



RGV160BL-S

High-Speed and High-Load Precision Rotation Stage



 **Newport®**

USER'S MANUAL

Warranty

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

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

Limitation of Warranty

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

CAUTION

Warranty does not apply to damages resulting from:

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



CAUTION

Please return equipment in the original (or equivalent) packing.

You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

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Original instructions.

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EC Declaration of Conformity

RGV160BL-S  **Newport®**

EU Declaration of Conformity

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

The manufacturer:

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

Hereby declares that the machinery:

- Description: " RGV160BL-S"
- Function: High-Speed and High-Load Precision Rotation Stage
- Models: RGV160BL-S

– the technical file of which was compiled by:

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

- complies with all the relevant provisions of the Directive 2006/42/EC on machinery.
- complies with all the relevant provisions of the Directive 2014/30/EU relating to electro-magnetic compatibility.
- complies with all the relevant provisions of the Directive 2011/65/EU relating to RoHS2.

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

- NF EN 61326-1:2013 « Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements »
- NF EN 55011:2010/A1:2011 Class A
- EN ISO 60204-1 « Safety of machinery – Electrical equipment of machines – Part 1 General requirements »

– 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 16 May 2017
Hervé LE COINTE
Quality Director



DC1-EN rev:A

Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety-related issues occur.

General Warning or Caution



The exclamation symbol may appear in warning and caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.



WARNING

Warning indicates a potentially dangerous situation which can result in bodily harm or death.



CAUTION

Caution indicates a potentially hazardous situation which can result in damage to product or equipment.

NOTE

Note indicates additional information that must be considered by the user or operator.

European Union CE Mark



The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

Warnings and Cautions



ATTENTION

This stage is a Class A device. In a residential environment, this device can cause electromagnetic interference. In this case, suitable measures must be taken by the user.

WARNING

When the RGV160BL-S is installed or combined with other instruments in a machine, additional testing to directive 2006/42/EC may be required. It is the responsibility of the end-user or integrator to perform a risk-analysis and the necessary tests to conform to the EC directives.

Newport is not liable for damages caused by not executing this responsibility.

Warnings

Improper use of the RGV160BL-S can cause material damage, shock, injury, or death. Read and understand this User's Manual before operating the RGV160BL-S.

If the RGV160BL-S is used in a condition not specified by Newport, the safety features provided by the stage can be impaired.

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

Rotating parts of the stage or any attachments can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.

WARNING

The connection of electrical devices must meet safety and electrical standards. Grounding methods indicated in this manual must be applied.

WARNING

Due to the nature of this stage, the installation, use and maintenance of this stage must be performed by trained personnel who are familiar with safety regulations that are applicable to this product.

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.

WARNING

Do not exceed speed and load limitations as specified in this manual.

Caution

CAUTION

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

CAUTION

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

CAUTION

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

- Operating temperature: +10 to +35 °C
 - Storage/Operating altitude: 1000 m
 - Storage/Operating humidity: 85%
 - 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-Speed and High-Load Precision Rotation Stage RGV160BL-S

1.0 Introduction

This manual provides operating instructions for the RGV160BL-S precision rotation stage.



RGV160BL-S precision rotation stage.

RECOMMENDATION

We recommend you read carefully the chapters 4.0 and 6.0 for the connection to an electronics, before using a RGV160BL-S rotation stage.

2.0 Description

The RGV160BL-S is a larger and higher load capacity version of the RGV100. It is a direct-drive rotation stage that provides ultra-fast rotation with very high resolution and outstanding positioning performance. Applications include semiconductor wafer inspection, micro-robotics, and precision metrology.

The direct-drive technology of the RGV160BL-S eliminates the worm gear of traditional rotation stages. The advantages are higher speeds, superior reliability, and enhanced position sensitivity. Speed, resolution, and repeatability are increased by a factor of up to ten times compared to worm-driven rotation stages of the same size. A high efficiency brushless DC torque motor with rare earth magnets supplies an optimum ratio of torque vs inertia for high acceleration, with minimal stage heating.

Precision is ensured by a high-resolution glass scale with 28,800 line pairs per revolution that directly measures the position of the rotating platen. The flat encoder is mounted on a precision ground reference surface and is perfectly aligned with the stage’s rotation axis to minimize position errors induced by eccentricity, wobble, or axial runout. The encoder signals are interpolated by Newport’s XPS motion controller with less than 0.1 mdeg resolution for outstanding position sensitivity and stability.

The RGV160BL-S features a proprietary double row of preloaded ball bearings on hardened surfaces. This unique, 2-piece design takes the full benefit of Newport’s excellent capabilities in the design, manufacturing and assembly of precision mechanics and integrates multiple functions, the bearing ways and the direct drive motor into a minimum number of parts. The result is a more compact rotation stage with superior stiffness, high reliability and outstanding wobble and eccentricity.

A 110 mm diameter through-hole allows convenient routing of cables and vacuum lines through the stage. An index pulse, triggered every revolution, permits precision homing to a unique home position. The RGV160BL-S does not have limit switches nor hard stops.

2.1 Design Details

Base Material	Aluminum
Bearings	Large diameter steel ball bearings
Motor	High-torque brushless DC-motor with rare earth magnets (no Hall effect sensors)
Motor Initialization	Has to be done by the controller (without using Hall effect sensors)
Motor Commutation	Done by the XPS controller on encoder signals
Feedback	Glass scale encoder with 28,800 line pairs per revolution, 1 V _{pp} , 1,250-fold signal subdivision when used with XPS controller
Limit Switches	The RGV160BL does not have limit switches nor hard stops
Origin	Optical, fixed at position 0°, including mechanical zero signal

3.0 Characteristics

3.1 Definitions

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

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

Absolute Accuracy

Difference between ideal position and real position.

Accuracy

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

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

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

$$\text{Absolute Accuracy} = \text{Accuracy} + \text{Correction Factor} \times \text{Travel}$$

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 accuracy, repeatability, and reversal error are made systematically with test equipment in controlled environment (20^{±1} °C).

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

Guaranteed and Typical Specifications

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

3.2 Mechanical Specifications



Travel Range (°)	360 continuous
Minimum Incremental Motion (mdeg)	0.04
Uni-directional Repeatability, Typical (Guaranteed) ⁽¹⁾ (mdeg)	±0.05 (±0.15)
Bi-directional Repeatability, Typical ⁽¹⁾ (mdeg)	±0.15
Accuracy, (Guaranteed) ⁽¹⁾ (mdeg)	(±7.5)
Max. Speed [no load] (°/s)	1000
Inertia [no load] (kg.m ²)	0.02411
Bearing Drag Torque (Nm)	0.35
Wobble, Typical (Guaranteed) ⁽¹⁾⁽²⁾ (μrad)	±5.0 (±10)
Eccentricity, Typical (Guaranteed) ⁽¹⁾ (μm)	±0.8 (±2.0)
MTBF (h)	20,000 with 90 kg load, 1,000 °/s speed and a duty cycle of 30%

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

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

Note: The following specifications are controller/drive dependent: MIM, Accuracy, Repeatability, Max. Speed and Max. Acceleration.

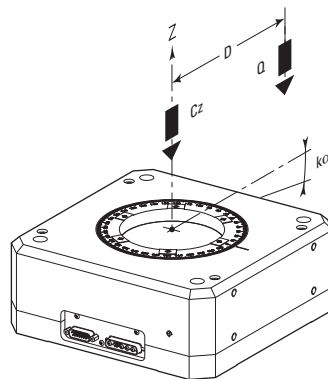
Refer to the RGV160BL-S page on www.newport.com for specifications achievable with specific Newport controller/drive combination.



CAUTION

To achieve the specifications stated, stages must be fixed on a plane surface with a flatness of 10 μm.

3.3 Load Characteristics and Stiffness



Cz, Normal centered load capacity	2,700 N
Kα, Transversal compliance	1 μrad/Nm
Q, Off-center load	$Q \leq Cz \div (1 + D/50)$
Where: D = Cantilever distance in mm	



CAUTION

When a RGV160BL-S rotation stage is integrated in an assembly or in a system, vibration due to the rotation of an off-center load at a high speed must be taken into account.

These events can affect the RGV160BL-S's performance and the system's performance, or damage the stage and assembly.

3.4 Stage Weight

The stage weight indicated below does not include the cables.

	Weight [lb (kg)]
RGV160BL-S	38.6 (17.5)

4.0 Drive & Motor

4.1 Motor Characteristics

The RGV160BL-S rotation stage is equipped with a brushless DC-motor and a high-resolution glass scale encoder.

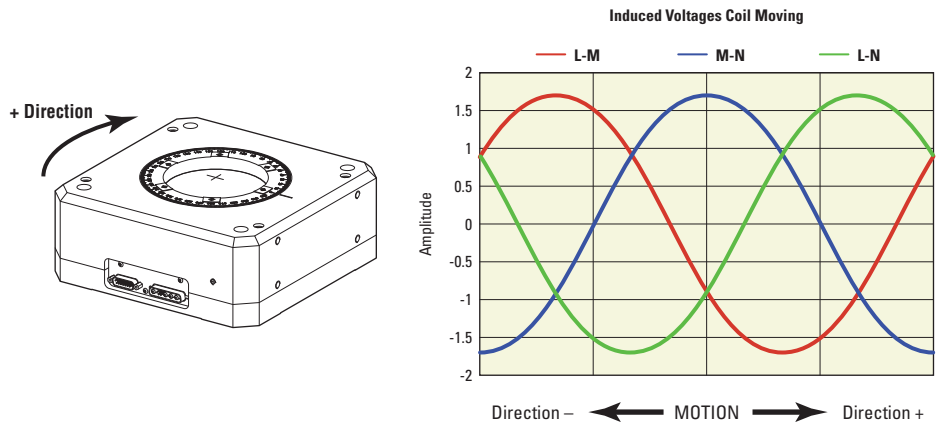
Max. rated torque	112 Nm
Design voltage Vp	300 V
Magnet pitch (Commutation period)	11.25°
Motor constant	3.89 Nm ² /W
Torque sensitivity	2.212 Nm/Arms
Back-emf constant	1.806 V/rad/s
Motor resistance	0.839 Ω
Motor inductance	4.05 mH
Thermal resistance	0.68 °C/W
Max. speed @ Vp	160 rad/s
Peak current @ Vp	50 Arms
Peak torque @ Vp	112 Nm
Max. rms current	9.47 Arms
Max. rms torque	20.9 Nm



CAUTION

High RMS current will generate motor heating which will degrade characteristics of the stage, such as repeatability, accuracy, etc...

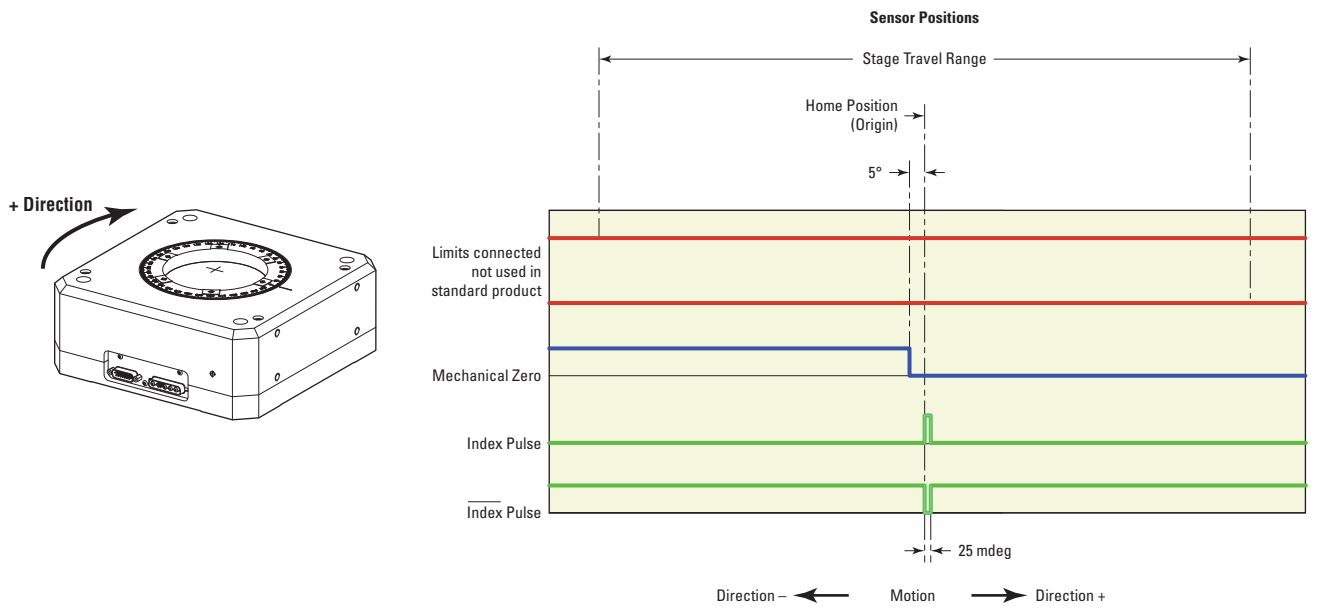
4.2 Command Signals



NOTE

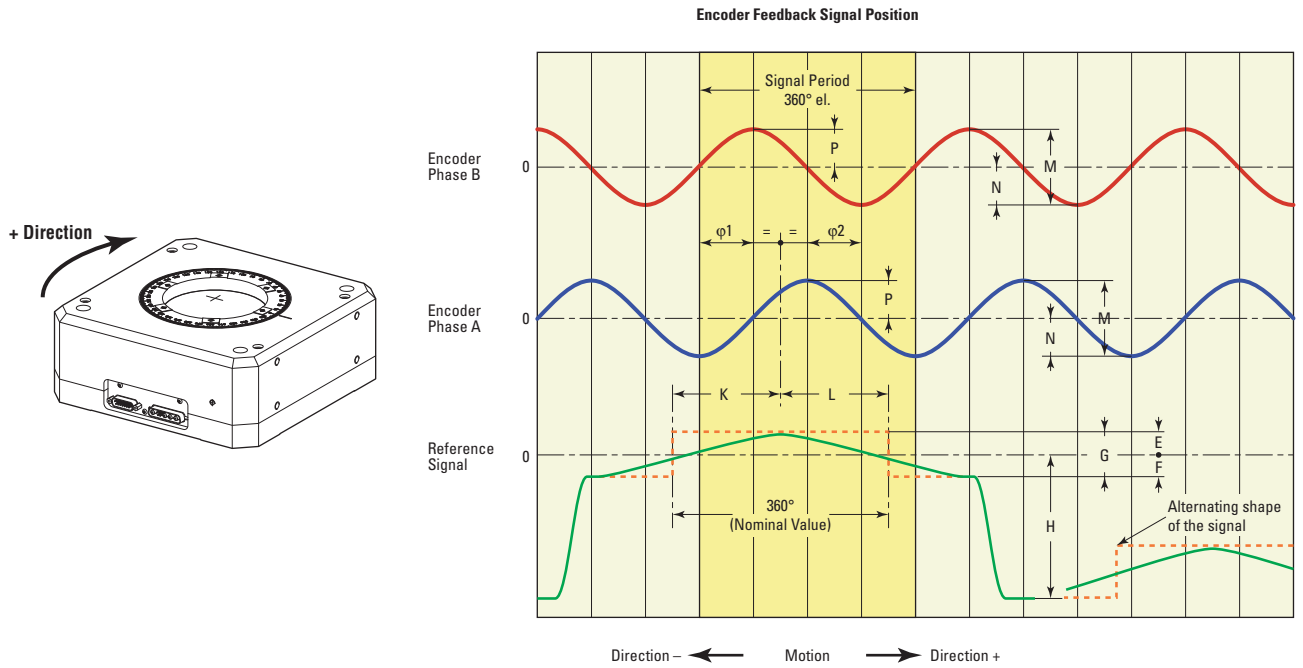
The values above indicate induced voltages between coils. A positive value for L-M would indicate a higher voltage on L relative to M.

4.3 Sensor Positions



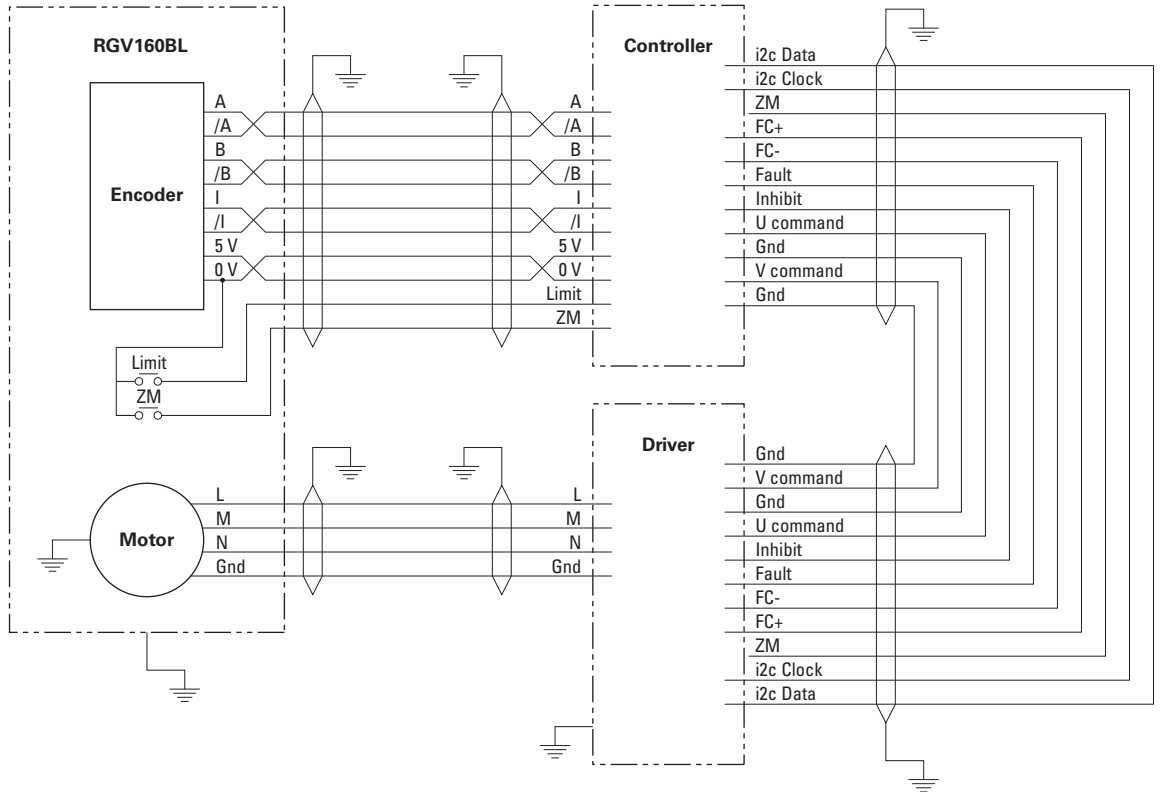
4.4 Position Feedback Signals

Power supply	5 VDC ±5% @ 33 mA
Output signal	Sine/Cosine
Resolution	28,800 lines/rev.



Interface	Sinusoidal voltage signals	1 VDC
Incremental signals	2 signals with sinusoidal shape, A and B	
	Signal range, M:	0.6 to 1.2 VDC; 1 VDC typical
	Gap of symmetry $ P - N /2M$	≤ 0.065
	Signal ratio M_A/M_B :	0.8 to 1.25
Reference signal	Phase difference $ \varphi_1 + \varphi_2 /2$:	$90^\circ \pm 10^\circ$ el.
	1 or several peaks of signal, R	
	Usable range, G:	≥ 0.2 V
	Sleeping value, H:	≥ 1.7 V
	Signal/Noise ratio, E and F:	0.04 to 0.68 V
	Zero crossing, K and L	$180^\circ \pm 90^\circ$ el.

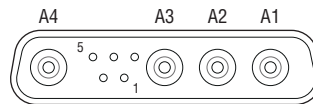
4.5 General Wiring



4.6 Pinouts

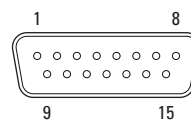
The pinout diagrams for RGV160BL-S stage connectors are shown below.

4.6.1 Motor Connector



DB9W4M	
A1	Phase L Motor
A2	Phase M Motor
A3	Phase N Motor
A4	Ground
1	N.C.
2	N.C.
3	N.C.
4	N.C.
5	N.C.

4.6.2 Encoder & Sensors Connector



SUBD15M	
1	Encoder Phase B
2	Ground
3	Encoder Phase A
4	+5 V
5	N.C.
6	N.C.
7	Index Pulse /I
8	Home
9	Encoder Phase /B
10	N.C.
11	Encoder Phase /A
12	N.C.
13	N.C.
14	Index Pulse I
15	N.C.

4.7 Cables

The RGV160BL-S rotation stage is supplied without cables.

The appropriate cable kit must be ordered separately, in accordance with the XPS controller configuration used. Please refer to our website for ordering information.



WARNING

The RGV160BL-S rotation stage operates only with 5-meter max. cables.



WARNING

Cables of the kits are shielded correctly. For a correct operation, make sure to lock connectors (ground continuity provided by the cable).



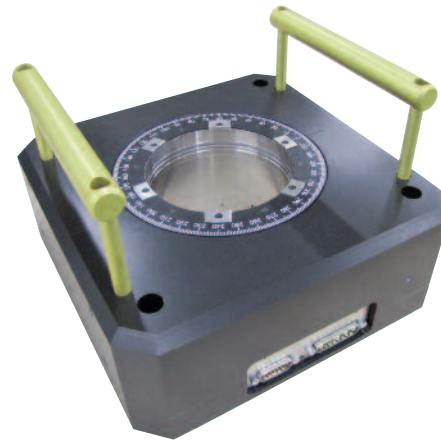
WARNING

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

5.0 Stage Installation

5.1 Unpacking

The RGV160BL-S stage is delivered to your site in packaging designed for safe transport. Attached to the body of the stage are handles for safe removal from packaging. It is recommended to carefully lift the stage from packaging using these handles.



The stage comes with a test report that shows that the stage performs within the guaranteed specifications. These measurements were taken in a controlled environment under flat mounting conditions.

5.2 Mounting Conditions

The RGV160BL-S stage features a four-point mounting surface. The compactness of its body provides good stiffness, however it is recommended that the mounting conditions below be followed for best performance.

Installation Considerations	
Mounting surface flatness	10 μ m
Payload surface flatness	10 μ m
Max. M8 mounting screw torque	16.5 Nm
Max. M6 mounting screw torque	7 Nm
Max. M5 mounting screw torque on:	
aluminum interface	4 Nm
steel interface	6 Nm

6.0 Connection to Newport Controllers

NOTE

Visit www.newport.com for compatible Newport controllers.

6.1 Operating with Newport Controllers/Drives

Newport provides detailed documentation for connecting and configuring RGV160BL-S stages with compatible Newport controllers/drives. These configurations can be adjusted for optimal operation under various applications and load conditions. Refer to documentation available on the RGV160BL-S Page for additional information.

6.2 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.

Specifications listed in this guide are based on operation with Newport Control and Drive Electronics. The Newport controllers with ESP technology are delivered with a configuration file that has been developed at the factory for operation in a no-load condition for immediate plug-and-play operation.

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.

6.3**Connection**

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

**WARNING**

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

WARNING

Ensure the stage is stopped before connecting or disconnecting. The rotation can generate voltages and currents dangerous for workers and for the equipment.

6.4**Wiring**

The RGV160BL-S rotation stage is not supplied with cables (see chapter 4.7: "Cables").

7.0 Connection to Non-Newport Electronics

Newport stages can be operated with Non-Newport controllers. However, under such operational conditions Newport makes no guarantee regarding achievable specifications. To aid Newport customers using non-Newport Controllers with RGV160BL-S stages we have provided wiring conventions and motor characteristics below. It should be noted, damage caused by improper configuration or operation while in use with non-Newport controllers is not covered by the warranty.

Please refer to Design Details and Specifications for more information to help configure the stage with your controller. Newport also provides a tech note on configuring third party stages with Newport controllers on the RGV160BL-S website, which may be useful as a reference.

WARNING

Newport is not responsible for malfunction or damage of RGV160BL-S stages when used with non-Newport controllers.

WARNING

Newport guarantees “C” compliance of RGV160BL-S stages only if used with the appropriate Newport cable kit and a XPS series controller.

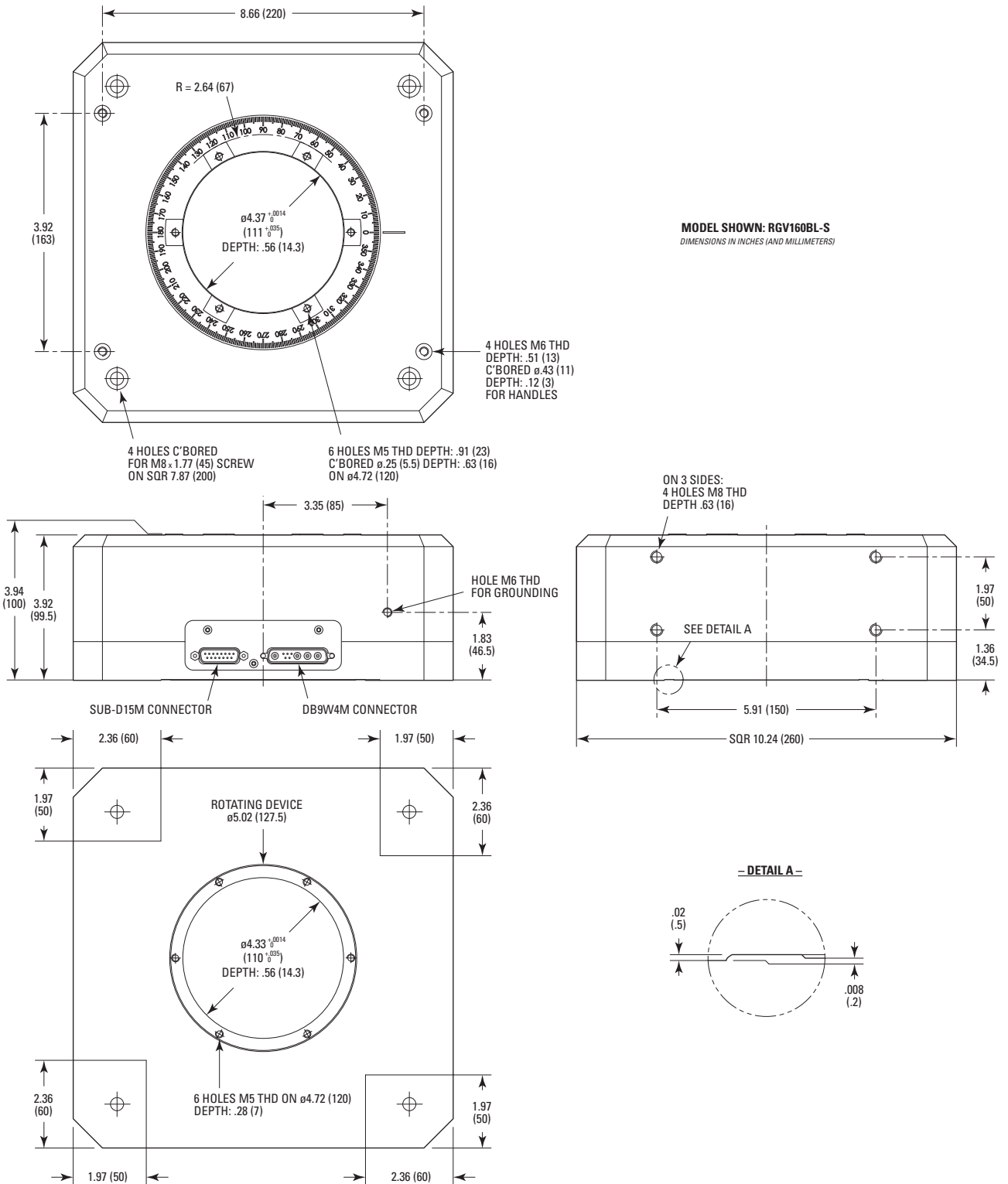


It is the customer's responsibility to modify the cables and take care of sensor signal connections, when using the stage with non-Newport controllers.

WARNING

- **Maximum peak voltage: 350 V_{peak}**
 - **Maximum rms current: 9.47 Arms.**
-

8.0 Dimensions



9.0 Maintenance

RECOMMENDATION

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

9.1 Maintenance

The RGV160BL-S stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and operated with caution.

PRECAUTIONS

The RGV160BL-S stage must be used or stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

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

If the RGV160BL-S stage is mounted on a workstation and cannot be easily removed, please contact Newport's After Sales Service for further instructions.

9.2 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.

9.3 Calibration



CAUTION

It is recommended to return your RGV160BL-S stage to Newport once a year for recalibration to its original specifications.



Visit Newport Online at:
www.newport.com

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Irvine, CA 92606, USA

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