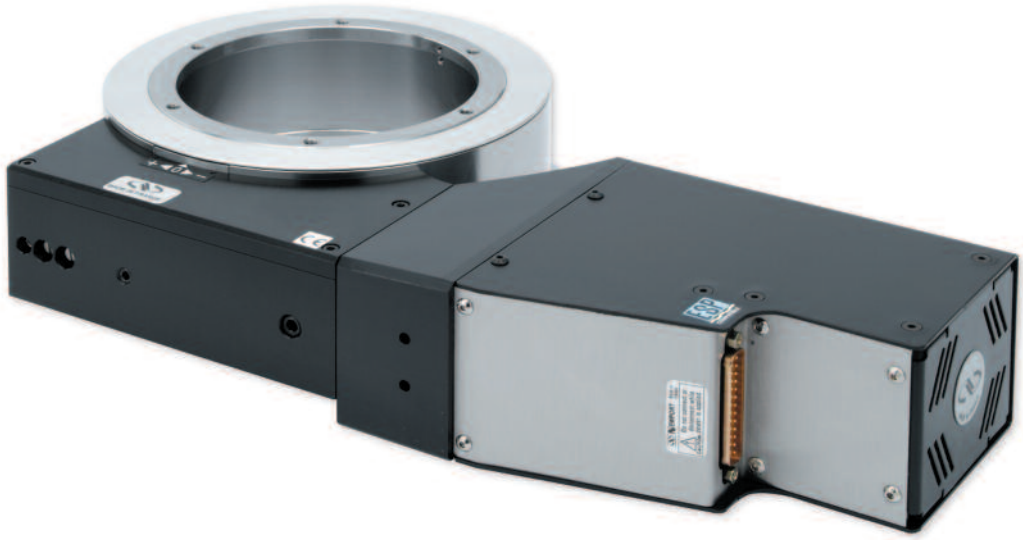
RV Series

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.

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

RV Series

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: " RV"
- Function: High Performance Precision Rotation Stage
- Models: RV120/160/240/350/CC/CC-F/CCHL/CCHL-F/HAHL/HAHLT/HAHLT-F/HAT/HAT-F/PE/PE-F/PEV6/PP/PP-F

– 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 61000-4-6

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 RV Series

1.0 Introduction

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

- Direct motor:
  - RV-PP
  - RV-PE
  - RV-PEV6 (1)(2)
  - RV120PEBV6 (1)(3)
  - RV-CC
  - RV-CCHL
  - RV-HAT
  - RV120HAHL (4)
  - RV-HAHLT (2)
- Folded motor (except RV80):
  - RV-PP-F
  - RV-PE-F
  - RV-PEV6-F (1)(2)
  - RV120PE-FBV6 (1)(3)
  - RV-CC-F
  - RV-CCHL-F
  - RV-HAT-F
  - RV120HAHL-F (4)
  - RV-HAHLT-F (2)

1) NOTES

1) **Vacuum compatible rotation stages to 10^{-6} hPa. In this case, max. speed and load capacity have to be divided by two.**
2) **Except RV120 model.**
3) **Vacuum compatible rotation stages RV120 are only available in RV120PEBV6 & RV120PE-FBV6 versions.**
4) **Only RV120 model.**



RV Series rotation stages.

RECOMMENDATION

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

2.0 Description

The RV Series rotation stages provide high-precision angular positioning accuracy combined with high load capacity in a compact, annular design. We offer four stage sizes and nine drive configurations enabling a variety of operating conditions for optimizing load capacity, torque, speed, and resolution.

All RV 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 largest member of the RV product family can bear up to 650 kg or rotate up to 80 °/s while maintaining eccentricity of less than 4 µm.

In standard, these stages are equipped with limit switches (limited to ±170°) for protecting the equipment, and a home position search device. A switch enables inhibiting the limit switches in order to use the rotation stage over 360° or more (except HAT, HAHL & HAHLT versions).

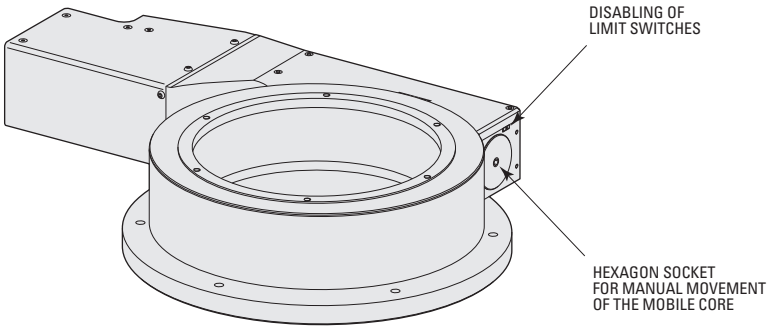
ATTENTION

Newport Corporation shall not be liable for any damage resulting from improper use of RV Rotation Stages while limit switches are inhibited.

The drive is ensured by a worm and gear located on the rotation part of the stage. The worm/gear ratio is 1/90.

The position is measured by a 4000 cts/rev encoder placed on the motor shaft (except HAT, HAHL & HAHLT versions), without tachometer.

The HAT, HAHL & HAHLT (High Accuracy) versions are available in diameters from 120 up. These stages are equipped with an optical encoder fixed on the mobile core and the HAHLT version is equipped with a tachometer. They avail the best indexing accuracy characteristics. The travel is limited to ±170° (limit switches are not inhibited in this case).



At the end of the drive screw in RV stages (side opposite motor), a hexagon socket is given for manual movement of the mobile core, using an "Allen" wrench.

ATTENTION

Do not attempt to move the mobile core manually with the rotation stage switched on.

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

The RV Series rotation stages are supplied with a 3-meter cable for connection to our motion controllers

2.1 Design Details

Base Material	Stainless Steel
Bearings	Double row ball bearings
Drive Mechanism	Ground worm gear with self compensating preload
Worm Gear Ratio	1/90
Feedback	Except for HAT, HAHL and HAHLT versions: Worm mounted rotary encoder, 4,000 cts/rev, Index pulse HAT, HAHL and HAHLT versions: Direct reading optical encoder on the rotating platen, 20 µm signal period
Limit Switches	Optical, at ±170°, can be disabled for continuous rotation (except HAT, HAHL and HAHLT versions)
Origin	Optical
Cable Length	3 m cable included
Vacuum Compatibility	Vacuum compatible versions are available up to 10^{-6} hPa using full-step motor, in this case, max. speed and load capacity have to be divided by two
MTBF	20,000 h

RoHS Compliant

NOTE

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



RV120 rotation stage mounted in a vertical configuration with an EQ120 to an (M-)ILS stage.

3.0 Characteristics

NOTE

Apart from the dimensions, the specifications of the rotation stages equipped with a folded motor are the same as those of the direct motor versions.

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 ±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

Travel Range (°)	360 continuous	With disabled limits, except HAT, HAHL & HAHLT versions
	±170	HAT, HAHL & HAHLT versions
Minimum Incremental Motion (°)	0.001	Except HAT, HAHL & HAHLT versions
	0.00075	HAT versions
	0.0002	HAHL & HAHLT versions
Uni-directional Repeatability, Guaranteed [1] (°)	0.002	Except HAT, HAHL & HAHLT versions
	0.0002	HAT, HAHL & HAHLT versions
Bi-directional Repeatability, Guaranteed [1] (°)	0.004 or ±0.002	Except HAT, HAHL & HAHLT versions
	0.0012 or ±0.0006	HAT, HAHL & HAHLT versions
Absolute Accuracy, Guaranteed [1] (°)	0.01 or ±0.005	Except HAT, HAHL & HAHLT versions
	0.005 or ±0.0025	HAT, HAHL & HAHLT versions
Maximum Speed (°/s)	80	CC & HAT versions
	20	PP motor option
	16	CCHL, HAHL & HAHLT versions
	2	PE versions
Wobble, Guaranteed [1] [2] (µrad)	20 or ±10	RV120 & RV160
	16 or ±8	RV 240 & RV350
Eccentricity, Guaranteed [1] (µm)	4 or ±2	

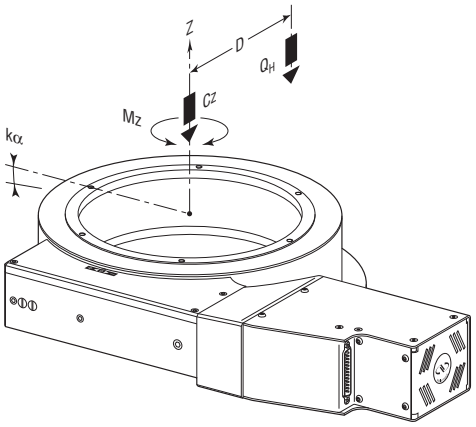
1) Shown are peak to peak, guaranteed specifications or ± half the value as sometimes shown. For the definition of typical specifications which are about 2X better than the guaranteed values, visit www.newport.com for the Motion Control Metrology Primer.

2) 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 Specifications Definitions



Load Capacity (Cz)

This is the maximum load that a rotation stage can move. This value is given with the conditions of speed and acceleration specific to the stage.

This value corresponds to a normal centered load on bearings. It further depends on the static load capacity of the plane.

Centered Load Capacity (Cz)

Direct centered load capacity with the specified speed and acceleration conditions.

This value defines the vertical load capacity.

Off-center Load (Q)

This is the maximum cantilever load that the rotation stage can move:

$$Q \leq \frac{Cz}{(1 + D/a)}$$

D : Off-center distance.

a : Construction parameter.

WARNING

Off-center loads can generate high moments of inertia. Refer to the table of maximum allowed inertia (see Chapter 3.6) before using the RV rotation stage.

Angular Stiffness (kα)

This value is based on the stage construction. We specify the stiffness perpendicular to the rotation axis, to enable determining the distortion of the stage due to the torque generated by an off-center load.

Of the two values specified, the first corresponds to the stage fixed at 3 points at 120°, the second to a plane fixing with 5 points. In the second case, the quality of the fixing plane has an impact on the quality of displacement. In order to be compliant with the specifications stated for RV stages, the load-bearing surface must have a plane value of less than 5 µm.

Maximum Inertia

We specify the maximum value of the moment of inertia of the carried load, for each model of the RV stage. This value is expressed in $kg.cm^2$.

It is limited in order to avoid any risk of damage to the stage in the event of a sudden halt during a high speed rotation.

In each case, the specified value corresponds to the acceptable limit with the stage rotating at the maximum speed (see Chapter 3.6).

WARNING

The rotation of heavy loads and the high moments of inertia may cause the equipment to downgrade and carry risks for the operators.

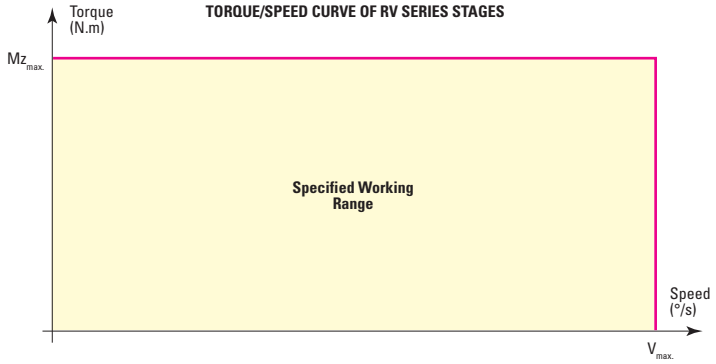
NEVER EXCEED THE SPECIFIED INERTIA VALUES.

Torque (Mz)/Speed

The torque available on each rotation stage depends on the following:

- Kinematic chain.
- Motor.
- Use of the stage (speed).

In order to obtain the best performance from your RV rotation stage, see the stage use diagrams given below, for each version (see Chapter 3.7).



with:
$Mz_{max.}$ = Maximum torque
$V_{max.}$ = Maximum allowed speed

3.4 Specifications for RV Rotation Stages with Vacuum Preparation

NOTE

RV-PE rotation stages are primarily designed for applications requiring the direct positioning accuracy to be maintained to within the stage's mechanical resolution when power is switched off, such as operation in vacuum (10^{-6} hPa vacuum preparation on request).

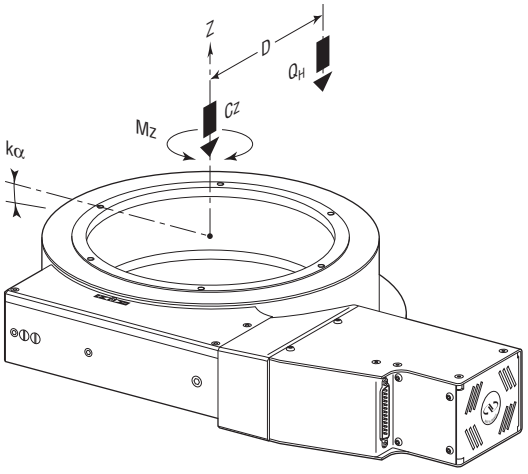
In this case, specifications for speed (°/s), load capacity (Cz) and torque (Mz) have to be divided by two.

3.5 Load Specifications

		RV120	RV160	RV240	RV350
Cz, Normal centered load capacity (N)		1800	2700	4000	6500
a, construction parameter (mm)		40	50	70	100
b[1], (mm)	except HAT, HAHL & HAHLT	53	57	59	73
	for HAT, HAHL & HAHLT	71	75	77	91
kα, radial compliance (µrad/Nm)		1.5	0.6	0.3	0.1
Q_H, Off-center load, vertical rotation axis		$Q_H \leq Cz \div (1+D/a)$			
Q_V, Off-center load, horizontal rotation axis		$Q_V \leq Cz/2 \div (1+D/a)$			

[1] *Construction parameter = Distance between the top surface of the RV stage and the bearing center.*

Horizontal Load Characteristics



where:

Q_H : Off-center load,

$$Q_H \leq \frac{Cz}{(1 + D/a)}$$

Cz : Normal centered load capacity on bearings

D : Off-center distance in mm

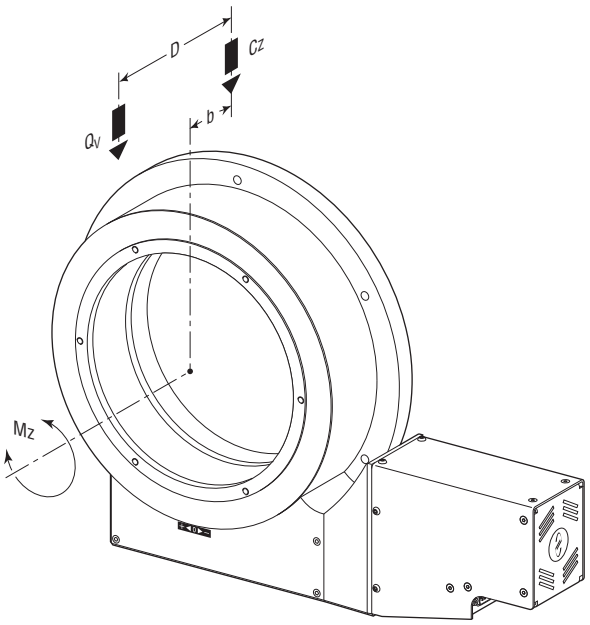
a : Construction parameter

kα : Angular stiffness

Example: *Q_H at a distance D of 100 mm, for RV160 rotation stage.*

$$Q_H = \frac{2700}{(1 + 100/50)} = 900 \text{ N}$$

Vertical Load Characteristics



where:

Q_V : Off-center load,

$$Q_V \leq \frac{Cz}{[2 \times (1 + D/a)]}$$

Cz : Normal centered load capacity on bearings

D : Off-center distance in mm

a : Construction parameter

b : Construction parameter:
Distance between the top surface and the bearings center

Example: *Q_V at a distance D of 100 mm, for RV160 rotation stage.*

$$Q_V = \frac{2700}{[2 \times (1 + 100/50)]} = 450 \text{ N}$$

In this example, the load Q_V is placed at 43 mm (100 - 57) from the mounting plane of the stage.

3.6 Maximum Inertia Tables

The maximum moment of inertia of the load borne by the stage depends on the size of the rotation stage used and on its kinematic chain. The table below gives the maximum allowed values for each model in the standard range. The applicable limits are the same for direct motor versions and folded motor versions.

	Maximum Inertia ($kg.m^2$)			
Versions	**RV120**	**RV160**	**RV240**	**RV350**
PP	1	3	4	4
PE	70	100	150	220
CC	0.2	0.7	1.5	1.8
CCHL	7	24	38	56
HAT	0.9	1	1.1	1.2
HAHL	7	–	–	–
HAHLT	–	8	10	10

This table specifies the maximum inertia value for each RV stage. This value represents the maximum kinetic energy that the rotation stage can absorb in the event of a sudden halt at the maximum speed. This inertia is also in agreement with the capability of the stage to accelerate from a halted state to the maximum speed in 250 ms.

The inertia is expressed in $kg.m^2$ and is given with respect to the rotation axis of the RV rotation stage (1 $kg.m^2$ is the inertia of a load of 1 kg placed at a distance of 1 m from the rotation axis).

Example of Inertia Value

A load of 20 kg must be placed at 240 mm from the rotation axis of the RV rotation stage. The corresponding inertia is:

$$20 \times 0.24 \times 0.24 = \mathbf{1.152\ kg.m^2}$$

It is therefore possible to use the RV240CC rotation stage (Iz max. = 1.5 $kg.m^2$) and to move a load up to 80 °/s.

Verification of Other Values

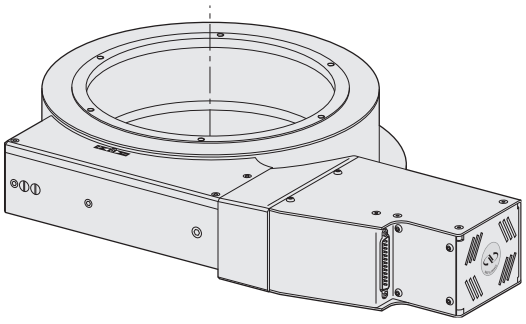
The maximum load capacity at 240 mm from the rotation axis of the RV240 rotation stage is:

$$Q_H = \frac{4000}{(1 + 240/70)} = 903\ N \approx \mathbf{90\ kg}\ (>20\ kg)$$

The maximum torque of the RV240 rotation stage is 13 N.m. At 240 mm, this torque represents a load of:

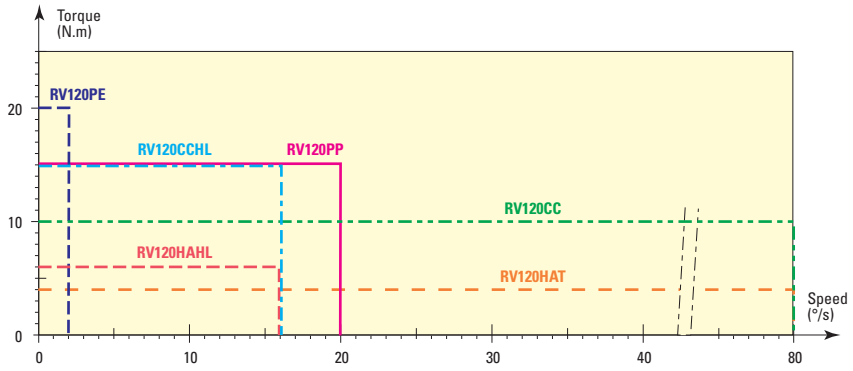
$$M_z = \frac{13}{0.24} = 54\ N \approx \mathbf{5.4\ kg}\ (<20\ kg)$$

In these conditions, the RV240 rotation stage can be used only in the horizontal position (where the rotation axis is vertical).



3.7 Torque (Mz)/Speed

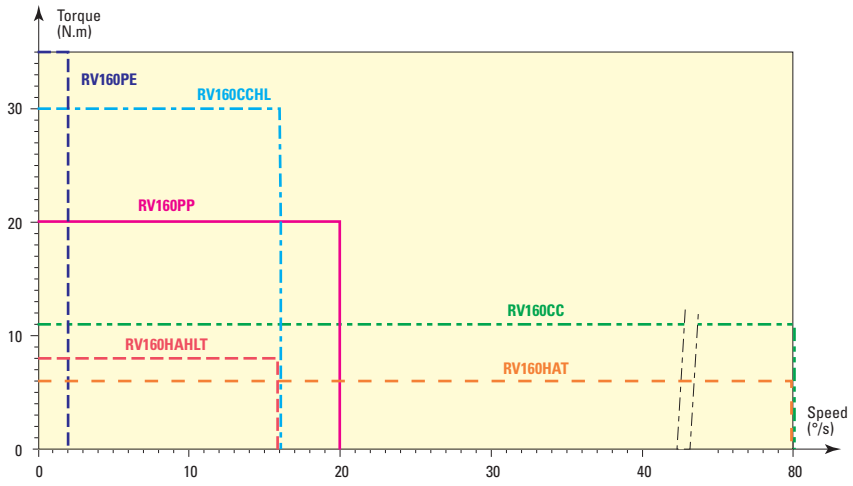
RV120 Rotation Stages



MODEL	$Mz_{max.}$ (N.m)	$V_{max.}$ (°/s)
RV120PP	15	20
RV120PE	20	2
RV120CC	10	80
RV120CCHL	15	16
RV120HAT	4	80
RV120HAHL	6	16

with:
$Mz_{max.}$ = Maximum torque
$V_{max.}$ = Maximum allowed speed

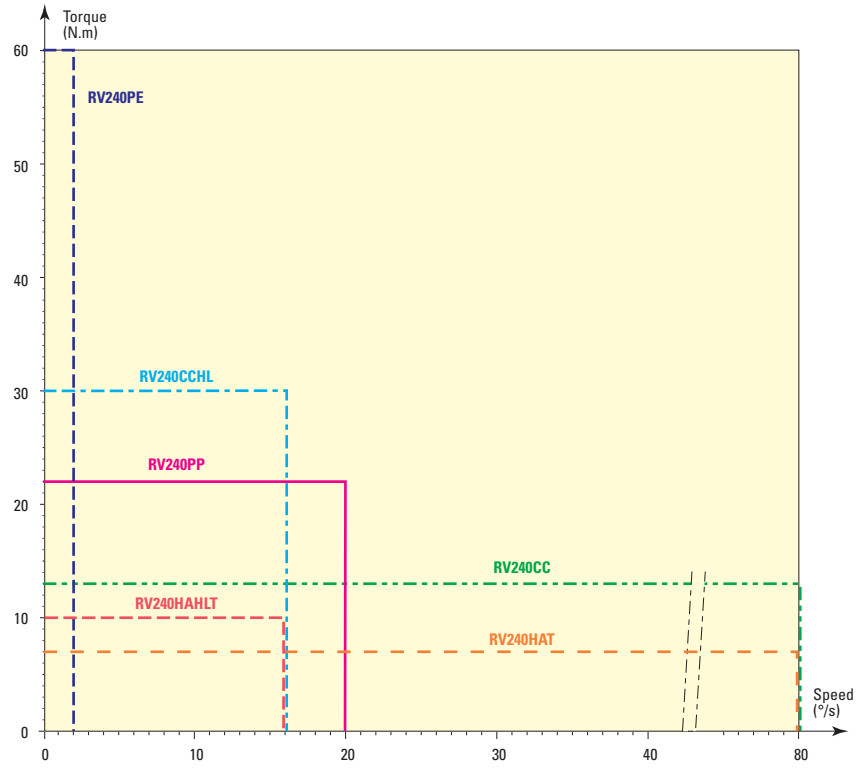
RV160 Rotation Stages



MODEL	$Mz_{max.}$ (N.m)	$V_{max.}$ (°/s)
RV160PP	20	20
RV160PE	35	2
RV160CC	11	80
RV160CCHL	20	16
RV160HAT	6	80
RV160HAHLT	8	16

with:
$Mz_{max.}$ = Maximum torque
$V_{max.}$ = Maximum allowed speed

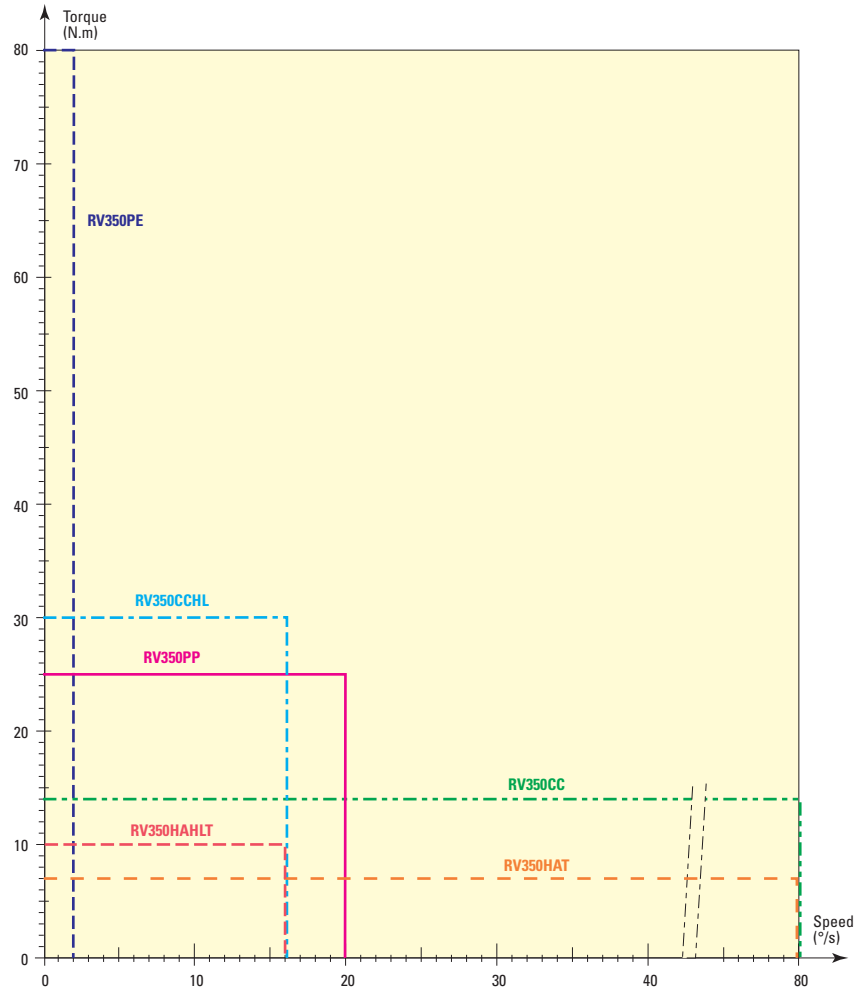
RV240 Rotation Stages



MODEL	$Mz_{max.}$ (N.m)	$V_{max.}$ (°/s)
RV240PP	22	20
RV240PE	60	2
RV240CC	13	80
RV240CCHL	30	16
RV240HAT	7	80
RV240HAHLT	10	16

with:
$Mz_{max.}$ = Maximum torque
$V_{max.}$ = Maximum allowed speed

RV350 Rotation Stages



MODEL	$Mz_{max.}$ (N.m)	$V_{max.}$ (°/s)
RV350PP	25	20
RV350PE	80	2
RV350CC	14	80
RV350CCHL	30	16
RV350HAT	7	80
RV350HAHLT	10	16

with:
$Mz_{max.}$ = Maximum torque
$V_{max.}$ = Maximum allowed speed

3.8 Working Reliability and Safety

The optimum reliability of the components of the stage was ensured right from the initial design phases of the RV rotation stages. CETIM participated in this study and ensured the conformity of the approach used.

Several tests were conducted in order to guarantee the safety of working with a minimum level of maintenance.

Reliability Criteria

Version	MTBF
RV-PP RV-CC RV-HAT	20,000 h
RV-PE RV-CCHL RV-HAHL RV-HAHLT	10,000 h



ATTENTION

The MTBF values are given for conditions of use of our rotation stages in which the load and speed are in keeping with the specifications.

3.9 Rotation Stage Weights

Weights indicated into the below table are average values for rotation stages with a typical drive unit installed.

	Weight [lb (kg)]	
	Except HAT version	HAT version
RV120	14.3 (6.5)	17.6 (8.0)
RV160	19.8 (9.0)	24.2 (11.0)
RV240	35.3 (16.0)	41.9 (19.0)
RV350	57.5 (27.0)	72.8 (33.0)
3-meter MMCABLE-3 Cable	1.54 (0.7)	
3-meter MCAB-3 Cable	1.32 (0.6)	

The weight variation between drive units is not very significant.

4.0 Drive

4.1 Stepper Drive Versions

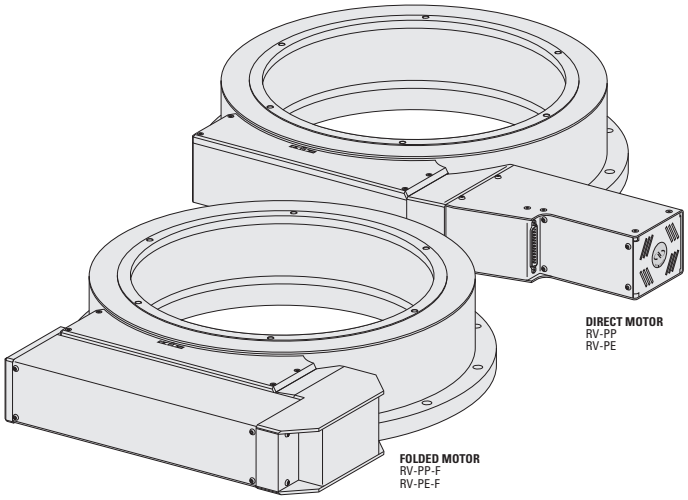
Stepper motor-driven versions are available in 2 variations:

- One mini-step drive version (PP) with 1/10-step per encoder count enabling high angular speed motions up to 20 °/s.
- One full-step version (PE) equipped with an additional step-down gear in order to obtain higher torque values. This version causes no motor heating in static position, and maintains the position, when the power is switched off. It is the recommended motor option for operation in a vacuum.

NOTE

RV-PE rotation stages are primarily designed for applications requiring the direct positioning accuracy to be maintained to within the stage's mechanical resolution when power is switched off, such as operation in vacuum (10^{-6} hPa vacuum preparation on models RV-PEV6, RV-PEV6-F, RV120PEBV6 and RV120PE-FBV6).

In this case, specifications for speed (°/s), load capacity (Cz) and torque (Mz) have to be divided by two.



Mini-Step Drive

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

For these rotation stages a mini-step equals 1/10 of a full step.

Full-Step Drive

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

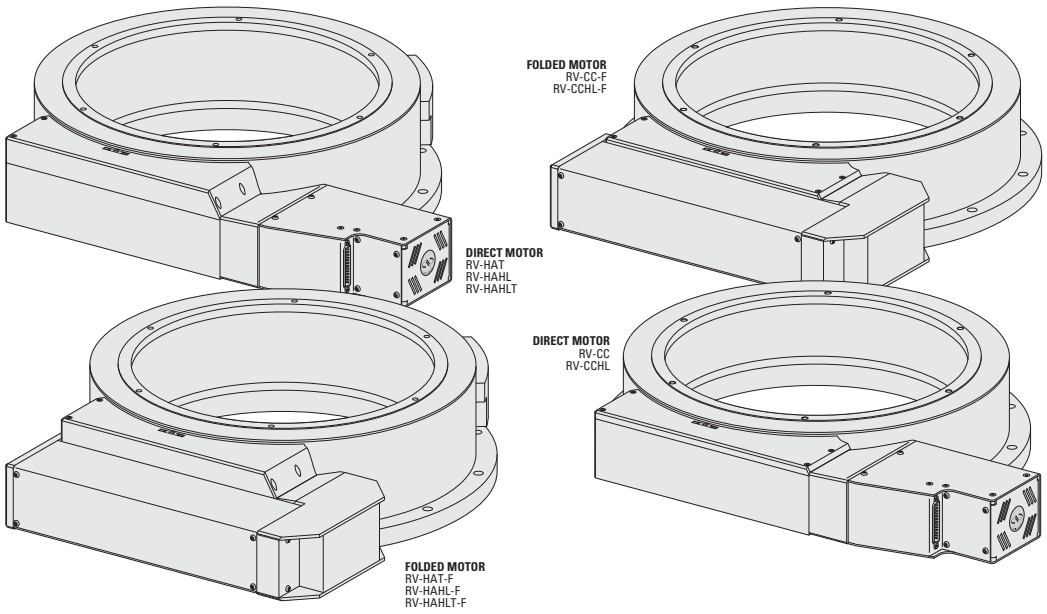
Stepper Motor Performance Specifications

	Resolution (°)	Speed (°/s)	Motor
RV120 to 350PP	0.001	40	UE63PP
RV120PE	0.001	4	UE41PP
RV120PEBV6	0.001	2	UE41PPV6
RV160 to 350PE	0.001	4	UE63PP

4.2 DC-Servo Drive Versions

DC-motor-driven stages are offered in four variations:

- Two high-speed DC-servo versions (CC and HAT) enabling speeds up to 80 °/s. The CCHAT features a high-resolution direct reading encoder and tachometer for superior repeatability, position stability and speed regulation.
- Two high-torque DC-servo versions (CCHL and HAHLT) equipped with a step-down gear to provide superior torque and maximum inertia values. The HAHLT version features a high-resolution direct reading encoder and tachometer for superior repeatability, position stability and speed regulation.



DC-Motor Performance Specifications

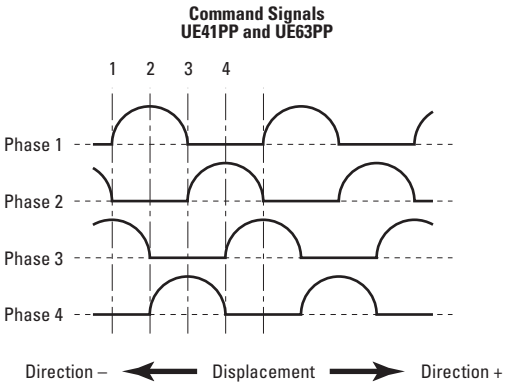
	Resolution (°)	Speed (°/s)	Motor
RV120 to 350CC	0.001	80	UE511S
RV120HAT	0.0001	80	UE511S-T
RV160HAT	0.000075	80	UE511S-T
RV240HAT	0.00005	80	UE511S-T
RV350HAT	0.000035	80	UE511S-T
RV120CCHL	0.001	16	UE404S
RV160 to 350CCHL	0.001	16	UE511S
RV120HAHL	0.0001	16	UE40CC
RV160HAHLT	0.000075	16	UE511S-T
RV240HAHLT	0.00005	16	UE511S-T
RV350HAHLT	0.000035	16	UE511S-T

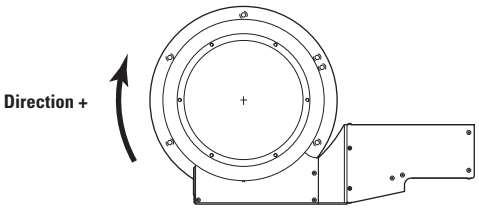
5.0 Motor

5.1 Stepper Motor Characteristics

Motor	Angle by Step (°)	RMS Current per Phase (A)	Resistance (Ω)	Inductance (mH)	Newport Utilization
UE41PP	1.8	0.61	2.9	3.4	Full-Step or Mini-Step
UE41PPV6	1.8	0.23	5.7	11.3	Full-Step
UE63PP	1.8	1.56	1.16	2.9	Mini-step

5.2 Command Signals for the Stepper Motors

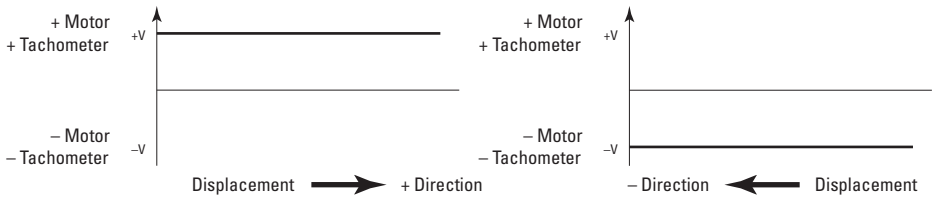


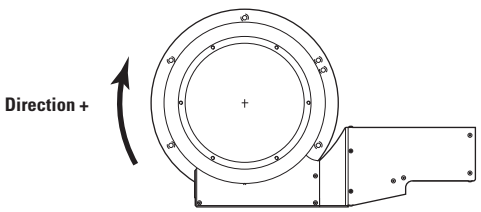


5.3 DC-Motor Characteristics

Motor	Nominal Voltage (V)	Max. RMS Current (A)	Max. Peak Current (A)	Resistance (Ω)	Inductance (mH)	Tachometer Const. (V/krpm)
UE404S	48	1.35	2.7	1.75	0.47	–
UE40CC	48	2	4	1.16	0.329	–
UE511S	48	2	4	1.57	1.04	–
UE511S-T	48	2	4	1.57	1.04	7 (±10%)

5.4 Command Signals for the DC-Motors



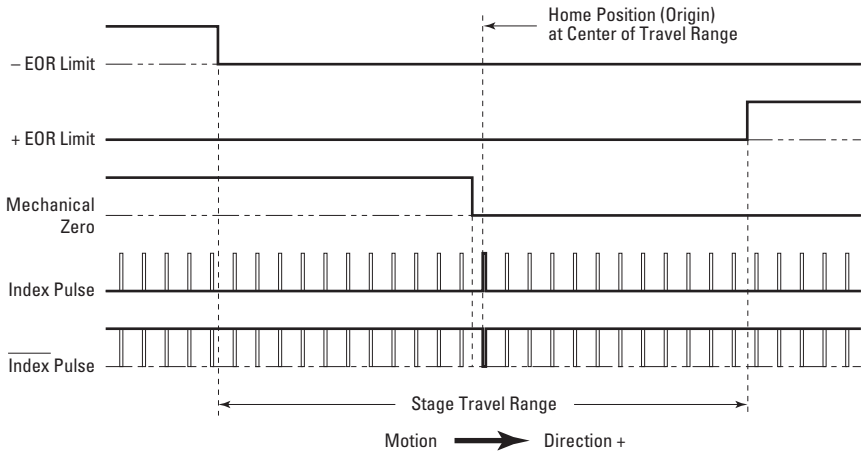


In the above drawings, + Motor signal is referred to – Motor signal,
+ Tacho Generator signal is referred to – Tacho Generator signal.

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.

5.5 Sensor Position



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

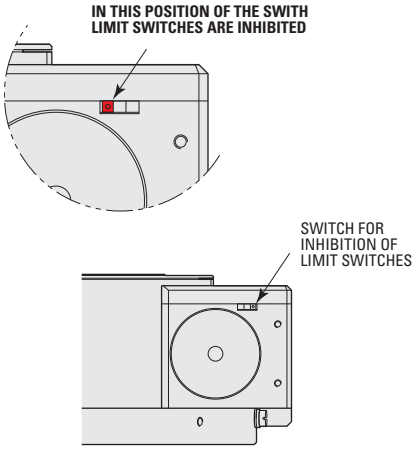
The Index Pulse provides a repeatable Home Position at ±1 step.

CAUTION

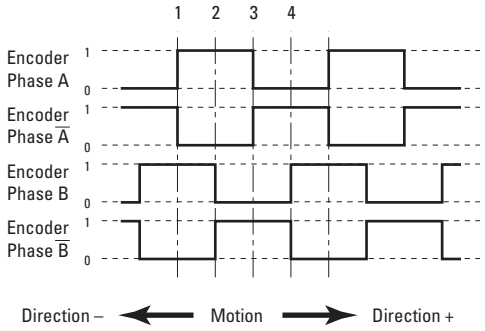
"End-of-Run" and "Mechanical Zero" are active signals and should not be connected to any other source.

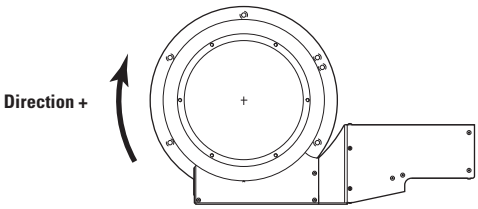
5.6 Inhibition of Limit Switches

In standard, except for HAT, HAHL & HAHLT versions, RV 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.

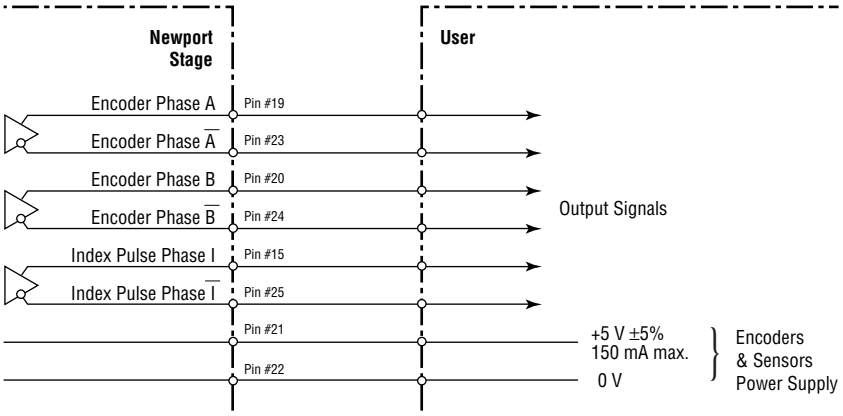


5.7 Feedback Signal Position

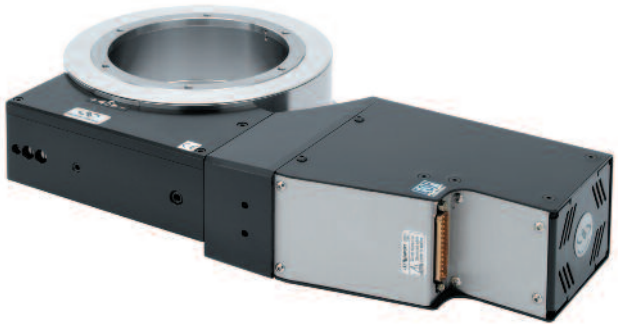




The incremental sensor consists of a optical scale and an encoder head. When the carriages of the stage move, the encoder head generates square signals in quadrature, sent to pins #19, #20, #23 and #24 of the SUB-D25 connector.



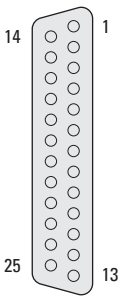
"Encoder" and "Index Pulse" are "differential pair" (type RS-422) type output signals. Using these signals permits a high immunity to noise. Emission circuits generally used by Newport are 26LS31 or MC3487. Reception circuits to use are 26LS32 or MC3486.



RV160 rotation stage.

5.8 Pinouts

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



	UE41PP, UE41PPV6 & UE63PP		UE40CC, UE404S & UE511S		UE511S-T
1	Phase 1	**1**	N.C.	**1**	+ Tachometer
2	Phase 1	**2**	N.C.	**2**	+ Tachometer
3	Phase 2	**3**	N.C.	**3**	– Tachometer
4	Phase 2	**4**	N.C.	**4**	– Tachometer
5	Phase 3	**5**	+ Motor	**5**	+ Motor
6	Phase 3	**6**	+ Motor	**6**	+ Motor
7	Phase 4	**7**	– Motor	**7**	– Motor
8	Phase 4	**8**	– Motor	**8**	– Motor
9	N.C.	**9**	N.C.	**9**	N.C.
10	N.C.	**10**	N.C.	**10**	N.C.
11	N.C.	**11**	N.C.	**11**	N.C.
12	N.C.	**12**	N.C.	**12**	N.C.
13	Mechanical Zero	**13**	Mechanical Zero	**13**	Mechanical Zero
14	Shield Ground	**14**	Shield Ground	**14**	Shield Ground
15	Index Pulse I	**15**	Index Pulse I	**15**	Index Pulse I
16	0 V logic	**16**	0 V logic	**16**	0 V logic
17	+ End-of-Run	**17**	+ End-of-Run	**17**	+ End-of-Run
18	– End-of-Run	**18**	– End-of-Run	**18**	– End-of-Run
19	Encoder Phase A	**19**	Encoder Phase A	**19**	Encoder Phase A
20	Encoder Phase B	**20**	Encoder Phase B	**20**	Encoder Phase B
21	+5 V Encoder	**21**	+5 V Encoder	**21**	+5 V Encoder
22	0 V Encoder	**22**	0 V Encoder	**22**	0 V Encoder
23	Encoder Phase /A	**23**	Encoder Phase /A	**23**	Encoder Phase /A
24	Encoder Phase /B	**24**	Encoder Phase /B	**24**	Encoder Phase /B
25	Index Pulse /I	**25**	Index Pulse /I	**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

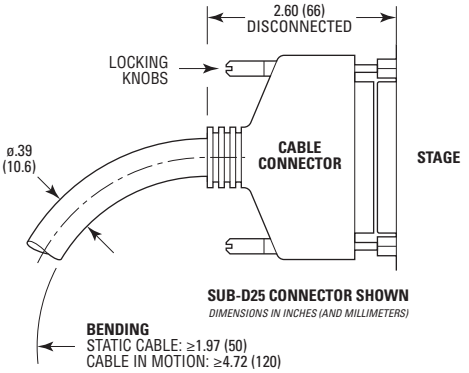
Our stages are delivered with a **MMCABLE-3** or **MCAB-3** 3-meter cable according to the RV rotation stage you bought. This cable is equipped with a SUB-D25M connector so it can be directly connected to our controllers/drivers.

The cable supplied with your RV rotation stages is given in the following table:

	Model			
Type	**RV120**	**RV160**	**RV240**	**RV350**
RV-PP RV-PP-F	MMCABLE-3	MMCABLE-3	MMCABLE-3	MMCABLE-3
RV-PE RV-PE-F	MMCABLE-3	MMCABLE-3	MMCABLE-3	MMCABLE-3
RV-PEV6 RV-PEV6-F	–	MMCABLE-3	MMCABLE-3	MMCABLE-3
RV-PEBV6 RV-PE-FBV6	MCAB-3	–	–	–
RV-CC RV-CC-F	MCAB-3	MCAB-3	MCAB-3	MCAB-3
RV-CCHL RV-CCHL-F	MCAB-3	MCAB-3	MCAB-3	MCAB-3
RV-HAT RV-HAT-F	MCAB-3	MCAB-3	MCAB-3	MCAB-3
RV-HAHL RV-HAHL-F	MCAB-3	–	–	–
RV-HAHLT RV-HAHLT-F	–	MCAB-3	MCAB-3	MCAB-3

6.4 MMCABLE-3 Cable





WARNING

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

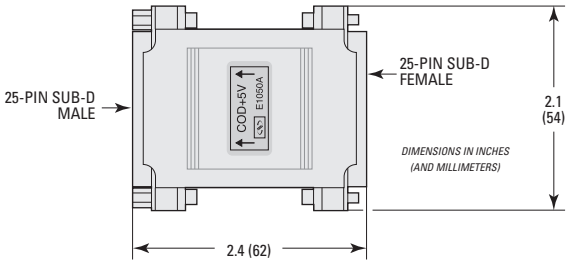
For applications where the standard 3-meter cable (**MMCABLE-3**) included with your rotation stage is not adequate, Newport offers longer length cables designed to ensure the integrity of your positioning application.

These cables are specially shielded and terminated with Newport's standard SUB-D25 connectors. They are available in 5-m (**MMCABLE-5**), 7-m (**MMCABLE-7**) or 10-m (**MMCABLE-10**) lengths.

WARNING

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

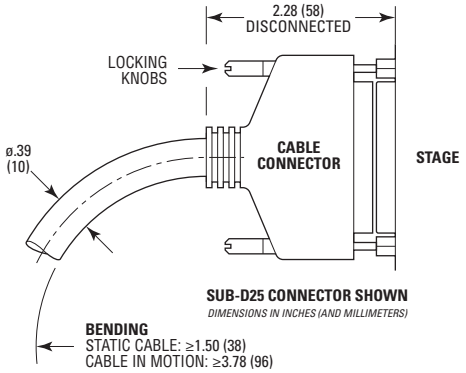
For cable lengths in excess of 3 meters, we recommend the **MMCABLE-REG** to ensure a high quality, regulated 5 V supply to the rotation stages.



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.

6.5 MCAB-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 (**MCAB-3**) included with 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**), 7-m (**MCAB-7**) or 10-m (**MCAB-10**) lengths.

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 RV stage when it is used with non- Newport controllers.

WARNING

Newport guarantees "CE" compliance of the RV stage only if they are used with Newport cables and controllers.

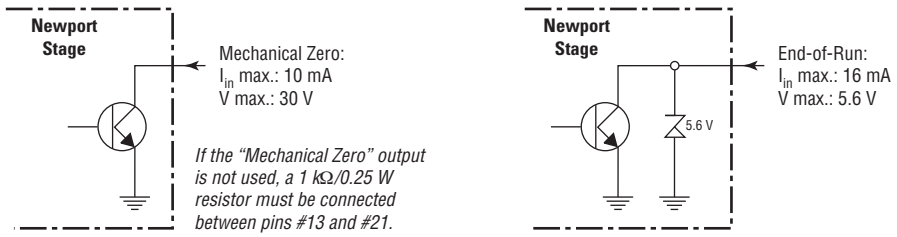
Nevertheless, the figure below shows the wiring when a RV stage is used with non-Newport controllers.



Sub-D25 male Connector	Connection UE41PP, UE41PPV6 & UE63PP	Connection UE40CC, UE404S & UE511S	Connection UE511S-T
1	Phase 1	N.C.	+ Tachometer
2	Phase 1	N.C.	+ Tachometer
3	Phase 2	N.C.	– Tachometer
4	Phase 2	N.C.	– Tachometer
5	Phase 3	+ Motor	+ Motor
6	Phase 3	+ Motor	+ Motor
7	Phase 4	– Motor	– Motor
8	Phase 4	– Motor	– Motor
14	Ground	Ground	Ground
16	0 V logic	0 V logic	0 V logic
13	Mechanical Zero [1]	Mechanical Zero [1]	Mechanical Zero [1]
19	Encoder Phase A	Encoder Phase A	Encoder Phase A
23	Encoder Phase /A	Encoder Phase /A	Encoder Phase /A
20	Encoder Phase B	Encoder Phase B	Encoder Phase B
24	Encoder Phase /B	Encoder Phase /B	Encoder Phase /B
15	Index Pulse I	Index Pulse I	Index Pulse I
25	Index Pulse /I	Index Pulse /I	Index Pulse /I
17	+ End-of-Run [2]	+ End-of-Run [2]	+ End-of-Run [2]
18	– End-of-Run [2]	– End-of-Run [2]	– End-of-Run [2]
21	+5 V Encoder	+5 V Encoder	+5 V Encoder
22	0 V Encoder	0 V Encoder	0 V Encoder
Connector Cap	Connector Cap	Connector Cap	Connector Cap

[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 Mounting

WARNING

Before operating the RV rotation stage, you must fix it in one of the following ways:

- **Directly on the rectified working surface.**
- **To another stage, directly or indirectly using an assembly interface.**

The rotation stage must, under no circumstances, remain unfixed.
It is equally necessary to fix the object to be moved on the carriage.

CAUTION

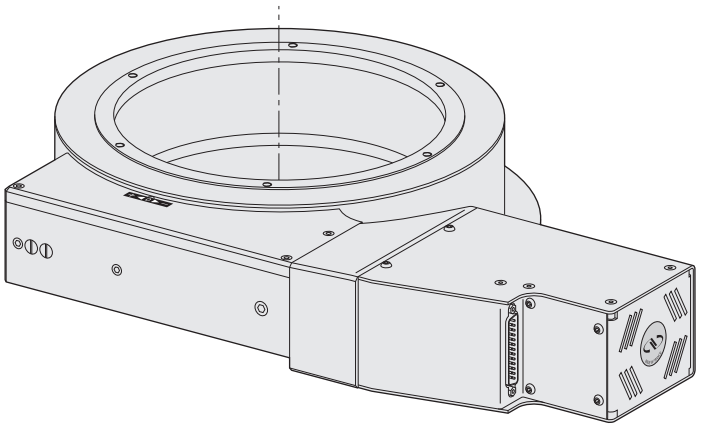
The flatness of the working surface has a direct impact on the performance levels of the rotation stages.

The mounting interfaces of RV rotation stages are illustrated in the diagrams given at the end of this manual (see Chapter: “Dimensions”).

CAUTION

Do not use a fastener screw whose length exceeds the working depth values given in the diagrams. Otherwise, the internal components of the rotation stage may be damaged.

8.1 Horizontal Rotation Stages (Vertical Rotation Axis)



The RV rotation stage is fixed on a horizontal surface. The external flange has various holes provided for fastening.

The 3-point fastening method is recommended for mounting surfaces whose flatness need not be very accurate.

This fastening method guarantees a minimum constraint on the rotation stage, and consequently produces a better wobble.

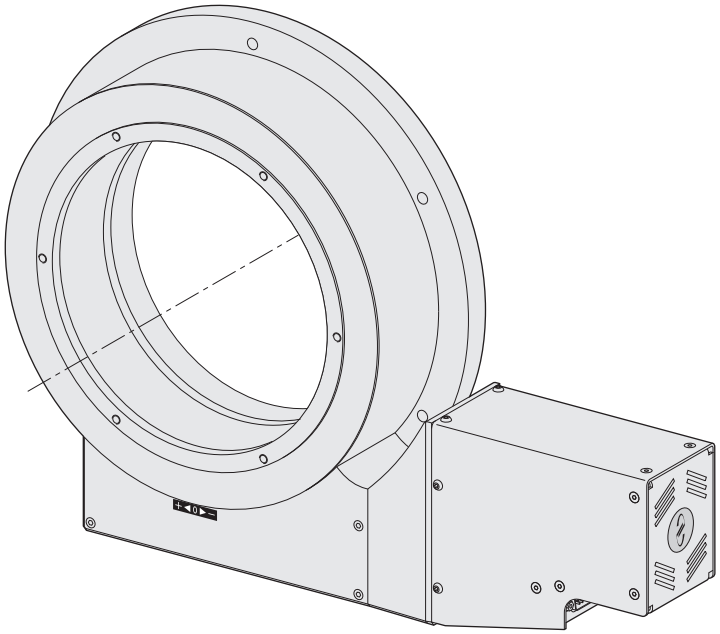
This fastening method is not recommended when high levels of stiffness are required.

The 3-point fastening method uses 3 holes equidistant from each other at 120°, on the external flange.

The 5-point fastening method produces better results in terms of stiffness. This type of fastening requires a mounting surface whose flatness is extremely accurate in order to obtain the best positioning accuracy (wobble). For all RV stages, a flatness accuracy of 5 µm is required.

The 5-point fastening method uses 5 holes equidistant from each other, on the external flange.

8.2 Vertical Rotation Stages (Horizontal Rotation Axis)



The RV rotation stage is fixed on a vertical surface. The external flange has various holes provided for fastening.

This type of stage is fixed using the same fastening methods as for the horizontal rotation stage (3 or 5 fastening points). The same precautions are applicable as well.

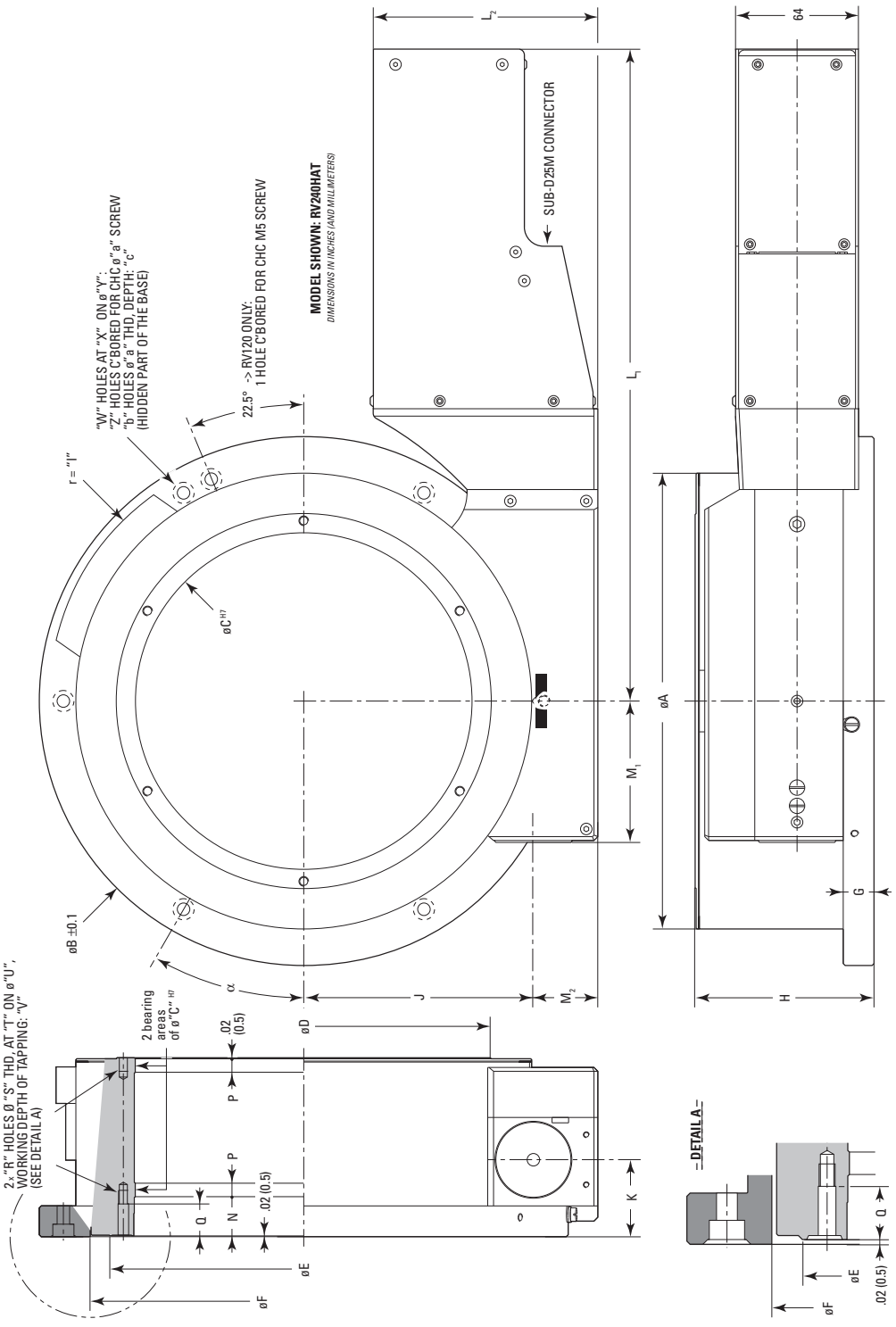
ATTENTION

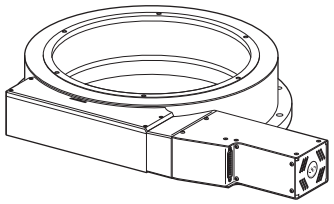
When using a connection angle, ensure that its stiffness is calculated in conformity with the required specifications of the geometry of the movement.

Contact Newport for high-accuracy mounting.

8.0 Dimensions

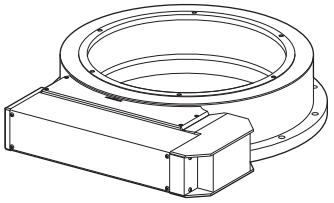
9.1 RV120 to RV350 Rotations Stages





ROTATION STAGE, DIRECT MOTOR

MODEL	L_1				M_1	L_2	M_2
	PP	PE	CC	CCHL			
RV120	9.90 (251.5)	9.90 (251.5)	9.90 (251.5)	11.87 (301.5)	1.79 (45.5)	4.61 (117)	1.32 (33.5)
RV160	10.39 (264)	12.36 (314)	10.39 (264)	12.36 (314)	2.13 (54)		
RV240	11.38 (289)	13.35 (339)	11.38 (289)	13.35 (339)	2.89 (73.5)		
RV350	12.40 (315)	14.37 (365)	12.40 (315)	14.37 (365)	4.13 (105)		



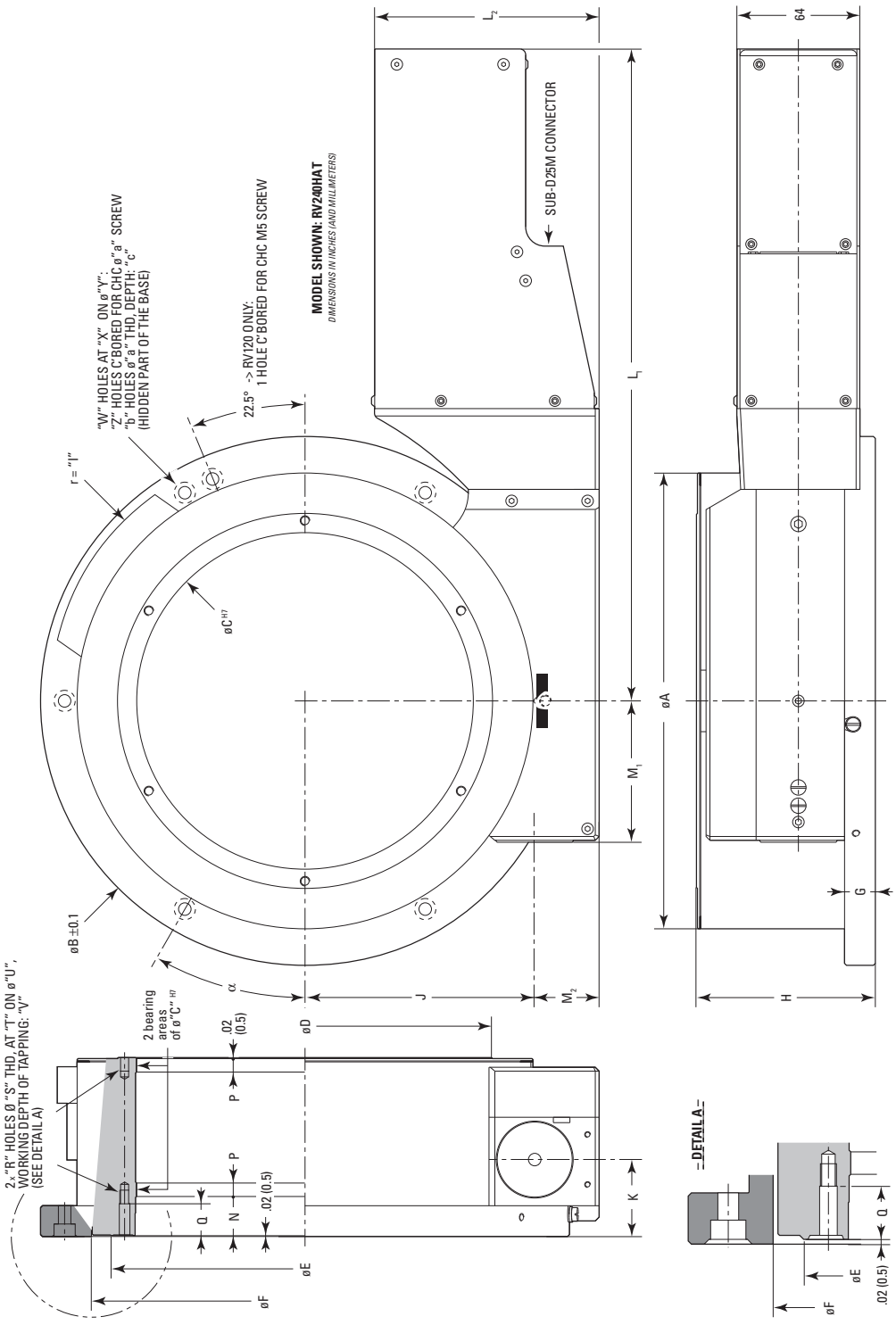
ROTATION STAGE, FOLDED MOTOR

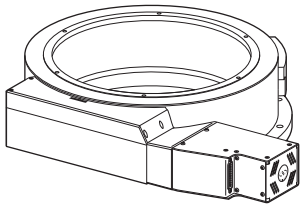
MODEL	L_1	M_1	L_2	M_2
RV120	6.12 (155.5)	2.15 (54.5)	6.32 (160.5)	4.35 (110.5)
RV160	6.61 (168)	2.48 (63)		
RV240	7.60 (193)	3.25 (82.5)		
RV350	8.62 (219)	4.49 (114)		

MODEL	A	B	C	D	E	F	G	H	I	J	K	N	P	Q
RV120	4.96 (126)	6.10 (155)	3.07 (78)	3.66 (93)	3.90 (99)	4.55 (115.5)	.55 (14)	3.39 (86)	3.15 (80)	2.48 (63)	1.34 (34)	.75 (19)	.16 (4)	.59 (15)
RV160	6.42 (163)	7.56 (192)	4.33 (110)	5.08 (129)	5.28 (134)	5.98 (152)	.55 (14)	3.50 (89)	3.86 (98)	3.21 (81.5)	1.42 (36)	.73 (18.5)	.20 (5)	.57 (14.5)
RV240	9.33 (237)	10.83 (275)	6.89 (175)	7.64 (194)	8.03 (204)	8.74 (222)	.63 (16)	3.66 (93)	5.22 (132.5)	4.70 (119.5)	1.58 (40)	.80 (20.3)	.28 (7)	.65 (16.6)
RV350	14.02 (356)	15.55 (395)	11.02 (280)	11.89 (302)	12.40 (315)	13.05 (331.5)	.69 (17.5)	4.25 (108)	7.44 (189)	7.05 (179)	1.97 (50)	.84 (21.3)	.31 (8)	.68 (17.3)

MODEL	R	S	T	U	V	W	X	Y	Z	a	b	c	α
RV120	4	M4	90°	3.44 (87.5)	.24 (6)	6	60°	5.39 (137)	5	M5	1	7	17.5°
RV160	6	M5	60°	4.72 (120)	.28 (7)	6	60°	6.85 (174)	5	M5	1	7	25°
RV240	6	M5	60°	7.38 (187.5)	.28 (7)	6	60°	9.84 (250)	5	M6	1	10	30°
RV350	6	M6	60°	11.61 (295)	.28 (7)	12	30°	14.65 (372)	10	M8	2	12	10°

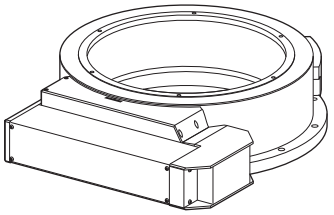
9.2 RV-HA & RV-HAT Versions





ROTATION STAGE, DIRECT MOTOR

MODEL	L_1		M_1	L_2	M_2
	HAT	HAHL & HAHLT			
RV120	11.87 (301.5)	11.87 (301.5)	1.79 (45.5)	4.61 (117)	1.32 (33.5)
RV160	12.36 (314)	14.06 (357)	2.13 (54)		
RV240	13.35 (339)	15.04 (382)	2.89 (73.5)		
RV350	14.37 (365)	16.06 (408)	4.13 (105)		



ROTATION STAGE, FOLDED MOTOR

MODEL	L_1	M_1		L_2	M_2
		HAT-F	HAHLT & HAHLT-F		
RV120	6.12 (155.5)	2.15 (54.5)	3.13 (79.5)	6.32 (160.5)	4.35 (110.5)
RV160	6.61 (168)	2.48 (63)	4.23 (107.5)		
RV240	7.60 (193)	3.25 (82.5)	3.25 (82.5)		
RV350	8.62 (219)	4.49 (114)	4.49 (114)		

MODEL	A	B	C	D	E	F	G	H	I	J	K	N	P	Q
RV120	4.96 (126)	6.10 (155)	3.07 (78)	3.66 (93)	3.90 (99)	4.55 (115.5)	.55 (14)	3.39 (86)	3.15 (80)	2.48 (63)	1.34 (34)	.75 (19)	.16 (4)	.59 (15)
RV160	6.42 (163)	7.56 (192)	4.33 (110)	5.08 (129)	5.28 (134)	5.98 (152)	.55 (14)	3.50 (89)	3.86 (98)	3.21 (81.5)	1.42 (36)	.73 (18.5)	.20 (5)	.57 (14.5)
RV240	9.33 (237)	10.83 (275)	6.89 (175)	7.64 (194)	8.03 (204)	8.74 (222)	.63 (16)	3.66 (93)	5.22 (132.5)	4.70 (119.5)	1.58 (40)	.80 (20.3)	.28 (7)	.65 (16.6)
RV350	14.02 (356)	15.55 (395)	11.02 (280)	11.89 (302)	12.40 (315)	13.05 (331.5)	.69 (17.5)	4.25 (108)	7.44 (189)	7.05 (179)	1.97 (50)	.84 (21.3)	.31 (8)	.68 (17.3)

MODEL	R	S	T	U	V	W	X	Y	Z	a	b	c	α
RV120	4	M4	90°	3.44 (87.5)	.24 (6)	6	60°	5.39 (137)	5	M5	1	7	17.5°
RV160	6	M5	60°	4.72 (120)	.28 (7)	6	60°	6.85 (174)	5	M5	1	7	25°
RV240	6	M5	60°	7.38 (187.5)	.28 (7)	6	60°	9.84 (250)	5	M6	1	10	30°
RV350	6	M6	60°	11.61 (295)	.28 (7)	12	30°	14.65 (372)	10	M8	2	12	10°

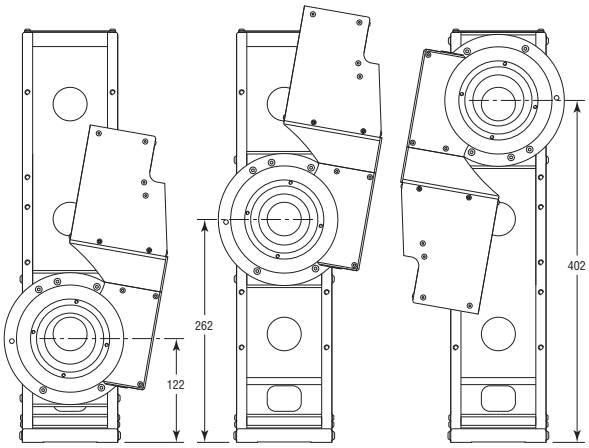
10.0 Accessories: EQ120 & EQ180 Brackets

Newport's EQ120 and EQ180 brackets (to order separately) are ideal for mounting our ILS or IMS Series of linear stages and RV80 to RV160 rotation stages for stable and stiff muti-axis positioning systems.

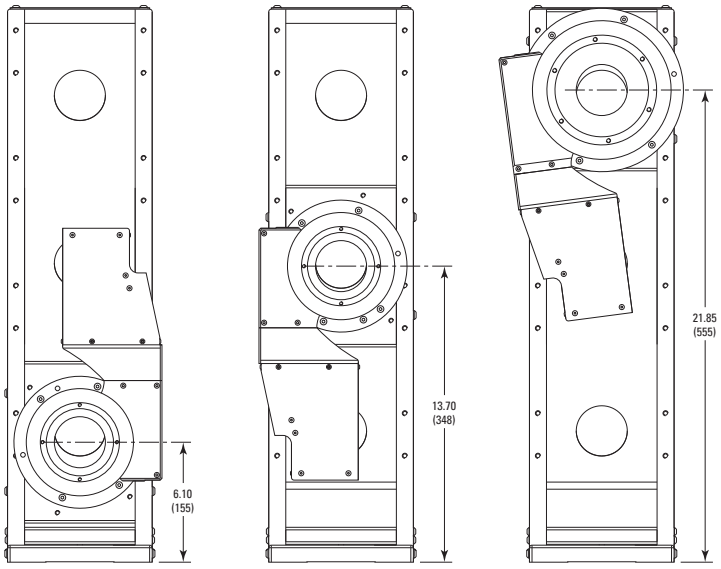


EQ180 bracket on an (M-)IMS stage, with an RV160 in vertical configuration.

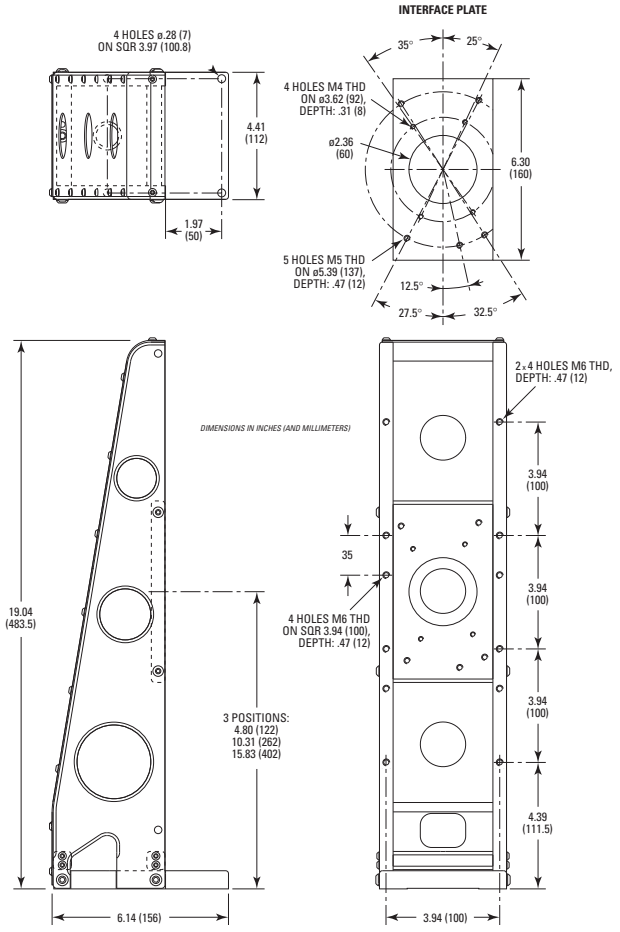
Interface plate position of the EQ120 bracket



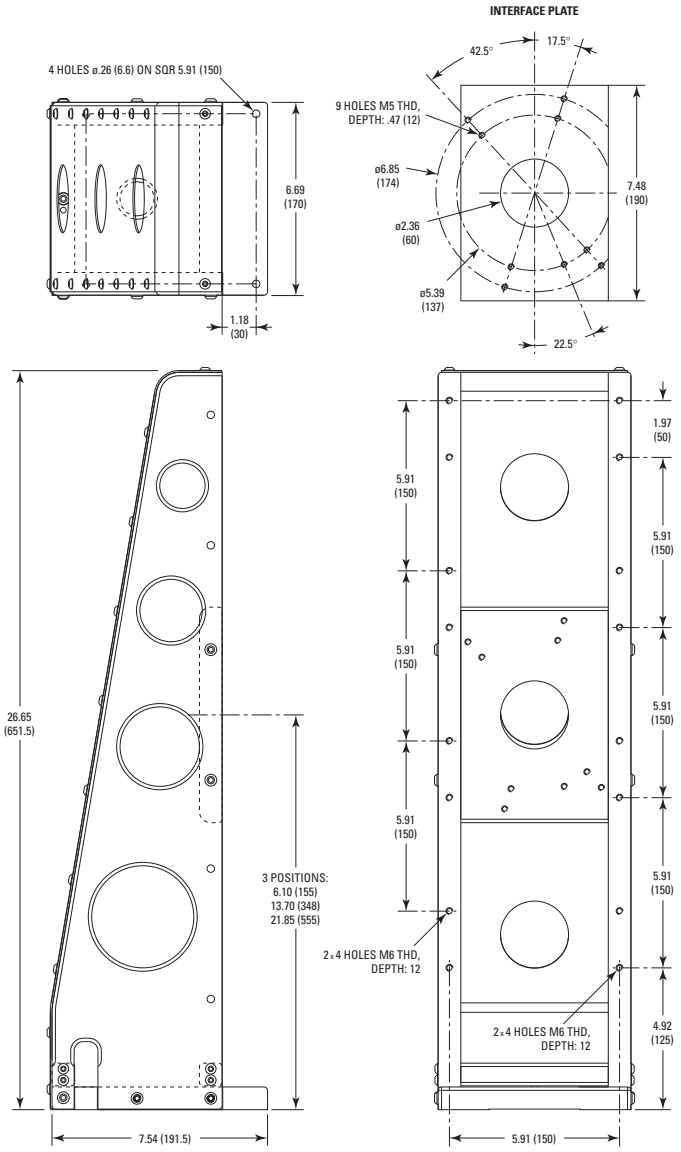
Interface plate position of the EQ180 bracket



EQ120 Bracket



EQ180 Bracket



11.0 Maintenance

RECOMMENDATION

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

11.1 Maintenance

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

PRECAUTIONS

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

RECOMMENDATION

It is recommended to return your RV 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.

11.2 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.

11.3 Calibration



CAUTION

It is recommended to return your RV 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: _____

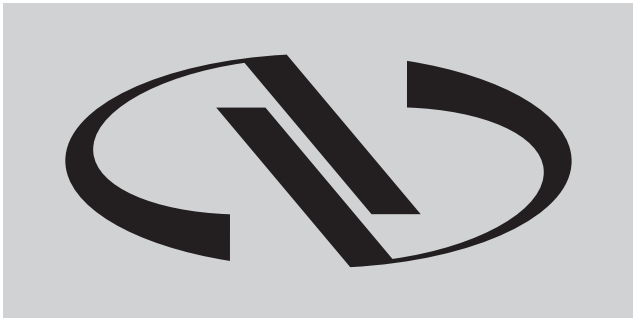
P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

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



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