RVS80 Series

High-Performance Precision Rotation Stages

Newport®
Experience | Solutions

USER'S MANUAL

Precision Motion – *Guaranteed*™

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.

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

RVS Series

EC Declaration of Conformity

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

Newport
Experience | Solutions

The manufacturer:

MICRO-CONTROLE Spectra-Physics,
9 rue du Bois Sauvage
F-91055 Evry FRANCE

Hereby declares that the machinery:

- Description: " RVS"
- Function: High-Performance Precision Rotation Stages
- Models: RVS80CC/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

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.

Cautions

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.

High-Performance Precision Rotation Stages RVS80 Series

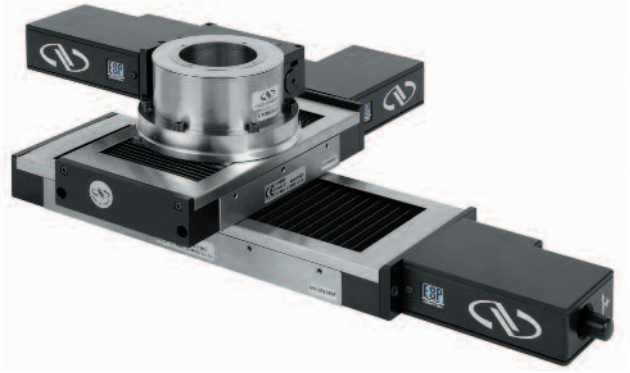
1.0 Introduction

This manual provides operating instructions for the RVS80 series rotation stages: RVS80PP or RVS80CC.

RVS80PP and RVS80CC rotation stages.

RECOMMENDATION

We recommend you read carefully the chapter “Connection to electronics” before using the RVS80 rotation stage.



RVS80 rotation stage and UTS translation stages in XYθz configuration

2.0 Description

The new RVS80 rotation stages are the successor of our popular RV80 series. They provide high-precision angular positioning accuracy combined with high load capacity in a compact, annular design.

RVS80 rotation stages are available in two variants: The DC motor option features an ultra-high resolution 8,000 cts/rev rotary encoder with index pulse for precision homing and is the recommended choice for applications requiring accurate bi-directional positioning. For the tightest position control, the rotary encoder is directly mounted on the worm screw. This eliminates most of the possible error sources appearant with indirect position read-out. The high-torque DC motor provides the highest dynamic speed range and allows for rotating speeds up to 40 °/s.

The stepper motor version is a more economic variant for less demanding applications. When using with our XPS or ESP300 motion controllers with high micro-step capability, low noise operation and very small incremental motions are guaranteed. The stepper motor versions do not use encoder feedback, but calculate position by the number of commanded steps and micro-steps. For this purpose, the stepper motor is directly attached to the worm screw with a proprietary bellow coupling with high torsional stiffness and no gear or belt drive in between. Furthermore, the high output torque of the stepper motor minimizes the risk of lost steps and provides optimum motion sensitivity with good linearity between commanded micro-steps and the actual motion of the stage.

All RVS80 rotation stages are constructed of tool steel with the rotation accuracy ensured by a double row of preloaded ball bearings on hardened surfaces. This allows for high off-center loads within a reduced footprint. The single monolithic design offers improved stiffness without compromising dynamic performance characteristics. The flexible preloading system for the worm gear has been improved to guarantee a backlash-free operation with an MTBF of 20,000 hours.

2.1 Design Details

Base Material	Hardened steel body
Bearings	Double row of preloaded ball bearings
Drive Mechanism	Grinded worm gear with self-compensating preload. Additional 1:2.75 drive belt with RVS80CC versions (no belt on RVS80PP versions)
Worm Gear Ratio	1:180
Feedback	RVS80CC: Worm mounted rotary encoder, 8,000 cts/rev, index pulse. RVS80PP: None
Limit Switches	Two independently adjustable optical limit switches
Origin	Optical, fixed at position 0°. Typical 0.0025° repeatability for RVS80CC and 0.02° repeatability for RVS80PP
Manual Adjustment	Via a knob at the end of the motor box.
Motor	RVS80CC: DC servo motor UE34CC RVS80PP: 2-phase stepper motor UE34PP, 1 Full step = 0.01°
Cable	SUB-D15F/SUB-D25M cable, length 3 m
MTBF	20000 h

RoHS Compliant

NOTE

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

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.

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

	RVS80PP	RVS80CC
Travel Range (°)	360 continuous [1]	
Minimum Incremental Motion (°)	0.0002	0.001
Uni-directional Repeatability (°)	0.002	0.001
Bidirectional Repeatability [2] (°)	0.003 or ±0.0015	
Absolute Accuracy [2] (°)	0.015° or ±0.0075	
Max. Speed (°/s)	20	40
Wobble [2][3] (µrad)	40 or ±20	
Eccentricity [2] (µm)	4 or ±2	

1) *With disabled limit switches.*

2) *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.*

3) *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.

3.3 Load Specification Definitions

Normal Load Capacity (Cz)

Maximum load a rotation stage can move while maintaining specifications.

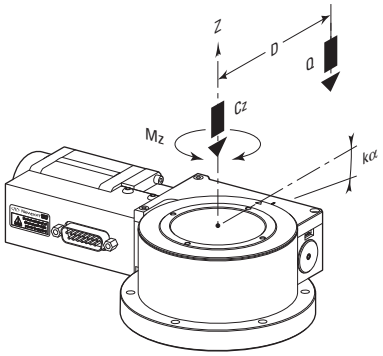
This value is given with speed and acceleration specified for each rotation stage, and with a load perpendicular to bearings.

Off-Centered Load (Q)

Maximum cantilever-load a rotation stage can move: $Q \leq Cz \div (1 + D/30)$

D: Cantilever distance.

3.4 Load Characteristics and Stiffness



	3-point @ 120° mounting	5-point mounting on a flatness plane <5 µm
Cz, Normal centered load capacity (N)	90	
Kα, Transversal stiffness (µrad/Nm)	5	3.5
Mz, Nominal Torque (Nm)	2	
Inertia (kg.m²)	0.1	
Q, Off-center load (N)	$Q \leq Cz \div (1 + D/30)$	
Where D = Cantilever distance (mm)		

3.5 Stage Weights

Weights indicated into the below table is the one of a rotation stage without any cable.

	Weight [lb (kg)]
RVS80	4.0 (1.8)
3-meter MSCABLE-3 Cable	0.66 (0.3)

4.0 Drive

4.1 DC-Motor Drive Version

	Resolution (°)	Speed (°/s)	Motor
RVS80CC	0.00025	40	UE34CC

4.2 Stepper Motor Drive Version

	Full-Step Resolution [1] (°)	Speed (°/s)	Motor
RVS80PP	0.01	20	UE34PP

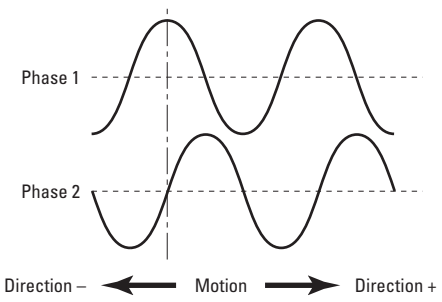
1) When used with Newport motion controllers, this motor is driven in a dynamic micro-stepping mode (software communication). In that case, the mechanical sensitivity is approx. 1/100 of a full step.

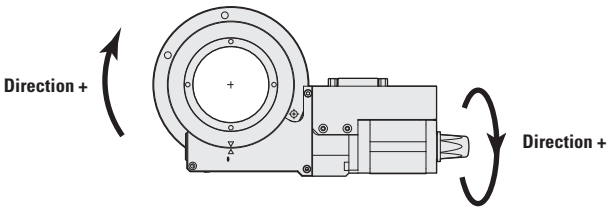
5.0 Motor

5.1 UE34PP Motor Characteristics

Motor	Angle by Step (°)	RMS Current per Phase (A)	Resistance (Ω)	Inductance (mH)	Newport Utilization
UE34PP	1.8	0.71	1.7	2.8	Micro-Step

5.2 Command Signals for the Stepper Motor

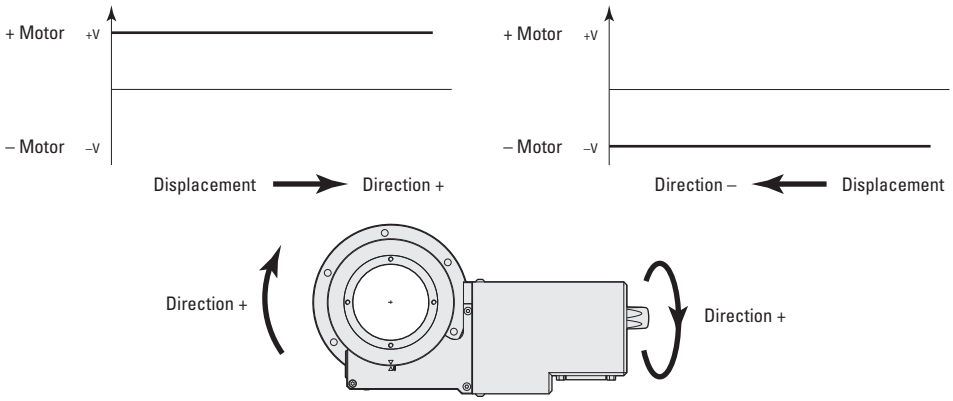




5.3 UE34CC Motor Characteristics

Motor	Nominal Voltage (V)	Max. RMS Current (A)	Max. Peak Current (A)	Resistance (Ω)	Inductance (mH)
UE34CC	48	0.9	1.8	2.52	0.51

5.4 Command Signals for the DC-Motor

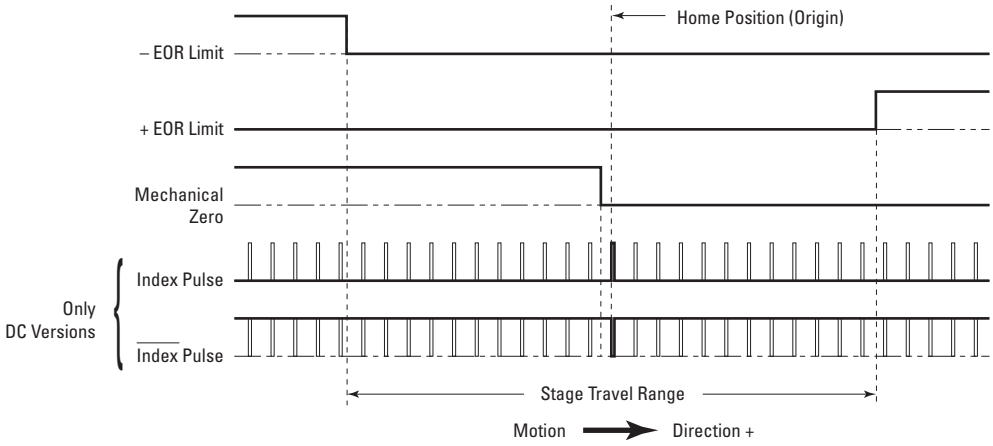


In the above drawings, + Motor signal is referred to – Motor signal

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.

5.5 Sensor Position



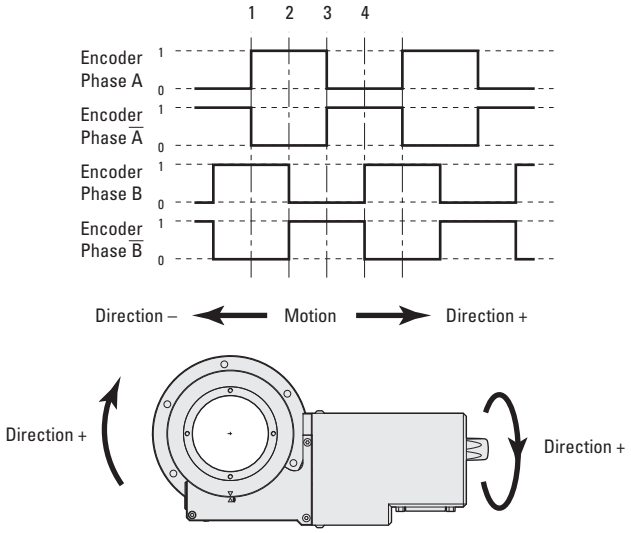
End-of-Run and Mechanical Zero are 5 V open collector type.

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

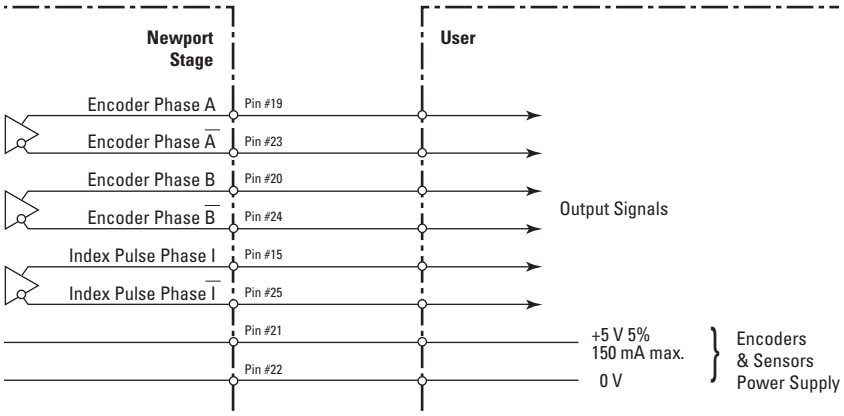
CAUTION

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

5.6 Feedback Signal Position



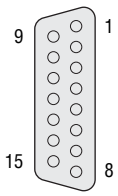
The incremental sensor consists of a optical scale and an encoder head. When the carriages of the stage move, the encoder head generates square signals in quadrature, sent to pins #19, #20, #23 and #24 of the SUB-D25 connector.



"Encoder" 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.

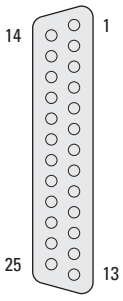
5.7 Pinouts

The SUB-D15 connection for RVS80 Series rotation stages is given in the following table.



	RVS80PP UE34PP		RVS80CC UE34CC
1	+ Phase 1	**1**	N.C.
2	+ Phase 2	**2**	+ Motor
3	Mechanical Zero	**3**	Mechanical Zero
4	– End-of-Run	**4**	– End-of-Run
5	0 V	**5**	0 V
6	N.C.	**6**	Encoder Phase /A
7	N.C.	**7**	Encoder Phase /B
8	N.C.	**8**	Index Pulse /I
9	– Phase 1	**9**	N.C.
10	– Phase 2	**10**	– Motor
11	+ End-of-Run	**11**	+ End-of-Run
12	+5 V	**12**	+5 V
13	N.C.	**13**	Encoder Phase A
14	N.C.	**14**	Encoder Phase B
15	N.C.	**15**	Index Pulse I

The SUB-D25 connection at the end of the cable is given in the following table:



	RVS80PP UE34PP		RVS80CC UE34CC
1	+ Phase 1	**1**	N.C.
2	N.C.	**2**	N.C.
3	– Phase 1	**3**	N.C.
4	N.C.	**4**	N.C.
5	+ Phase 2	**5**	+ Motor
6	N.C.	**6**	+ Motor
7	– Phase 2	**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	N.C.	**14**	Shield Ground
15	N.C.	**15**	Index Pulse I
16	N.C.	**16**	0 V logic
17	+ End-of-Run	**17**	+ End-of-Run
18	– End-of-Run	**18**	– End-of-Run
19	N.C.	**19**	Encoder Phase A
20	N.C.	**20**	Encoder Phase B
21	+5 V	**21**	+5 V
22	0 V	**22**	0 V Encoder
23	N.C.	**23**	Encoder Phase /A
24	N.C.	**24**	Encoder Phase /B
25	N.C.	**25**	Index Pulse /I

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.

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.

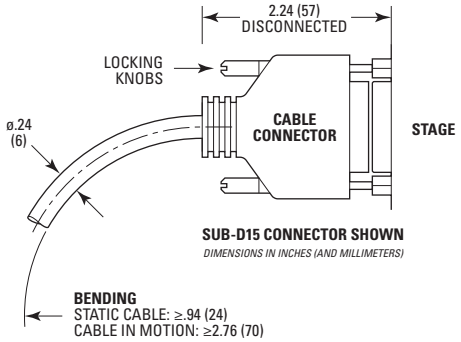
NOTE

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 RVS80 rotation stages are delivered with a **MSCABLE-3** 3-meter cable. This cable is equipped with a SUB-D25M connector so it can be directly connected to our controllers/drivers.

6.4 MSCABLE-3 Cable



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 standard 3-meter cable (**MSCABLE-3**) included with your stage is not adequate, Newport offers a 10-m longer length cable (**MSCABLE-10**) designed to ensure the integrity of your positioning application.

These cables are specially shielded and terminated with Newport's standard SUB-D15 and SUB-D25 connectors.

WARNING

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

7.0 Connection to Non-Newport Electronics

7.1 Connections

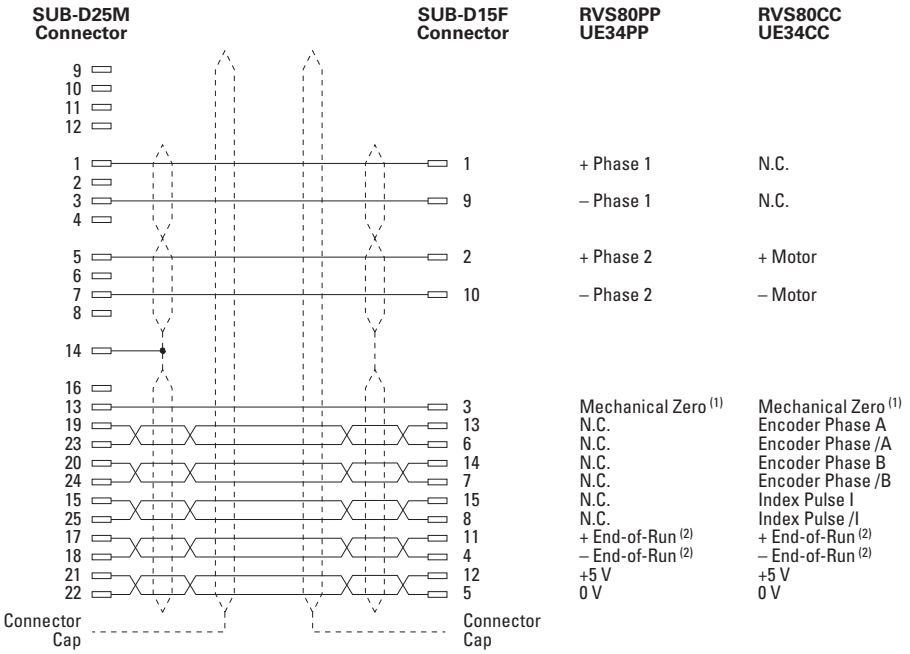
WARNING

Newport is not responsible for malfunction or damage to a RVS80 rotation stage when it is used with non- Newport controllers.

WARNING

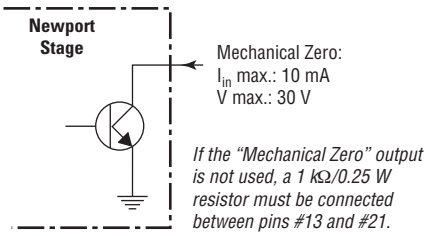
Newport guarantees "CE" compliance of the RVS80 rotation stages only if they are used with Newport cables and controllers.

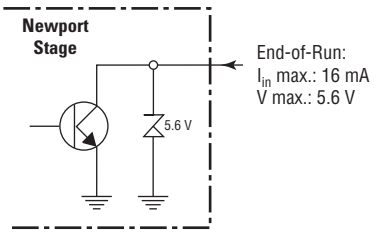
Nevertheless, the figure below shows the wiring when a RVS80 rotation stage is used with non-Newport controllers.



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

(2) Open collector type with a 5.6 V protective Zener diode.

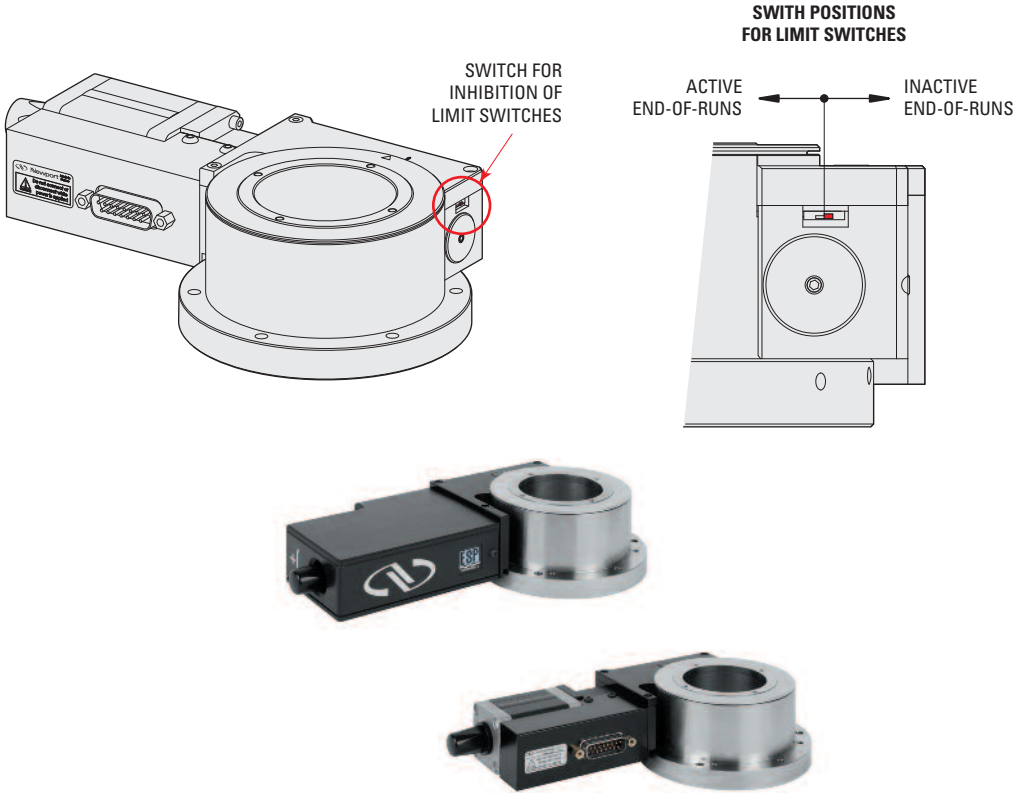




"Encoder " and "Index Pulse" are "differential pair" (type RS-422) type output signals. Using these signals permits a high immunity to noise. Emission circuits generally used by Newport are 26LS31 or MC3487. Reception circuits to use are 26LS32 or MC3486.

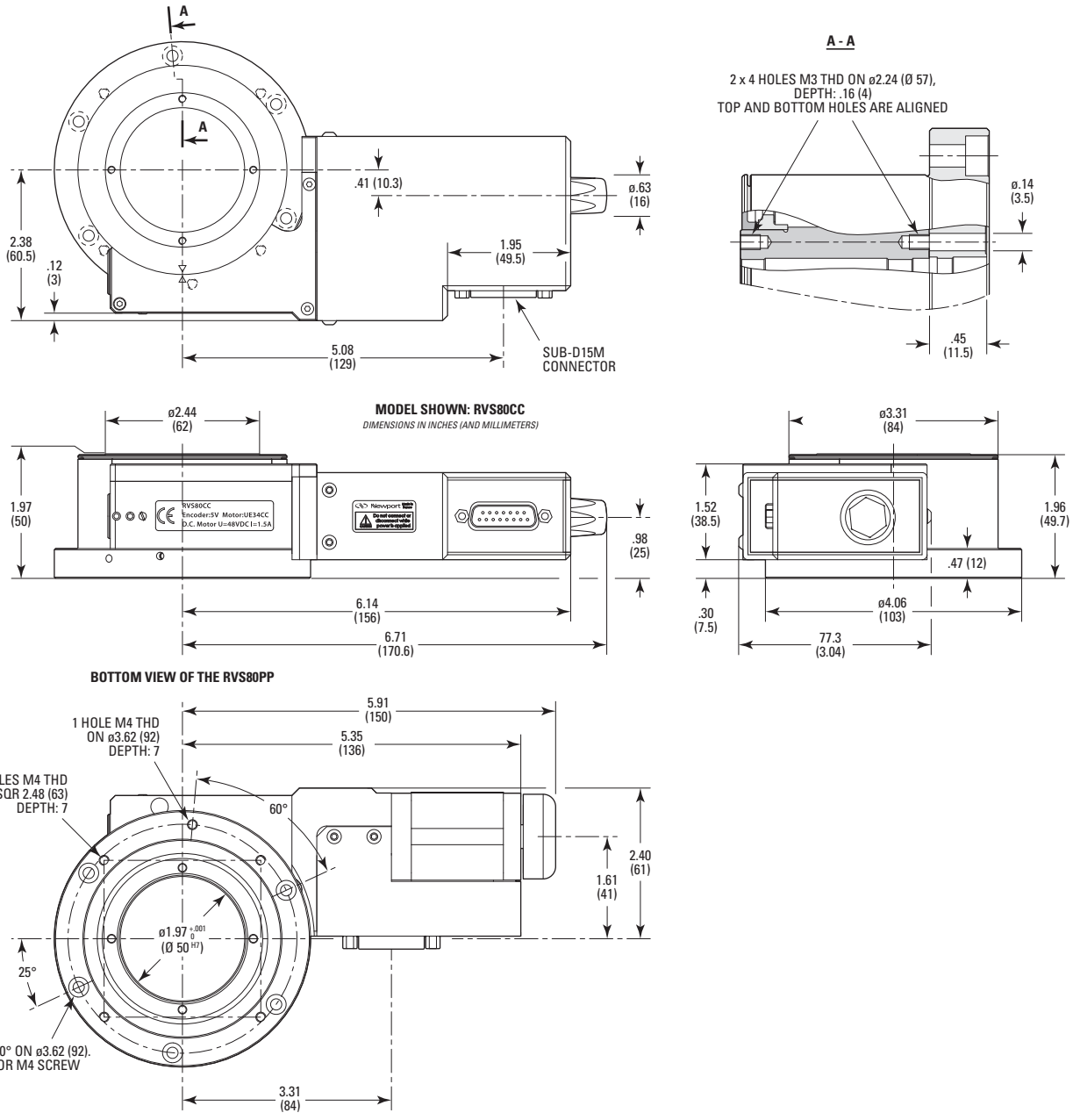
8.0 Disabling of Limit Switches

In standard RVS80 rotation stages are equipped with limit switches (limited to ±170°) for protecting the equipment. A switch enables inhibiting the limit switches in order to use the rotation stage over 360° or more.



RVS80CC and RVS80PP rotation stages.

9.0 Dimensions



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 RVS80 stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and operated with caution.

PRECAUTIONS

The RVS80 stage must be used or stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return your RVS80 stage to Newport's After Sales Service after every 2000 hours of use for lubrication.

If your 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 RVS80 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: _____

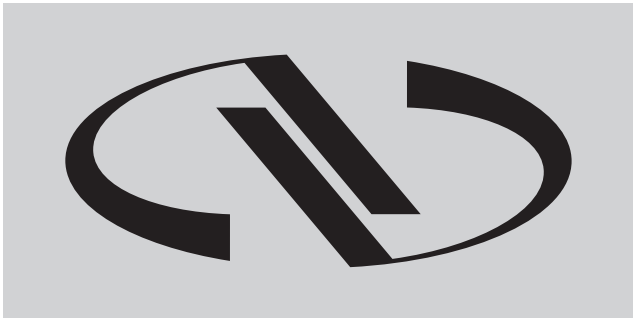
P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

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



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