mks

IMS-V Series

High-Performance Linear Stages for Vertical Use

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.

Table of Contents

EC Declaration of Conformity

2 Tech Drive
Andover, MA 01810
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(7)
☒ 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 (4) 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: **High-Performance Linear Stages for Vertical Use**

Model Number(s) (6): **M-/IMS100V, M-/IMS300V**

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: 6/9/2022

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

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(7)
☒ Waste Electrical and Electronic Equipment – Directive 2012/19/EU

Standard(s) to which conformity is declared:
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☒BS EN ISO 12100:2010 Safety of Machinery – General Principles of Design – Risk Assessment and Risk Reduction

Emissions:
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☒BS 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: **High-Performance Linear Stages for Vertical Use**

Model Number(s) (6): **M-/IMS100V, M-/IMS300V**

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Date: 6/9/2022

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.

WARNING

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

CAUTION

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

NOTE

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

European Union CE Mark

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

Warnings and Cautions

ATTENTION

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

Warnings

WARNING

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

WARNING

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

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

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

WARNING

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

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

Contact your Newport service facility and request repairs.

WARNING

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

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

Contact your Newport service facility for repairs.

WARNING

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

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

Contact your Newport service facility and request repairs.

WARNING

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

WARNING

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

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 temperature: -10 to +40 °C (in its original packaging)**

CAUTION

Do not move this stage if its motor power is on.

Make sure that the cable to the electronics is disconnected before moving the stage. Failure to do so may damage the cable and cause an electrical shock.

CAUTION

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

CAUTION

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

CAUTION

When the carriage is in its end-of-run position, it is strongly recommended not to go beyond this point as this may damage the stage mechanism.

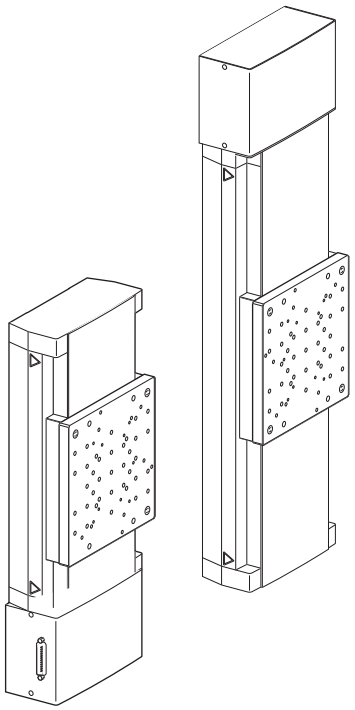
CAUTION

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

High-Performance Linear Stages for Vertical Use IMS-V Series

1.0 Introduction

This manual provides operating instructions for the stage that you have purchased in the IMS-V Series:



IMS-V Series linear stages: 100 and 300 mm travel ranges.

RECOMMENDATION

We recommend you read carefully the chapter “Connection to electronics” before using the (M-)IMS-V stage.

2.0 Description

EQ180 bracket to be used with:

- *(M-)IMS100V for payloads ≤400 N*
- *(M-)IMS300V for payloads ≤100 N*

The IMS-V Series linear stage complements the (M-)IMS Series by providing linear travel ranging of 100 and 300 mm. The stages feature robust designs with high performance but without high cost, making them cost-effective solutions for precision industrial and laboratory applications.

Using the same industry-proofed technology as the (M-)ILS Series, the IMS-V Series features a FEM optimized, aluminum extruded body that is highly stiff, while minimizing the bending effect caused by different thermal expansion coefficients of the aluminum body and the steel rails.

Smooth running recirculating ball bearing slides with ball separators provide accurate linear motion and avoid ball cage migration found on linear ball bearings or crossed roller bearings.

A highly-stiff, backlash-free, 3 mm pitch friction lead screw ensures vertical movement with capability to handle high payload.

For more demanding precision positioning requirements, the IMS-V Series is equipped with a highly interpolated linear scale providing 0.1 µm resolution feedback.

The completely closed design of the IMS-V Series with an upper rigid cover, underlining its robustness and long lasting values. IMS-V stages also feature a motor side mounted origin for repeatable initialization, limit switches to prevent over travel, and elastomeric end-of-run dampers for smooth emergency braking.

For optimal performance, we recommend the use of our motion controllers to choose in accordance with the payload.

The IMS-V stages are supplied with a 5-meter cable for connection to our motion controllers.

2.1 Design Details

Base Material	Extruded Aluminum
Bearings	Four way equal loaded caged recirculating ball bearings
Drive Mechanism	Precision ground 16 mm diameter lead screw, High-wear resistance polyethylene terephthalate nut, no preload
Drive Screw Pitch (mm)	3
Feedback	Linear steel scale, 20 µm signal period, 0.1 µm resolution
Limit Switches	Optical
Origin	Optical, approx. 8 mm from motor side limit
Motor	DC servo
Cable	5 m long motor cable included

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:

$$Absolute\ Accuracy = Accuracy + Correction\ Factor \times Travel$$

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 ($20^{\pm 1}$ °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

	IMS100V	IMS300V
Travel Range (mm)	100	300
Minimum Incremental Motion (µm)	0.3 µm with XPS, 0.6 µm with ESP301 or SMC100CC	
Uni-directional Repeatability, Typical (Guaranteed) (µm)	±0.10 (±0.25)	±0.12 (±0.25)
Bi-directional Repeatability, Typical (Guaranteed) [1] (µm)	±0.15 (± 0.50)	±0.20 (± 0.50)
Accuracy, Typical (Guaranteed) [1] (µm)	±0.6 (±2.0)	±3.5 (±5.0)
Maximum Speed	20 mm/s with up to 100 N load 5 mm/s with higher loads	
Pitch, Typical (Guaranteed) [1][2] (µrad)	±15 (±50)	±35 (±125)
Yaw, Typical (Guaranteed) [1][2] (µrad)	±10 (±38)	±20 (±75)
MTBF	20,000 h with 300 N load and with a 10% duty cycle	

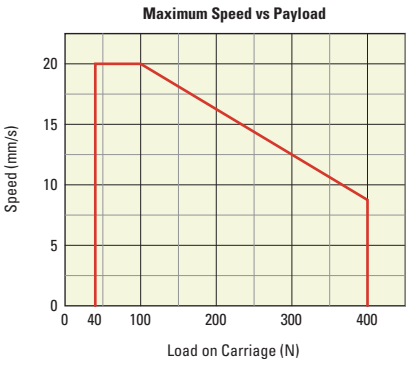
[1] *For the definition of Typical and Guaranteed specifications see "Motion Basics Terminology & Standards" Tutorial at www.newport.com*

[2] *To obtain arcsec units, divide µrad value by 4.8.*

CAUTION

To reach specifications stated, stages must be fixed on a plane surface with a flatness of 5 µm.

3.3 Load Specification Definitions *(Depends on the Controller)*



	Payload (N)	
	100	400
Specified Speed [1] (mm/s)	20	5
Specified Acceleration (mm/s²)	80	20

[1] *The variation of the speed is linear between 100 N and 400 N.*

CAUTION

To go over the indicated speed in accordance with the payload may damage the stage mechanism.

Axial Load Capacity (±Cx)

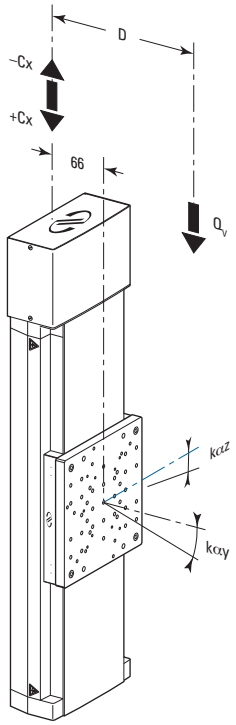
Maximum load along the direction of the drive train.

Off-Centered Load (Q)

Maximum cantilever-load a stage can move: $Q_V \leq 1500 \div (1 + D/90)$, but not greater than Cx Max.

D: Cantilever distance.

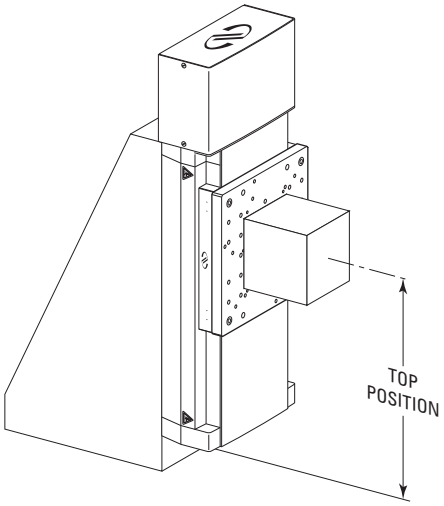
3.4 Load Characteristics and Stiffness



Min. -Cx; +Cx	40 N
Max. -Cx; +Cx	400 N with XPS 100 N with ESP302
kαy, Compliance in pitch	0.2 µrad/Nm
kαz, Compliance in yaw	1 µrad/Nm
Q_V, Off-center load	$Q_V \leq 1500 \div (1 + D/90)$
D, Cantilever distance in mm between the center of mass of the load and the bearings center.	
Distance between top surface and the bearings center	66 mm

NOTES

1. **The vertical load must be within the axial Cx, and cantilevered, Q_V load limit.**
2. **Motor down orientation is preferred for easier tuning.**
3. **Minimum preload is required.**



WARNING

Because of the use of a friction lead screw and the stick-slip effect, the sensitivity of (M-)IMS-V stages at full load depends a lot on the controller/driver features and tuning. Back and forth motions of a few counts after settling are normal. The self locking of the lead screw allow to turn off the servo loop to stop these oscillations, without getting unwanted motion.

WARNING

To reach the specifications stated for a (M-)IMS-V stage, the mounting bracket or the fastening support of the stage must have a minimum stiffness at the level of the load in top position, as indicated below:

Max. load	Min. stiffness
100 N	5 N/µm
400 N	10 N/µm

3.5 Stage Weights

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

	Weight [lb (kg)]
(M-)IMS100V	30.0 (13.6)
(M-)IMS300V	37.5 (17.0)

4.0 Drives and Motors

4.1 DC-Servo Drive Version

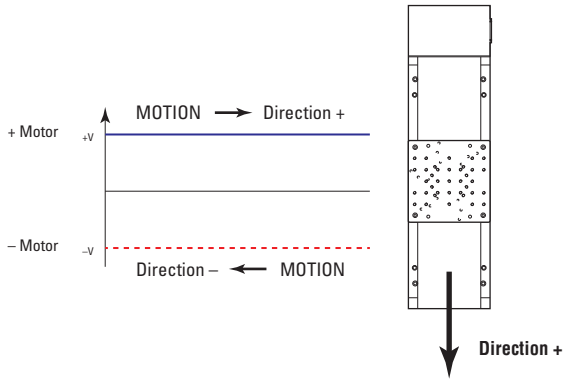
A DC-motor and a linear steel scale, 20 µm signal period, 0.1 µm resolution.

DC-Motor Performance Specifications and Characteristics

	Resolution (µm)	Speed (mm/s)	Nominal Voltage (V)	Max RMS Current (A)	Max. Peak Current (A)	Resistance (Ω)	Inductance (mH)	Tachometer Const. (V/krpm)
IMS-V	0.1	20 [1]	48	1.5	2.3	5.1	3.2	–

1) With up to 100 N load.

Command Signals for the DC-Motor

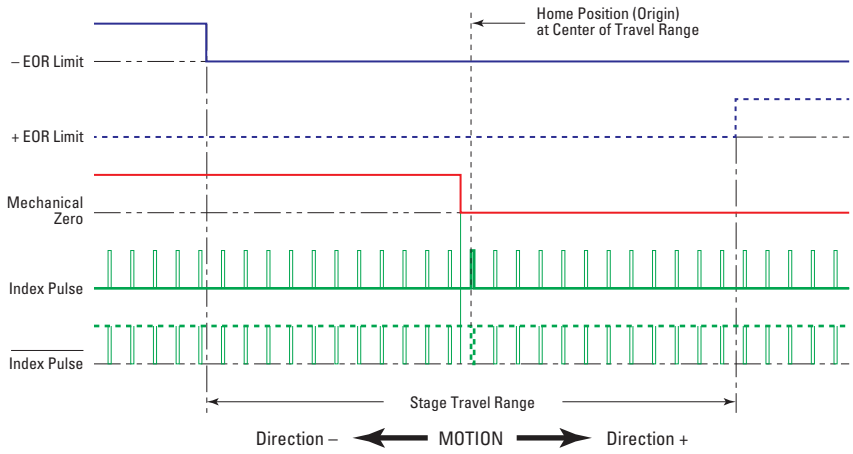


In the above drawings, + Motor signal is referred to – Motor signal.

① When the stage moves in + Direction, the + Motor voltage is higher than – Motor voltage.

② When the stage moves in – Direction, the + Motor voltage is lower than – Motor voltage.

4.2 Sensor Position



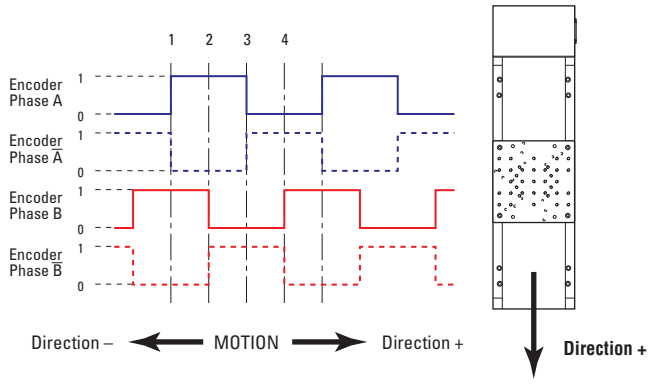
End-of-Run and Mechanical Zero are 5 V open collector type.

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

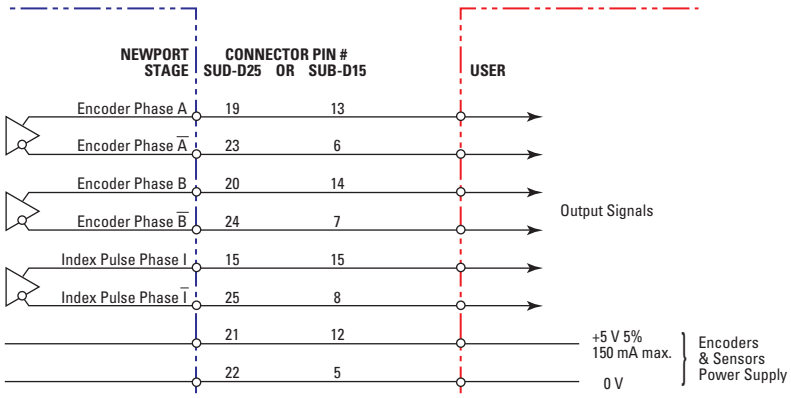
CAUTION

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

4.3 Feedback Signal Position



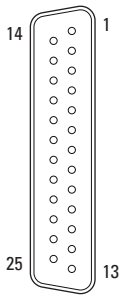
The incremental sensor consists of an optical scale and an encoder head. When the carriage moves, the encoder head generates square signals in quadrature and sends to pins #19, #20, #23 and #24 of the SUB-D25 connector.



"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.

4.4 Pinouts

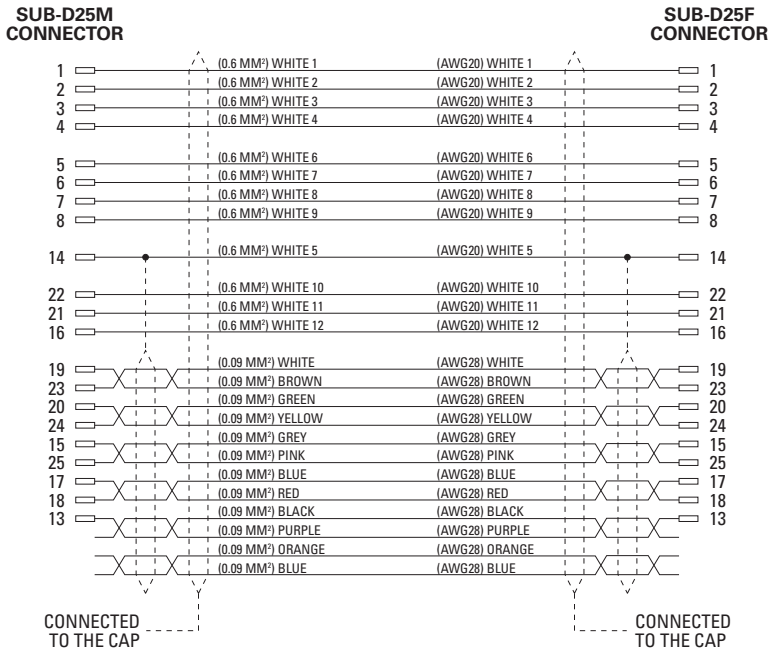
The pinout diagram for the IMS-V stages SUB-D25M connector is shown below.



	IMS-V
1	N.C.
2	N.C.
3	N.C.
4	N.C.
5	+ Motor
6	+ Motor
7	– Motor
8	– Motor
9	N.C.
10	N.C.
11	N.C.
12	N.C.
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

4.5 MCAB-5 Cable

A 5-meter MCAB-5 cable is supplied with each IMS-V stage (see section 5.5: ”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 to XPS Controller

	Max. Payload (N)	
	100	400
Max. Speed (mm/s)	20	5

5.3 Connection to ESP301 Controller

	Max. Payload (N)
	100
Max. Speed (mm/s)	20

WARNING

With these controllers, the payload can't be over than 100 N.

5.4 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

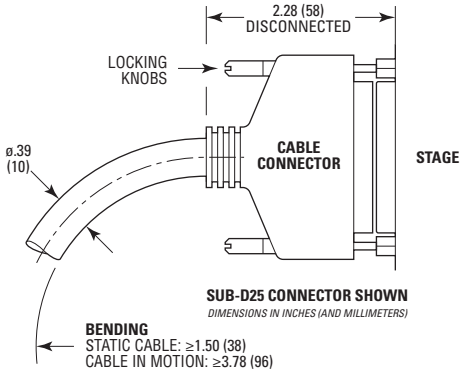
These stages are ESP compatible. Enhanced System Performance is Newport's exclusive technology that enables Newport ESP motion controllers to recognize the connected Newport ESP stage and upload the stage parameters. This ensures that the user can operate the motion system quickly and safely.

5.5 Cables

All IMS-V stages are delivered with **MCAB-5** 5-meter cables with a SUB-D25M connector for direct connection to Newport Controllers.

WARNING

IMS-V Series translation stages operate only with a 5-meter max. cable.



WARNING

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

WARNING

Keep this cable 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

WARNING

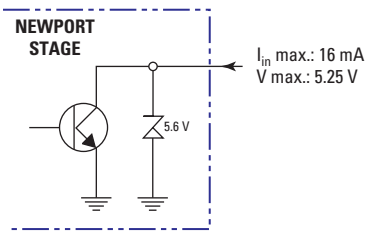
Newport is not responsible for malfunction or damage of IMS-V stages when used with non-Newport controllers.

WARNING

Newport guarantees "CE" compliance of IMS-V stages only if used with Newport cables and controllers.

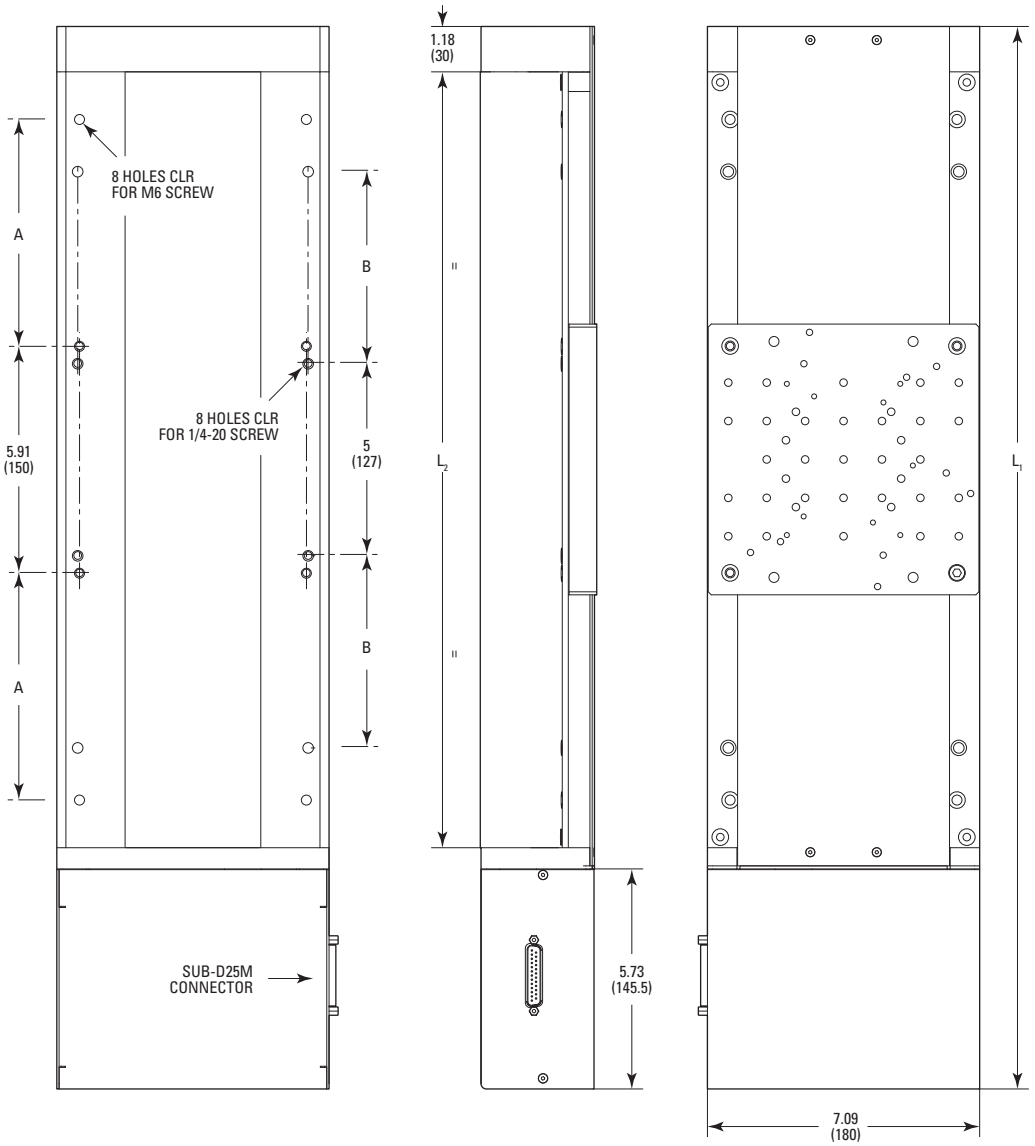
It is the customer's responsibility to modify the cable and take care of sensor signal connections, when using the stage with non-Newport controllers.

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



7.0 Dimensions

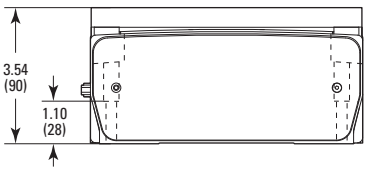
7.1 (M-)IMS-V Stages



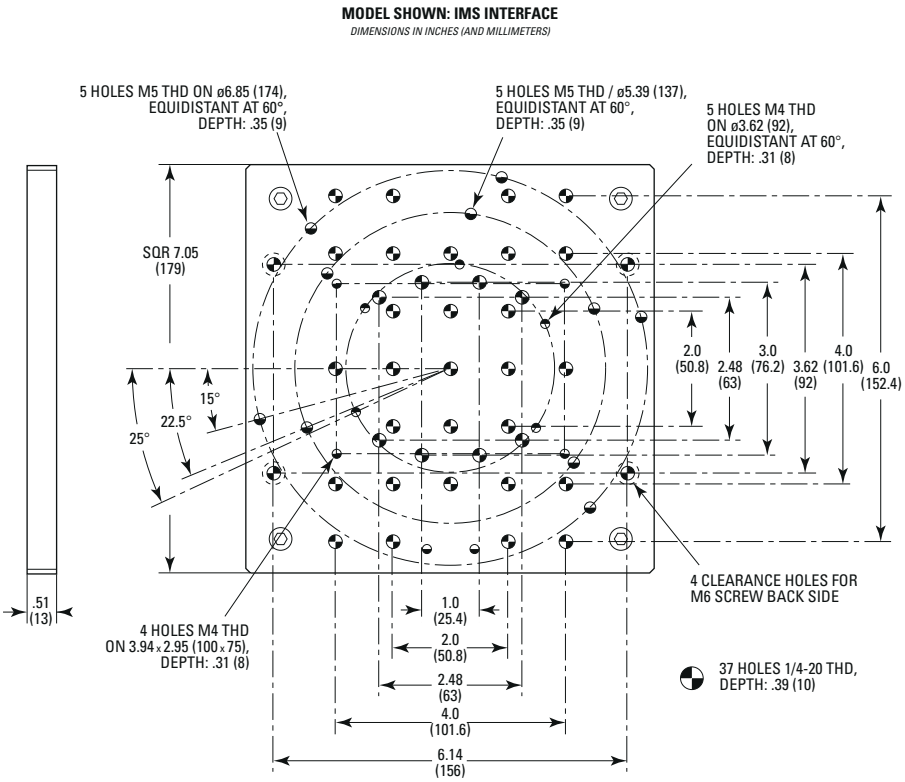
MODEL SHOWN: IMS300V

DIMENSIONS IN INCHES (AND MILLIMETERS)

MODEL (METRIC)	A	B	L_1	L_2	TRAVEL
(M-)IMS100V	1.97 (50)	2.00 (50.8)	19.78 (502.5)	12.32 (313)	3.94 (100)
(M-)IMS300V	6.91 (150)	5.00 (127)	27.66 (702.5)	20.20 (513)	11.81 (300)



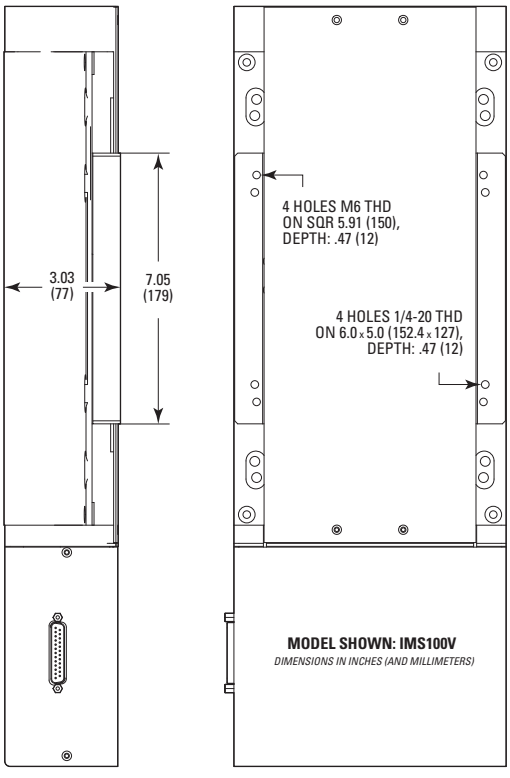
7.2 Top Plate Interface



7.3 (M-)IMS-V Stages without Top Plate Interface

Sometimes, it is necessary to remove the top plate interface of a (M-)IMS-V stage.

To do that, just unscrew the 4 CHc M6 x .63 (16) on sqr 5.91 (150) screws at the 4 corners of the plate with the wrench supplied with the stage. Both IMS-V and M-IMS-V stages will then have the same opposite interfaces.



8.0 Maintenance

RECOMMENDATION

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

8.1 Maintenance

The (M-)IMS-V stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and operated with caution.

PRECAUTIONS

The (M-)IMS-V 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-lubrication after 2000 hours of use.

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

8.2 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.

8.3 Calibration

CAUTION

It is recommended to return your (M-)IMS-V stage to Newport once a year for recalibration to its original specifications.

Service Form

Your Local Representative
Tel.: _____
Fax: _____

Name: _____ Return authorization #: _____
(Please obtain prior to return of item)

Company: _____

Address: _____ Date: _____

Country: _____ Phone Number: _____

P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

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

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