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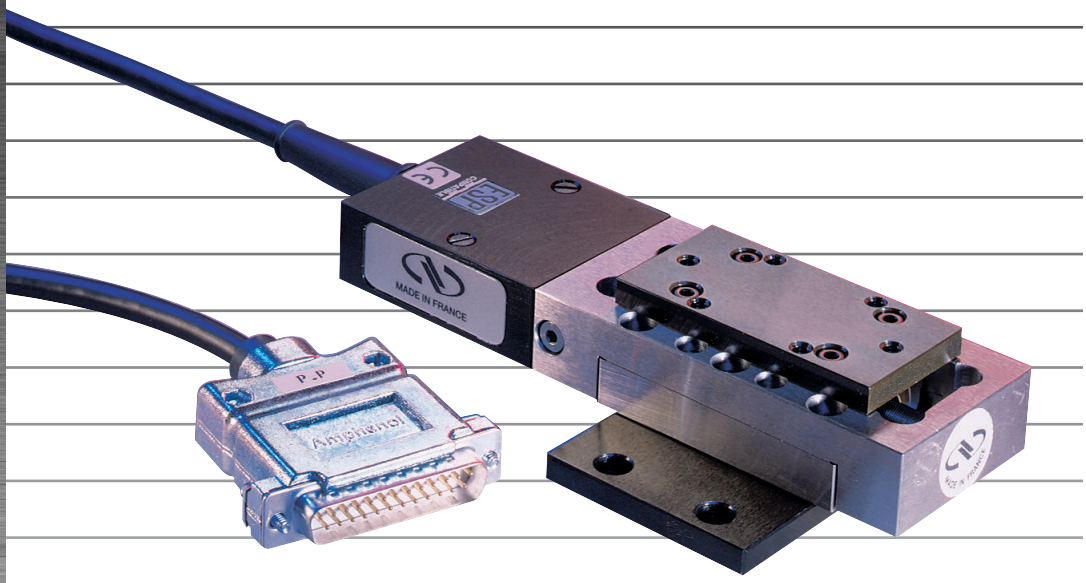
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Find the *Newport M-MFN25PP* at our website: *Click HERE*

# (M-)MFN

# Miniature Linear Stages




## USER'S MANUAL

Newport®

www.newport.com

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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 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.**

---

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 translation 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**

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


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# Miniature Linear Stages (M-)MFN

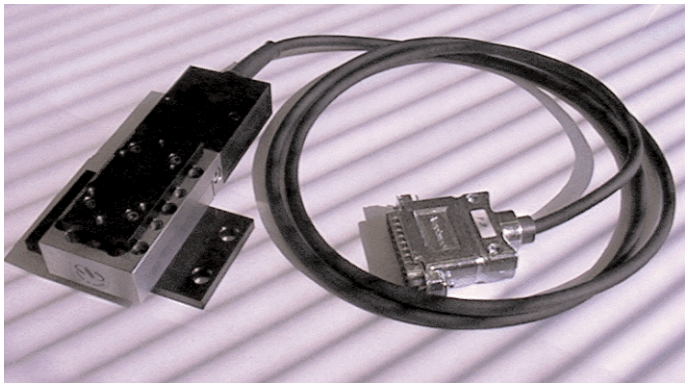
## 1.0 Introduction

This manual provides operating instructions for the stage that you have purchased in the (M-)MFN Series:

- (M-)MFNPP
- (M-)MFNPPV6 [1]
- (M-)MFNCC

**[1] REMARK**

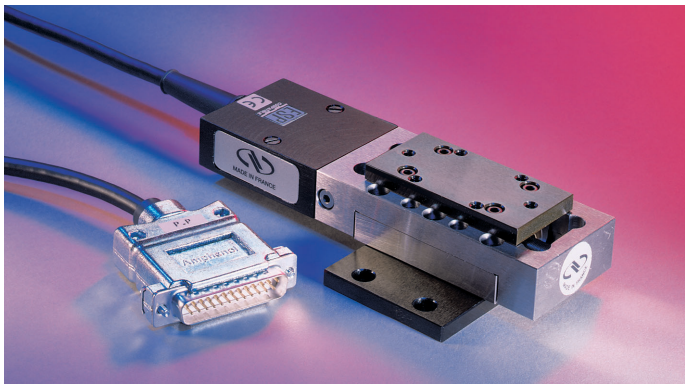
**Vacuum compatible stages to $10^{-6}$ Torr. In this case, max. speed and load capacity have to be divided by two.**



*(M-)MFN miniature linear stage.*

**RECOMMENDATION**

**We recommend you read carefully the chapter "Connection to electronics" before using the (M-)MFN stage.**




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## 2.0 Description

Designed for space-limited applications and compact multi-axis assemblies, MFN Series linear stages supply very high resolution, single-axis translation in a low-cost, motorized package. Typical applications for this stage are fiber optic alignment, laser diode research, and inspection systems.

Components mount to the top surface of the stage via tapped mounting holes. Modular stage design facilitates easy assembly of MFN Series stages into multi-axis configurations.

A miniature DC-or stepper motor, housed within the carriage of the stage, actuates motion via a backlash-compensated lead screw and nut system. Precision-ground, double-row ball bearings ensure accurate linear travel. To meet high positioning requirements, a motor-mounted rotary encoder delivers better than 0.1 µm resolution. End-of-run limit switches prevent bearing damage from accidental over-travel.

For optimal performance, we recommend the use of our ESP or MM series motion controllers.

The (M-)MFN Series 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 linear ball bearings |
| Drive Mechanism | Backlash-compensated leadscrew |
| Drive Screw Pitch | 0.5 mm |
| Reduction Gear | 141:1 |
| Feedback | (M-)MFNPP: Motor mounted rotary encoder, 48 pts/rev.<br>(M-)MFNCC: Motor mounted rotary encoder, 64 pts/rev. |
| Limit Switches | Mechanical |
| Origin | Uses motor side limit for homing, typically <20 µm repeatability |
| Motor | (M-)MFNCC: DC-servo motor UE16CC<br>(M-)MFNPP: 2-phase stepper motor UE16PP, 1 Full step = 2 Encoder pulses |
| Cable Length | 1.5 m |
| Vacuum Compatibility | Vacuum compatible versions are available up to $10^{-6}$ Torr:<br>(M-)MFN08PPV6 and (M-)MFN25PPV6 |


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# 3.0 Characteristics

## 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 stage can achieve. Our 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 stage can measure.

**Yaw, Pitch**

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

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 stage is tested with a laser interferometer.

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


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## 3.2 Mechanical Specifications

| | | |
|---|---|---|
| Travel Range | (mm) | 8; 25 |
| Resolution | (µm) | 0.055 (DC-Brush Servo),<br>0.074 (Stepper motor) |
| Minimum Incremental Motion | (µm) | 0.2 |
| Unidirectional Repeatability | (µm) | 1 |
| Reversal Value (Hysteresis) | (µm) | 3 |
| On Axis Accuracy | (µm) | 10 |
| Maximum Speed | (mm/sec) | 0.3 |
| Roll | (µrad) | 60 |
| Pitch | (µrad) | 100 |
| Yaw | (µrad) | 100 |

## 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 (±Cx)

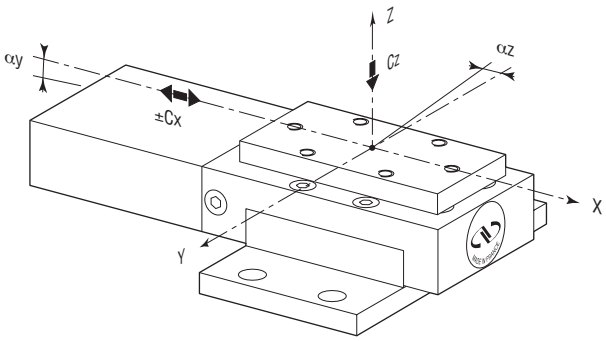
Maximum load along the direction of the drive train.

### Off-Centered Load (Q)

Maximum cantilever-load a stage can move: $Q \leq Cz / (1 + D/20)$

D: Cantilever distance.

## 3.4 Load Characteristics and Stiffness




| | | |
|---|---|---|
| Cz | (N) | 50 |
| -Cx | (N) | 10 |
| +Cx | (N) | 10 |
| kαx | (µrad/N.m) | 60 |
| kαy | (µrad/N.m) | 100 |

Q: Off-center load, $Q \leq Cz / (1 + D/20)$
D: Cantilever distance in mm
Cz: Normal center load capacity on bearings
+Cx: Direct load capacity on X axis
-Cx: Inverse load capacity on X axis
kαx: Angular stiffness (Roll)
kαy: Angular stiffness (Pitch)

## 3.5 Stage Weights

Weights indicated into the below table are average values for stages with their cable installed.

| | | |
|---|---|---|
| (M-)MFN08 | [lb (kg)] | 0.7 (0.3) |
| (M-)MFN25 | [lb (kg)] | 0.9 (0.4) |

The weight variation between drive units is not very significant.


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# 4.0 Drive

## 4.1 Stepper Drive Version

Stepper-motor-driven stages are offered in one half-step drive version: (M-)MFNPP.

**Half-Step Drive**

Is used for stepper motors, when 1 pulse emitted by electronic corresponds to theoretical physical motion of 1/2 of a full step of the motor.

**Stepper Motor Performance Specifications**

| | Resolution (µm) | Speed (mm/sec) | Motor |
|---|---|---|---|
| (M-)MFNPP | 0.074 | 0.3 | UE16PP |

## 4.2 DC-Motor Drive Version

One DC-motor-driven configuration is available: (M-)MFNCC.

**DC-Motor Performance Specifications**

| | Resolution (µm) | Speed (mm/sec) | Motor |
|---|---|---|---|
| (M-)MFNCC | 0.055 | 0.3 | UE16CC |

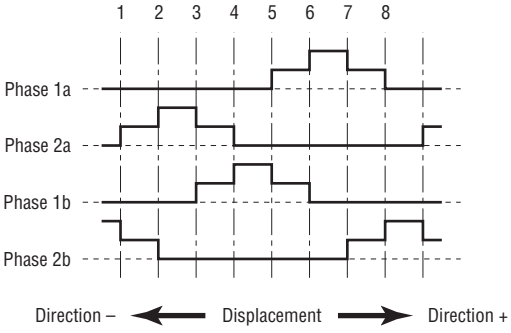
# 5.0 Motor

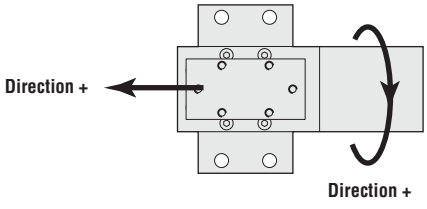
## 5.1 UE16PP Motor Characteristics

| Motor | Angle by Step (°) | Current (A) | Resistance (Ω) | Inductance (mH) | Newport Utilization |
|---|---|---|---|---|---|
| UE16PP | 15 | 0.25 (1)<br>0.18 (2) | 12.5 | 5.5 | Half-Step;<br>1 phase at once |

*1) 1 phase at once: 0.25 A — 2) 2 phases at once: 0.18 A by phase.*

## 5.2 Command Signals for the Stepper Motor



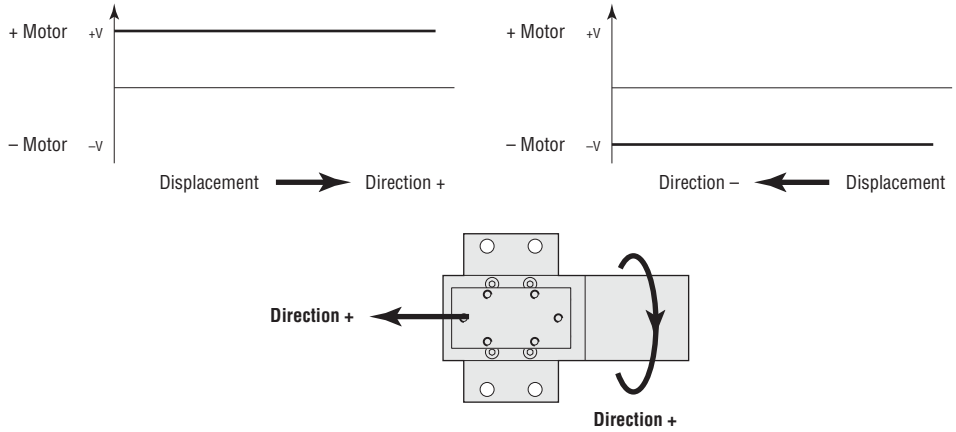


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### 5.3 UE31CC Motor Characteristics

| Motor | Mechanical Power (W) | Nominal Voltage (V) | Armature Resistance (Ω) |
|---|---|---|---|
| UE31CC | 0.31 | 12 | 115 |

### 5.4 Command Signals for the DC-Motor

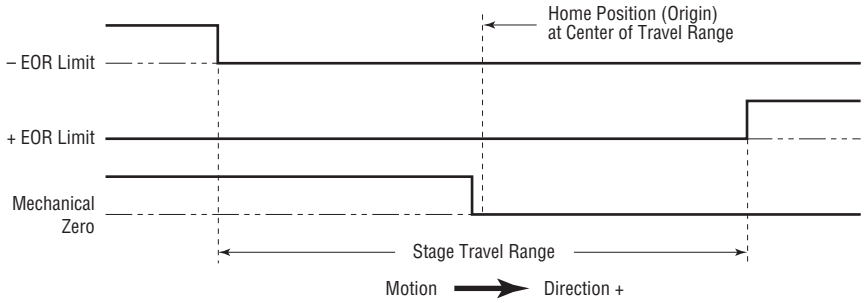



In the above drawings, + Motor signal is referred to – Motor signal.

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

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

### 5.5 Sensor Position




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

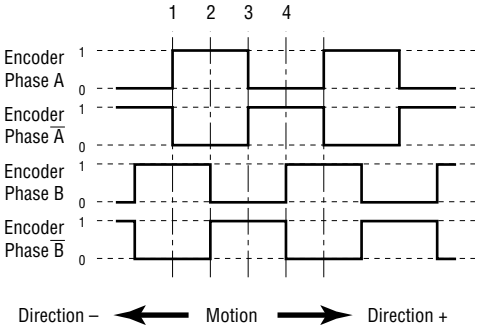
Use of the Index Pulse provides a repeatable Home Position at ±1 step.

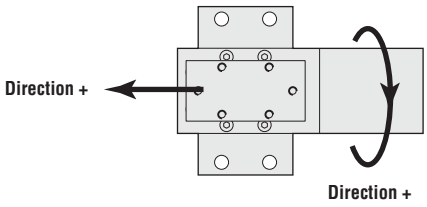
**CAUTION**

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

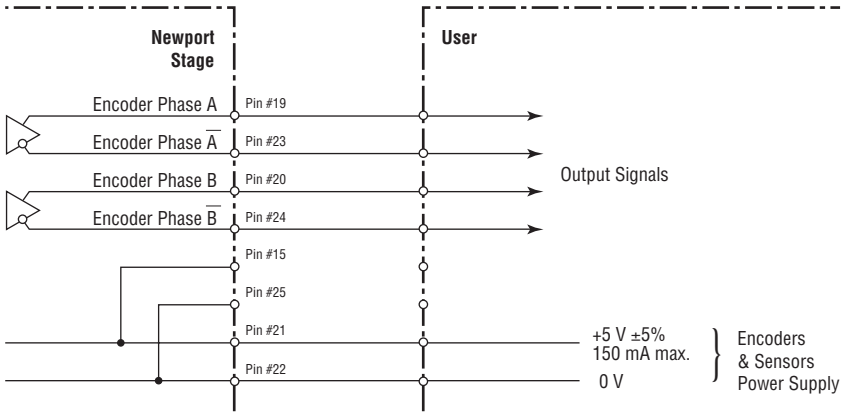

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## 5.6 Feedback Signal Position




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.

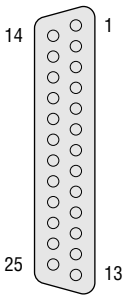




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## 5.7 Pinouts

The 25-pin Sub-D connection for the (M-)MFN stages is given in the following table:




| | UE16PP: (M-)MFNPP | | UE16CC: (M-)MFNCC |
|---|---|---|---|
| **1** | Phase 1a | **1** | N.C. |
| **2** | N.C. | **2** | N.C. |
| **3** | Phase 1b | **3** | N.C. |
| **4** | N.C. | **4** | N.C. |
| **5** | Phase 2a | **5** | + Motor |
| **6** | N.C. | **6** | + Motor |
| **7** | Phase 1b | **7** | – Motor |
| **8** | N.C. | **8** | – Motor |
| **9** | N.C. | **9** | N.C. |
| **10** | N.C. | **10** | N.C. |
| **11** | N.C. | **11** | N.C. |
| **12** | N.C. | **12** | N.C. |
| **13** | Mechanical Zero | **13** | Mechanical Zero |
| **14** | Shield Ground | **14** | Shield Ground |
| **15** | Connected to +5 V | **15** | Connected to +5 V |
| **16** | 0 V logic | **16** | 0 V logic |
| **17** | + End-of-Run | **17** | + End-of-Run |
| **18** | – End-of-Run | **18** | – End-of-Run |
| **19** | Encoder Phase A | **19** | Encoder Phase A |
| **20** | Encoder Phase B | **20** | Encoder Phase B |
| **21** | Encoder Power: +5 V | **21** | Encoder Power: +5 V |
| **22** | 0 V Encoder | **22** | 0 V Encoder |
| **23** | Encoder Phase /A | **23** | Encoder Phase /A |
| **24** | Encoder Phase /B | **24** | Encoder Phase /B |
| **25** | Connected to 0 V | **25** | Connected to 0 V |


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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 stage is represented a label which indicates its name, its serial number and the motor it is equipped with (ex.: UE16PP).

| | |
|---|---|
| MFN25PP | S/N# |
| ENCODER:5V | MOTOR:UE16PP |
| Stepper Motor | U=30VDC I=0.25A |

**WARNING**

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

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 stage may occur if the stage is not the same type as shown on driver label located near the 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 stage.**

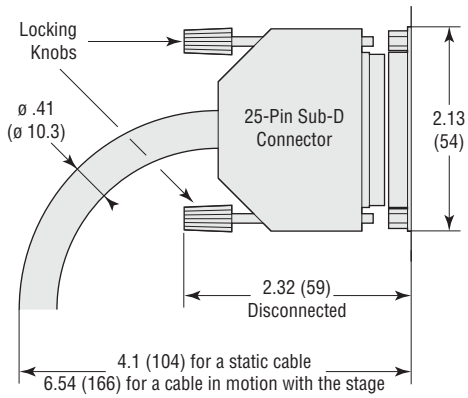
**WARNING**

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

## 6.3 Cables

All our (M-)MFN stages are delivered equipped with a 1.5-meter cable with a 25-pin Sub-D connector 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 the connector (ground continuity provided by cables).**


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For applications where the standard 1.5-meter cable included with your stage is not adequate, Newport offers longer length cables designed to ensure the integrity of your positioning application.



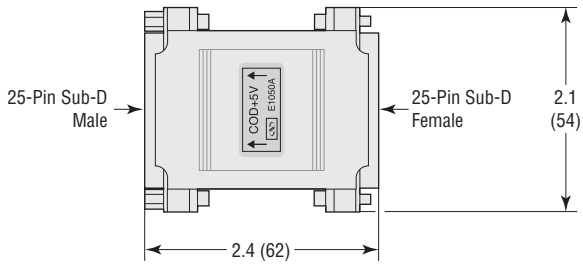
These cables are specially shielded and terminated with Newport's standard 25-pin sub-D connectors. They are available in 3-m (**MMCABLE-3**), 5-m (**MMCABLE-5**), 7-m (**MMCABLE-7**) or 10-m (**MMCABLE-10**) lengths.

**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 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

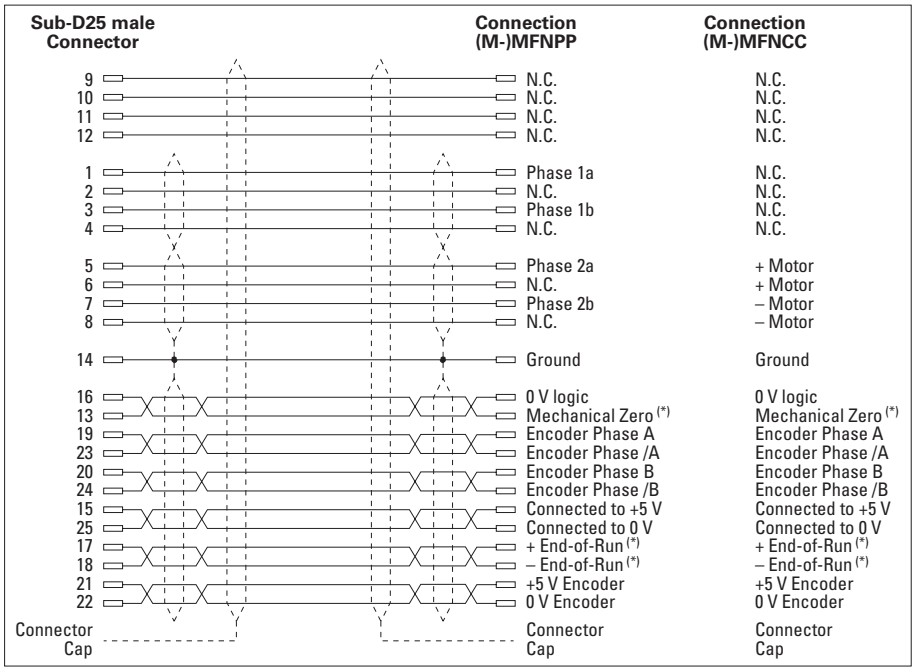
**WARNING**

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

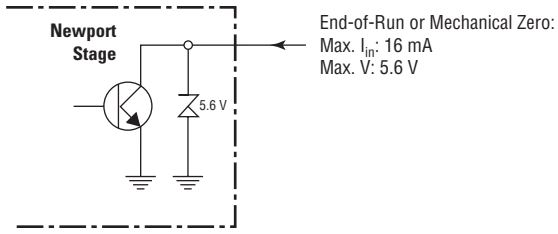
**WARNING**

**Newport guarantees the "CE" compliance of the (M-)MFN translation stages only if they are used with Newport cables and controllers.**

**Nevertheless, the figure below indicates the recommended wiring when a (M-)MFN 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" 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

## 8.1 Stage Mountings

**WARNING**

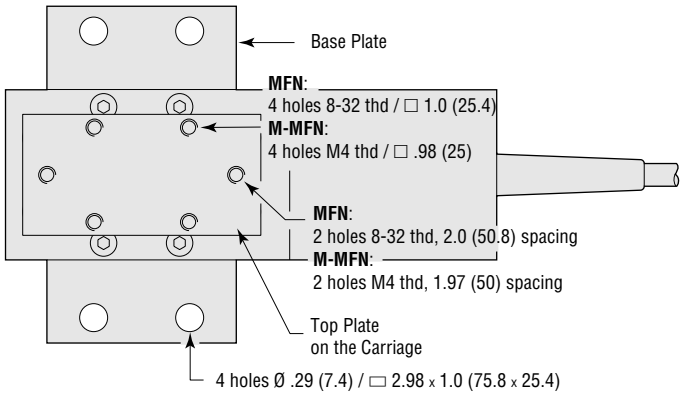
**Before to use a (M-)MFN stage, it is imperative to fix it:**

- **directly on a rectified working surface, from holes located on the mounting plate,**
- **on another stage, directly or with a mounting interface.**

**but in no case, the stage has to remain without fastening.**

**It is equally necessary to fasten the device to move on the carriage:**

- **directly,**
- **removing the plate on the top of the stage.**



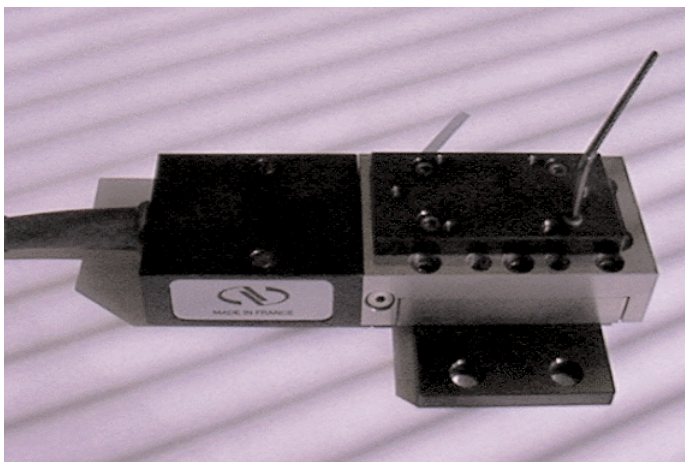

*Dimensions in inches (millimeters)*

**CAUTION**

**The working surface flatness directly influences stage accuracy and performance.**

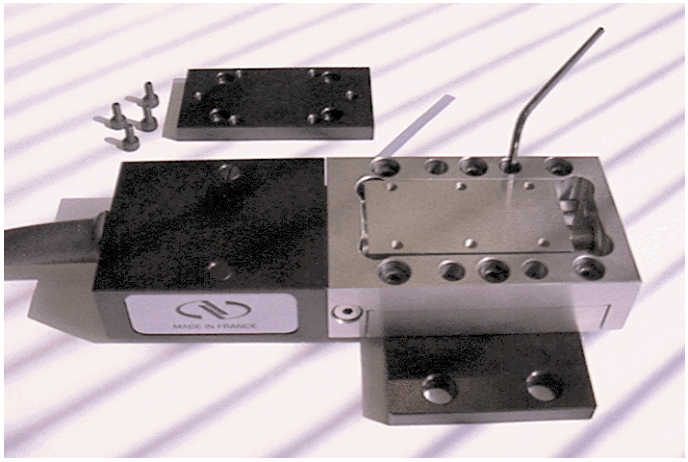
## 8.2 Interfaces Disassembling

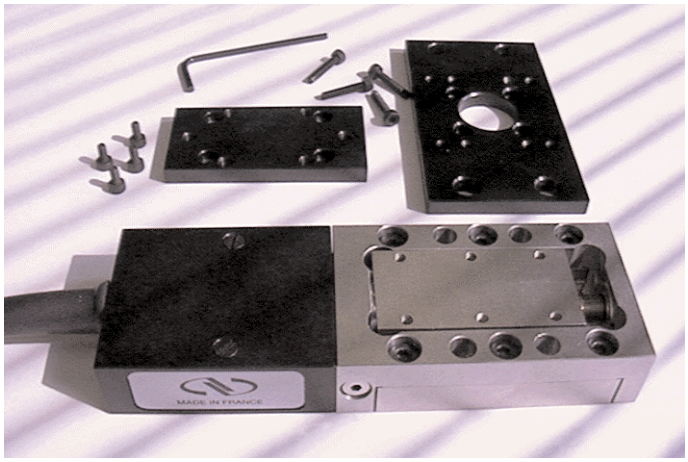
❶ Disassemble the top plate fixed on the carriage of the stage with 4 CHc M3 screws / ▭ 1.4 x .79 (36 x 20 mm).




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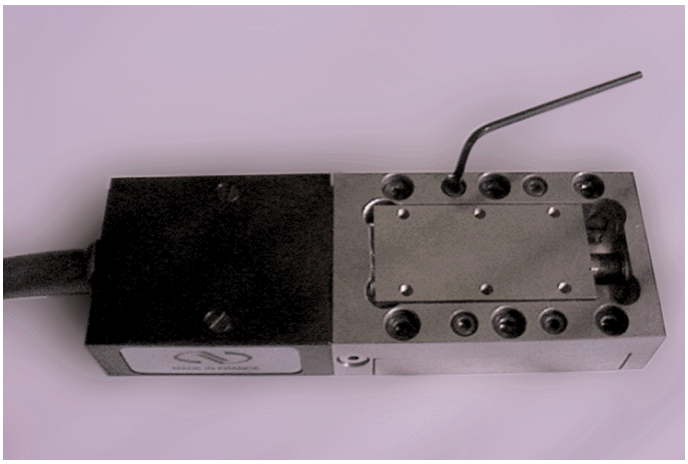
❷ Disassemble the base plate fixed with 4 CHc M3 screws on □ 1.4 x .79 (36 x 20 mm).





## 8.3 Mounting on Working Surface

❶ Stage on the right side, fasten the stage on the working surface by 4 CHc M3 screws / □ 1.4 x .79 (36 x 20 mm).



## 8.4 Disassembling

Make steps of “Mounting on Working Surface” chapter in the opposite order.

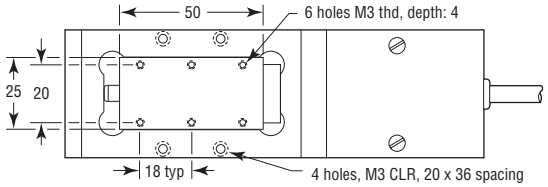

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### 8.5 Interface Plates Mounting

Make steps of “Interfaces Disassembling” chapter in the opposite order.

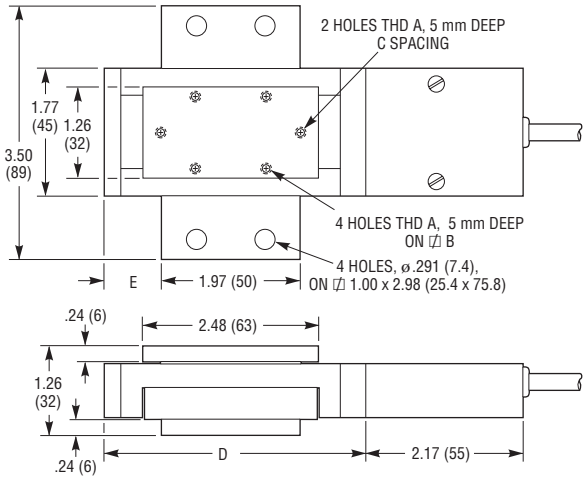
### 8.6 Assembly Pattern

Stacking (M-)MFN Series stages either together or with other Newport stage is easily accomplished. Below are example schematics of the assembly patterns used. These interfaces are accessed by unscrewing and removing the upper and/or lower plates of the stages (see dimension drawing).




*Dimensions in millimeters*

## 9.0 Dimensions




| | Thread | | Dimension [in. (mm)] | | |
|---|---|---|---|---|---|
| Model (Metric) | A | B | C | D | E |
| MFN08 (M-MFN08) | 8-32 (M4) | 1.0 (25.0) | 2.0 (50.0) | 2.95 (75.0) | 0.43 (11.0) |
| MFN25 (M-MFN25) | 8-32 (M4) | 1.0 (25.0) | 2.0 (50.0) | 3.62 (92.0) | 0.77 (19.5) |


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# 10.0 Maintenance

**RECOMMENDATION**

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

## 10.1 Maintenance

The (M-)MFN stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and manipulated with precaution.

**PRECAUTIONS**

**The (M-)MFN stage must operate, and be stocked in a clean environment, without dust, humidity, solvents or other substances.**

**RECOMMENDATION**

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

**If your (M-)MFN stage is mounted on a workstation and cannot be easily dismantled, please contact our After Sales Service for further instructions.**

## 10.2 Repairing

**CAUTION**

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

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

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

**CAUTION**

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

## 10.3 Calibration

**CAUTION**

**It is recommended to return your 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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# (M-)MFN

# Miniature Linear Stages

## 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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