mks

VP-5ZA

Precision
Vertical Linear Stage

GUARANTEED SPECIFICATIONS

ESP COMPATIBLE

Newport®

USER'S MANUAL

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.

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EC Declaration of Conformity

VP-5ZA

Newport®

EU 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: "VP-5ZA"
- Function: Precision Vertical Linear Stage
- Models: (M-)VP-5ZA

– the technical file of which was compiled by:

Mr Hervé LE COINTE , 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.
– complies with all the relevant provisions of the Directive 2011/65/EU relating to RoHS2.

– 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 16 May 2017
Hervé LE COINTE
Quality Director

DC1-EN rev:A

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.

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.

Caution

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.

Precision Vertical Linear Stage
VP-5ZA

1.0 Introduction

This manual provides operating instructions for the VP-5ZA precision vertical linear stage.

VP-5ZA vertical linear stage.

RECOMMENDATION

We recommend you read carefully the chapter “Connection to electronics” before using the VP-5ZA stage.

Ultra low-profile precision XYZ system consisting of two VP-25XA linear stages and one VP-5ZA vertical translation stage. Compared to traditional stacks of stages, this solution offers a lower-profile alternative with easy access to the load from any side.

2.0 Description

The VP-5ZA is an ultra-low profile, precision vertical translation stage ideally suited for semiconductor wafer inspection, photonics test and packaging, micro-assembly, precision metrology, and surface inspection systems. Based on the industry-proven technology used on our VP-25XA linear stages, the VP-5ZA offers highly reliable motion with nanometer sensitivity, high responsiveness, and a perfectly straight trajectory.

The ultra-low profile of the VP-5ZA is achieved by two 1/5-slope wedges which move past each other via inclined, recirculating ball bearings. To avoid any side motion, the upper wedge is constrained by 2 linear bearing slides with a double-row of balls, vertically mounted resulting in pure vertical motion.

A cool running, high torque DC-motor with a precision preloaded, long-life ball screw ensures high speed motion with minimum settling time. Manual movements can be accomplished using a standard screw driver. A high-resolution linear scale is directly attached to the horizontal moving rail of the actuator, eliminating all drive-train induced motion errors. The compact reading-head is fixed to the actuator static part to avoid any moving cables inside the stage and underlines the robustness and long lasting value of the VP-5ZA with an MTBF of 20,000 hours.

The VP-5ZA stage features end-of-run limit switches at both ends of the stage to prevent bearing damage from over-travel. The origin (Mechanical Zero) is at the center of travel, with a reference on the optical scale.

For optimal performance, we recommend the use of our ESP or MM series motion controllers.

The VP-5ZA stage is equipped with a cable of 1.5 m length and a 25-pin Sub-D connector for connection to our motion controllers.

A versatile grid of threaded holes on the top plate provides compatibility with the VP-25XA linear stages and other Newport positioning products. A standard 3-point mounting interface for a wafer chuck is provided as well. For mounting the VP-5ZA to optical tables or our ILS linear stages, use the optional base plate VP-BP.

2.1 Design Details

Base Material	Aluminum
Bearings	Recirculating ball bearings, double-row linear ball bearings for vertical guidance
Drive Mechanism	Inclined plane design with transmission ratio of 5:1; Backlash-free ball screw
Drive Screw Pitch (mm)	1
Feedback	Linear steel scale, 20 µm signal period, 0.1 µm resolution
Limit Switches	Optical
Origin	Optical, at center of travel, including mechanical zero signal
Motor	DC servo motor with tachometer
Cable Length (m)	1.5

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.

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:

$$Absolute\ Accuracy = Accuracy + Correction\ Factor \times Travel$$

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.

Yaw, Pitch

Rotation of carriage around the Z axis (Yaw) or Y axis (Pitch), when it moves.

The testing of accuracy, repeatability, and reversal error are made systematically with test equipment in controlled environment ($20^{\pm 1}$ °C).

A linear cycle with 21 data points on the travel and 4 cycles in each direction gives a total of 168 points.

Guaranteed and Typical 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 (mm)	4.8
Minimum Incremental Motion (µm)	0.06
Uni-directional Repeatability [1], Typical (Guaranteed) (µm)	±0.06 (±0.15)
Bi-directional Repeatability [1], Typical (Guaranteed) (µm)	±0.10 (± 0.25)
Accuracy [1], Typical (Guaranteed) (µm)	±0.6 (±1.5)
Maximum Speed (mm/s)	5
Pitch [1] [2], Typical (Guaranteed) (µrad)	±30 (±50)
Roll [1] [2], Typical (Guaranteed) (µrad)	±30 (±50)
MTBF (h)	20,000

1) For the definition of Typical and Guaranteed specifications see "Motion Basics Terminology & Standards" Tutorial at www.newport.com

2) To obtain arcsec units, divide µrad value by 4.8.

CAUTION

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

The MTBF value indicated above is given to use the stage with the following parameters:

Centered load	50 N
Displacements	1 back-and-forth of 2 mm + 200 backs-and-forth of 0.1 mm
Speed	5 mm/s
Acceleration	40 mm/s^2
Operating rate on the cycle	50%

3.3 Load Specification Definitions

Normal Load Capacity (Cz)

Maximum load a stage can move while maintaining specifications.

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

Max. Speed (mm/s)	5
Max. Acceleration (mm/s^2)	40

Axial Load Capacity (±Cx)

Maximum load along the direction of the drive train.

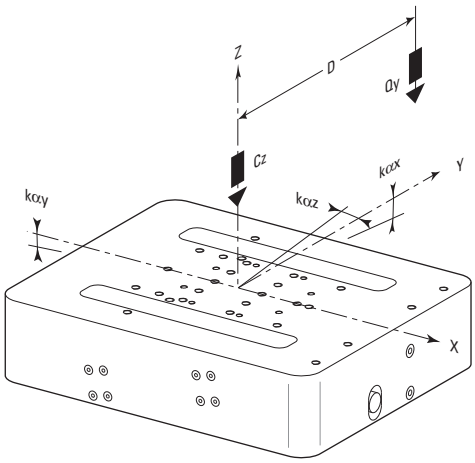
Off-Centered Load (Q)

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

D: Cantilever distance.

a: Construction parameter.

3.4 Load Characteristics and Stiffness



Cz, Normal centered load capacity	50 N
Kαx, Compliance in roll	50 µrad/Nm
Kαy, Compliance in pitch	45 µrad/Nm
Kαz, Compliance in yaw	10 µrad/Nm
Q, Off-center load (N)	Q ≤Cz ÷ (1 + D/30)
Where D = Cantilever distance (mm)	

3.5 Stage Weight

The stage weight below includes the cable.

	Weight [lb (kg)]
VP-5ZA	5.28 (2.4)

4.0 Drive and Motor

4.1 DC-Servo Drive Version

The VP-5ZA stage is equipped with DC-motor and a linear steel scale.

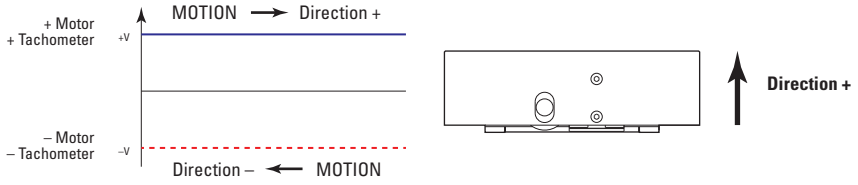
- Signal period: 20 µm
- Resolution: 0.1 µm

DC-Motor Performance Specifications and Characteristics

	Resolution (µm)	Speed (mm/s)	Nominal Voltage (V)	Max RMS Current (A)	Max. Peak Current (A)	Resistance (Ω)	Inductance (mH)	Tachometer Const. (V/krpm)
VP-5ZA	0.02 (1)	5	48	0.5	1	8	0.83	0.52

1) Nominal resolution. The real resolution is specified on a control report supplied with each VP-5ZA stage.

Command Signals for the DC-Motor

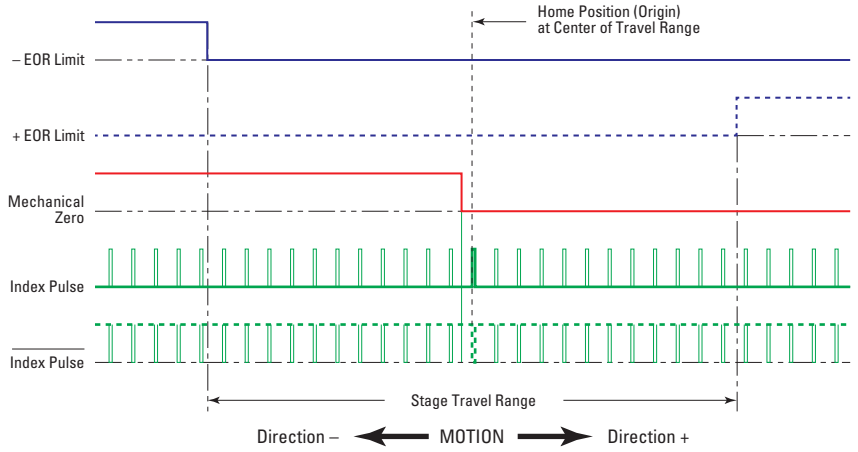


In the above drawings, + Motor signal is referred to – Motor signal, + Tacho Generator signal is referred to – Tacho Generator signal.

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

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

4.2 Sensor Position



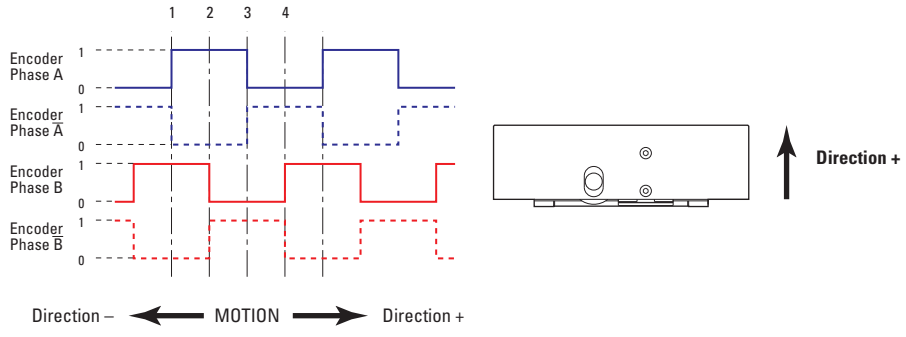
End-of-Run and Mechanical Zero are 5 V open collector type.

The Index Pulse provides a repeatable Home Position at ±1 step.

CAUTION

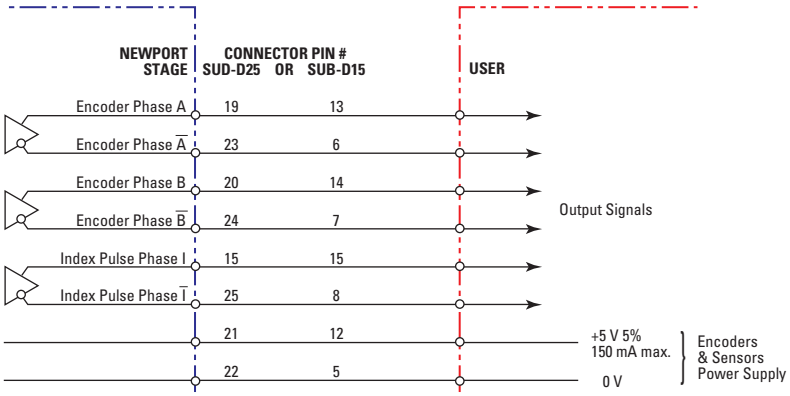
"End-of-Run" and "Mechanical Zero" are active signals and should not be connected to any other source.

4.3 Feedback Signal Position



The incremental sensor consists of an optical scale and an encoder head. When the carriage moves, the encoder head generates square signals in

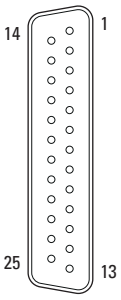
quadrature and sends to pins #19, #20, #23 and #24 of the SUB-D25 connector.



"Encoder" and "Index Pulse" 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.

4.4 Pinouts

The pinout diagram for the VP-5ZA stages SUB-D25M connector is shown below.



1	+ Tachometer	**14**	Ground
2	N.C.	**15**	Index Pulse I
3	– Tachometer	**16**	0 V
4	N.C.	**17**	+ End-of-Run
5	+ Motor	**18**	– End-of-Run
6	+ Motor	**19**	Encoder Phase A
7	– Motor	**20**	Encoder Phase B
8	– Motor	**21**	+5 V
9	N.C.	**22**	0 V
10	N.C.	**23**	Encoder Phase /A
11	N.C.	**24**	Encoder Phase /B
12	N.C.	**25**	Index Pulse /I
13	Mechanical Zero		

5.0 Connection to Newport Controllers

5.1 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.

5.2 Connection

There is a label on every stage indicating its part and serial numbers.

WARNING

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

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.

5.3 Cables

The VP-5ZA stage is delivered equipped with a 1.5-meter cable with a SUB-D25M connector for direct connection to Newport Controllers.

WARNING

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

WARNING

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

6.0 Connection to Non-Newport Electronics

6.1 Connections

WARNING

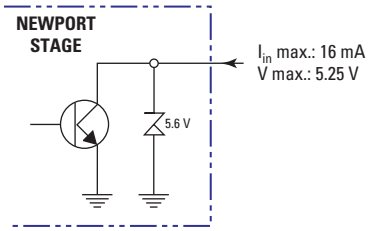
Newport is not responsible for malfunction or damage of VP-5ZA stages when used with non-Newport controllers.

WARNING

Newport guarantees "CE" compliance of VP-5ZA stages only if used with Newport cables and controllers.

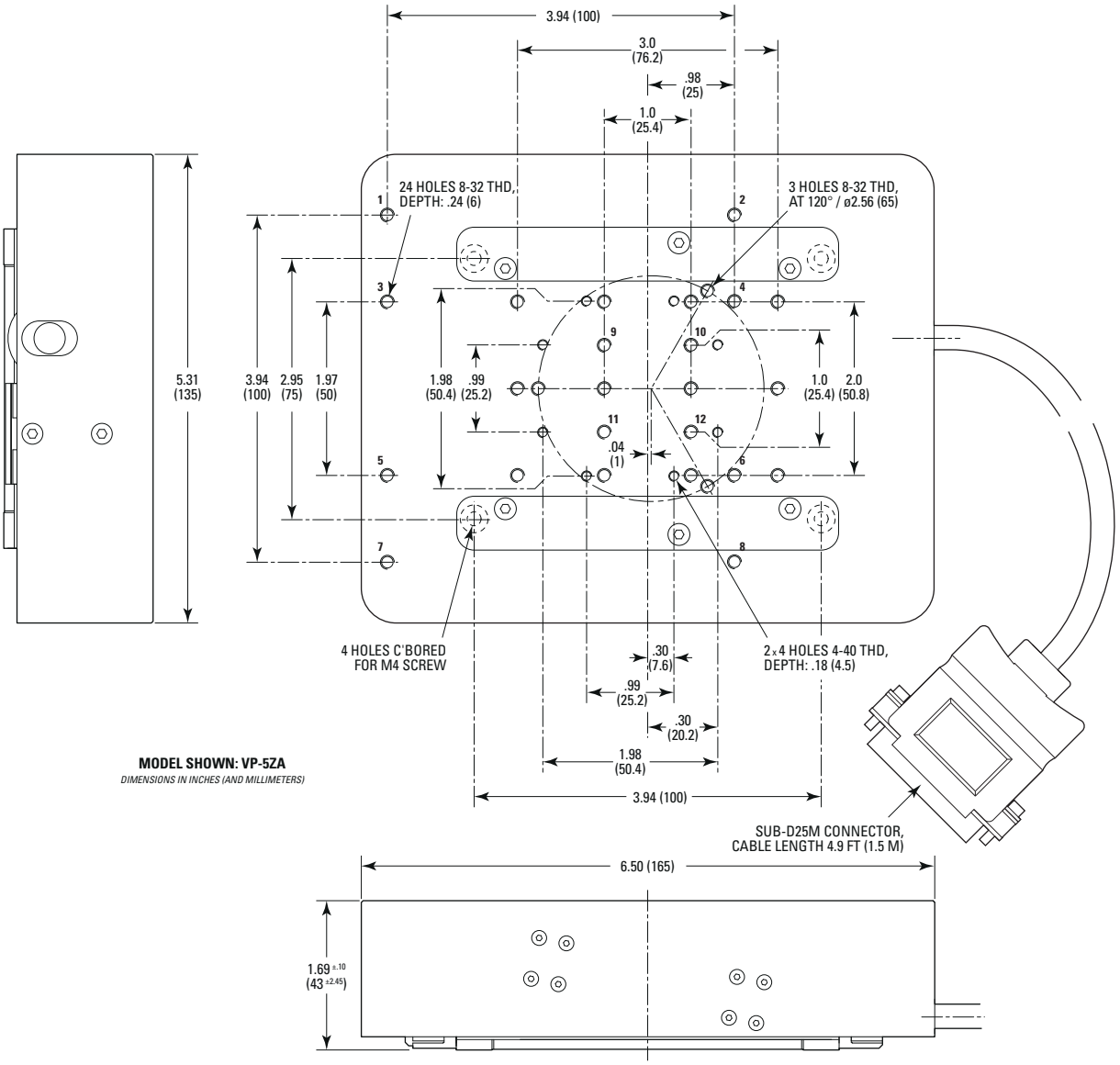
It is the customer's responsibility to modify the cable and take care of sensor signal connections, when using the stage with non-Newport controllers.

End-of-Runs and Mechanical Zero are open collector type with a 5.6 V protective Zener diode.



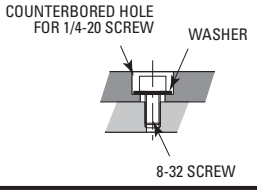
7.0 Dimensions

7.1 VP-5ZA Stage



Components with counterbored holes for 1/4-20 screws can be attached to the top plate of the VP-5ZA using 8-32 and the washers supplied with each stage.

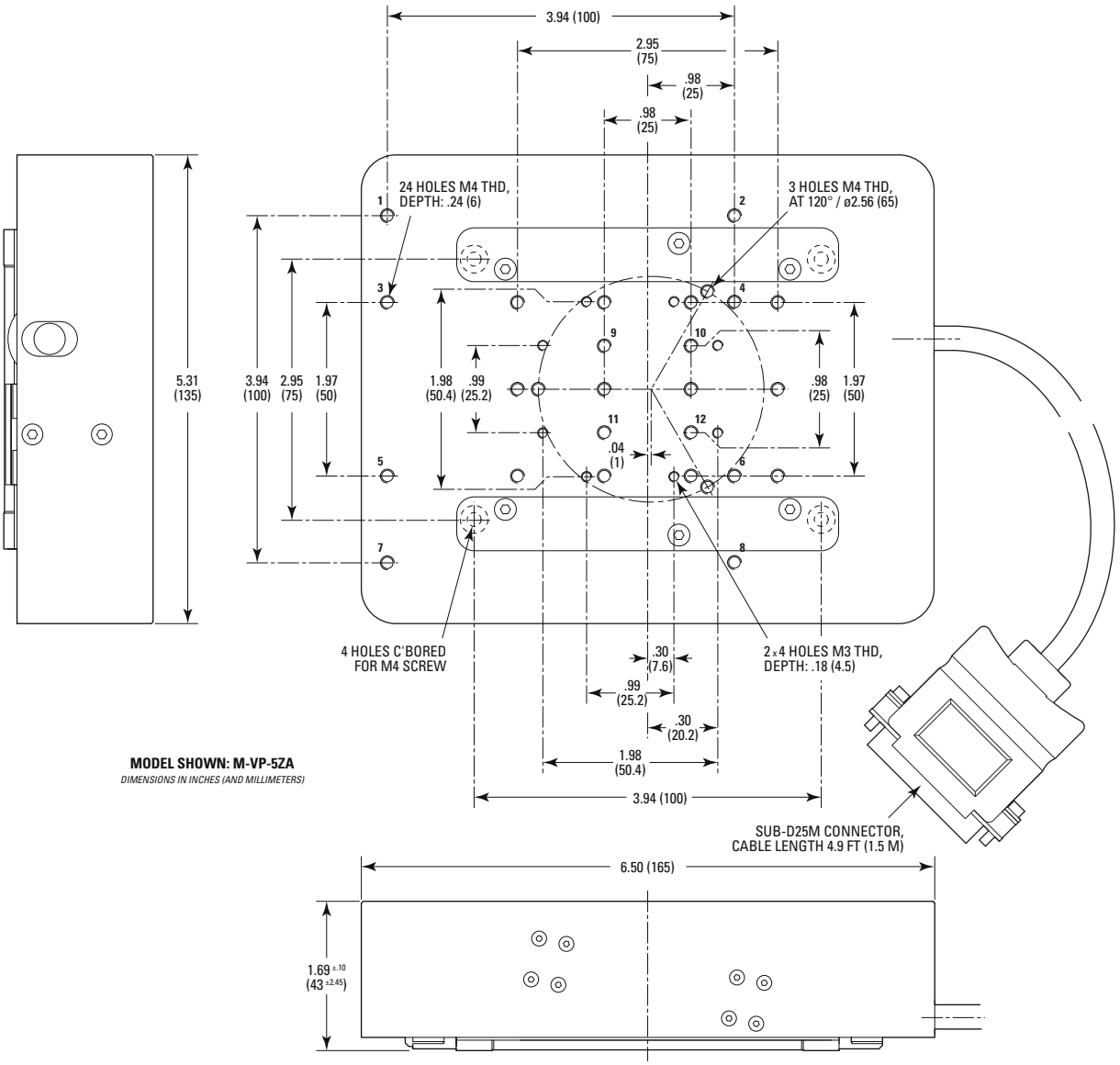
STAGE MOUNTED	HOLES USED	USING SUPPLIED WASHERS
RGV100BL/HL	1-2-7-8	●
VP-25XA	1-2-5-6 OR 3-4-7-8	–



CAUTION

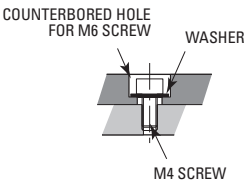
To reach specifications stated, stages must be fixed on a plane surface with a flatness of 5 µm.

7.2 M-VP-5ZA Stage



Components with counterbored holes for M6 screws can be attached to the top plate of the M-VP-5ZA using M4 and the washers supplied with each stage.

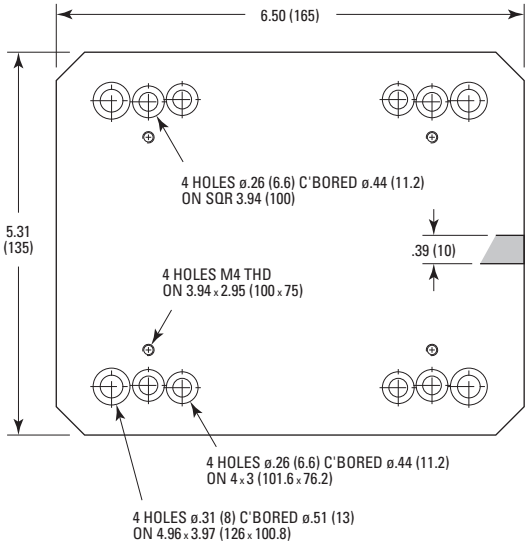
STAGE MOUNTED	HOLES USED	USING SUPPLIED WASHERS
RGV100BL/HL	1-2-7-8	●
M-VP-25XA	1-2-5-6 OR 3-4-7-8	–



CAUTION

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

7.3 VP-BP Universal Base Plate



CAUTION

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

A VP-5ZA stage mounted on top of an ILS linear stage (with optional VP-BP base plate). The vertical lift approach of the VP-5ZA allows centering of the payload over the bearings and close to the position feedback system. This avoids any cantilevered loads and results in more precise motion with higher load capacity.

8.0 Mounting a VP-5ZA Stage on its Support

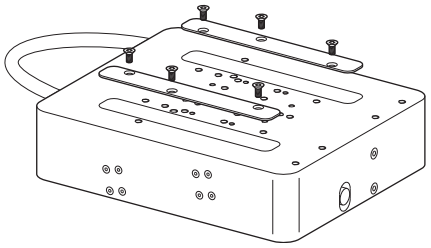
WARNING

Stages must be disconnected from any controller before each mounting or dismounting operation of VP-5ZA stages and their support.

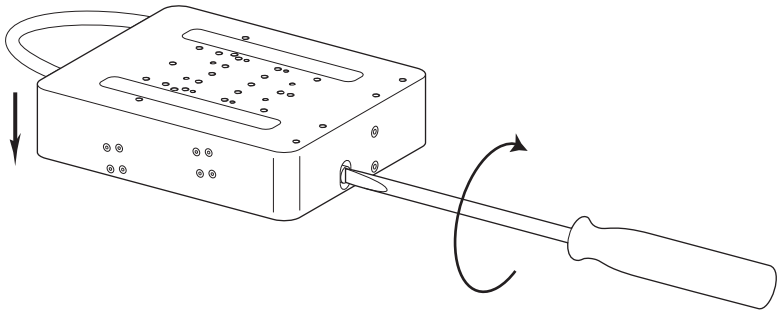
CAUTION

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

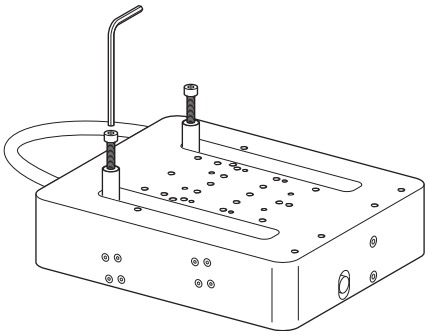
① Remove both protection plates.

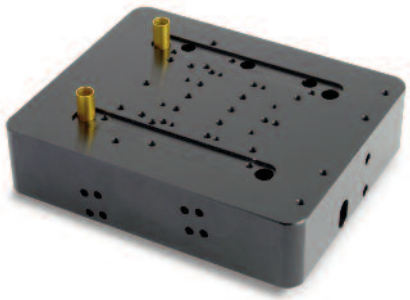


② Turn the manual knob with a slotted screwdriver to put the movable body in minus end-of-travel position (movable body in low position).



③ Inset one of both screw guides supplied in both mounting holes located on the cable output size of the stage, until the guide end is in contact with the bottom of the countersink receiving the mounting screw in the base. Slip one CHC M4 screw (not supplied) into each screw guide and screw it until the headscrew is in contact with the bottom of the countersink.

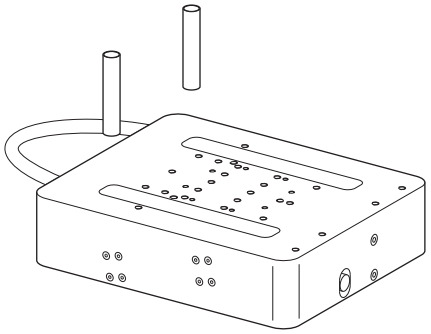




CAUTION

Any screw which the head is not in contact with the bottom of the countersink mounting hole may damage the internal mechanism when the stage is in motion.

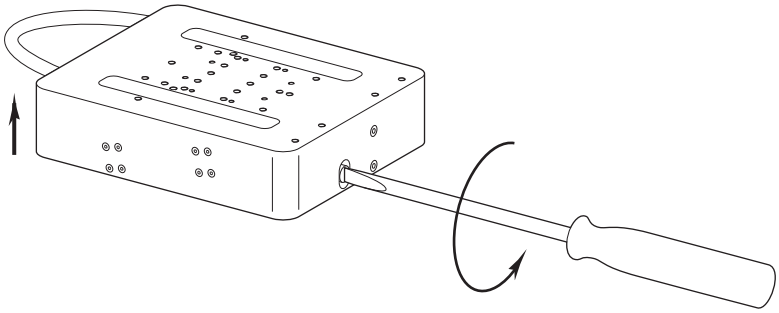
④ Remove both screw guides.



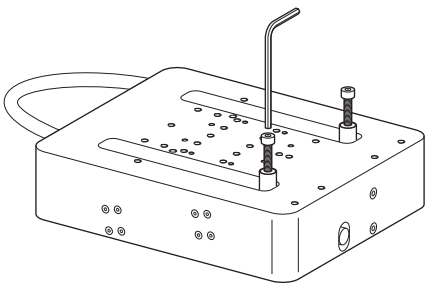
CAUTION

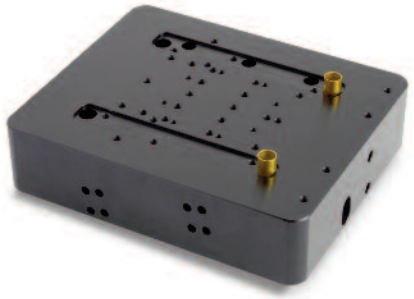
Never turn the manual knob when a screw guide is still in place in the stage; this may cause damage on the internal mechanism and damage stage specifications.

⑤ Turn the manual knob with a slotted screwdriver to put the movable body in plus end-of-travel position (movable body in high position).

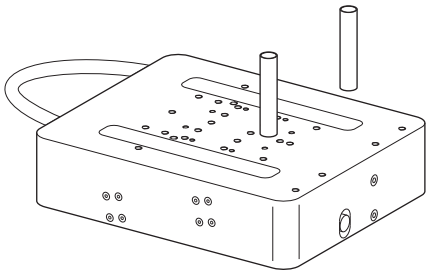


⑥ Repeat step ③ for both mounting holes located on the manual knob size of the stage. Tighten both mounting screws at the nominal torque.



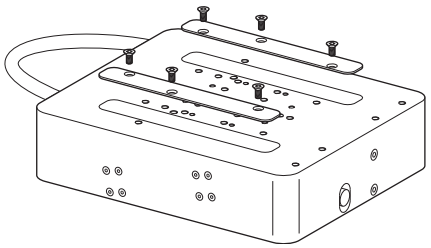


⑦ Remove both screw guides.



⑧ Repeat steps ②, ③ and ④, and tighten both mounting screws located on the cable output size of the stage at the nominal torque.

⑨ Re-mount both protection plates.

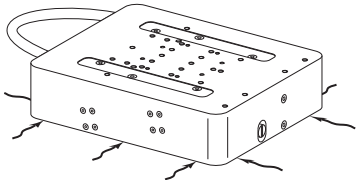


9.0 Using Precautions

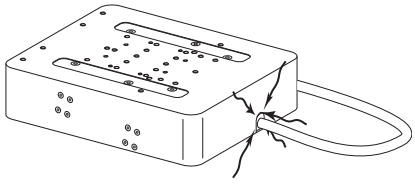
CAUTION

Take care that any object does not get into the internal mechanism of the stage through open spaces:

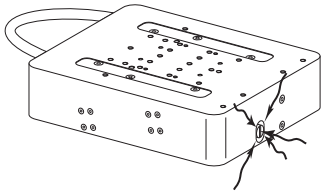
• between the base and the movable body,



• for the clearance of the cable,



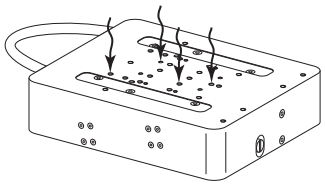
• for the clearance of the screwdriver to turn the manual knob;



this may damage stage specifications.

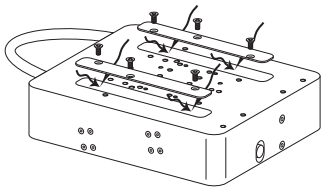
CAUTION

Take care that any object does not get into the internal mechanism of the stage through interface mounting holes located on the top of the movable body; this may damage stage specifications.



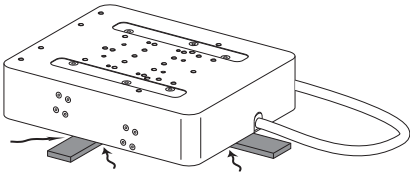
CAUTION

Protection plates of the movable body must be removed only for mounting a VP-5ZA stage on its support. Without these protection plates, objects can get into the internal mechanism of the stage through mounting holes located in the movable body; this may damage stage specifications.



CAUTION

Take care that any object does not inhibit the displacement of the movable body; this may damage stage specifications.



10.0 Maintenance

RECOMMENDATION

Please contact Technical Sales Support team for recommendations on application specific maintenance.

10.1 Maintenance

The VP-5ZA stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and operated with caution.

PRECAUTIONS

The VP-5ZA stage must be used or stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return the stage to Newport for re-lubrication after 2000 hours of use.

If the VP-5ZA 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 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 stage, please contact us immediately to arrange for a repair.

CAUTION

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

10.3 Calibration

CAUTION

It is recommended to return your VP-5ZA stage to Newport once a year for recalibration to its original specifications.

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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