



# MTN-BLHS Series

## Mid-Travel Steel Linear Stages with Brushless Motor

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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.

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## 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.**

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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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### 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.**

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# EC Declaration of Conformity



2 Tech Drive  
Andover, MA 01810  
[www.mksinst.com](http://www.mksinst.com)

## EU27 Declaration of Conformity

### Application of Council Directive(s):

- Electromagnetic Compatibility Directive (EMCD) – 2014/30/EU
- Machinery Directive – 2006/42/EC
- Restriction of Hazardous Substances Directive (RoHS3) – (EU) 2015/863<sup>(7)</sup>
- Waste Electrical and Electronic Equipment – Directive 2012/19/EU



### Standard(s) to which conformity is declared:

- EN 61326-1:2013 – (EMC)
- EN ISO 12100:2010 Safety of Machinery – General Principles of Design – Risk Assessment and Risk Reduction

### Emissions:

- EN 55011: 2016 +A1:2017 <sup>(4)</sup> Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

### Immunity:

- EN 61000-4-2:2009 EMC/Electrostatic Discharge Immunity Test
- EN 61000-4-3:2006+A2:2010 EMC/Radiated Radio Frequency Electromagnetic Field Immunity Test
- EN 61000-4-4:2012 EMC/Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-5:2014+A1:2017 EMC/Surge Immunity Test
- EN 61000-4-6:2014 EMC/Conducted Disturbances induced by Radio Frequency Fields Immunity Test

**Manufacturers Name: MKS Instruments, Inc., 2 Tech Drive, Andover, MA 01810 USA**

Authorized Representatives Name & Location: \_\_\_\_\_

Equipment Type/Description: **Mid-Travel Steel Linear Stages with Brushless Drive**

Model Number(s) <sup>(6)</sup>: **MTN100BLHS; MTN200BLHS; MTN300BLHS**

The object of the declaration described above is in conformity with the relevant Community harmonization legislation. MKS product conforms to the above Directive(s) and Standard(s) only when installed in accordance with manufacturer's specifications. This declaration has been issued under the sole responsibility of the manufacturer.

Date: 8/23/2023

**Le Cointe Hervé – Quality Director**

4) Class A, Group 2

6) Compliance of the above model numbers requires the use of a braided shielded cable properly terminated at both ends – if so noted in the MKS Instruction Manual.

7) RoHS Directive has to be checked for in scope products; cannot CE mark without compliance to RoHS. RoHS Directive can be unchecked only for systems which MKS sells which qualify for "Large Scale Industrial Tool" exclusion.

# UK Declaration of Conformity



2 Tech Drive  
Andover, MA 01810  
[www.mksinst.com](http://www.mksinst.com)

## UK Declaration of Conformity

### Application of Council Directive(s):

- Electromagnetic Compatibility Directive (EMCD) – 2014/30/EU
- Machinery Directive – 2006/42/EC
- Restriction of Hazardous Substances Directive (RoHS3) – (EU) 2015/863<sup>(7)</sup>
- Waste Electrical and Electronic Equipment – Directive 2012/19/EU



### Standard(s) to which conformity is declared:

- BS EN 61326-1:2013 – (EMC)
- BS EN ISO 12100:2010 Safety of Machinery – General Principles of Design – Risk Assessment and Risk Reduction

### Emissions:

- EN 55011: 2016 +A1:2017 <sup>(4)</sup> Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

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Date: 8/23/2023

**Le Cointe Hervé – Quality Director**

4) Class A, Group 2

6) Compliance of the above model numbers requires the use of a braided shielded cable properly terminated at both ends – if so noted in the MKS Instruction Manual.

7) RoHS Directive has to be checked for in scope products; cannot CE mark without compliance to RoHS. RoHS Directive can be unchecked only for systems which MKS sells which qualify for "Large Scale Industrial Tool" exclusion.

# 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.




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### WARNING

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

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### CAUTION

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

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### NOTE

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

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## 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




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### 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.**

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# Warnings



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**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.

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**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.

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**WARNING**

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

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**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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# Caution

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**CAUTION**

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

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**CAUTION**

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

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**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)
  - Vacuum compatible versions can be steamed at +60 °C
- 

**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.

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**CAUTION**

Be careful that the stage is not bumped when it is being carried. This may cause it to malfunction.

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**CAUTION**

When handling this stage, always unplug the equipment from the power source for safety.

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**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.

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**CAUTION**

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

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# Mid-Travel Steel Linear Stages with Brushless Motor

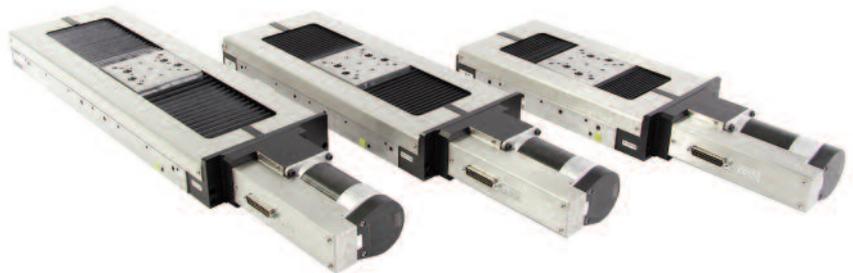
## MTN-BLHS Series

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### 1.0 Introduction

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This manual provides operating instructions for the MTN-BLHS stage that you have purchased.



*MTN-BLHS Series linear stages.*

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#### RECOMMENDATION

We recommend you read carefully the chapter “Connection to electronics” before using the MTN-BLHS stage.

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## 2.0 Description

MTN-BLHS are reliable all-steel construction stages with excellent stiffness, load capacity and thermal stability. They are ideal for applications that require moving heavy loads at high-speed with very fine repeatability.

Available in 100, 200 and 300 mm travel versions, the MTNBLHS stages can bear up to 100 kg centered load, when mounted horizontally. The ball screw drive along with linear guides guarantee fast, smooth and accurate motion trajectory, while the non migrating ball cage design prevents from drift.

### 2.1 Design Details

Base Material	Stainless Steel
Bearings	Linear ball bearings with anti- cage migration
Drive Mechanism	Ballscrew drive
Drive Screw Pitch	4 mm
Feedback	40,000 cts/rev.
Limit Switches	Optical
Origin	Optical, centered
Cable	3 m

## 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.

#### **Yaw, Pitch**

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

The testing of accuracy, repeatability, and reversal error are made systematically with test equipment in controlled environment (20<sup>±1</sup> °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](http://www.newport.com)

### 3.2 Mechanical Specifications



Travel Range (mm)	100; 200; 300
MIM ( $\mu\text{m}$ )	0.3
Uni-directional Repeatability, Typical (Guaranteed) <sup>(1)</sup> ( $\mu\text{m}$ )	$\pm 0.2$ ( $\pm 0.25$ )
Bi-directional Repeatability, Typical (Guaranteed) <sup>(1)</sup> ( $\mu\text{m}$ )	$\pm 0.3$ ( $\pm 0.5$ )
Accuracy, Typical (Guaranteed) <sup>(1)</sup> ( $\mu\text{m}$ )	$\pm 2.0$ ( $\pm 4.0$ )
Maximum Speed (mm/s)	250
Pitch, Typical (Guaranteed) <sup>(1)(2)</sup> ( $\mu\text{rad}$ ) <sup>(3)</sup>	MTN100BLHS: $\pm 10$ ( $\pm 20$ ) MTN200BLHS: $\pm 20$ ( $\pm 40$ ) MTN300BLHS: $\pm 30$ ( $\pm 60$ )
Yaw, Typical (Guaranteed) <sup>(1)(2)</sup> ( $\mu\text{rad}$ ) <sup>(3)</sup>	MTN100BLHS: $\pm 10$ ( $\pm 17$ ) MTN200BLHS: $\pm 17$ ( $\pm 35$ ) MTN300BLHS: $\pm 30$ ( $\pm 53$ )

<sup>1)</sup> For the definition of Typical and Guaranteed specifications see "Motion Basics Terminology & Standards" Tutorial at [www.newport.com](http://www.newport.com)

<sup>2)</sup> Over 100 mm travel.

<sup>3)</sup> To obtain arcsec units, divide mrad value by 4.8.



#### CAUTION

To reach specifications stated, stages must be fixed on a plane surface with a flatness of 5  $\mu\text{m}$ .

### 3.3 Load Specification Definitions

#### Normal Load Capacity (Cz)

Maximum load a stage can move while maintaining specifications.

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

#### Axial Load Capacity ( $\pm Cx$ )

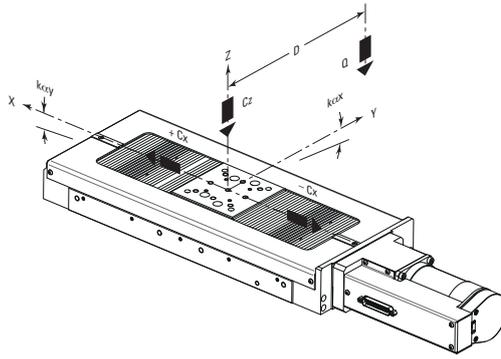
Maximum load along the direction of the drive train.

#### Off-Centered Load (Q)

Maximum cantilever-load the bearing can move:  $Q \leq Cz \div (1 + D/100)$

D: Cantilever distance.

### 3.4 Load Characteristics and Stiffness



Cz, Normal centered load capacity on bearings	1000 N
Cx, Direct load capacity on X axis	200 N
-Cx, Inverse load capacity on X axis	200 N
k <sub>cxx</sub> , Compliance in roll	4 μrad/Nm
k <sub>cyy</sub> , Compliance in pitch	6 μrad/Nm
k <sub>czz</sub> , Compliance in yaw	5 μrad/Nm
Q, Off-center load	$Q \leq C_z \div (1 + D/100)$
where: D = Cantilever distance in mm	



#### CAUTION

To achieve maximum speed and acceleration performance with the set of parameters provided by default, it is recommended not to exceed 35 kg load on a single-axis and 20 kg on an XY configuration.

### 3.5 Stage Weights

Weights indicated in the table below are average values.

	Weight [lb (kg)]
MTN100BLHS	23.15 (10.5)
MTN200BLHS	28.44 (12.9)
MTN300BLHS	33.95 (15.4)
MCAB-3-B 3-meter Cable	1.54 (0.7)

## 4.0 Drive and Motor

### 4.1 Brushless Motor Characteristics

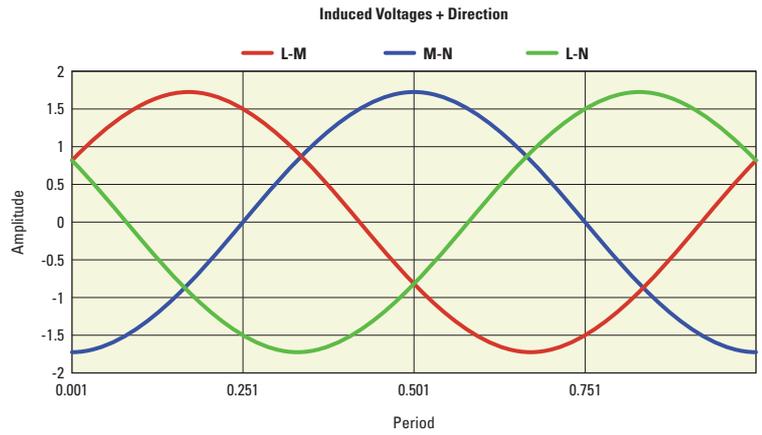
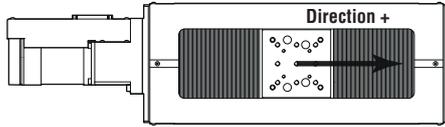
Number of poles	4
Number of phases	3
Rated voltage	36 V
Rated speed	4,000 rpm
Rated torque	0.32 Nm
Peak torque	1 Nm
Peak current	16.5 A
Resistance per phase	0.45 Ω
Inductance per phase	1.4 mH
Torque constant	0.063 Nm/A
Electromotive force	6.6 V/krpm



#### CAUTION

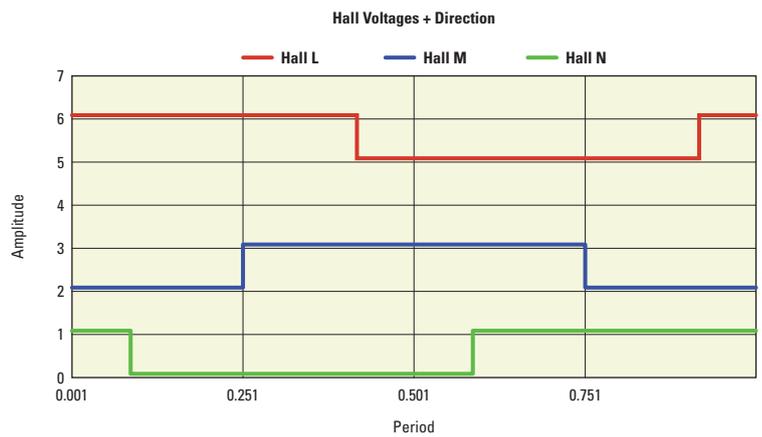
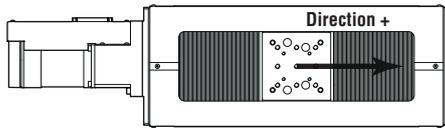
High RMS current will generate motor heating which will degrade characteristics of the stage, such as repeatability, accuracy, etc...

4.2 Command Signals



NOTE

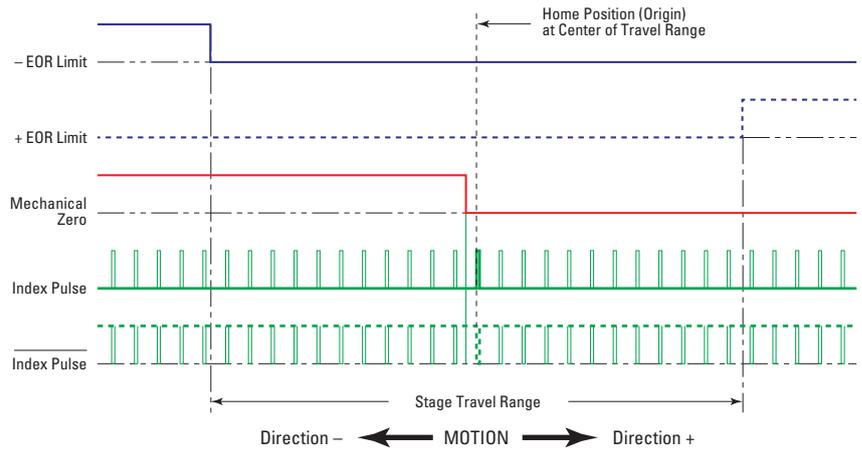
The values above indicate voltage induced by energized coil of one phase on next phase coil. A positive value for L-M would indicate a higher voltage on L relative to M.



NOTE

Motor phases and Hall signals are shifted in phase by 30°.

4.3 Sensor Position



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

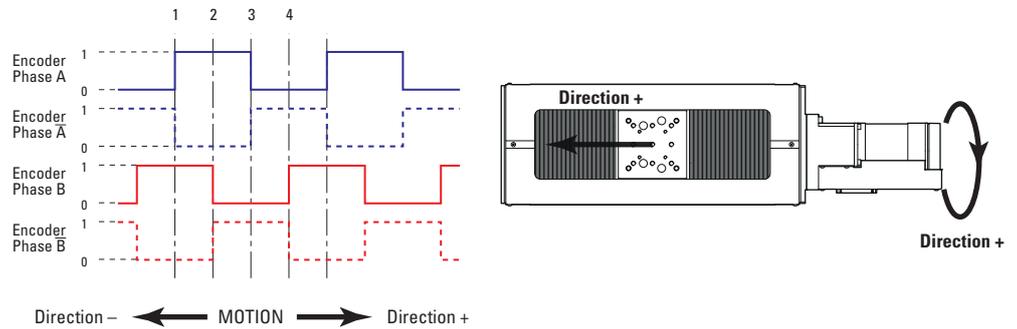
The Index Pulse provides a repeatable Home Position at ±1 step.



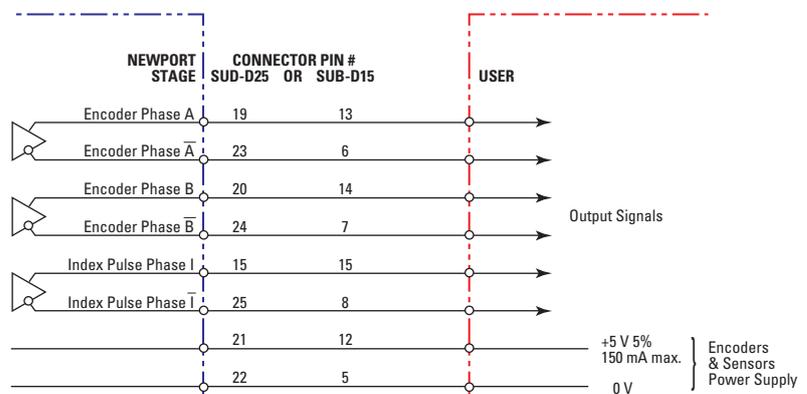
CAUTION

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

4.4 Feedback Signal Position



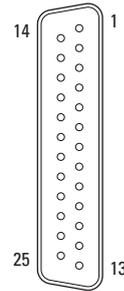
The incremental sensor consists of an optical scale and an encoder head. When the carriage moves, the encoder head generates square signals in quadrature and sends to pins #19, #20, #23 and #24 of the SUB-D25 connector.



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

4.5 Pinouts

The pinout diagram for the MTN-BLHS stage SUB-D25M connector is shown below.

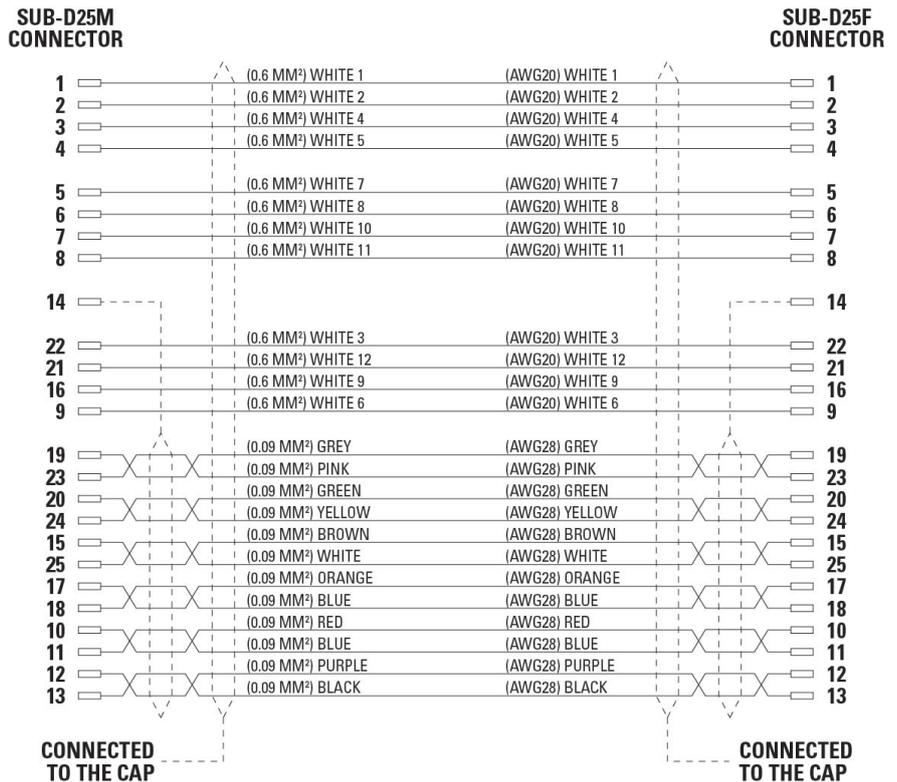


MTN-BLHS

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

4.6 MCAB-3-B Cable

A 3-meter MCAB-3-B cable is supplied with each stage (see section 5.3: "Cables").



## 5.0 Connection to Newport Controllers

### 5.1 Warnings on Controllers

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

---

#### WARNING

Disconnect the power plug under the following circumstances:

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

---

#### CAUTION

To protect the unit from damage, be sure to:

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



---

#### WARNING

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

Contact your electrician to check your receptacles.

---

#### WARNING

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

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

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

---

#### WARNING

This product operates with voltages that can be lethal.

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

---

5.2 Connection

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



**WARNING**

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

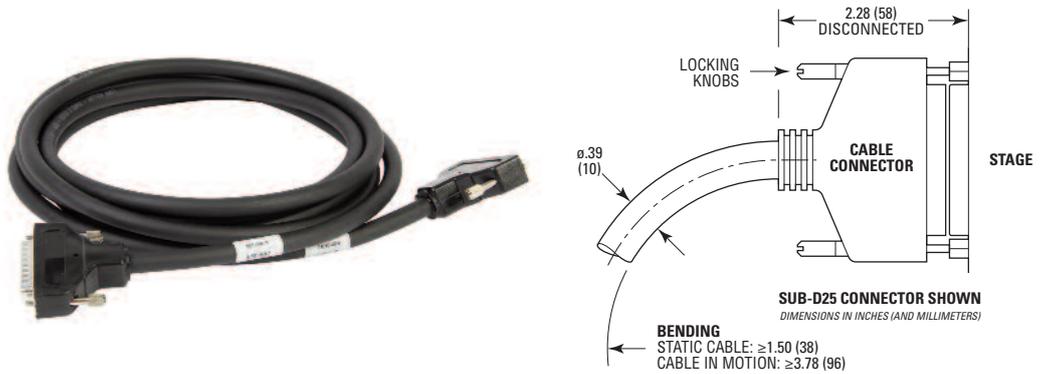
**NOTE**



These stages are ESP compatible. Enhanced System Performance is Newport's exclusive technology that enables Newport ESP motion controllers to recognize the connected Newport ESP stage and upload the stage parameters. This ensures that the user can operate the motion system quickly and safely.

5.3 Cables

All MTN-BLHS stages are delivered with **MCAB-3-B** 3-meter cables with a SUB-D25M connector for direct connection to Newport Controllers.



**WARNING**

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



**WARNING**

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

## 6.0 Connection to Non-Newport Electronics

### 6.1 Connections

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#### WARNING

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

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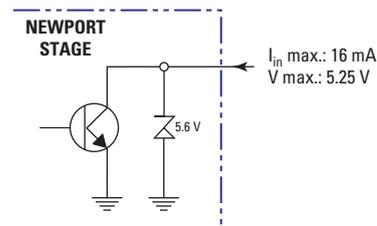
#### WARNING

Newport guarantees “CE” compliance of MTN-BLHS stages only if used with Newport cables and controllers.

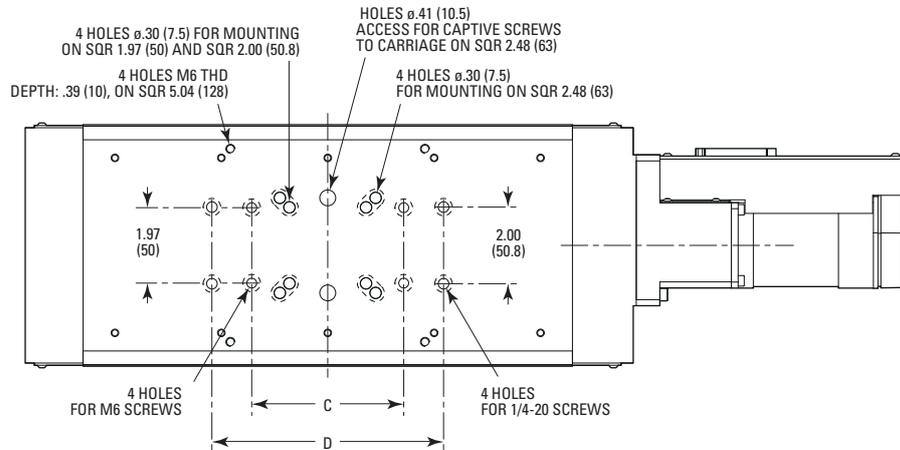
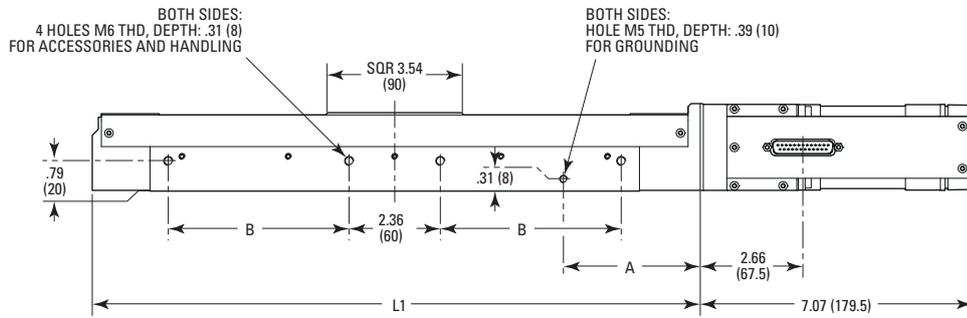
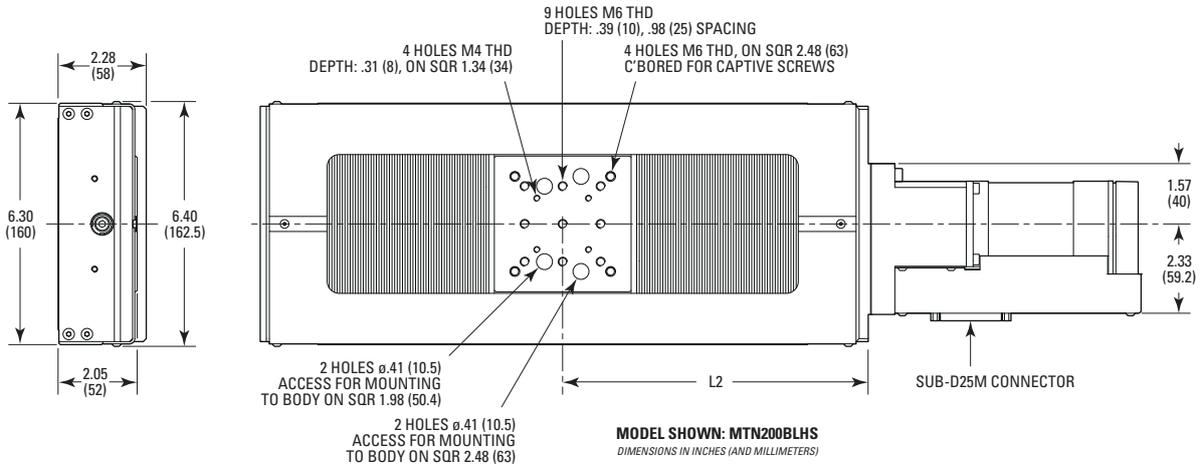


It is the customer's responsibility to modify the cable and take care of sensor signal connections, when using the stage with non-Newport controllers.

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



7.0 Dimensions



MODEL	A	B	C	D	L1	L2
MTN100BLHS	2.95 (75)	.20 (56)	-	-	11.81 (300)	5.94 (151)
MTN200BLHS	3.54 (90)	4.69 (119)	3.94 (100)	6.00 (152.4)	15.75 (400)	7.91 (201)
MTN300BLHS	3.54 (90)	6.14 (156)	9.84 (250)	8.00 (203.2)	19.69 (500)	9.88 (251)



MTN100BLHS



MTN300BLHS

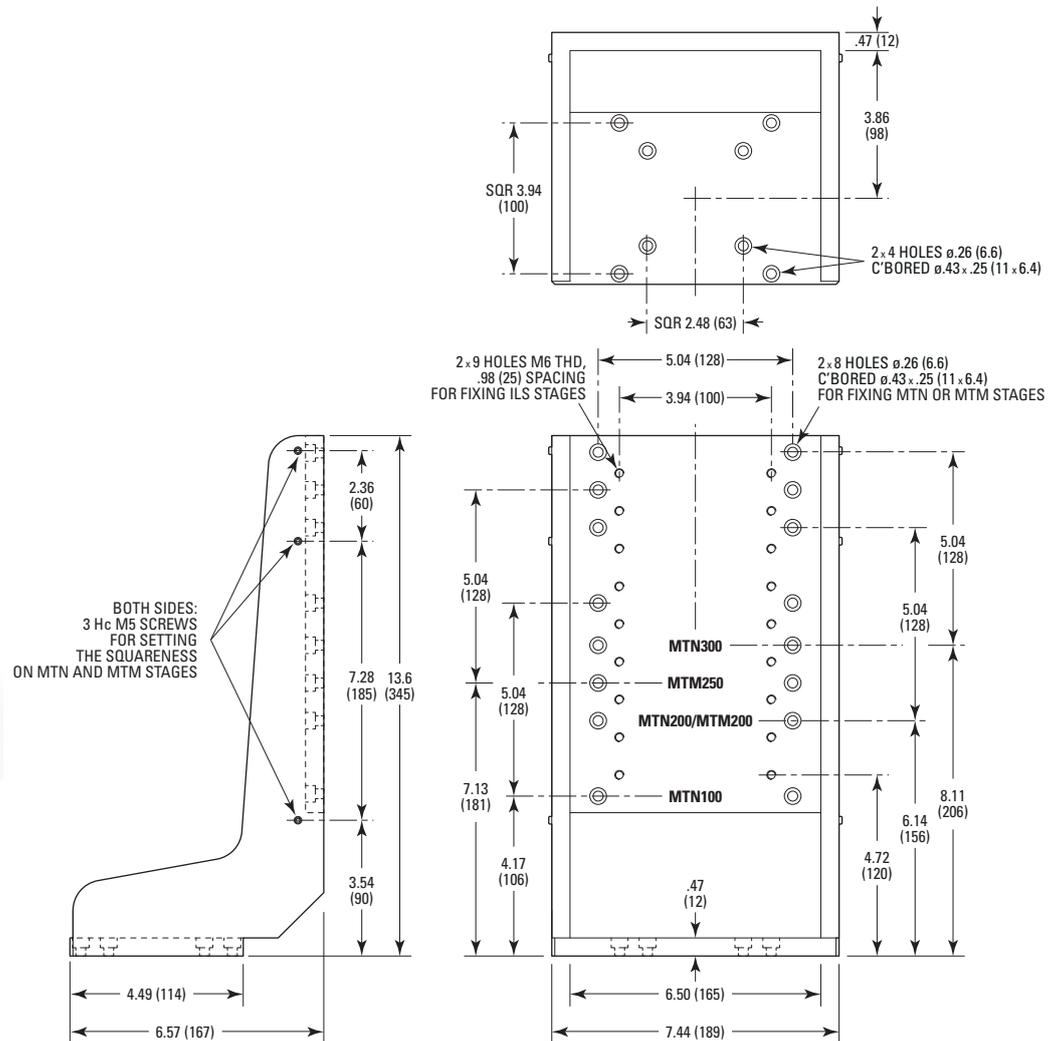
8.0 Accessories

8.1 EQ160 Bracket

The EQ160 right-angle brackets (to order separately) can be used for vertical mounting configurations of a MTN-BLHS stage.

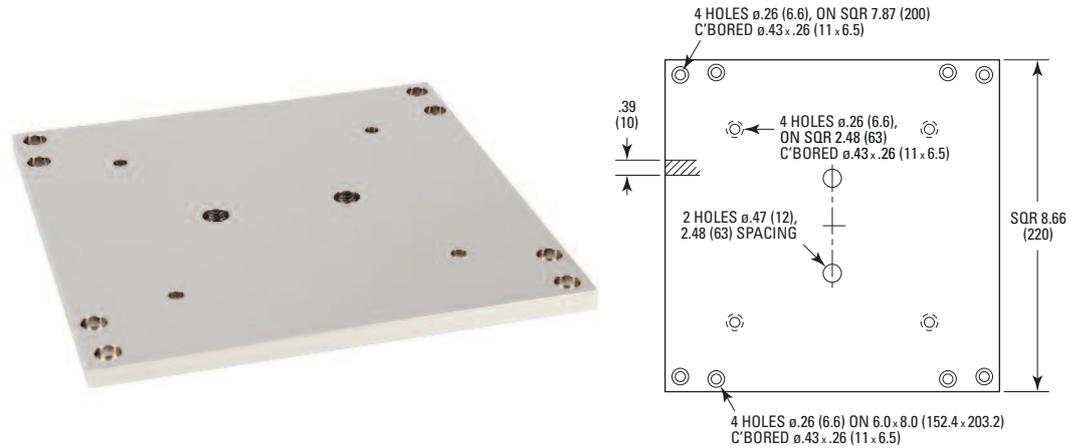
NOTE

The carriage can drift once power is turned off.



**8.2 MTN-BP Base Plate**

The MTN-BP base plate must be to ordered separately.



**NOTE**

**For an XY assembly, the lower stage must be equipped with a MTN-BP base plate.**

**It also allows to fasten the stage to an interface with an imperial hole pattern.**

**8.3 MTN-TP Top Plate**

This MTN-TP top plate is necessary if you need an interface with an imperial hole pattern (to be to ordered separately).



## 9.0 Maintenance

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### RECOMMENDATION

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

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#### 9.1 Maintenance

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

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### PRECAUTIONS

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

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### RECOMMENDATION

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

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

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#### 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.**

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

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### CAUTION

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

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#### 9.3 Calibration



### CAUTION

**It is recommended to return your MTN-BLHS stage to Newport once a year for recalibration to its original specifications.**

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