compatible and is designed to connect the vacuum feedthrough to a New Focus driver (Model 8751-C Intelligent closed-loop Picomotor™ driver)† via the DB-15 splitter cable provided (refer to the diagram on the next page). With the recommended driver, you will be able to move the actuator through a joystick (Model 8754), hand terminal (Model 8757), or computer (refer to the driver manuals for specific motion-control command sets).

To support vacuum motion applications, we have added an encoder power on/off function to the Model 8751-C Intelligent closed-loop Picomotor driver. In MCL, the command EPW <driver> <1/0> turns the encoder and limit sensor power on (1) or off (0). For direct control through the DCN network, the encoder power functions are included in the latest version of the DLL command set available at www.newfocus.com.

The limit and center (Home) sensors are TTL-level outputs. When the actuator is between the forward and reverse limits, the limit outputs will be pulled low. The center (Home) sensor switches from low to high as the actuator travels through the center of travel from retracted to extended position. The appropriate limit output switches from low to high when the actuator reaches that limit.

* *We recommend Accu-Glass Products vacuum feedthrough flanges (part number 100210).*

† *Note: do not open the motor cover or cut the motor cable. High voltages (up to 120 V, 200 mA) are accessible with the cover removed or the cable cut.*

## Mounting the Motor

The mounting shaft is 0.375"—typical in standard micrometers. We have provided a threaded nut so you can insert the motor into a bushing and tighten the nut to mount the motor. This is the preferred mounting method because it reduces the possibility of distortion on the motor's housing.

If instead you're going to mount the motor's shaft in a micrometer clamp, be careful not clamp too hard on the motor's housing. This can deform the motor's shank and may cause increased friction between the inner rotating screw and the fixed exterior housing. Please be careful, however, not to touch the threads of the screw with your tools. Any damage to the screw threads will result in a significantly shorter motor lifetime. (See the Tips for Achieving Nanometer-Scale Performance below.)

## Preparing the Motor for Vacuum

The Model 8310-V actuator undergoes a bake-out at 70 °C and is sealed in clean foil. To maintain vacuum cleanliness, do not open the inner package or handle the actuator except under clean, controlled conditions. If you require additional bake-out, we recommend 70 °C for 24 hours.

## Tips for Achieving Nanometer-Scale Performance

The Model 8310-V closed-loop Picomotor™ actuator offers <1-µm repeatability when approaching a target encoder count from any direction, <0.5-micron repeatability when approaching from a single direction, and 63.5-nm encoder resolution. (The actual inherent motor step size is considerably smaller—approximately 20 nm.) To achieve consistent nanometer-level performance, you need only keep a few precautions in mind.

- **Use a small amount of lubricant between the stainless-steel ball tip and the load surface to prevent wear and the generation of debris in the interface.** We recommend low-vapor pressure grease such as LVP LCT-42.
- **Keep the interface between the stainless-steel ball tip and the load surface clean of debris.** Even small particles on the order of a micron can result in 0.1 to 10 micron differences between the encoder reading and the actual moved distance.
- **Use the Model 8310-V for pushing against smooth, hard, flat surfaces only, such as the sapphire pads used in New Focus mirror mounts and translation stages.** Pushing on aluminum or stainless-steel surfaces will wear out the ball tip. If the load surface is too soft, small amounts of material can build up in the interface between the ball tip and load surface resulting in surface roughness which can degrade repeatability.
- **Do not push against cone or v-shapes, especially in softer materials such as aluminum.** When the ball wears against a cone or v-shape in softer materials, particle generation can lead to increased friction and torsional loads. These torsional loads can easily exceed the torsional load limit of 2.5 oz-in (0.018 N•m) thus stalling the motor.
- **Avoid damage to the screw threads.** Do not touch the screw threads with any hard object—even lightly. To provide the fine resolution, the screw has very fine-pitch threads. If the threads are damaged, this damaged area will produce repeated excessive wear within the fixed motor housing and significantly reduce the lifetime of the motor.
- **Avoid clamping tightly on the motor's housing.** As stated in Mounting the Motor, this can cause increased friction between the rotating inner screw and the fixed exterior housing resulting in slowed motor motion or complete failure. This can also result in damaged screw threads.
- **Periodically examine the stainless-steel ball tip and the load surface for wear.**

## Specifications

**Bi-Directional Repeatability:** ±1 µm Over Full Travel (from either direction)
**Uni-Directional Repeatability:** ±0.5 µm Over Full Travel (from same direction)
**Speed (@ 2 kHz pulse rate):** 1.2 mm/min (20 µm/sec typical)
**Closed-Loop Settling Time:** <100 ms with iPico™ Controller
**Closed-Loop Steady-State Error:** 0 counts with iPico Controller
**Encoder Resolution:** 63.5 nm per encoder count[1]
**Connector Type:** 15-pin D-sub vacuum chamber feedthrough
**Survival Temperature Range (non-operating):** -40 – 70 °C
**Mounting:** 0.375" (9.5 mm) Shank
**Minimum Incremental Motion:** <30 nm
**Angular Resolution:** <0.6 mrad
**Torque:** 2.5 oz-in (0.018 N ·m)
**Lifetime:** 2,500 Standard Cycles[2]
**Wire Type (vacuum-rated):** Teflon
**Linear Travel:** 0.50" (12.7 mm)
**Limit Sensors:** 2 and 1 Home Sensor
**Maximum Load:** 5 lbs (22 N)
**Operating Temperature:** 10–40 °C
**Vacuum Compliance:** $10^{-6}$ Torr
**Wire Length:** 19" (external cable length is 6 feet)

[1] *The encoder resolution is 1250 lines per revolution, and with quadrature encoding this results in 5000 counts per revolution. With the 80-pitch (80 turns per inch) screw sets used in the Model 8310-V, this results in an encoder resolution of 63.5 nm per encoder count.*

[2] *Standard cycle is 1 mm of travel range out and back pushing a 5-lb axial load.*

## Cable Pinout from Non-Vacuum-Compatible Cable

| Pin | Signal | Description |
|---|---|---|
| 1 | +5 | +5-V limit-sensors and encoder power supply |
| 2 | +L | Forward limit sensor (open collector output, normally closed) |
| 3 | -L | Reverse limit sensor (open collector output, normally closed) |
| 4 | -A | Encoder phase –A output |
| 5 | +A | Encoder phase +A output |
| 6 | GND | Interface ground |
| 7 | N/C | N/C |
| 8 | N/C | N/C |
| 9 | -B | Encoder phase –B output |
| 10 | +B | Encoder phase +B output |
| 11 | N/C | N/C |
| 12 | N/C | N/C |
| 13 | N/C | N/C |
| 14 | +Z | Home sensor (open collector output, normally closed) |
| 15 | N/C | N/C |

*Note: The Model 8310-V encoder outputs are differentially encoded on two wires. For a controller which accepts only single-ended encoder signals, tie –A, and –B to GND.*

## Example Wiring Diagram