



# Model 8310CE

## Closed Loop Picomotor™ Actuator



# Warranty

Newport Corporation warrants that this product will be free from defects in material and workmanship and will comply with Newport's published specifications at the time of sale for a period of one year from date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's option.

To exercise this warranty, write or call your local Newport office or representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the product, freight prepaid, to the indicated service facility. Repairs will be made, and the instrument returned freight prepaid. Repaired products are warranted for the remainder of the original warranty period or 90 days, whichever occurs last.

## Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part.

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### CAUTION

#### Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - Driven load greater than maximum specified load.
  - Actuator speed higher than specified speed.
  - Improper grounding.
    - Connectors must be properly secured.
    - When the load on the stage represents an electrical risk, it must be connected to ground.
  - Excessive or improper cantilever loads.
- **Modification of the actuator or any part thereof.**



#### CAUTION

Please return equipment in the original (or equivalent) packing.

You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

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This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages

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Original instructions.

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# EU Declaration of Conformity



## EU Declaration of Conformity

### Application of Council Directive(s):

- Electromagnetic Compatibility Directive (EMCD) - 2014/30/EU
- Low Voltage Directive (LVD) - 2014/35/EU
- European Pressure Equipment Directive (PED) - 2014/68/EU
- Machinery Directive - 2006/42/EC
- Restriction of Hazardous Substances Directive (RoHS) – 2011/65/EU <sup>7)</sup>

### Standard(s) to which conformity is declared:

- EN 61326-1:2013 - (EMC)
- EN 61326-2-3:2013 - (EMC)
- EN 61010-1:2010 + AMD 1:2016 (Ed 3) – (Safety)
- EN 60825-1:2014 Safety of Laser products - Part 1: Equipment classification and requirements
- PED Module SEP (Sound Engineering Practices): 2014

**Manufacturers Name: MKS Instruments, Inc. Andover, MA, USA**

Importer's Name & Location: /

Equipment Type/Description: Picomotor Piezo Actuator, Closed Loop, 12.7 mm Travel

Model Number(s) <sup>(6)</sup>: 8310CE

MKS confirms that, with respect to the products listed above, it believes it is in conformity with the **selected** European Union harmonization legislation – noted on the attached page of this document. MKS product conforms to the above Directive(s) and Standard(s) only when installed in accordance with manufacturer's specifications. This declaration has been issued under the sole responsibility of the manufacturer.

Date: 10/24/2019

A handwritten signature in black ink, appearing to read 'Le Cointe Hervé', written over a circular stamp or seal.

Le Cointe Hervé

Quality Director

# Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety-related issues occur.

## General Warning or Caution



The exclamation symbol may appear in warning and caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.



### WARNING

**Warning indicates a potentially dangerous situation which can result in bodily harm or death**



### CAUTION

**Caution indicates a potentially hazardous situation which can result in damage to product or equipment**

### NOTE

**Note indicates additional information that must be considered by the user or operator.**

## European Union CE Mark



The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

## Waste Electrical and Electronic Equipment (WEEE) Mark



This symbol on the product or on its packaging indicates that this product must not be disposed with regular waste. Instead, it is the user responsibility to dispose of waste equipment according to the local laws. The separate collection and recycling of the waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For information about where the user can drop off the waste equipment for recycling, please contact your local Newport representative.

## Protective Earth Symbol



The Protective Earth Symbol appears next to the grounding point at the front of the actuator housing.

# Warnings & Caution

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## WARNING

Do not attempt to operate this equipment if there is evidence of shipping damage or you suspect the unit is damaged. Damaged equipment may present additional hazards to you. Contact Newport technical support for advice before attempting to plug in and operate damaged equipment.

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## WARNING

The Picomotor is intended for use **ONLY** with Newport Picomotor Controller/Driver units. Connection of other devices to the motor may cause damage to the unit or the connected device, fire, and/or personal injury.

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## CAUTION

This motor is a Class A device. In a residential environment, this device can cause electromagnetic interference. In this case, suitable measures must be taken by the user.



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## WARNING

Do not use this motor when its motor is emitting smoke or is unusually hot to the touch or is emitting any unusual odor or noise or is in another abnormal state.

Stop using the motor immediately, switch off the motor power and then disconnect the electronics power supply.

After checking that smoke is no longer being emitted contact your Newport service facility and request repairs. Never attempt to repair the motor yourself as this can be dangerous.

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## CAUTION

Do not leave this motor in places subject to extremely high temperatures or low temperatures. This may cause an electric shock.

- Operating temperature: +10 to +40 °C
  - Storage/Operating altitude: 1000 m
  - Storage/Operating humidity: 85 %
  - Storage temperature: -40 to +100 °C (in its original packaging).
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**WARNING**

Make sure that this motor is not exposed to moisture and that liquid does not get into the motor.

Nevertheless, if any liquid has entered the motor, switch off the motor power and then disconnect the electronics from power supply.

Contact your Newport service facility and request repairs.

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**WARNING**

Do not insert or drop objects into this motor, this may cause an electric shock, or lock the motor.

Do not use this motor if any foreign objects have entered the motor. Switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility for repairs or replacement.

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**CAUTION**

Do not place this stage in a location affected by dust, oil fumes, steam or high humidity. This may cause an electric shock.

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**CAUTION**

There are no user serviceable parts inside the device. Work performed by persons not authorized by Newport will void the warranty.

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**CAUTION**

Be careful that the stage is not bumped when it is being carried. This may cause it to malfunction.

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**WARNING**

When handling this stage, always unplug the equipment from the power source for safety.

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**WARNING**

If this equipment is used in a manner not specified in this manual, the protection provided by this equipment may be impaired.

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# Closed Loop Picomotor™ Actuator

## Model 8310CE

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### 1.0 Getting Started

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The Model 8310CE closed loop Picomotor™ actuator has two cables—the motor cable terminated with a RJ-22 connector, and the encoder/limitswitch cable terminated in a high-density DB-15 connector. Because only the patented Picomotor drive waveform can be used to drive the Picomotor actuator, you must insert the RJ-22 connector into a Newport Picomotor controller & driver module (Model 8742 4-channel open loop, Model 8743-CL 2-channel closed loop), or single-axis Picomotor driver module (Model 8703 TTL/Analog driver). With these recommended drivers you should be able to move the actuator through a hand terminal (Model 8758), or computer (refer to the driver manuals for specific motion-control command sets).

If you are using the Model 8743-CL closed loop Picomotor controller & driver module, connect the high-density DB-15 to the driver's DB-15 port, and refer to the Model 8743-CL manual for more detailed directions on interfacing with the Model 8310CE.

If you are using a third-party motion controller, refer to the cable pinout to interface with the controller. (Keep in mind that you will still need to use a Picomotor driver such as the Model 8742 Picomotor controller & driver module or the Model 8703 TTL/Analog Picomotor driver module). The Model 8310CE is compatible with any third-party motion controller that can read TTL-level quadrature encoder signals. The limit sensors are openemitter outputs. When the actuator is centered, these outputs are pulled low through a transistor that is rated to 20 mA. When the actuator reaches its end of travel, one of the limit sensors will change to a floating voltage. By using a 10-k $\Omega$  pull-up resistor to 5 V, you can convert these sensor signals to TTL levels (See diagram in Cable Pinout).

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#### 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.**

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## 2.0 Mounting the Motor

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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 to 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. If the motor slows or fails completely, try loosening the clamp.

You can turn the motor manually using the hex nut at the end of the screw. 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).

## 3.0 Tips for Achieving Nanometer-Scale Performance

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The Model 8310CE closed loop Picomotor™ actuator offers <math><1\ \mu\text{m}</math> repeatability when approaching a target encoder count from any direction, <math><0.5\ \mu\text{m}</math> repeatability when approaching from a single direction, and 52.9 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 Krytox GPL 205 or the low-vapor pressure Krytox, LVP grease.
- 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  $\mu\text{m}$  differences between the encoder reading and the actual moved distance.
- Use the Model 8310CE for pushing against smooth, hard, flat surfaces only, such as the sapphire pads used in Newport 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.

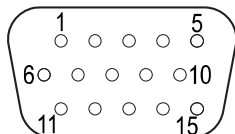
## 4.0 Specifications

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)	2.4 mm/min (40 µm/s typical)
Closed loop Settling Time	<100 ms with 8743-CL Controller
Closed loop Steady-State Error	0 counts with 8743-CL Controller
Encoder Resolution	52.9 nm per encoder count <sup>(1)</sup>
Connector Type: One Each	15-Pin High-Density D-sub and 4-Pin RJ-22
Survival Temperature Range (non-operating)	-30 to +85 °C
Mounting	0.375" (9.5 mm) Shank
Linear Travel	0.50" (12.7 mm)
Minimum Incremental Motion	<30 nm
Limit Sensors	2
Angular Resolution	<0.6 mrad
Maximum Load	5 lbs (22 N)
Torque	2.5 oz-in (0.018 N·m)
Operating Temperature	10–40 °C
Lifetime	1 Billion Steps <sup>(2)</sup>
Cable Length	6 Feet, Both Cables

<sup>1)</sup> The encoder resolution is 1500 cycles per revolution, and with quadrature encoding this results in 6000 counts per revolution. With the 80-pitch (80 turns per inch) screw sets used in the Model 8310CE, this results in an encoder resolution of 52.9 nm per encoder count.

<sup>2)</sup> Lifetime is tested by cycling actuator out 1 mm of travel range and back pushing a 5 lb load.

## 5.0 Encoder Cable Pinout

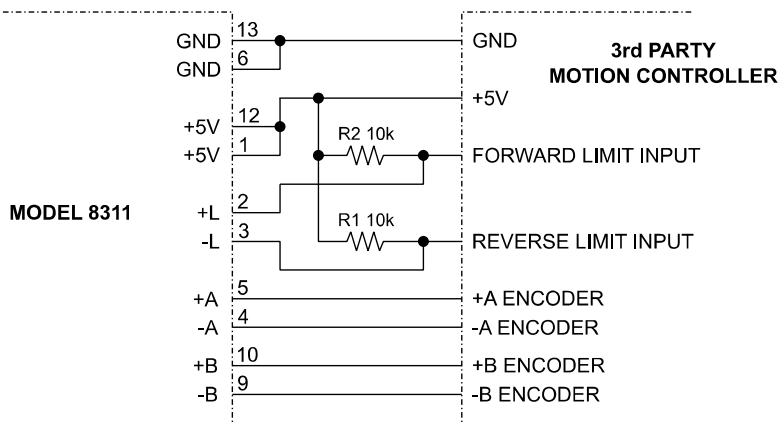


Pin	Signal	Description
1	+5V	+5V limit sensor power supply
2	+L	Forward limit sensor signal (open collector output, normally closed)
3	-L	Reverse limit sensor signal (open collector output, normally closed)
4	+A	Encoder phase +A output signal
5	-A	Encoder phase -A output signal
6	GND	Limit sensor ground
7	N.C.	No connect
8	N.C.	No connect
9	-B	Encoder phase -B output signal
10	+B	Encoder phase +B output signal
11	N.C.	No connect
12	+5V	+5V encoder power supply
13	GND	Encoder ground
14	N.C.	No connect
15	N.C.	No connect

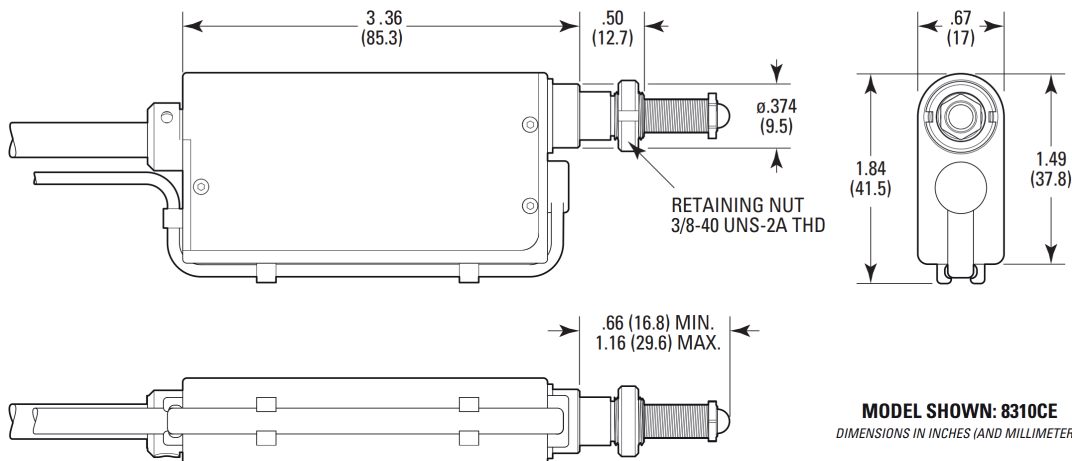
### NOTE

The Model 8310CE 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



## 6.0 Dimensions



# Service Form

**Your Local Representative**

Tel.: \_\_\_\_\_

Fax: \_\_\_\_\_

Name: \_\_\_\_\_

Return authorization #: \_\_\_\_\_  
*(Please obtain prior to return of item)*

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

Country: \_\_\_\_\_

Phone Number: \_\_\_\_\_

P.O. Number: \_\_\_\_\_

Fax Number: \_\_\_\_\_

Item(s) Being Returned: \_\_\_\_\_

Model#: \_\_\_\_\_

Serial #: \_\_\_\_\_

Description: \_\_\_\_\_

Reasons of return of goods (please list any specific problems): \_\_\_\_\_

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