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PR50 Series

Compact High-Speed Rotation Stages



Newport®
Experience | Solutions

USER'S MANUAL

Precision Motion – *Guaranteed*™

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Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's discretion.

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

Limitation of Warranty

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

CAUTION

Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - **Load on the stage greater than maximum specified load.**
  - **Carriage 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 stage 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.

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.

No part of this manual may be reproduced or copied without the prior written approval of Newport Corporation.

This manual has been provided for information only and product specifications are subject to change without notice. Any changes will be reflected in future printings.

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EC Declaration of Conformity

PR50 Series

Newport
Experience | Solutions

EC Declaration of Conformity

following Annex II-1A
of Directive 2006/42/EC on machinery

The manufacturer:

MICRO-CONTROLE Spectra-Physics,
9, rue du bois sauvage
F-91055 Evry FRANCE

Hereby declares that the machinery:

- Description: " PR50 "
- Function: Compact High-Speed Rotation Stages
- Models: PR50CC/PP

– the technical file of which was compiled by:

Mr Dominique DEVIDAL, Quality Director,
MICRO-CONTROLE Spectra-Physics, Zone Industrielle - B.P.29
F-45340 Beaune La Rolande France

– complies with all the relevant provisions of the Directive 2006/42/EC on machinery.
– complies with all the relevant provisions of the Directive 2014/30/EU relating to electro-magnetic compatibility.

– was designed and built in accordance with the following harmonised standards:

- NF EN 61326-1:2013 « Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements »
- NF EN 55011:2010/A1:2011 Class A

– was designed and built in accordance with the following other standards:

- NF EN 61000-4-2
- NF EN 61000-4-3
- NF EN 61000-4-4
- NF EN 61000-4-5
- NF EN 61000-4-6

ORIGINAL DECLARATION

Done in Beaune La Rolande on 26 June 2015
Dominique DEVIDAL
Quality Director



DC1-EN rev:A

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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.

Warnings and Cautions



ATTENTION

This stage 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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Warnings

WARNING



The motion of objects of all types carries potential risks for operators. Ensure the protection of operators by prohibiting access to the dangerous area and by informing the personnel of the potential risks involved.

WARNING

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

Stop using the stage 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 stage yourself as this can be dangerous.

WARNING

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

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

Contact your Newport service facility and request repairs.

WARNING



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

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

Contact your Newport service facility for repairs.

WARNING

Do not place this stage in unstable locations such as on a wobbly table or sloping surface, where it may fall or tip over and cause injury.

If this stage has been dropped or the case has been damaged, switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility and request repairs.

WARNING

Do not attempt to modify this stage; this may cause an electric shock or downgrade its performance.

WARNING

Do not exceed the usable depth indicated on the mounting holes (see section “Dimensions”). Longer screws can damage the mechanics or cause a short-circuit.

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Cautions

CAUTION

Due to its very low profile, the PR50 stage contains pressure sensitive components. For usage at a pressure level below 0.25 bar, please contact our sales department.

CAUTION

Do not place this stage in a hostile environment such as X-Rays, hard UV,… or in any vacuum environment.

CAUTION

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

CAUTION

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

- **Operating temperature: +10 to +35 °C**
- **Storage temperature: -10 to +40 °C (in its original packaging)**

CAUTION



Do not move this stage if its motor power is on.

Make sure that the cable to the electronics is disconnected before moving the stage. Failure to do so may damage the cable and cause an electrical shock.

CAUTION

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

CAUTION

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

CAUTION

When the carriage is in its end-of-run position, it is strongly recommended not to go beyond this point as this may damage the stage mechanism.

CAUTION

Contact your Newport service facility to request cleaning and specification control every year.

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Compact High-Speed Rotation Stages PR50 Series

1.0 Introduction

This manual provides operating instructions for the rotation stage that you have purchased in the PR50 Series:

- PR50PP
- PR50CC

REMARK

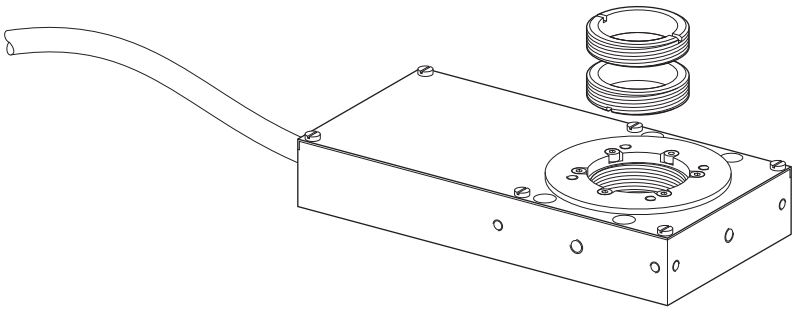
Due to its very low profile, the PR50 stage contains pressure sensitive components. For usage at a pressure level below 0.25 bar.



PR50 rotation stage.

RECOMMENDATION

We recommend you read carefully the chapter "Connection to electronics" before using the PR50 rotation stage.



PR50 rotation stage and its 2 retaining rings.

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2.0 Description

The PR50 Series low profile rotation stages are designed to rotate up to 1 in. diameter optical components, such as polarizers, wave plates, or wedges. The small size (only 60 mm width x 110 mm length x 21 mm height) allows use in confined spaces such as laser cavities, disk texturing machines, or manufacturing areas for optical components.

Similar to our higher-resolution rotation stages SR50, the PR50 stages feature a low-profile, lightweight design based on an aluminum body construction with preloaded ball bearings. The motor is folded inside the outer body providing a small footprint.

The PR50 stages are a cost-efficient alternative to the SR50 for applications that do not require the high-resolution and precision of the SR50, or for applications that could benefit from higher speeds up to 20 °/s. The stages feature angular resolution of 0.01°, which may be achieved with either DC-Servo or open-loop stepper motors in half-step mode. The stages are equipped with a hardware origin and allow for continuous rotation of 360°.

For optimal performance, we recommend the use of our motion controllers.

The PR50 rotation stages are equipped with a 3-meter cable for connection to our motion controllers.

2.1 Design Details

Base Material	Aluminum
Bearings	Ball bearings
Drive Mechanism	Ground worm gear
Worm Gear Ratio	1:63
Reduction Gear	11.8642:1
Feedback	PR50CC: Motor mounted rotary encoder, 48 pts/rev PR50PP: Open-loop, no encoder
Origin	Optical
Motor	PR50CC: DC servo motor UE17CC PR50PP: 2-phase stepper motor UE16PPSC, 1 Full step = 0.002°
Cable	3 m

RoHS Compliant

NOTE

This product complies with the RoHS directive (Restriction of Hazardous Substances).

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3.0 Characteristics

3.1 Definitions

Specifications of our products are established in reference to ISO 230 standard part II “Determination of accuracy and repeatability of positioning numerically controlled axes”.

This standard gives the definition of position uncertainty which depends on the 3 following parameters:

(Absolute) Accuracy

Difference between ideal position and real position.

On-Axis Accuracy

Difference between ideal position and real position after the compensation of linear errors.

Linear errors include: cosine errors, inaccuracy of screw or linear scale pitch, angular deviation at the measuring point (Abbe error) and thermal expansion effects. All Newport motion electronics can compensate for linear errors.

The relation between absolute accuracy and on-axis accuracy is as follows:

$$Absolute\ Accuracy = On\text{-}Axis\ Accuracy + Correction\ Factor_{x}\ Travel$$

Repeatability

Ability of a system to achieve a commanded position over many attempts.

Reversal Value (Hysteresis)

Difference between actual position values obtained for a given target position when approached from opposite directions.

Minimum Incremental Motion (MIM or Sensitivity)

The smallest increment of motion a device is capable of delivering consistently and reliably.

Resolution

The smallest increment that a motion device can theoretically move and/or detect. Resolution is not achievable, whereas MIM, is the real output of a motion system.

Eccentricity

Displacement of the geometric center of a rotation stage from the rotation axis in the plane defined by bearings.

Wobble

Tilt of rotation axis during rotation of a stage, measured on a reference surface.

The testing of on-axis accuracy, repeatability, and reversal error are made systematically with test equipment in an air-conditioned room ($20^{\pm 1}$ °C).

A linear cycle with 21 data points on the travel and 4 cycles in each direction gives a total of 164 points.

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Guaranteed Specifications

Guaranteed maximum performance values are verified per Newport's A167 metrology test procedure. For more information, please consult the metrology tutorial section in the Newport catalog or at **www.newport.com**

3.2 Mechanical Specifications

Travel Range (°)	360 continuous
Minimum Incremental Motion (°)	0.02
Uni-directional Repeatability (°)	0.05
Bidirectional Repeatability[1] (°)	0.15 or ±0.075
Absolute Accuracy[1] (°)	0.1 or ±0.05
Maximum Speed[2] (°/s)	20
Wobble[1] (µrad)	100 or ±50
MTBF (h)	10,000

1) Shown are peak to peak, guaranteed specifications or ±half the value as sometimes shown. For the definition of typical specifications which are about 2X better than the guaranteed values, visit www.newport.com for the Motion Control Metrology Primer.

2) Max. speed with SMC100PP: 8 °/s for PR50PP.

CAUTION

To reach specifications stated, stages must be fixed on a plane surface with a flatness of 5 µm.

3.3 Load Specification Definitions

Normal Load Capacity (Cz)

Maximum load a rotation stage can move while maintaining specifications.

This value is given with speed and acceleration specified for each rotation stage, and with a load perpendicular to bearings.

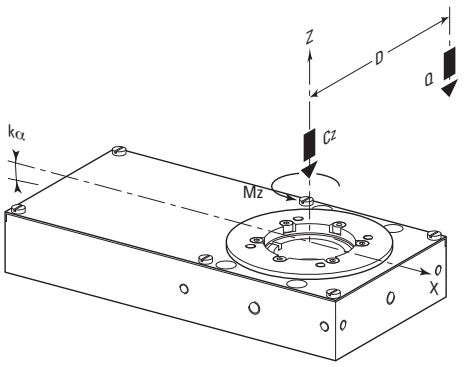
Off-Centered Load (Q)

Maximum cantilever-load a rotation stage can move: $Q \leq Cz \div (1 + D/a)$

D: Cantilever distance.

a: Construction parameter

3.4 Load Characteristics and Stiffness



	PR50CC	PR50PP
Cz, Normal centered load capacity (N)	10	
Kα, Transversal Stiffness (µrad/Nm)	100	
Mz, Nominal Torque (Nm)	0.1	
Q, Off-center load (N)	Q ≤Cz ÷ (1 + D/22)	
Where D = Cantilever distance (mm)		

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3.5 Stage Weights

The weights indicated into the below table is the value for the rotation stage with its cable installed.

	Weight [lb (kg)]
PR50	0.88 (0.4)

The weight variation between drive units is not very significant.

4.0 Drive

4.1 Stepper Drive Version

Stepper-motor-driven stages are offered in one half-step drive version: PR50PP.

Half-Step Drive

Is used for stepper motors, when 1 pulse emitted by electronic corresponds to theoretical physical motion of 1/2 of a full step of the motor.

Stepper Motor Performance Specifications

	Resolution (°)	Speed (°/s)	Motor
PR50PP	0.01	20	UE16PPSC

NOTES

- **The UE16PPSC does not use an encoder.**
- **The real resolution for PR50PP rotation stages is 0.0100341°.**

4.2 DC-Motor Drive Version

One DC-motor-driven configuration is available: PR50CC.

DC-Motor Performance Specifications

	Resolution (°)	Speed (°/s)	Motor
PR50CC	0.01	20	UE17CC

NOTE

The real resolution for PR50CC rotation stages is 0.0100341°.

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5.0 Motor

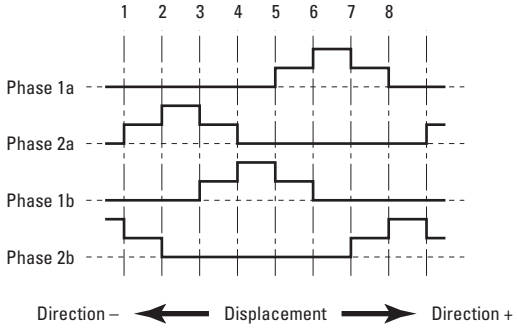
5.1 UE16PPSC Motor Characteristics

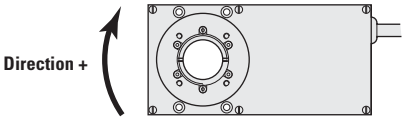
Motor	Angle by Step (°)	RMS Current per Phase (A)	Resistance (Ω)	Inductance (mH)	Newport Utilization
UE16PPSC	15	0.25 (1) 0.18 (2)	12.5	5.5	Half-Step; 1 phase at once

1) 1 phase at once: 0.25 A.

2) 2 phases at once: 0.18 A by phase.

5.2 Command Signals for the Stepper Motor

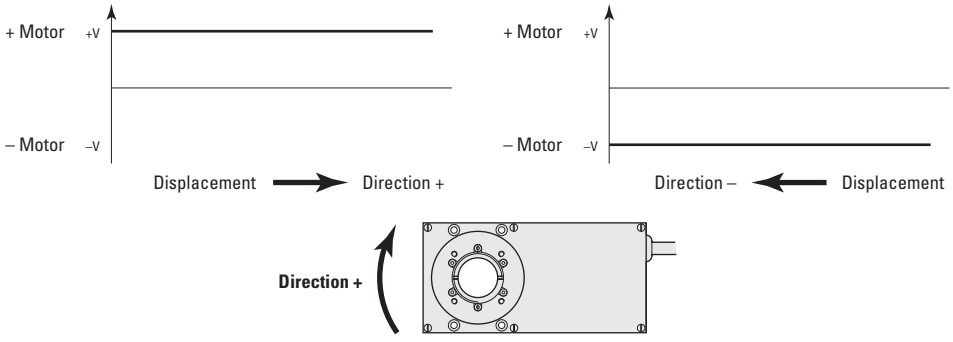




5.3 UE17CC Motor Characteristics

Motor	Nominal Voltage (V)	Max. RMS Current (A)	Max. Peak Current (A)	Resistance (Ω)	Inductance (mH)
UE17CC	12	0.15	0.3	24	0.75

5.4 Command Signals for the DC-Motor



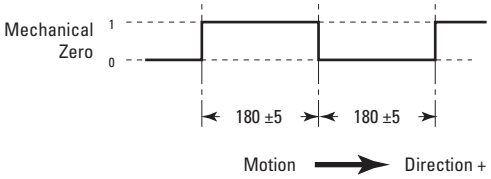
In the above drawings, + Motor signal is referred to – Motor signal.

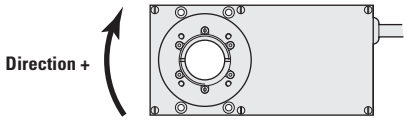
① When the stage moves in + Direction, the + Motor voltage is higher than – Motor voltage.

② When the stage moves in – Direction, the + Motor voltage is lower than – Motor voltage.

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5.5 Mechanical Zero





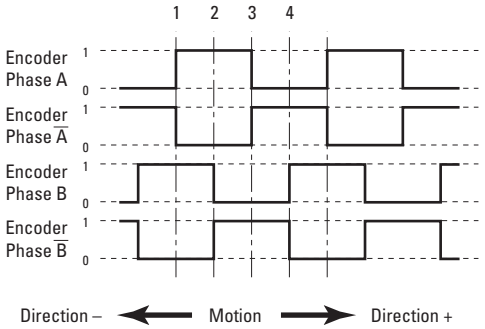
Mechanical Zero is a 5 V open collector type.

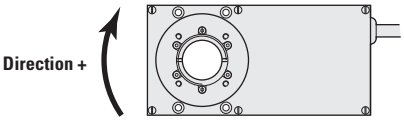
Mechanical Zero repeatability is <0.01°.

CAUTION

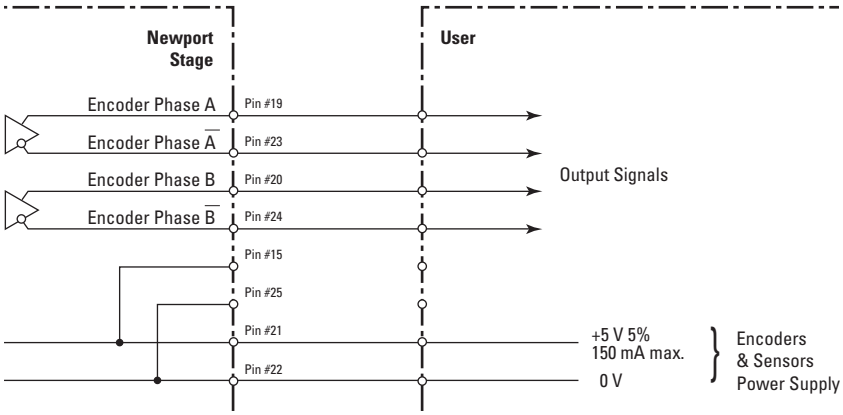
"Mechanical Zero" is an active signal and should not be connected to any other source.

5.6 Feedback Signal Position (PR50CC Only)





The incremental sensor consists of a optical scale and an encoder head. When the carriages of the stage move, the encoder head generates square signals in quadrature, sent to pins #19, #20, #23 and #24 of the SUB-D25 connector.

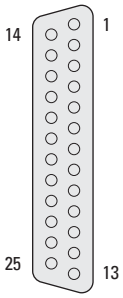


"Encoder" are "differential pair" (type RS-422) type output signals. Using these signals permits a high immunity to noise. Emission circuits generally used by Newport are 26LS31 or MC3487. Reception circuits to use are 26LS32 or MC3486.

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5.7 Pinouts

The SUB-D25 connection for the PR50 rotation stages is given in the following table:



	PR50PP UE16PPSC		PR50CC UE17CC
1	Phase 1a	**1**	N.C.
2	N.C.	**2**	N.C.
3	Phase 1b	**3**	N.C.
4	N.C.	**4**	N.C.
5	Phase 2a	**5**	+ Motor
6	N.C.	**6**	+ Motor
7	Phase 1b	**7**	– Motor
8	N.C.	**8**	– Motor
9	N.C.	**9**	N.C.
10	N.C.	**10**	N.C.
11	N.C.	**11**	N.C.
12	N.C.	**12**	N.C.
13	Mechanical Zero	**13**	Mechanical Zero
14	Shield Ground	**14**	Shield Ground
15	Connected to +5 V	**15**	Connected to +5 V
16	0 V logic	**16**	0 V logic
17	Do not connect	**17**	Do not connect
18	Do not connect	**18**	Do not connect
19	N.C.	**19**	Encoder Phase A
20	N.C.	**20**	Encoder Phase B
21	N.C.	**21**	Encoder Power: +5 V
22	N.C.	**22**	0 V Encoder
23	N.C.	**23**	Encoder Phase /A
24	N.C.	**24**	Encoder Phase /B
25	Connected to 0 V	**25**	Connected to 0 V

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6.0 Connection to Newport Controllers

6.1 Warnings on Controllers

Controllers are intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Read the controller user's manual carefully before operating the instrument and pay attention to all written warnings and cautions.

WARNING

Disconnect the power plug under the following circumstances:

- **If the power cord or any attached cables are frayed or damaged in any way.**
- **If the power plug is damaged in any way.**
- **If the unit is exposed to rain, excessive moisture, or liquids are spilled on the unit.**
- **If the unit has been dropped or the case is damaged.**
- **If you suspect service or repair is required.**
- **Whenever you clean the electronics unit.**

CAUTION

To protect the unit from damage, be sure to:

- **Keep all air vents free of dirt and dust.**
- **Keep all liquids away from the unit.**
- **Do not expose the unit to excessive moisture (85% humidity).**
- **Read this manual before using the unit for the first time.**



WARNING

All attachment plug receptacles in the vicinity of this unit are to be of the grounding type and properly polarized.

Contact your electrician to check your receptacles.

WARNING

This product is equipped with a 3-wire grounding type plug.

Any interruption of the grounding connection can create an electric shock hazard.

If you are unable to insert the plug into your wall plug receptacle, contact your electrician to perform the necessary alterations to ensure that the green (green-yellow) wire is attached to earth ground.

WARNING

This product operates with voltages that can be lethal.

Pushing objects of any kind into cabinet slots or holes, or spilling any liquid on the product, may touch hazardous voltage points or short out parts.

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6.2 Connection

On each stage is represented a label which indicates its name and its serial number.

WARNING

Always turn the controller's power OFF before connecting to a stage.

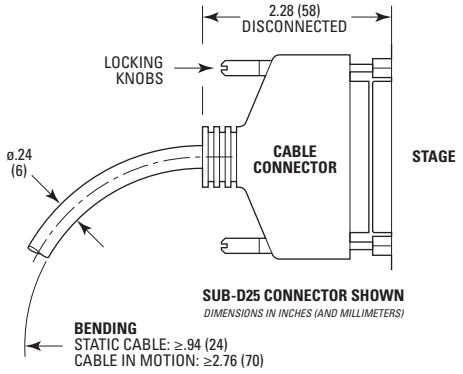
Stages may be connected to the rear panel motor connectors any time prior to power-up with the supplied cable assemblies.

NOTE

These stages are ESP compatible. Enhanced System Performance is Newport's exclusive technology that enables Newport ESP motion controllers to recognize the connected Newport ESP stage and upload the stage parameters. This ensures that the user can operate the motion system quickly and safely.

6.3 Cables

Our PR50 stages are delivered with a 3-meter cable. This cable is equipped with a SUB-D25M connector so it can be directly connected to our controllers/drivers.



WARNING

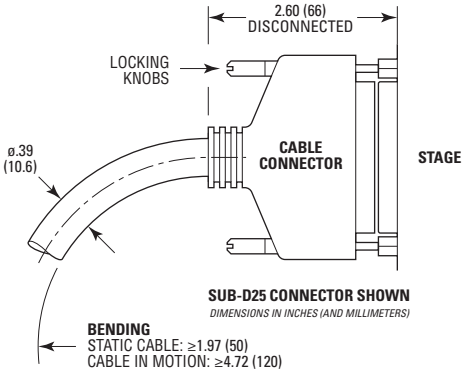
This cable is shielded correctly. For a correct operation, make sure to lock connectors (ground continuity provided by the cable).

For applications where the cable attached to your stage is not adequate, Newport offers longer length cables designed to ensure the integrity of your positioning application.

These cables are specially shielded and terminated with Newport's standard SUB-D25 connectors. They are available in 5-m (**MCAB-5**) or 7-m (**MCAB-7**) lengths.

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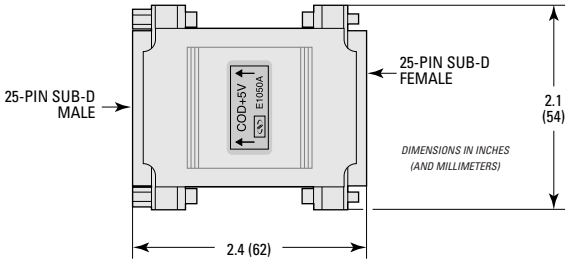




WARNING

Keep the motor cables at a safe distance from other electrical cables in your environment to avoid potential cross talk.

For cable lengths in excess of 3 meters, we recommend the **MCAB-REG** to ensure a high quality, regulated 5 V supply to the stages.



This regulator is available as an option. Please note that for best efficiency, this regulator should be attached to the stage to re-adjust the 5 V coming from the controller through the long cable.

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7.0 Connection to Non-Newport Electronics

7.1 Connections

WARNING

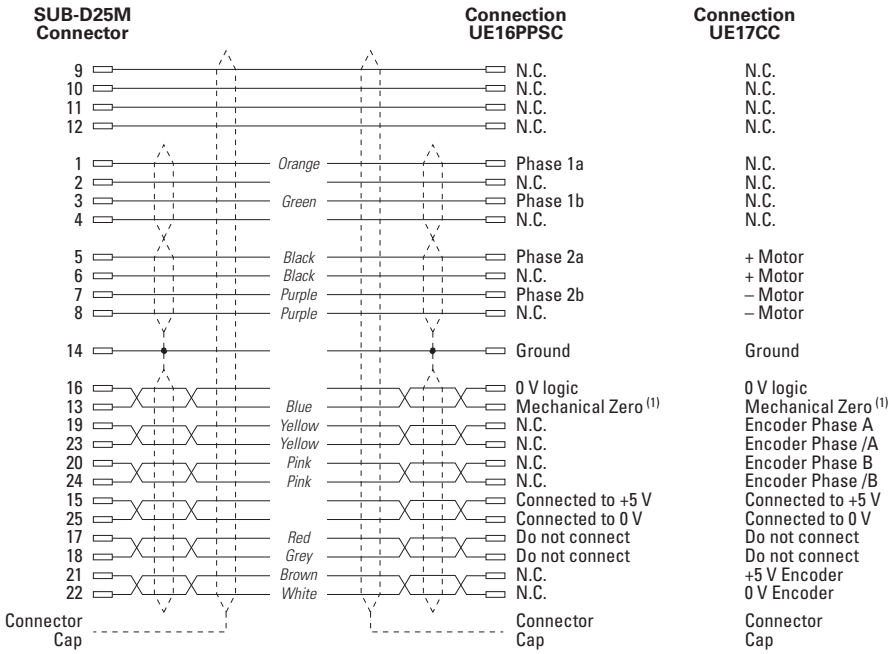
Newport is not responsible for malfunction or damage to a PR50 rotation stage when it is used with non-Newport controllers.

WARNING

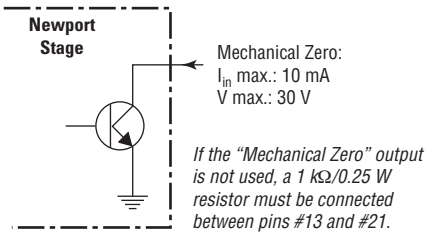
Newport guarantees "CE" compliance of the PR50 rotation stages only if they are used with Newport cables and controllers.

Nevertheless, the figure below shows the wiring when a PR50 rotation stage is used with non-Newport controllers.





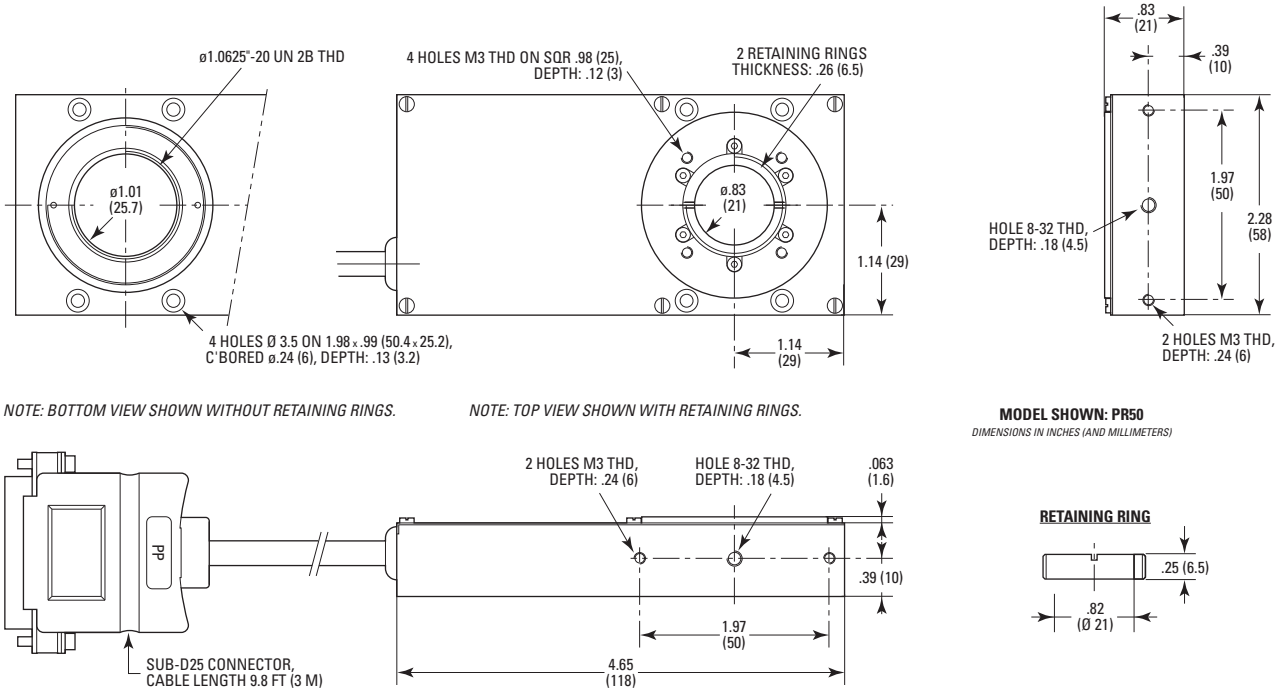
(1) The Mechanical Zero logic signal is open collector type. It supports until 30 V and 10 mA.



"Encoder" are "differential pair" (type RS-422) type output signals. Using these signals permits a high immunity to noise. Emission circuits generally used by Newport are 26LS31 or MC3487. Reception circuits to use are 26LS32 or MC3486.

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8.0 Dimensions



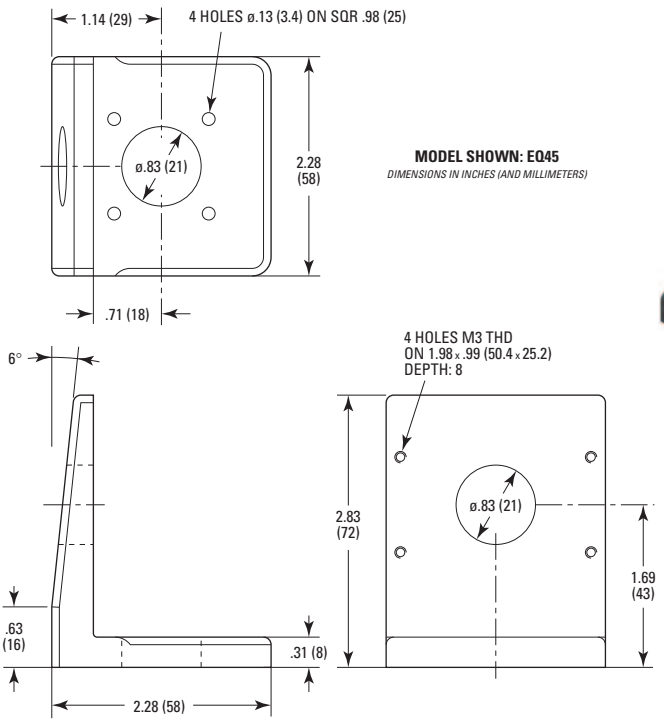
Interface

The central aperture is threaded 1.063-20 in. PR50 stages are delivered with two retaining rings with the same diameter to allow mounting of any 1" (25.4 mm) diameter optics within the aperture. 4 M3 holes allow for fixation of custom top plates.

9.0 Accessory: EQ45 Bracket

The EQ45 bracket (to order separately) can be used for vertical mounting of an PR50 rotation stage.







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10.0 Maintenance

RECOMMENDATION

It is recommended to contact our After Sales Service which will know to define the appropriate maintenance for your application.

10.1 Maintenance

The PR50 rotation stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and operated with caution.

PRECAUTIONS

The PR50 rotation stage must be used or stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return your PR50 rotation stage to Newport's After Sales Service after every 2000 hours of use for lubrication.

If your rotation stage is mounted on a workstation and cannot be easily removed, please contact Newport's After Sales Service for further instructions.

10.2 Repair



CAUTION

Never attempt to disassemble a component of the rotation stage that has not been covered in this manual.

To disassemble a non specified component can cause a malfunction of the stage.

If you observe a malfunction in your rotation stage, please contact us immediately to arrange for a repair.



CAUTION

Any attempt to disassemble or repair a rotation stage without prior authorization will void your warranty.

10.3 Calibration



CAUTION

It is recommended to return your PR50 rotation stage to Newport once a year for recalibration to its original specifications.

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Service Form

Your Local Representative
Tel.: _____
Fax: _____

Name: _____
Company: _____
Address: _____
Country: _____
P.O. Number: _____

Return authorization #: _____
(Please obtain prior to return of item)
Date: _____
Phone Number: _____
Fax Number: _____

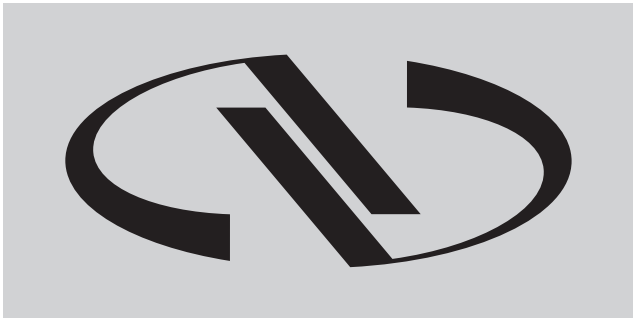
Item(s) Being Returned:

Model #: _____
Serial #: _____

Description: _____

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

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