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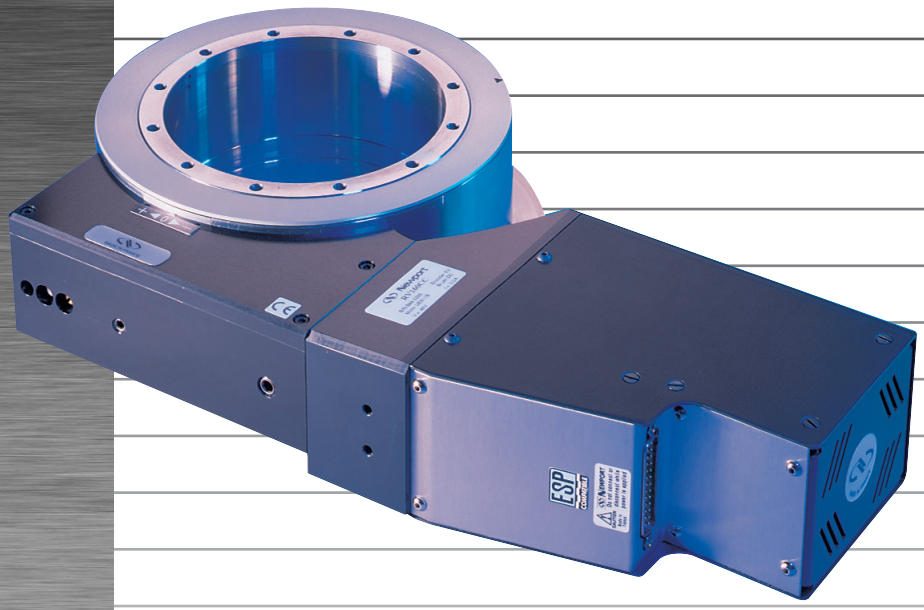
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RV

High-Performance Precision Rotation Stages



USER'S MANUAL

Newport®

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Warranty

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

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

Limitation of Warranty

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

CAUTION

Warranty does not apply to damages resulting from:

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

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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We declare that the accompanying product, identified with the "CE" mark, meets all relevant requirements of Directives:

- 73/23/EEC, for Low Voltage Compatibility.
- 89/336/EEC for Electromagnetic Compatibility.

Generic standard:

Emission: NF EN61326-1, for measurement, lab and control equipment.

Immunity: NF EN61326-1, for measurement, lab and control equipment.

Safety: EIC 1010-1, safety standards for measurement, lab and control equipment.

Newport Corporation shall not be liable for damages when using the product:

- Modification of the product.
- Using modified connector, or modified or not supplied cables.
- Connecting this product to non-CE equipment.

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Warnings

WARNING

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

WARNING

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

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

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

WARNING

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

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

Contact your Newport service facility and request repairs.

WARNING

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

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

Contact your Newport service facility for repairs.

WARNING

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

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

Contact your Newport service facility and request repairs.

WARNING

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

WARNING

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

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Cautions

CAUTION

Do not place this stage in a hostile environment such as X-Rays, hard UV,... or in a vacuum environment less than 10^{-2} Torr.

CAUTION

Do not place this stage in a location affected by dust, oil fumes or steam. 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

To reach the specifications stated for RC, rotation stages must be fixed on a plane surface with a flatness <5 µm.

CAUTION

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

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High-Performance Precision Rotation Stages RV

1.0 Introduction

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

- Direct motor:
  - RVPP
  - RVPE
  - RVPEV6 (1)
  - RVCC
  - RVCCHL
  - RVHAT
  - RVHAHLT
  - RVMS
- Folded motor (except RV80):
  - RVPP-F
  - RVPE-F
  - RVPEV6-F (1)
  - RVCC-F
  - RVCCHL-F
  - RVHAT-F
  - RVHAHLT-F

1) REMARK

Vacuum compatible rotation stages to 10^{-6} Torr. In this case, max. speed and load capacity have to be divided by two.



RV Series rotation stages.

RECOMMENDATION

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

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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 five stage sizes and seven 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°/sec 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 & 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.

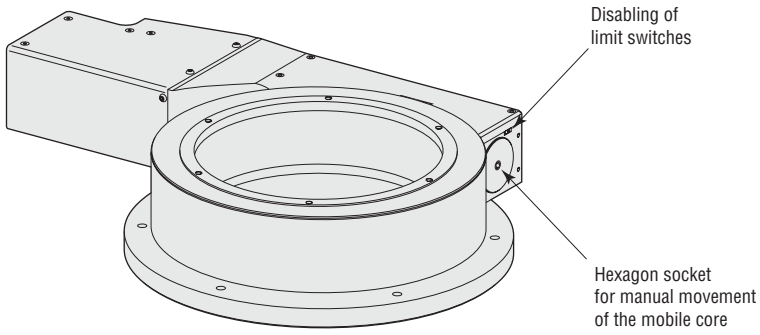
The drive is ensured by a worm and gear located on the rotation part of the stage. The worm/gear ratio is:

- 1/180 for RV80 rotation stages.
- 1/90 for RV120 to RV350 rotation stages.

The position is measured by an encoder placed on the motor shaft (except HAT & HAHLT versions), without tachometer:

- 2000 pts/rev. encoder for RV80 rotation stages.
- 4000 pts/rev. encoder for RV120 to RV350 rotation stages.

The HAT & 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 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.

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ATTENTION

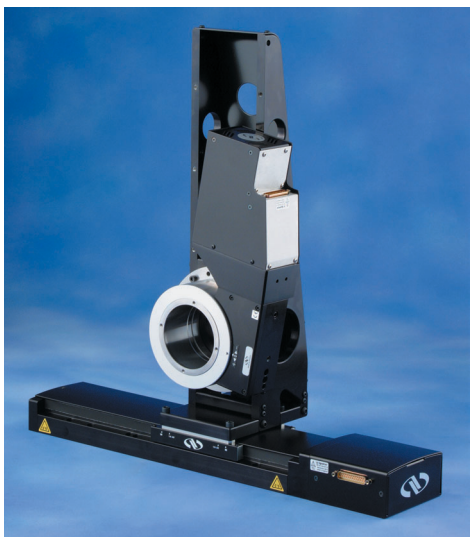
Do not attempt to move the mobile core manually with the rotation stage switched on.

For optimal performance, we recommend the use of our ESP or MM series 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 of ball bearings
Drive Mechanism	Ground worm gear with self compensating preload
Worm Gear Ratio	**RV80**: 1:180 **RV120 to RV350**: 1:90
Reduction Gear	Reduction gear before encoder on some versions (please contact Newport for details)
Feedback	**HAT and HAHLT**: Direct reading optical encoder on the rotating platen **Others**: Worm mounted rotary encoder, 2,000 pts/rev., Index pulse (RV80) or worm mounted rotary encoder, 4,000 pts/rev., Index pulse (RV120-350)
Limit Switches	Optical, at ± 170°, can be disabled for continuous 360° rotation (except HAT and HAHLT)
Origin	Optical
Vacuum Compatibility	Vacuum compatible versions are available up to 10^{-6} Torr using full-step motor (PE)
MTBF	20,000 h



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

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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 the position, precision and repeatability of the machine tools with CNC”.

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

(Absolute) Accuracy

Difference between ideal position and real position.

On-Axis Accuracy

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

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

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

Absolute Accuracy = On-Axis Accuracy + Slope 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 (Sensitivity)

Minimum motion that a rotation stage can achieve. Our rotation stages and our kinematic chain are conceived in such a way that sensitivity is better than the resolution of the encoder.

Resolution

The smallest motion an encoder fixed to the rotation stage can measure.

Concentricity

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.

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The testing of on-axis accuracy, repeatability, and reversal error are made systematically with our test equipment in an air-conditioned room (20 °C ±1 °C).

Each rotation stage is tested with a precision optical encoder.

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

3.2 Mechanical Specifications

Diameter	(mm)	80, 120, 160, 240, 350
Travel Range		
Except HAT & HAHLT versions		360° continuous (1)
HAT & HAHLT versions		±170°
Resolution		
Except HAT & HAHLT versions		0.001°
RV120HAT & HAHLT		0.0001°
RV160HAT & HAHLT		0.000075°
RV240HAT & HAHLT		0.00005°
RV350HAT & HAHLT		0.000035°
Unidirectional Repeatability		
Except HAT & HAHLT versions		0.002°
HAT & HAHLT versions		0.0002°
Reversal Value (Hysteresis)		
Except HAT & HAHLT versions		0.002°
HAT & HAHLT versions		0.001°
Absolute Accuracy		
RV80		0.015°
RV120 to RV350		0.010°
HAT & HAHLT versions		0.005°
Wobble: 3-Point @ 120° Mounting		
RV80		50 µrad
RV120		30 µrad
RV160 & RV240		25 µrad
RV350		30 µrad
Wobble: 5-Point Mounting on a Flat Plane <5 µm		
RV80		40 µrad
RV120 & RV160		20 µrad
RV240 & RV350		16 µrad
Eccentricity		4 µm
Operating Temperature		+10 °C to +35 °C
Storage Temperature		-10 °C to +40 °C (into its original packaging)

1) *With disabled limit switches, see chapter 5.6: "Disabling of Limit Switches".*

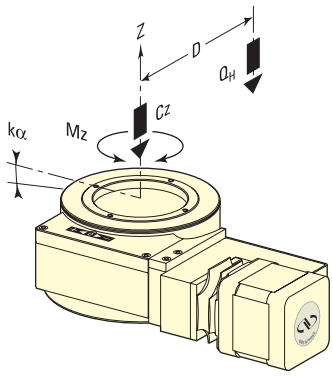
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3.3 Load Specifications Definitions

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.

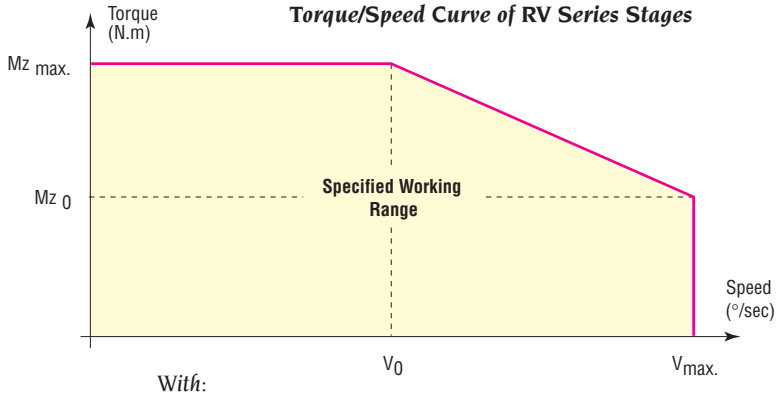
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Torque (Mz)/Speed

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).



Torque/Speed Curve of **RV** *Series Stages*

With:

Mz_0 : *Max. torque at max. allowed speed* (N.*m*).
$Mz_{Max.}$: *Max. torque* (N.*m*).
V_0 : *Max. speed at max. torque* (°/*sec*).
$V_{Max.}$: *Max. allowed speed* (°/*sec*).

3.4 Specifications for RV Rotation Stages with Vacuum Preparation

NOTE

RVPE 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} Torr vacuum preparation on request).

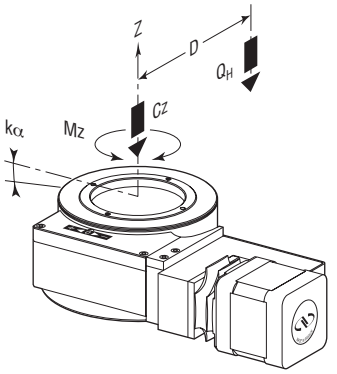
In this case, specifications for speed (°/sec), load capacity (Cz) and torque (Mz) have to be divided by two.

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3.5 Load Specifications

		RV80	RV120	RV160	RV240	RV350
Cz	(N)	900	1800	2700	4000	6500
a	(mm)	30	40	50	70	100
b	(mm)	39	53	57	59	73
		HAT & HAHLT Versions.				
		–	71	75	77	91
kα	(µrad/N.m)	*3-point @ 120° mounting*				
		5	2.5	1.2	0.6	0.25
		5-point mounting on a flatness plane <5 µm				
		3.5	1.5	0.6	0.3	0.1

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

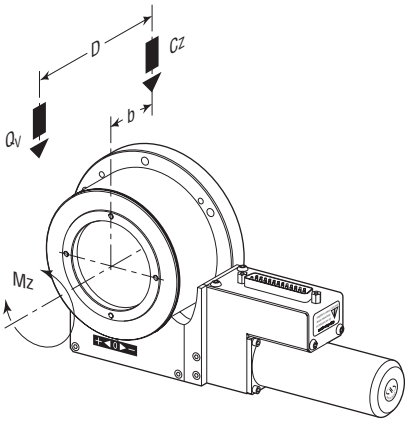
a : Construction parameter

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.

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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.m²)				
Versions	**RV80**	**RV120**	**RV160**	**RV240**	**RV350**
PP	0.1	1	3	4	4
PE	12	70	100	150	220
CC & HAT	0.02	0.2	0.7	1.5	1.5
CCHL & HAHLT	7.5	7	24	38	56

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 msec.

The inertia is expressed in kg.m² and is given with respect to the rotation axis of the RV rotation stage (1 kg.m² 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.m²) and to move a load up to 80 °/sec.

Verification of Other Values

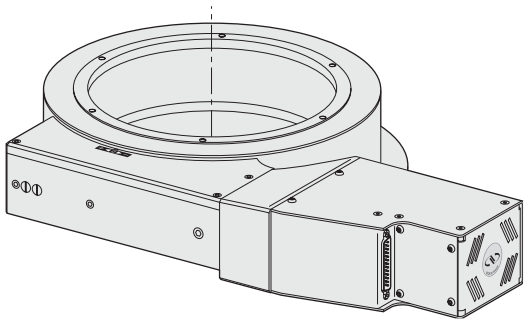
The maximum load capacity at 240 mm from the rotation axis of the RV240 rotation stage is:

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

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

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

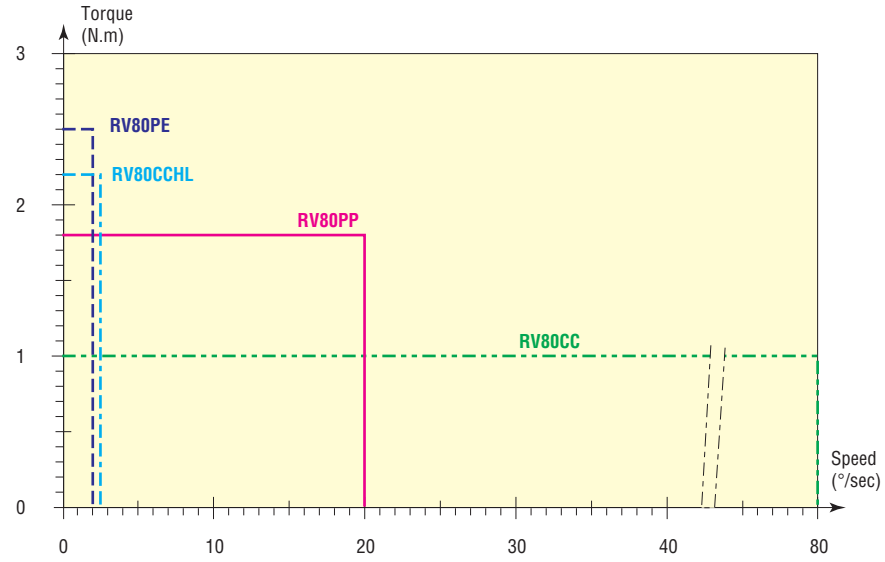
In these conditions, the RV240 rotation stage can be used only in the horizontal position (where the rotation axis is vertical).



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3.7 Torque (Mz)/Speed

RV80 Rotation Stages

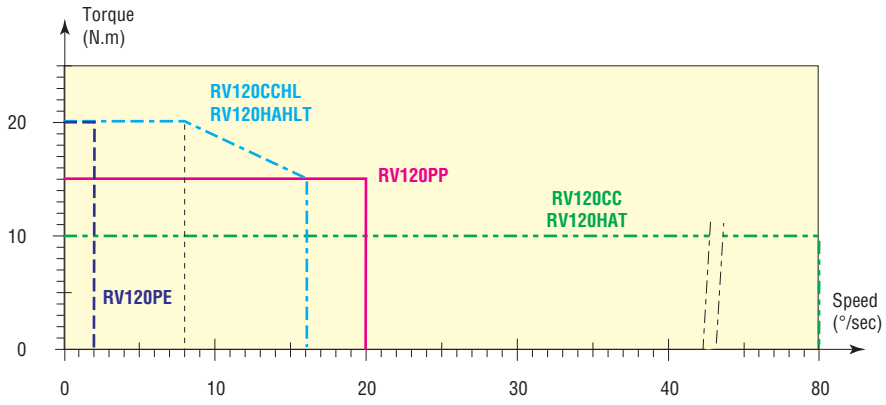


Torque/Speed curve of RV80.

	$Mz_{max.}$ (N.m)	V_0 (°/sec)	Mz_0 (N.m)	$V_{max.}$ (°/sec)
RV80PP	1.8	20	1.8	20
RV80PE	2.5	2	2.5	12
RV80CC	1	80	1	80
RV80CCHL	2.2	2.5	2.2	2.5

with:
Mz_0 : Maximum torque at maximum allowed speed.
$Mz_{max.}$: Maximum torque.
V_0 : Maximum speed at maximum torque.
$V_{max.}$: Maximum allowed speed.

RV120 Rotation Stages



Torque/Speed curve of RV120.

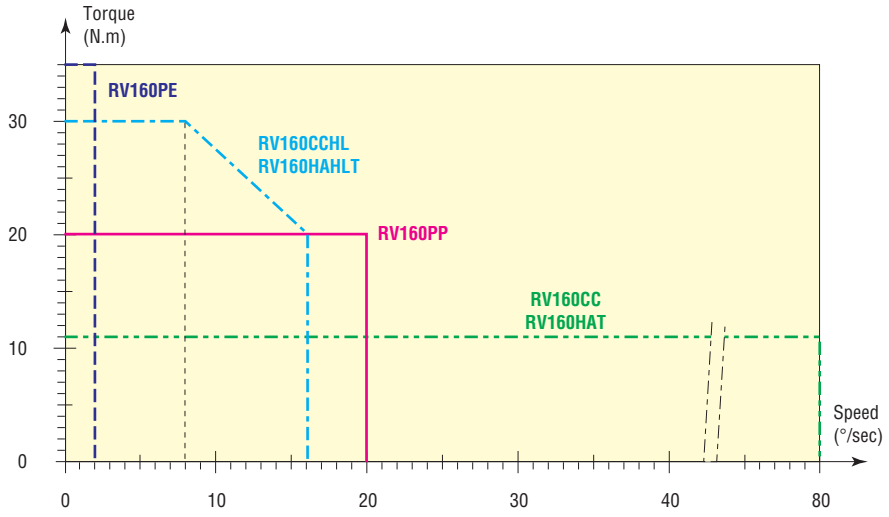
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	$Mz_{max.}$ (N.m)	V_0 (°/sec)	Mz_0 (N.m)	$V_{max.}$ (°/sec)
RV120PP	15	20	15	20
RV120PE	20	2	20	2
RV120CC (1)	10	80	10	80
RV120CCHL (2)	20	8	15	16

1) and RV120HAT — 2) and RV120HAHLT

with:
Mz_0 : Maximum torque at maximum allowed speed.
$Mz_{max.}$: Maximum torque.
V_0 : Maximum speed at maximum torque.
$V_{max.}$: Maximum allowed speed.

RV160 Rotation Stages



Torque/Speed curve of RV160.

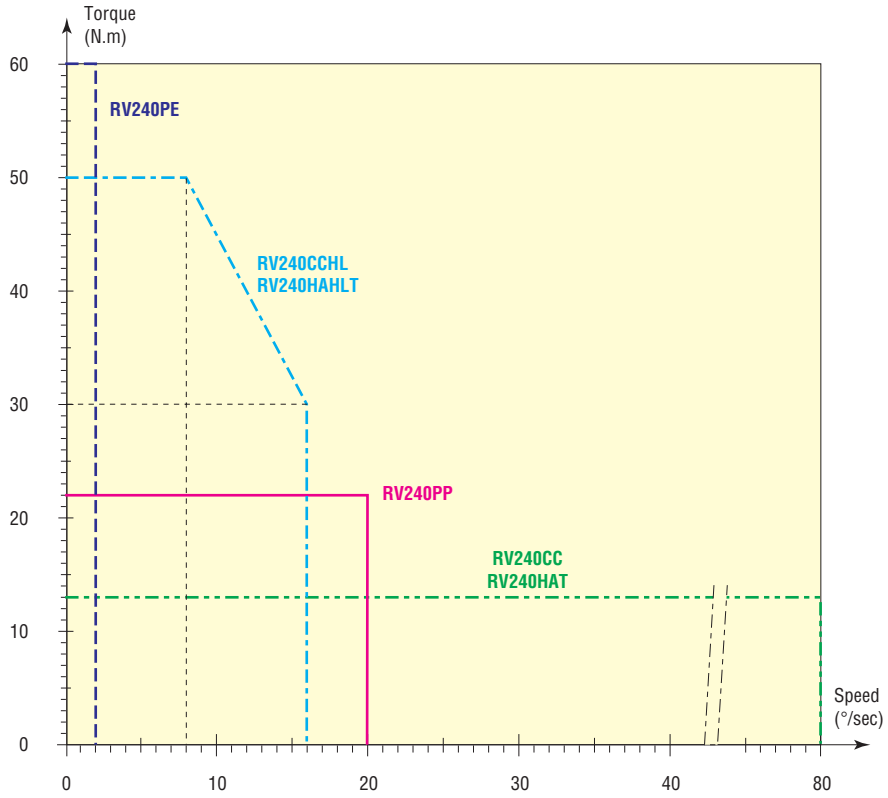
	$Mz_{max.}$ (N.m)	V_0 (°/sec)	Mz_0 (N.m)	$V_{max.}$ (°/sec)
RV160PP	20	20	20	20
RV160PE	35	2	35	2
RV160CC (1)	11	80	11	80
RV160CCHL (2)	30	8	20	16

1) and RV160HAT — 2) and RV160HAHLT

with:
Mz_0 : Maximum torque at maximum allowed speed.
$Mz_{max.}$: Maximum torque.
V_0 : Maximum speed at maximum torque.
$V_{max.}$: Maximum allowed speed.

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RV240 Rotation Stages



Torque/Speed curve of RV240.

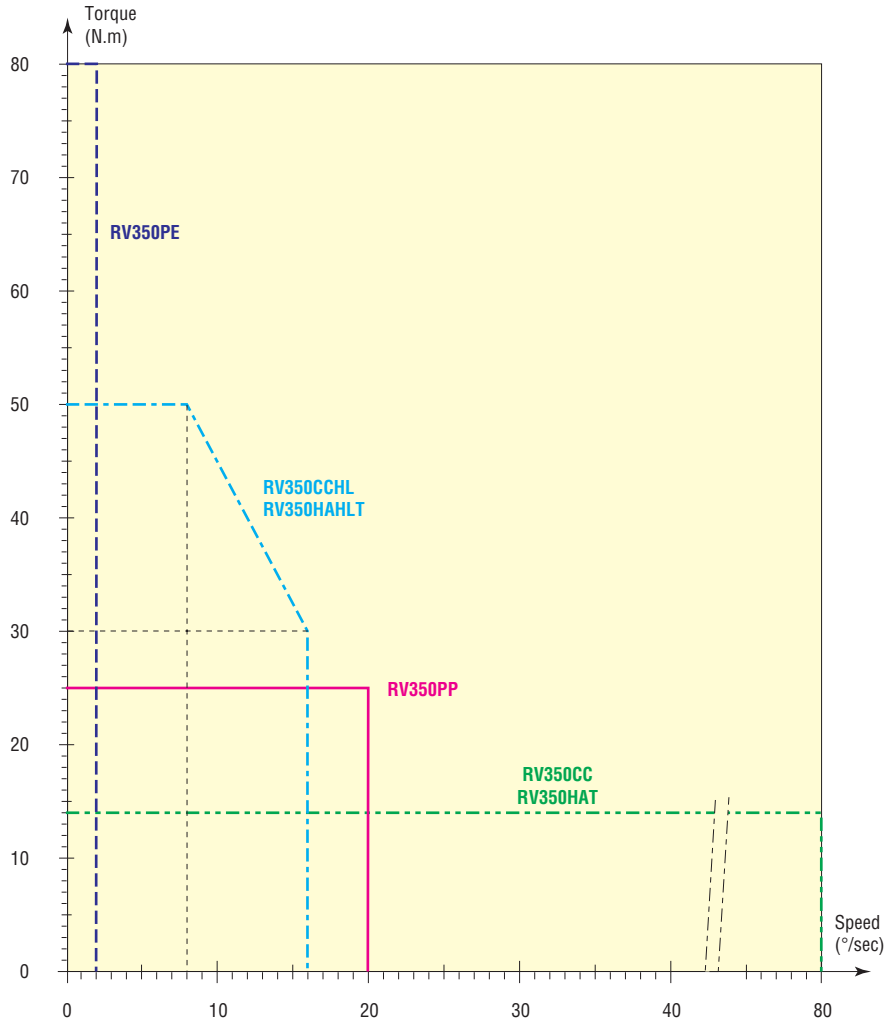
	$Mz_{max.}$ (N.m)	V_0 (°/sec)	Mz_0 (N.m)	$V_{max.}$ (°/sec)
RV240PP	22	20	22	20
RV240PE	60	2	60	2
RV240CC (1)	13	80	13	80
RV240CCHL (2)	50	8	30	16

1) and RV240HAT — 2) and RV240HAHLT

with:
Mz_0 : Maximum torque at maximum allowed speed.
$Mz_{max.}$: Maximum torque.
V_0 : Maximum speed at maximum torque.
$V_{max.}$: Maximum allowed speed.

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RV350 Rotation Stages



Torque/Speed curve of RV350.

	$Mz_{max.}$ (N.m)	V_0 (°/sec)	Mz_0 (N.m)	$V_{max.}$ (°/sec)
RV350PP	25	20	25	20
RV350PE	80	2	80	2
RV350CC (1)	14	80	14	80
RV350CCHL (2)	50	8	30	16

1) and RV350HAT — 2) and RV350HAHLT

with:
Mz_0 : Maximum torque at maximum allowed speed.
$Mz_{max.}$: Maximum torque.
V_0 : Maximum speed at maximum torque.
$V_{max.}$: Maximum allowed speed.

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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
RVPP RVCC RVHAT	20,000 h
RVPE RVCCHL RVHAHLT	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.

	Except HAT version [lb (kg)]	HAT version [lb (kg)]
RV80	4.0 (1.8)	–
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)

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:

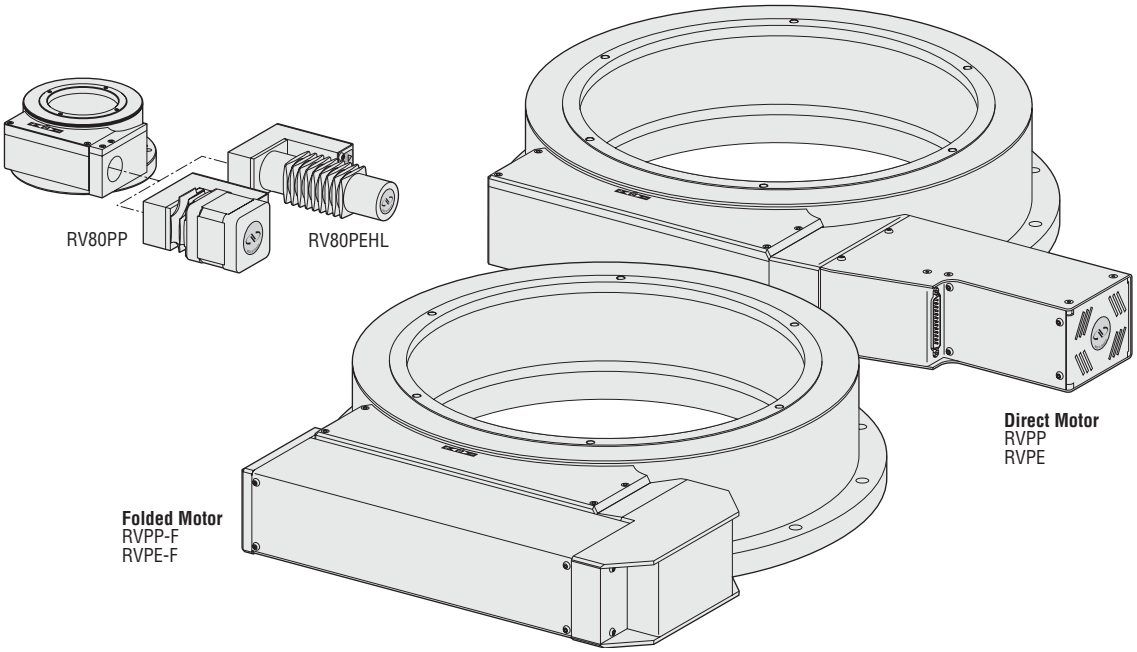
- One mini-step drive version (PP) with 1/10-step per encoder count enabling high angular speed motions up to 20°/sec.
- One full-step version (PE) equipped with an additional step-down gear in order to obtain higher torque values. This version causes no motor heating in static position, and maintains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

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NOTE

RV80PEHL and RVPPHL rotation stage 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 Torr vacuum preparation on request).

In this case, specifications for speed (°/sec), 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

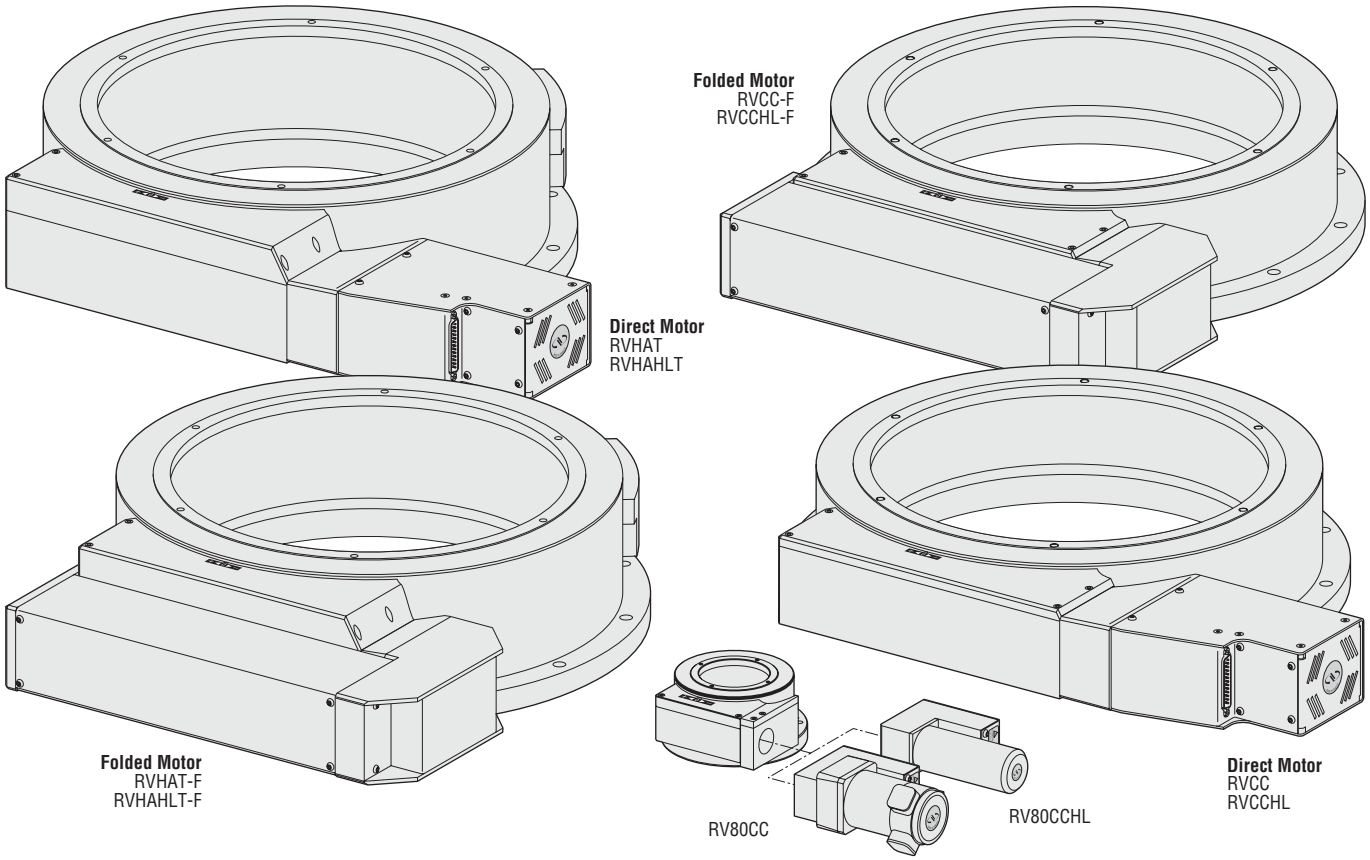
	Resolution (°)	Speed (°/sec)	Motor
RV80PP	0.001	40	UE41PP
RV120 to 350PP	0.001	40	UE63PP
RV80PE	0.001	4	UE31PP
RV120PE	0.001	4	UE41PP
RV160 to 350PE	0.001	4	UE63PP

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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 °/sec. 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.



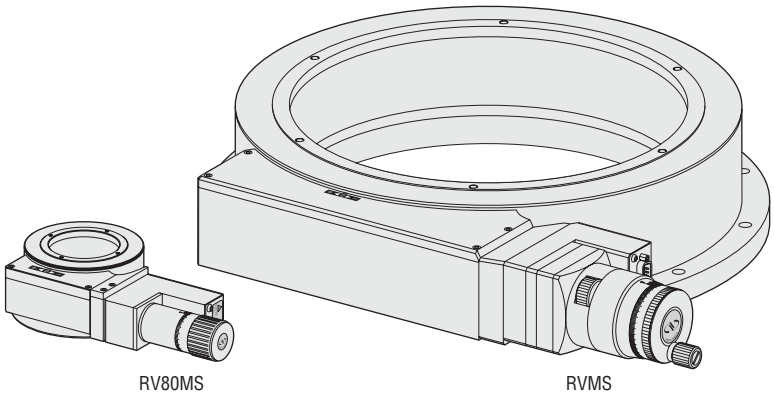
DC-Motor Performance Specifications

	Resolution (°)	Speed (°/sec)	Motor
RV80CC	0.001	80	UE404S
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
RV80CCHL	0.001	2.5	UE31CC
RV120CCHL	0.001	16	UE404S
RV160 to 350CCHL	0.001	16	UE511S
RV120HAHLT	0.0001	16	UE511S-T
RV160HAHLT	0.000075	16	UE511S-T
RV240HAHLT	0.00005	16	UE511S-T
RV350HAHLT	0.000035	16	UE511S-T

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4.3 Manual Drive

The RV Series rotation stages are also available with manual drive (MS) and rotary encoder providing 0.001° resolution. The manual knob permits a rotation of 2 °/rev. (RV80MS) or 4 °/rev. (RV120MS to RV350MS).



RV80MS RVMS

Manual Performance Specifications

	Resolution (°)	Travel per Revolution (°/rev.)
RV80MS	0.001	2
RV120 to 350MS	0.001	4



CV1000 display counter.

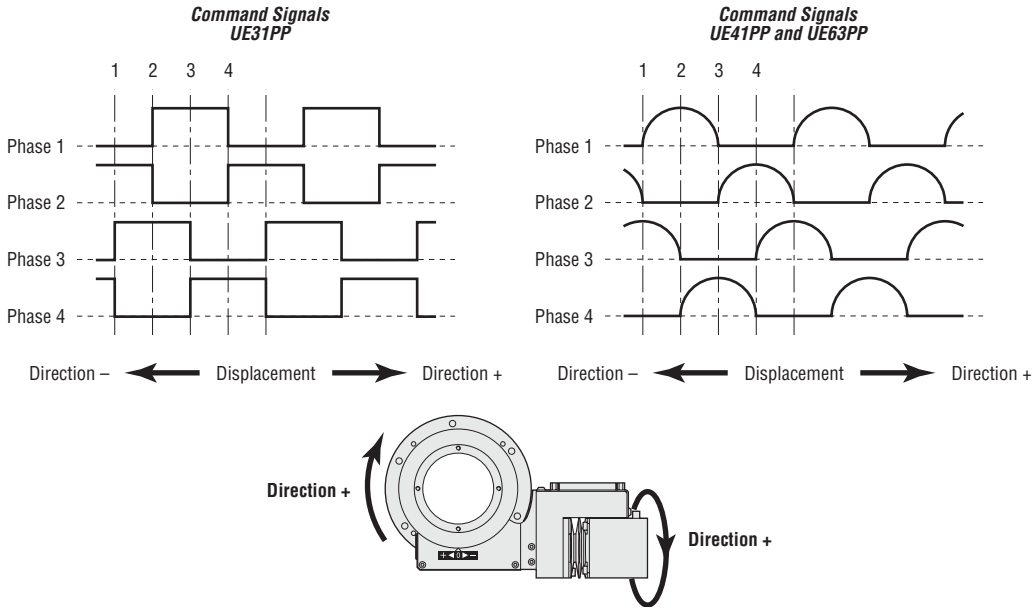
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5.0 Motor

5.1 Stepper Motor Characteristics

Motor	Angle by Step (°)	Current (A)	Resistance (Ω)	Inductance (mH)	Newport Utilization
UE31PP	3.6	0.56	7.6	8.4	Full-Step
UE41PP	1.8	1.2	3	4.3	Full-Step or Mini-Step
UE63PP	1.8	2.9	1.16	2.0	Mini-step

5.2 Command Signals for Stepper Motors





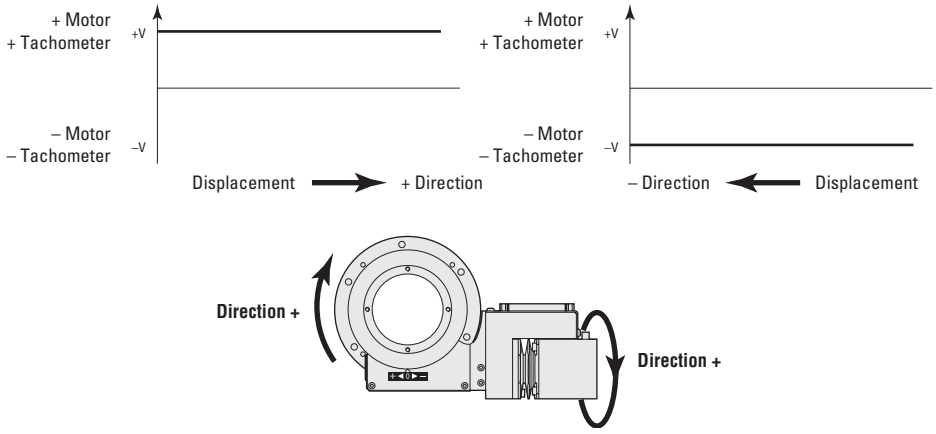
RV120 rotation stages.

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5.3 DC-Motor Characteristics

Motor	Mechanical Power (W)	Nominal Voltage (V)	Armature Resistance (Ω)	Tachometer (V/Krpm)
UE31CC	2	24	57	–
UE404S	40	24	2	–
UE404S-T	40	75	18.6	3 (±10%)
UE511S	110	48	1.6	–
UE511S-T	110	75	5.1	7 (±10%)

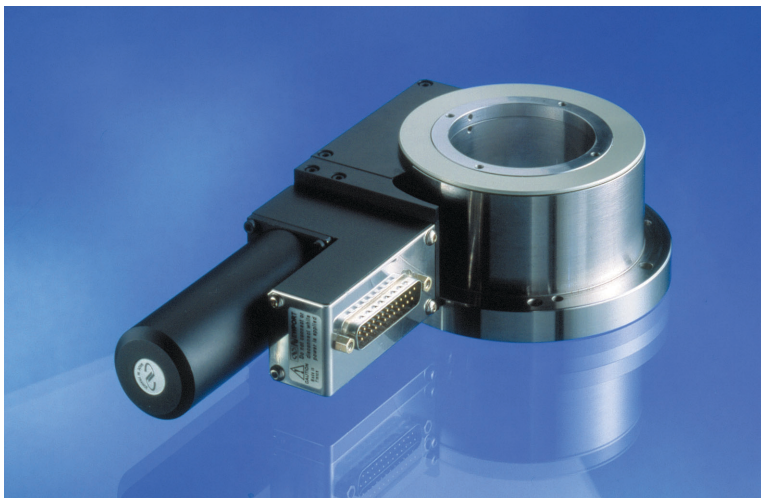
5.4 Command Signals for DC-Motors



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

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

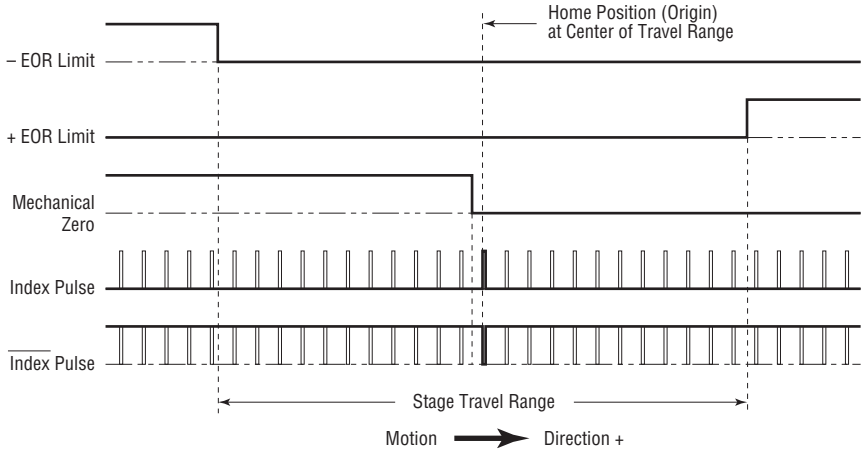
❷ When the stage moves in – Direction, the + Motor voltage is lower than – Motor voltage, and + Tacho Generator voltage is lower than – Tacho Generator voltage.



RV80CCHL rotation stage.

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5.5 Sensor Position



End-of-Run and Mechanical Zero are TTL type: 5 V ±5%, 2 mA max.

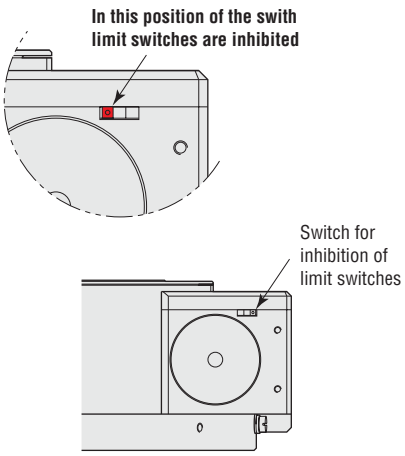
Use of the Index Pulse provides a repeatable Home Position at ±1 step.

CAUTION

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

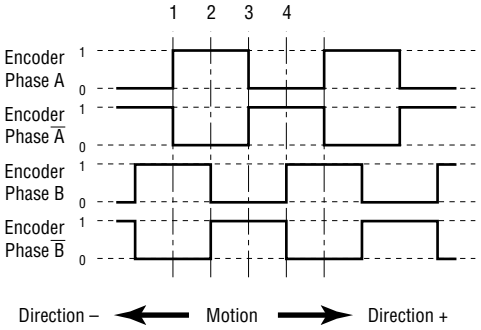
5.6 Inhibition of Limit Switches

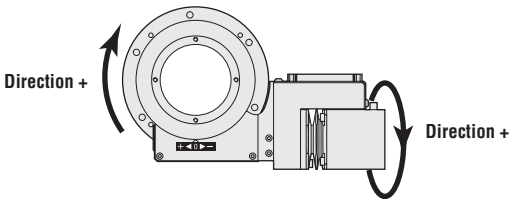
In standard, except for HAT & HAHLT versions, RV rotation stages are equipped with limit switches (limited to ±170°) for protecting the equipment. A switch enables inhibiting the limit switches in order to use the rotation stage over 360° or more.



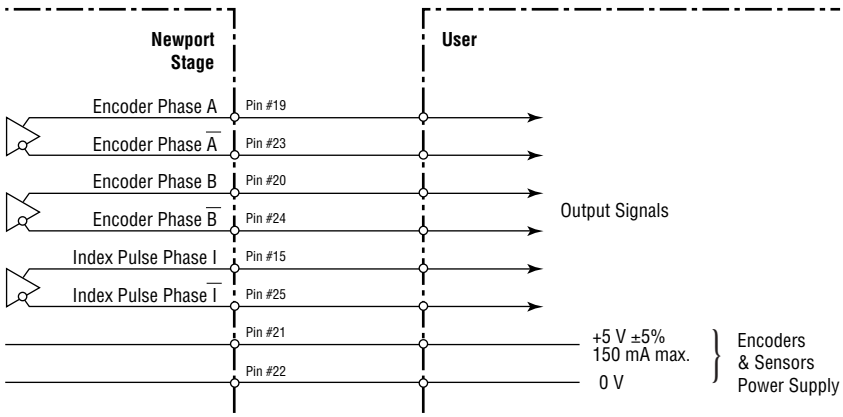
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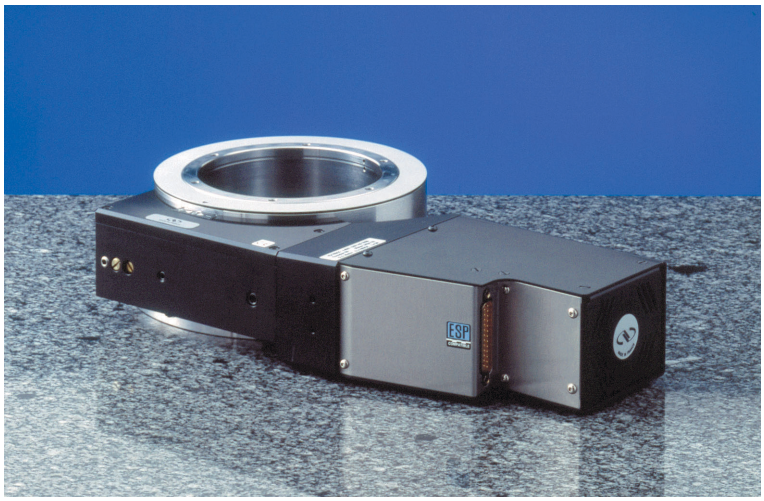
5.7 Feedback Signal Position





The incremental sensor operates following the photoelectric measurement principle, with a disk including slides. When the sensor shaft turns, the sensor generates square signals in quadrature, sent to pins #19, #20, #23 and #24 of the 25-pin Sub-D connector.



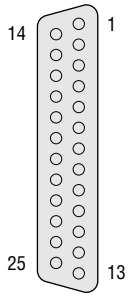


RV160 rotation stage.

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5.8 Pinouts

The 25-pin Sub-D connection for the RV rotation stages is given in the following table:



	UE31PP UE41PP UE63PP		UE31CC UE404S UE511S		UE404S-T UE511S-T		Manual Versions
1	Phase 1	**1**	N.C.	**1**	+ Tachometer	**1**	N.C.
2	Phase 1	**2**	N.C.	**2**	+ Tachometer	**2**	N.C.
3	Phase 2	**3**	N.C.	**3**	– Tachometer	**3**	N.C.
4	Phase 2	**4**	N.C.	**4**	– Tachometer	**4**	N.C.
5	Phase 3	**5**	+ Motor	**5**	+ Motor	**5**	N.C.
6	Phase 3	**6**	+ Motor	**6**	+ Motor	**6**	N.C.
7	Phase 4	**7**	– Motor	**7**	– Motor	**7**	N.C.
8	Phase 4	**8**	– Motor	**8**	– Motor	**8**	N.C.
9	Common Phase 3-4	**9**	N.C.	**9**	N.C.	**9**	N.C.
10	N.C.	**10**	N.C.	**10**	N.C.	**10**	N.C.
11	Common Phase 1-2	**11**	N.C.	**11**	N.C.	**11**	N.C.
12	N.C.	**12**	N.C.	**12**	N.C.	**12**	N.C.
13	Mechanical Zero	**13**	Mechanical Zero	**13**	Mechanical Zero	**13**	Mechanical Zero
14	Shield Ground	**14**	Shield Ground	**14**	Shield Ground	**14**	Shield Ground
15	Index Pulse I	**15**	Index Pulse I	**15**	Index Pulse I	**15**	Index Pulse I
16	0 V logic	**16**	0 V logic	**16**	0 V logic	**16**	0 V logic
17	+ End-of-Run	**17**	+ End-of-Run	**17**	+ End-of-Run	**17**	+ End-of-Run
18	– 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	**19**	Encoder Phase A
20	Encoder Phase B	**20**	Encoder Phase B	**20**	Encoder Phase B	**20**	Encoder Phase B
21	Encoder Power: +5 V	**21**	Encoder Power: +5 V	**21**	Encoder Power: +5 V	**21**	Encoder Power: +5 V
22	0 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	**23**	Encoder Phase /A
24	Encoder Phase /B	**24**	Encoder Phase /B	**24**	Encoder Phase /B	**24**	Encoder Phase /B
25	Index Pulse /I	**25**	Index Pulse /I	**25**	Index Pulse /I	**25**	Index Pulse /I

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6.0 Connection to Newport Controllers

6.1 Warnings on controllers

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

WARNING

Disconnect the power plug under the following circumstances:

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

CAUTION

To protect the unit from damage, be sure to:

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

WARNING

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

Contact your electrician to check your receptacles.

WARNING

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

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

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

WARNING

This product operates with voltages that can be lethal.

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

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6.2 Connection

On each rotation stage is represented a label which indicates its name, its serial number and the motor it is equipped with (ex.: UE31PP).

RV80PE□□	S/N#
ENCODER:5V	MOTOR:UE31PP
Stepper Motor	U=30VDC I=0.4A

WARNING

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

Rotation stages may be connected to the rear panel motor connectors labeled “Motor…” any time prior to power-up with the supplied cable assemblies.

WARNING

With MM series controllers, damage to rotation stage may occur if the rotation stage is not the same type as shown on driver label located near the rotation stage interface connector.

Check that the option number specified on this label correspond to the number indicated in the driver module options table for your rotation stage.

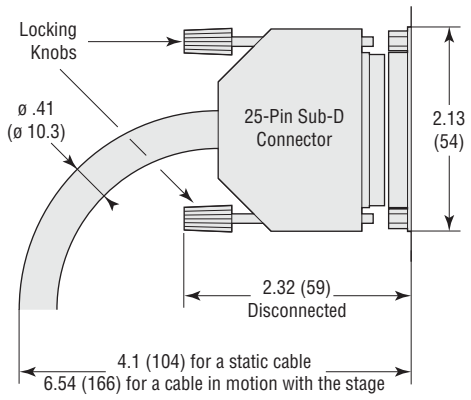
WARNING

Vacuum compatible rotation stages have to be configured if running with an ESP series controller.

6.3 Cables

All our RV rotation stages are delivered equipped with a 3-meter cable with 25-pin Sub-D connectors so they can be directly connected to our controllers/drivers of MM or ESP series.

Dimensions in inches (millimeters)



WARNING

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

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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.



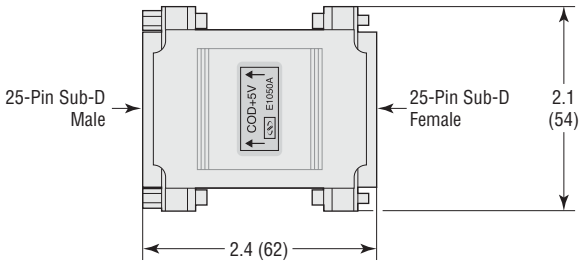
These cables are specially shielded and terminated with Newport's standard 25-pin sub-D connectors. They are available in 5-m (**MMCABLE-5**), 7-m (**MMCABLE-7**) or 10-m (**MMCABLE-10**) lengths.

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.

Dimensions in inches (millimeters)



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 volts coming from the controller through the long cable.

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7.0 Connection to Non-Newport Controllers

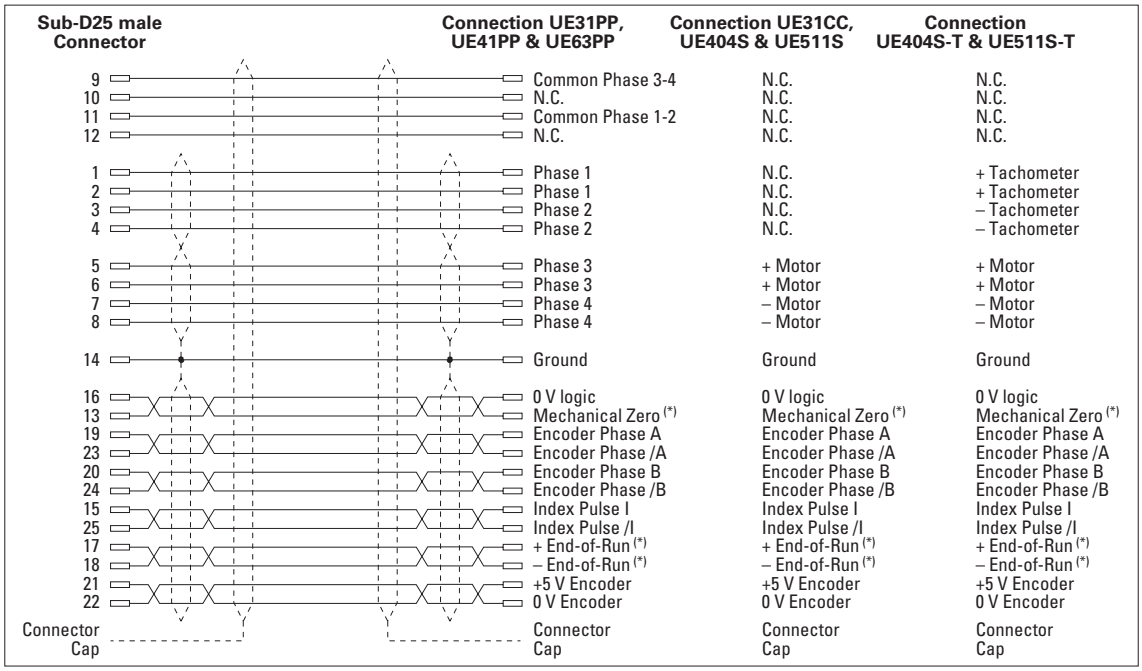
WARNING

Newport takes no responsibility for improper functioning or damage of a rotation stage when it is used with any non- Newport controllers.

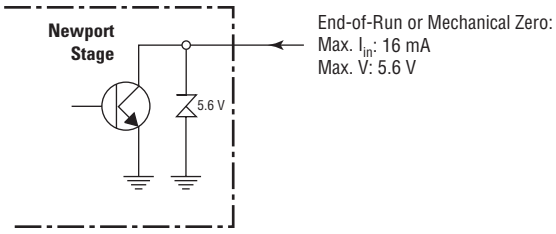
WARNING

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

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



*** Open collector type with a 5.6 V protective Zener diode.**



If the "Mechanical Zero" output is not used, a 1 kΩ/0.25 W resistor must be connected between pins #13 and #21.

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

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8.0 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

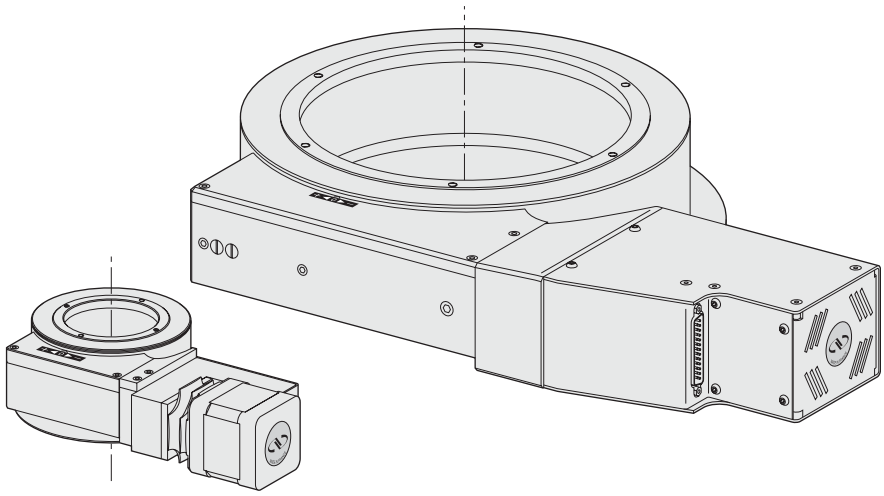
The flatness of the working surface has a direct impact on the performance levels of the rotation stages.

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.

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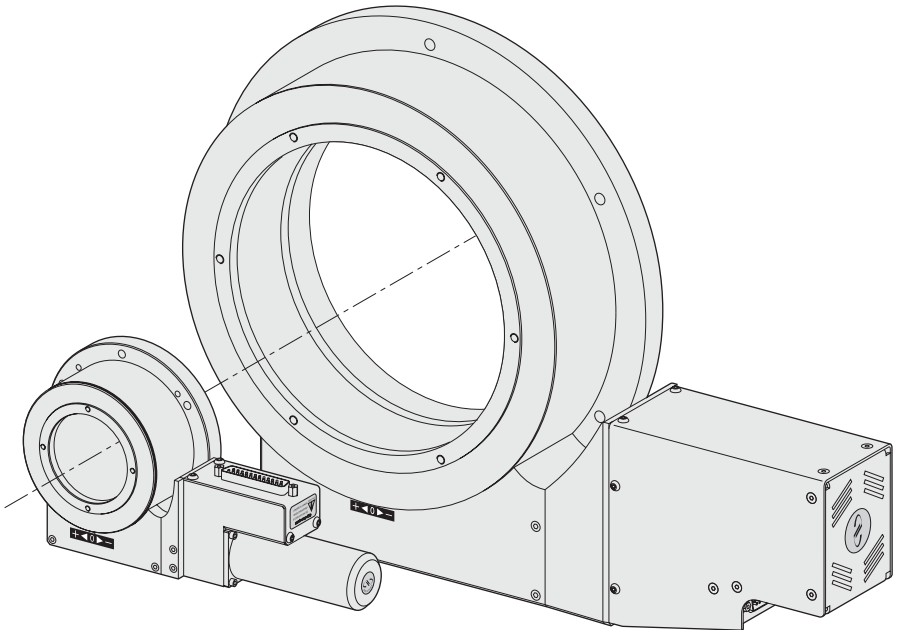
This fastening method is not recommended when high levels of stiffness are required.

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

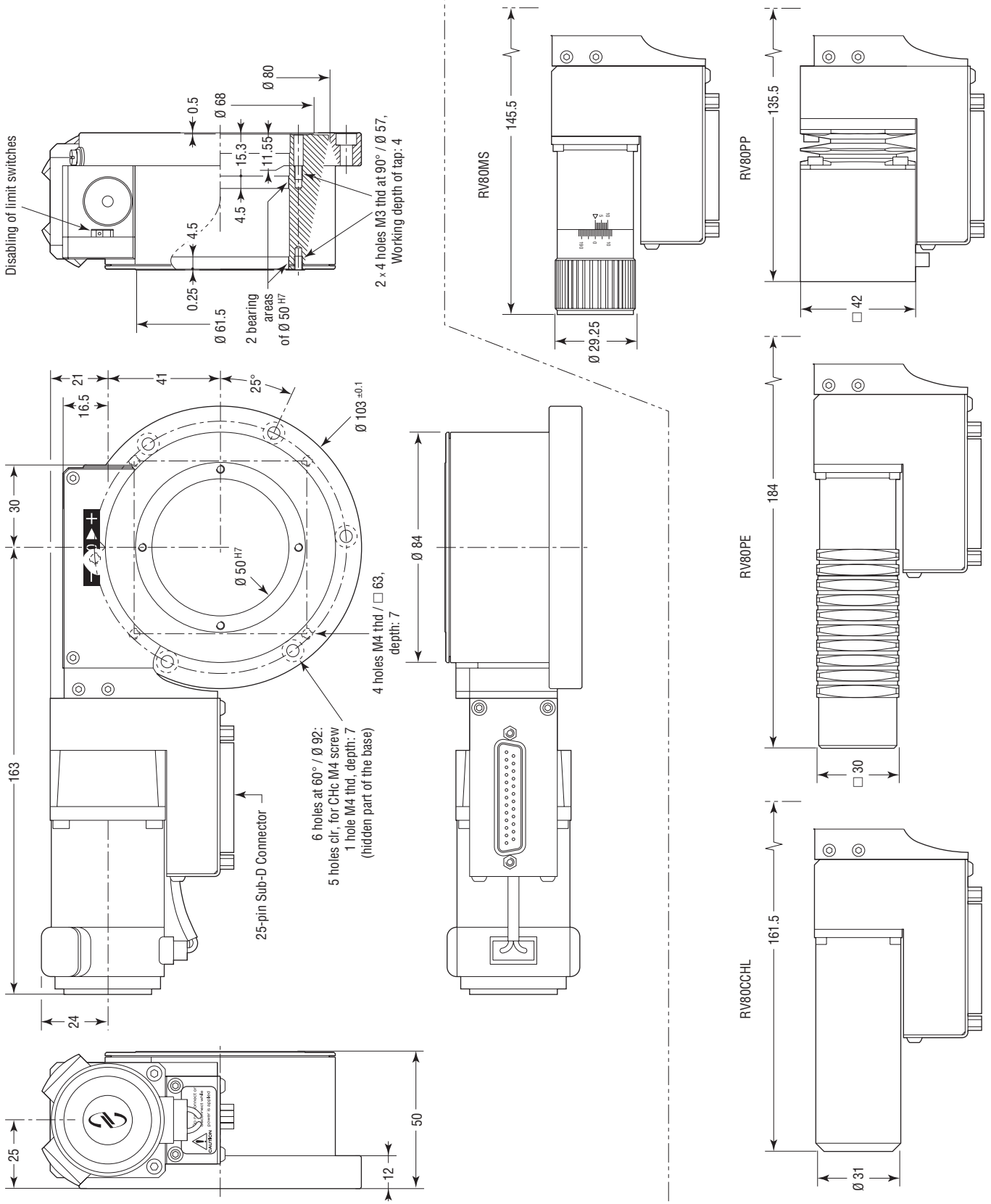
When using a connection angle, ensure that its stiffness is calculated in conformity with the required specifications of the geometry of the movement.

Contact Newport for high-accuracy mounting.

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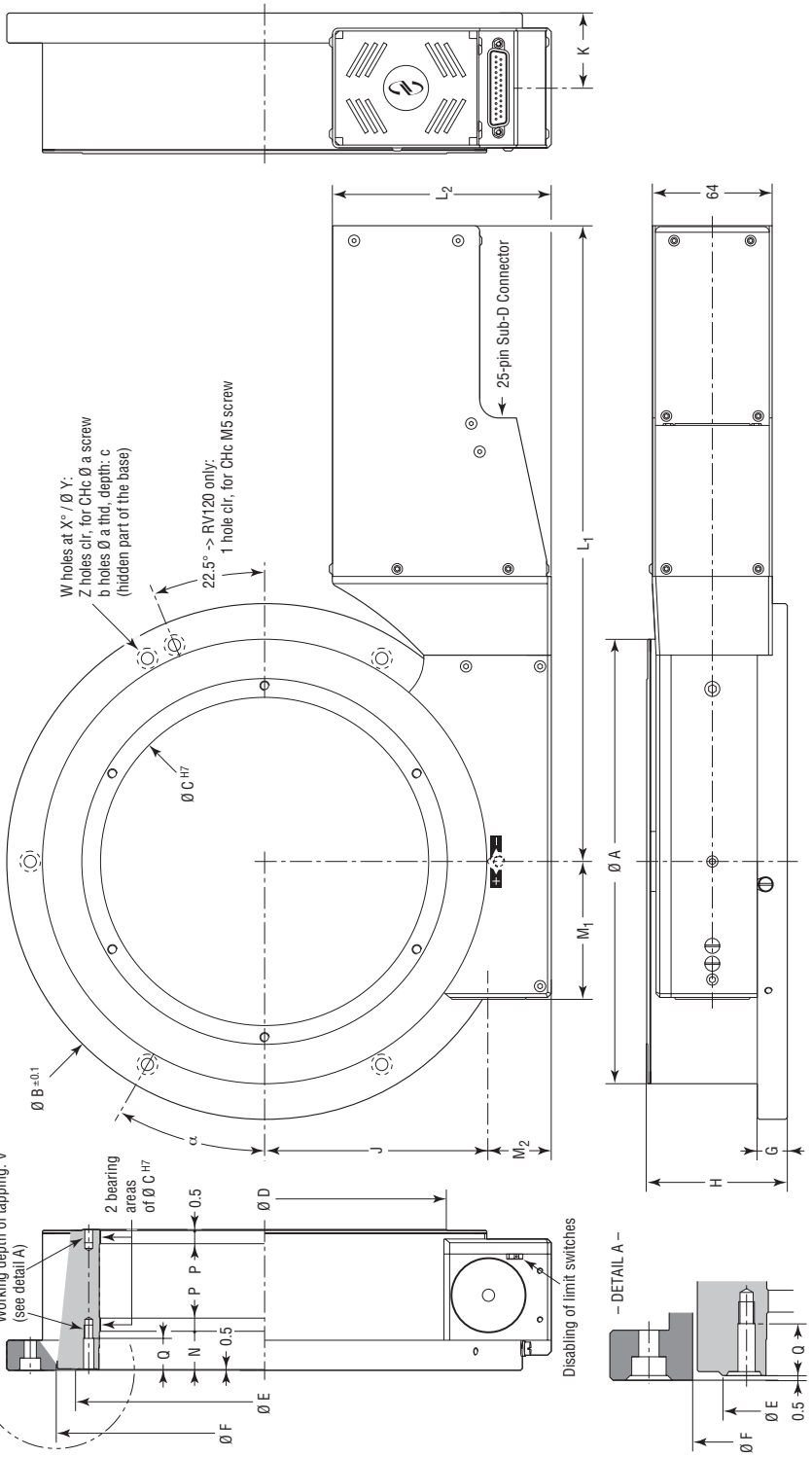
9.0 Dimensions

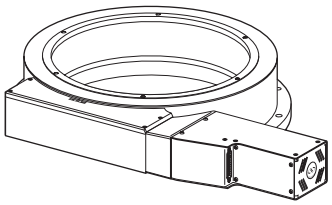
9.1 RV80 Rotations Stages

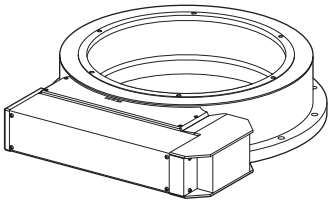


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9.2 RV120 to RV350 Rotations Stages







Dimension (mm)

Model	A	B	C	D	E	F	G	H	J	K	N	P	Q
RV120	126	155	78	93	99	115.5	14	68	63	34	19	4	15
RV160	163	192	110	129	134	152	14	71	81.5	36	18.5	5	14.5
RV240	237	275	175	194	204	222	16	75	119.5	40	20.3	7	16.6
RV350	356	395	280	302	315	331.5	17.5	90	179	50	21.3	8	17.3

Dimension (mm)

Model	R	S	T	U	V	W	X	Y	Z	a	b	c	α
RV120	4	M4	90	87.5	6	6	60	137	5	M5	1	7	17.5
RV160	6	M5	60	120	7	6	60	174	5	M5	1	7	25
RV240	6	M5	60	187.5	7	6	60	250	5	M6	1	10	30
RV350	6	M6	60	295	7	12	30	372	10	M8	2	12	10

Rotation Stages, Direct Motor

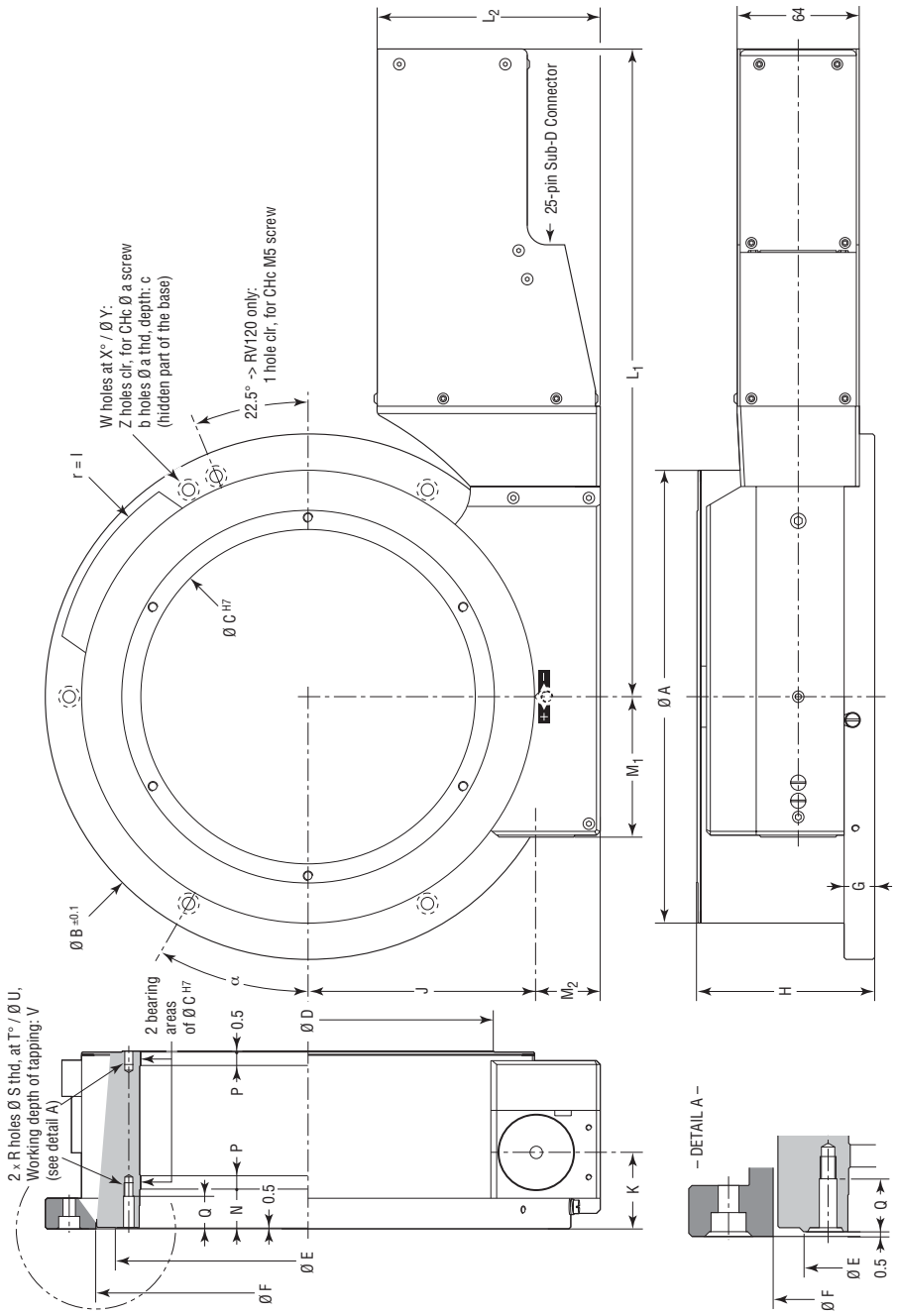
Model	L_1				M_1	L_2	M_2
	PP	PE	CC	CCHL			
RV120	251.5	251.5	251.5	301.5	45.5	117	33.5
RV160	264	314	264	314	54		
RV240	289	339	289	339	73.5		
RV350	315	365	315	365	105		

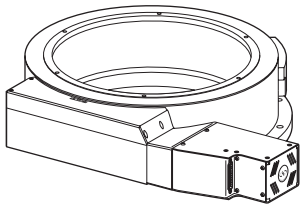
Rotation Stages, Folded Motor

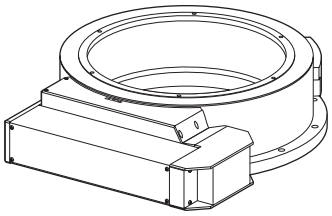
Model	L_1	M_1	L_2	M_2
RV120	155.5	54.5	160.5	110.5
RV160	168	63		
RV240	193	82.5		
RV350	219	114		

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9.3 RVHA & RVHAT Versions







Dimension (mm)

Model	A	B	C	D	E	F	G	H	I	J	K	N	P	Q
RV120	126	155	78	93	99	115.5	14	86	80	63	34	19	4	15
RV160	163	192	110	129	134	152	14	89	98	81.5	36	18.5	5	14.5
RV240	237	275	175	194	204	222	16	93	132.5	119.5	40	20.3	7	16.6
RV350	356	395	280	302	315	331.5	17.5	108	189	179	50	21.3	8	17.3

Dimension (mm)

Model	R	S	T	U	V	W	X	Y	Z	a	b	c	α
RV120	4	M4	90	87.5	6	6	60	137	5	M5	1	7	17.5
RV160	6	M5	60	120	7	6	60	174	5	M5	1	7	25
RV240	6	M5	60	187.5	7	6	60	250	5	M6	1	10	30
RV350	6	M6	60	295	7	12	30	372	10	M8	2	12	10

Rotation Stages, Direct Motor

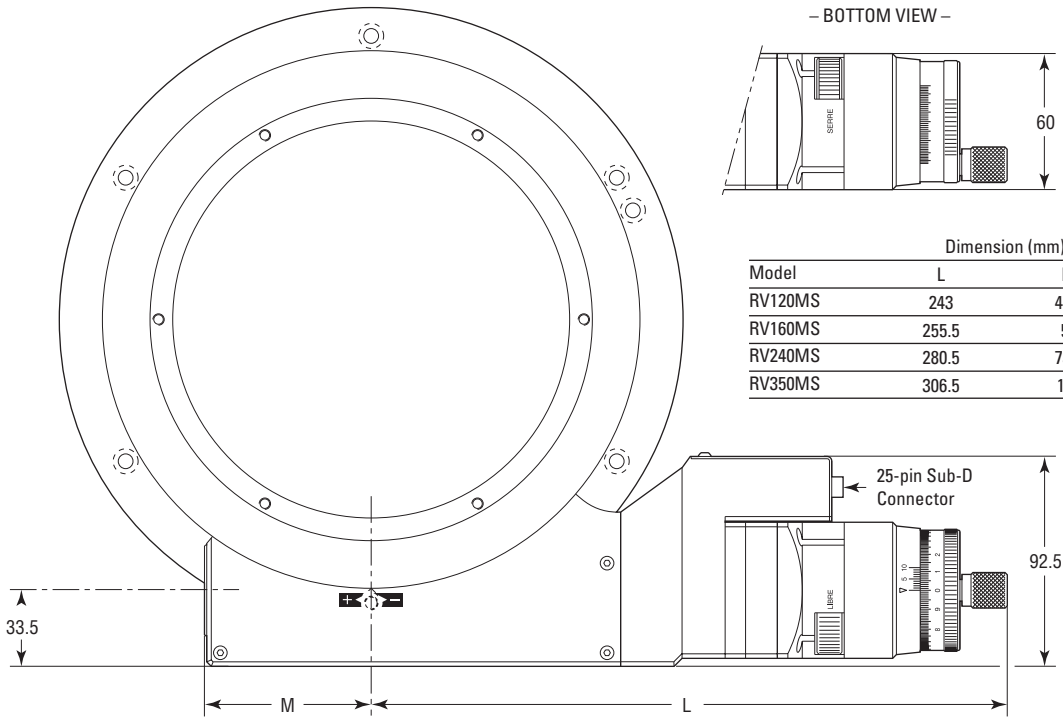
Model	L_1		M_1	L_2	M_2
	HAT	HAHLT			
RV160	301.5	301.5	45.5	117	33.5
RV160	314	357	54		
RV240	339	382	73.5		
RV350	365	408	105		

Rotation Stages, Folded Motor

Model	L_1	M_1 HAT-F	M_1 HAHLT-F	M_2
RV120	155.5	54.5	75.5	110.5
RV160	168	63	107.5	
RV240	193	82.5	82.5	
RV350	219	114	114	

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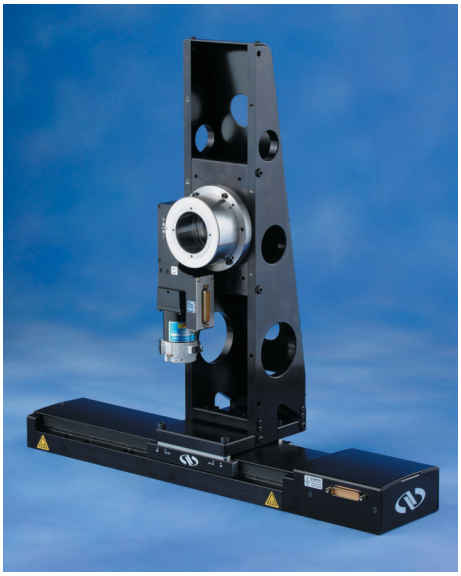
9.4 RVMS Versions



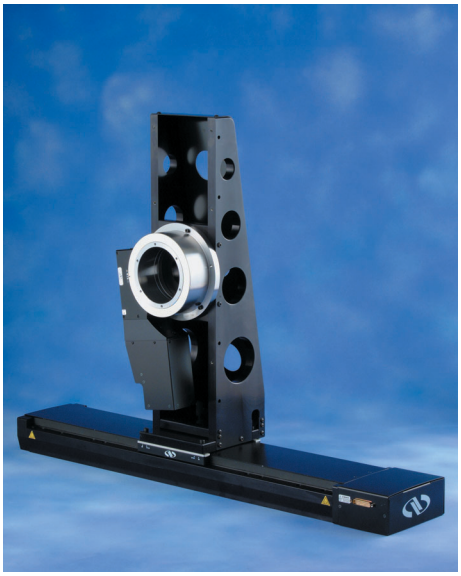
Model	Dimension (mm) L	M
RV120MS	243	45.5
RV160MS	255.5	54
RV240MS	280.5	73.5
RV350MS	306.5	105

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.



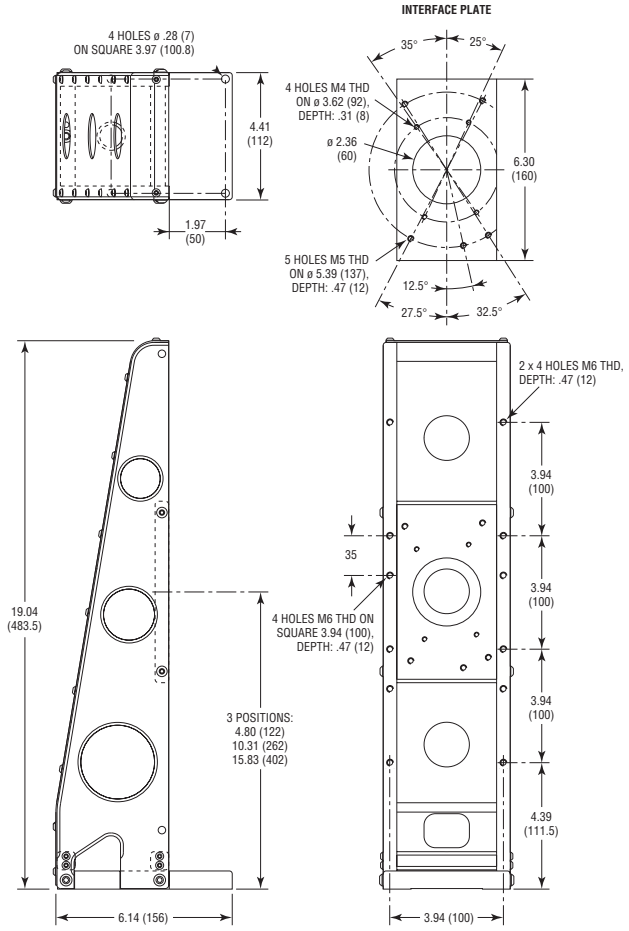
EQ120 bracket on an (M-)ILS stage, with an RV80 in vertical configuration.



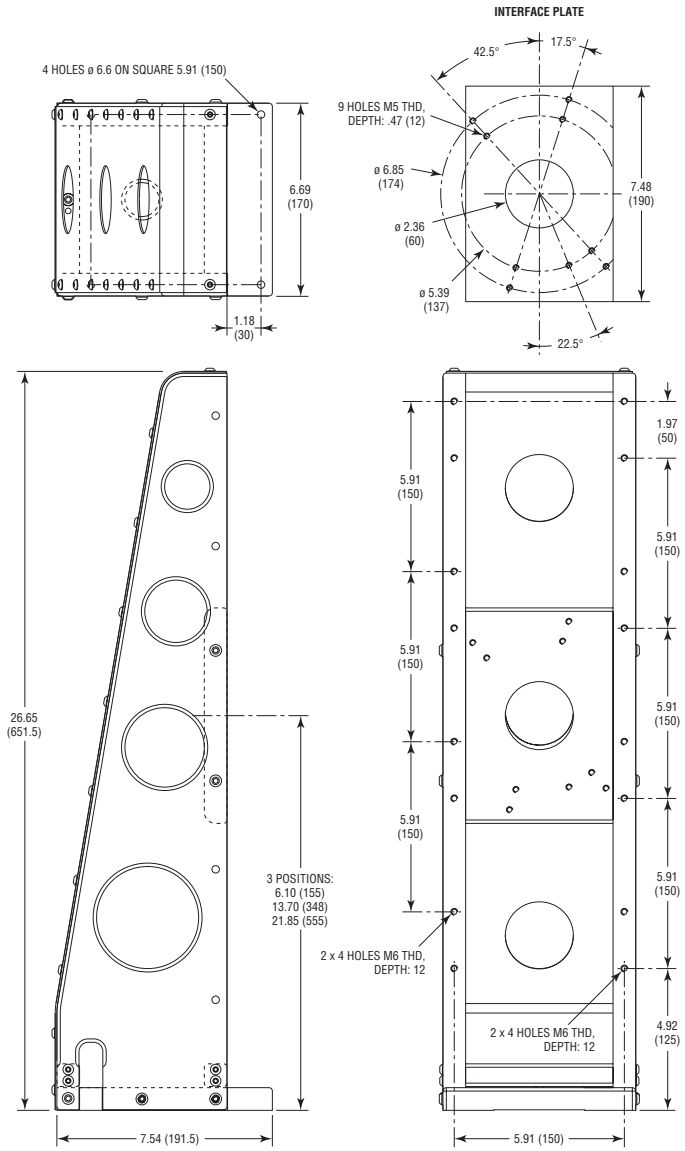
EQ180 bracket on an (M-)IMS stage, with an RV160 in vertical configuration.

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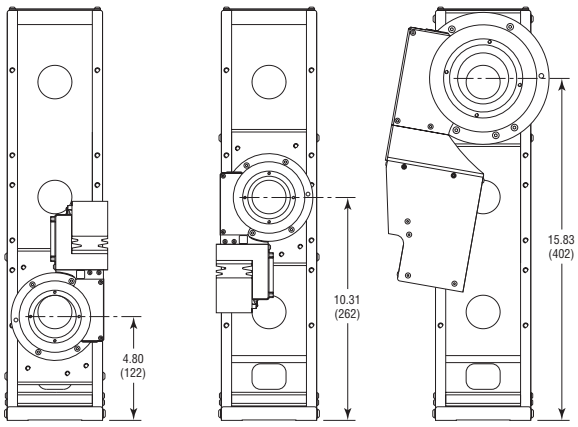
EQ120 Bracket



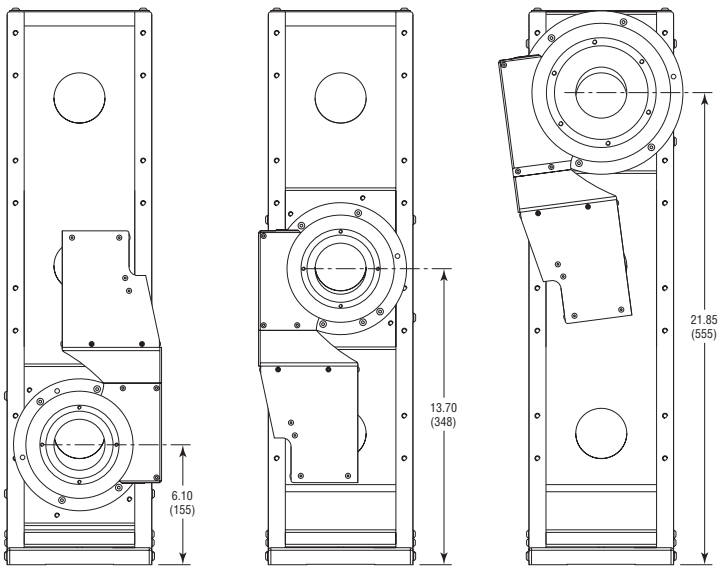
EQ180 Bracket



Interface plate position of the EQ120 bracket



Interface plate position of the EQ180 bracket



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11.0 Maintenance

RECOMMENDATION

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

11.1 Maintenance

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

PRECAUTIONS

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

RECOMMENDATION

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

If your RV rotation stage is mounted on a workstation and cannot be easily dismantled, please contact our After Sales Service for further instructions.

11.2 Repairing

CAUTION

Never attempt to disassemble an element of the rotation stage that has not been specified in this manual.

Disassembling a non specified element can cause a malfunction of the rotation stage.

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

CAUTION

All disassembly attempts or repair of rotation stage without authorization will void your warranty.

11.3 Calibration

CAUTION

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

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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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Newport®

CE Declaration of Conformity

We declare that the accompanying product, identified with the "CE" mark, meets all relevant requirements of Directive:

- 73/23/CEE, for Low Voltage Compatibility.
- 89/336/EEC for Electromagnetic Compatibility.

Compliance was demonstrated to the following specifications:

EMISSION:

Radiated and Conducted Emission in accordance with relative prescription to the EMC, NF EN61326-1: Standards for measurement, lab and control equipment.

IMMUNITY:

Radiated and Conducted Immunity in accordance with relative prescription to the EMC, NF EN61326-1: Standards for measurement, lab and control equipment.

SAFETY:

CEI 1010-1, safety standards for measurement, lab and control equipment.



Jean-Marc DELAHAYE
Quality Director
Zone Industrielle
45340 Beaune-la-Rolande, France

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