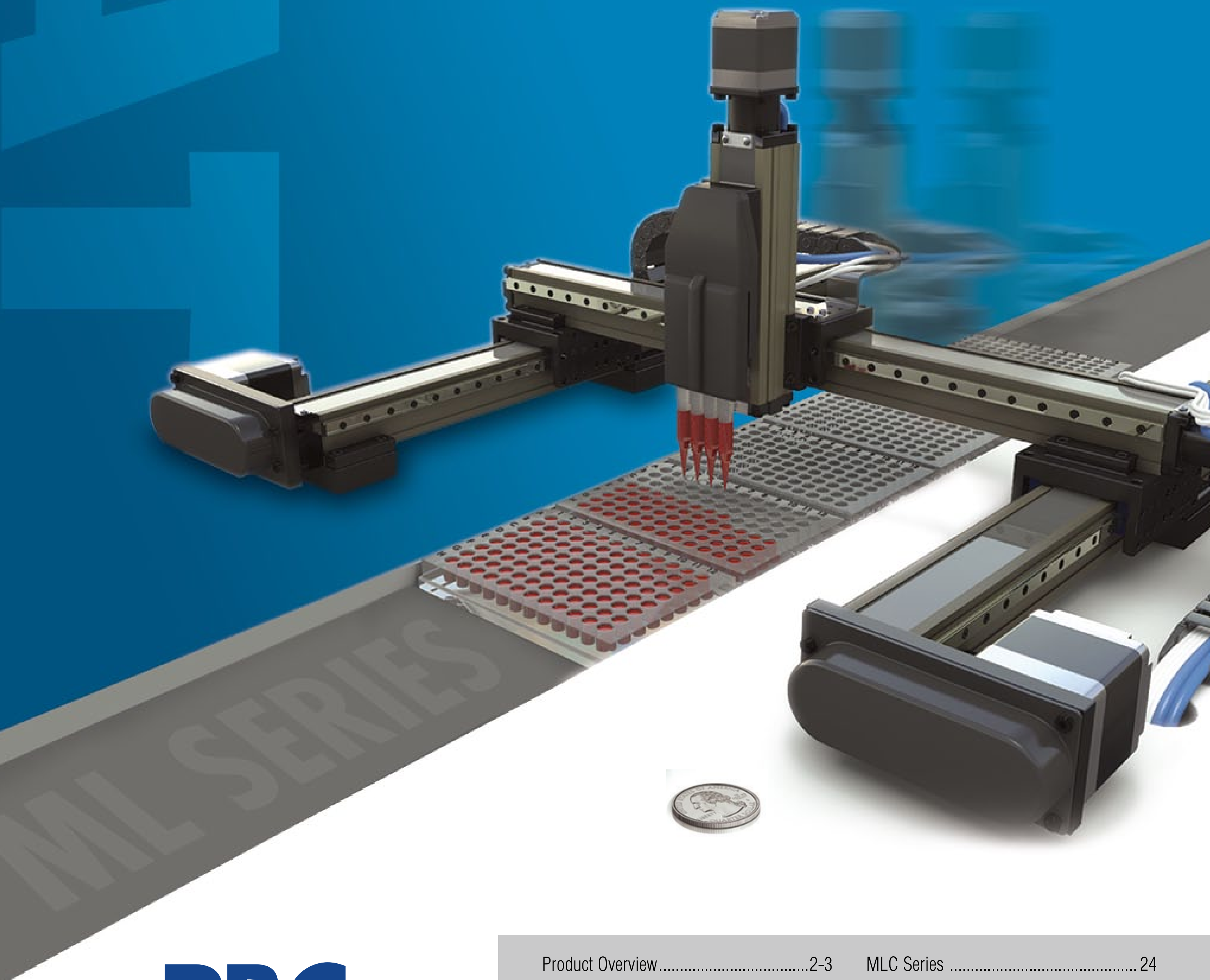
LINEAR ACTUATOR TECHNOLOGY

# ML Series
## Miniature Linear Actuator

Precision Machined

SIMO

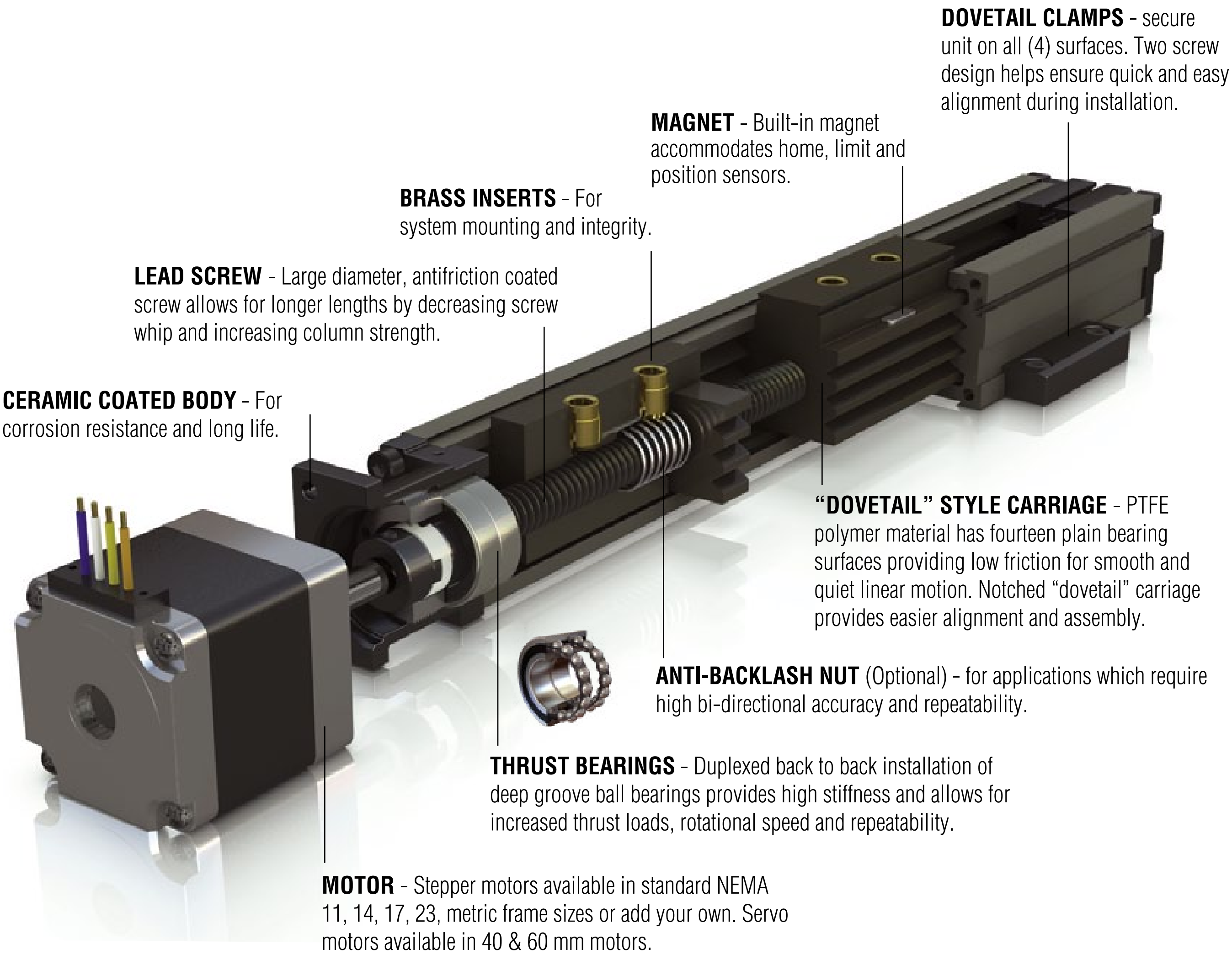
PATENT PENDING






PBC LINEAR®
A PACIFIC BEARING CO.

# **ML Series** Overview




## ML ADVANTAGE

- **Small, Compact Profile** - 28 x 32mm
- **Patent Pending SIMO™ Process -** ensures precision mounting, accurate installation and lightweight composition.
- **Lead Screw Driven** - High accuracy and precise repeatability
- **Multi-Axis Configurations**
- **Long Travel Lengths** - Up to 650mm

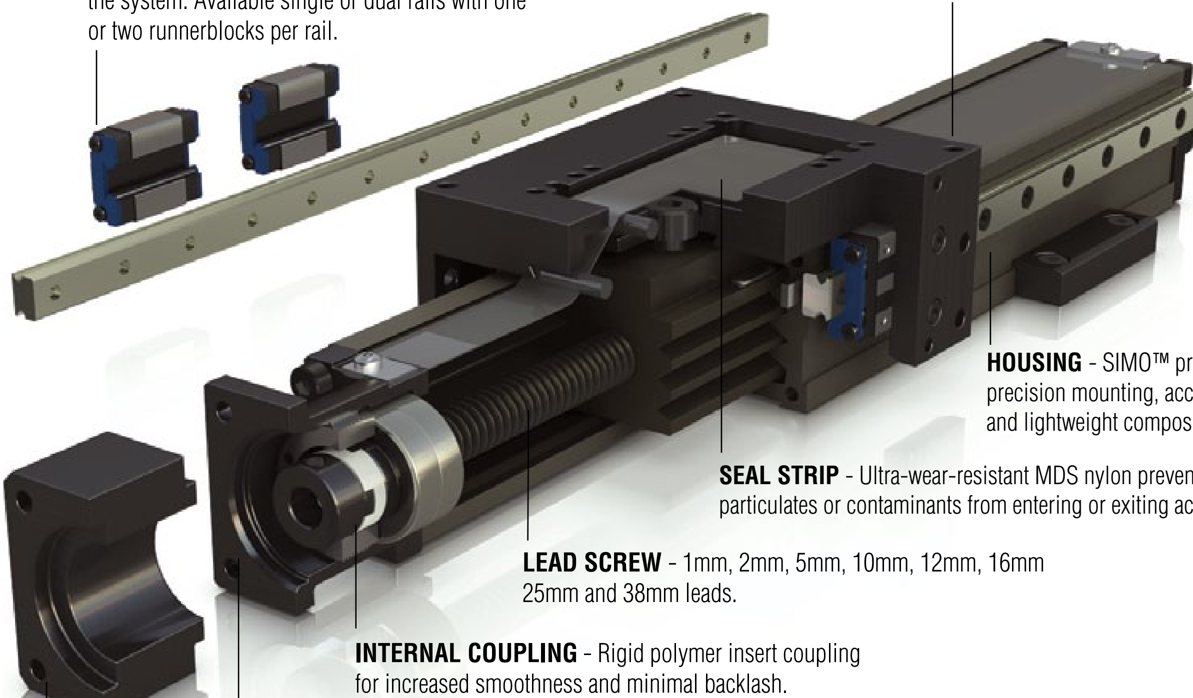
## MLB SERIES - Motor Driven

Pre-mounted stepper or servo motors.
*(Page 14)*

PBC LINEAR A PACIFIC BEARING CO. OMRON FASTECH

**LINEAR GUIDE SUPPORTS** - Provide increased load and moment capacities and overall rigidity to the system. Available single or dual rails with one or two runnerblocks per rail.

**MOUNTING HOLES** - Carriage brackets feature extra mounting holes for ease of installation and multi-axis assemblies.



**HOUSING** - SIMO™ process ensures precision mounting, accurate installation and lightweight composition.

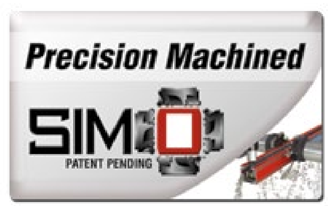
**SEAL STRIP** - Ultra-wear-resistant MDS nylon prevents particulates or contaminants from entering or exiting actuator.

**LEAD SCREW** - 1mm, 2mm, 5mm, 10mm, 12mm, 16mm 25mm and 38mm leads.

**INTERNAL COUPLING** - Rigid polymer insert coupling for increased smoothness and minimal backlash.

**MOTOR MOUNT** - Specially constructed with an optimized length, resulting in an overall shorter system with PBC Linear™ brand stepper motors.

**MOTOR MOUNT ADAPTER (MLC)** - Adapter plate designed to fit any manufacturer's motor. Compensates for variations in pilot diameter, depth, shaft diameter, length and mounting screw patterns.

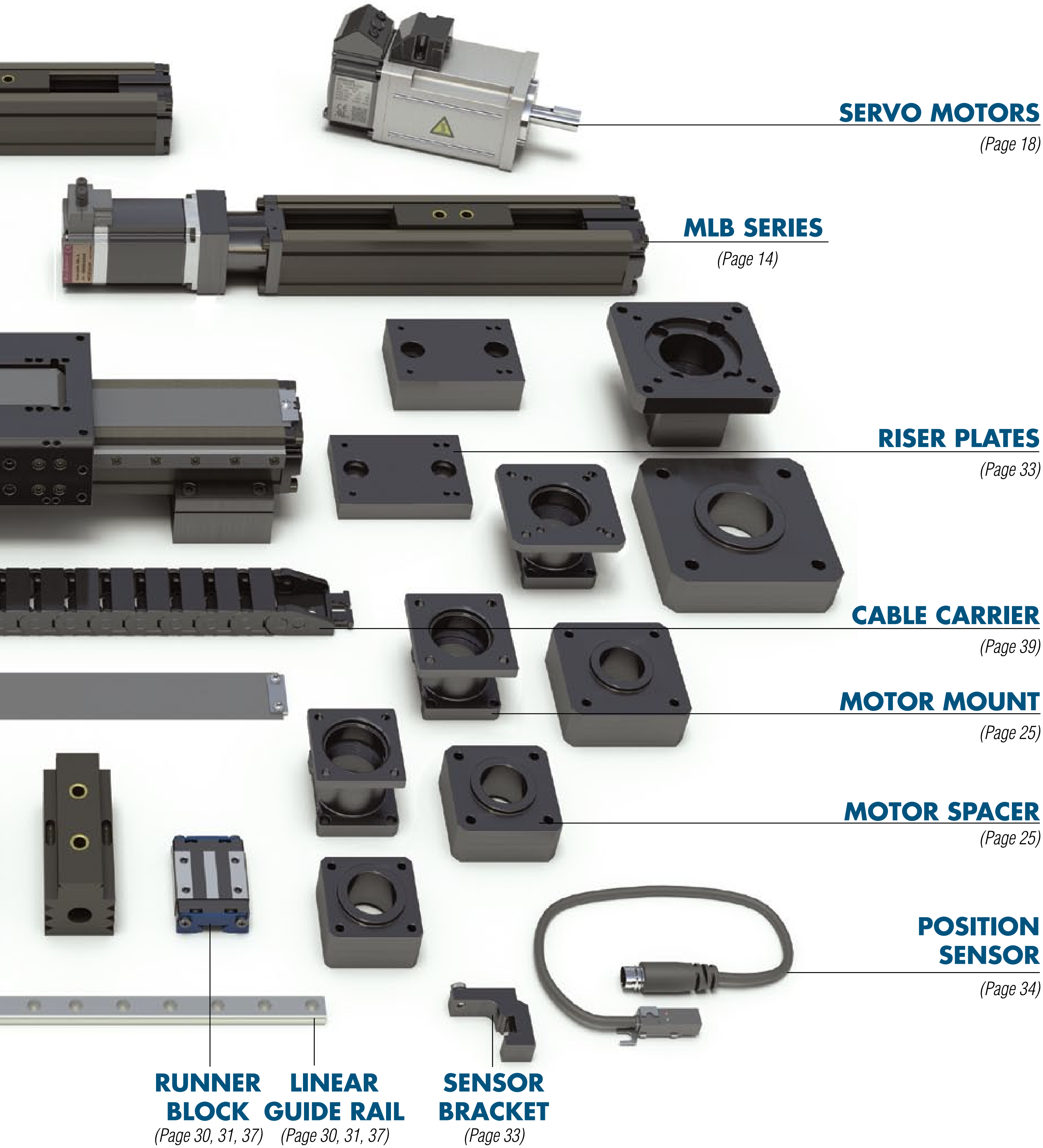



| **MLC SERIES** - Motor Mount only | **MLD SERIES** - Hand Driven (shaft or knob) |
|---|---|
| Specially designed motor mounts and couplings for easy mounting and extended life. *(Page 24)* | Adjustable hand operated knob and brake for precision control. *(Page 26)* |

# **ML** Components


**IN COOPERATION WITH OUR PARTNERS**

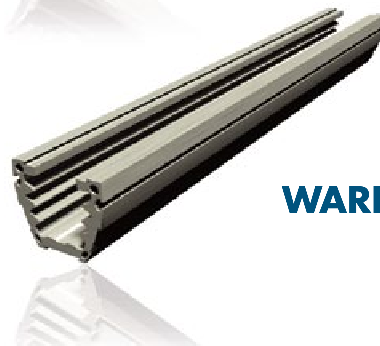
KabelSchlepp OMRON FASTECH


SERVO MOTORS
(Page 18)
MLB SERIES
(Page 14)
RISER PLATES
(Page 33)
CABLE CARRIER
(Page 39)
MOTOR MOUNT
(Page 25)
MOTOR SPACER
(Page 25)
POSITION SENSOR
(Page 34)
RUNNER BLOCK
(Page 30, 31, 37)
LINEAR GUIDE RAIL
(Page 30, 31, 37)
SENSOR BRACKET
(Page 33)

SIMO™
PATENT PENDING


**BOW**


**TWIST**


**WARP**

## - Patent Pending Machining Process
## - High Precision Mounting Surfaces
## - Tight Tolerances ± 0.025mm (0.001 in)

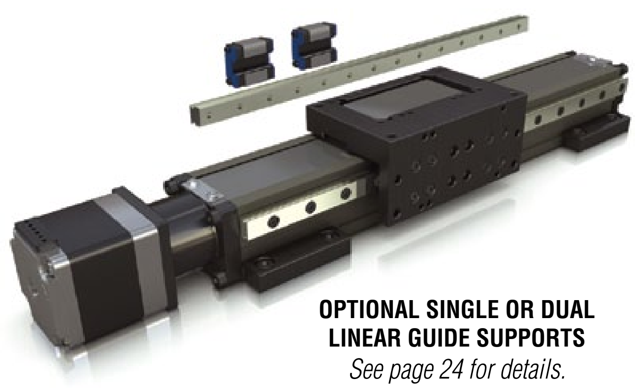
PBC Linear has revolutionized traditional machining with the patent pending SIMO™ (Simultaneous Integral Milling Operation).

The typical aluminum extrusion process produces a natural bow, twist and variance. Costly straightening and aligning is traditionally used to combat this variance, resulting in a semi-straight aluminum extrusion that drives the cost up.

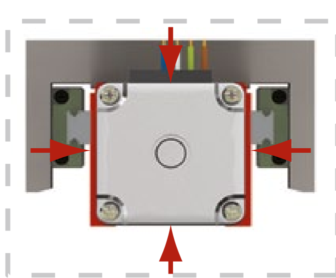
PBC's SIMO process uses synchronized cutters, eliminating built-in extrusion variances by machining all critical edges concurrently in one pass. This ensures tight tolerances, limited variance and a remarkably straight and repeatable surface at negligible additional cost!

## ML Advantage

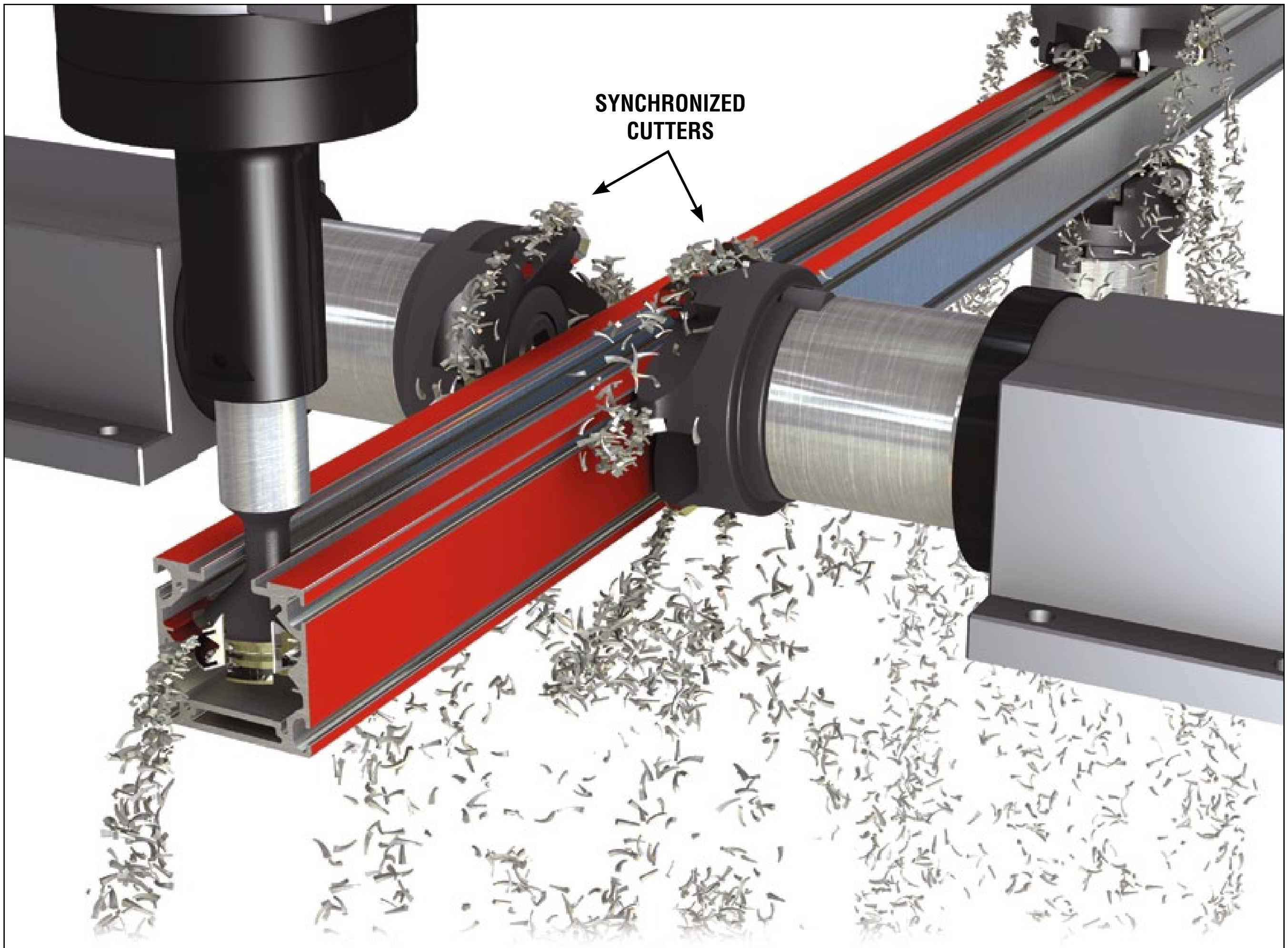
Using the machine tooled precision and rigid surfaces sustained by the SIMO™ process, the ML's bridge gantry design can support 1 or 2 linear guides on the sides of the ML. These supports work together to increase load capacities and sustain stability while utilizing re-circulating caged-ball technology to provide smooth and quiet linear motion guidance.


**OPTIONAL SINGLE OR DUAL LINEAR GUIDE SUPPORTS**
*See page 24 for details.*

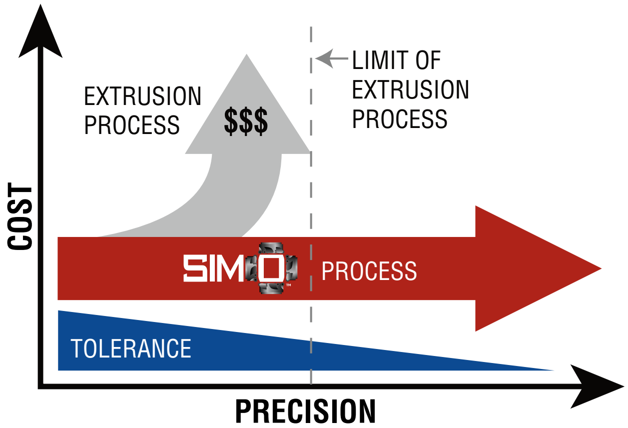
**BRIDGE GANTRY DESIGN**



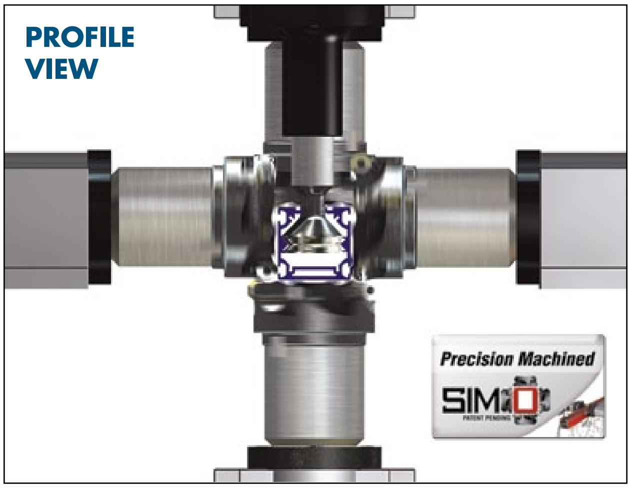
**4X REFERENCE QUALIFIED EDGE**




**Machine tools are built on precision machined castings or weldments... Why shouldn't your actuator be built the same?**




As tolerances get tighter, the cost of machining with conventional processes increases dramatically over the SIMO process.



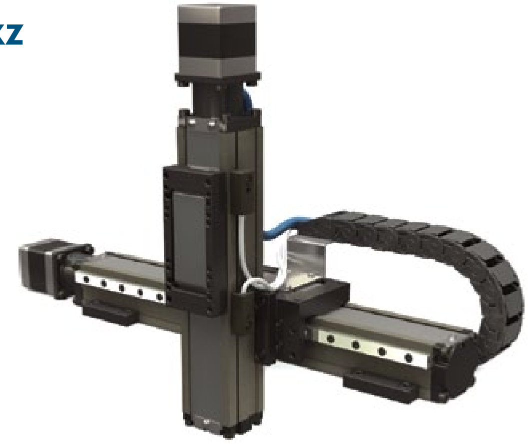
# **Multi-Axis** Mounting

ML actuators are designed to perform well in XY and other Cartesian arrangements. The actuator body forms a strong beam with higher moment loading capacity. Special dovetail slots on all sides allow the actuators to be mounted on their bottom surface or on either side.

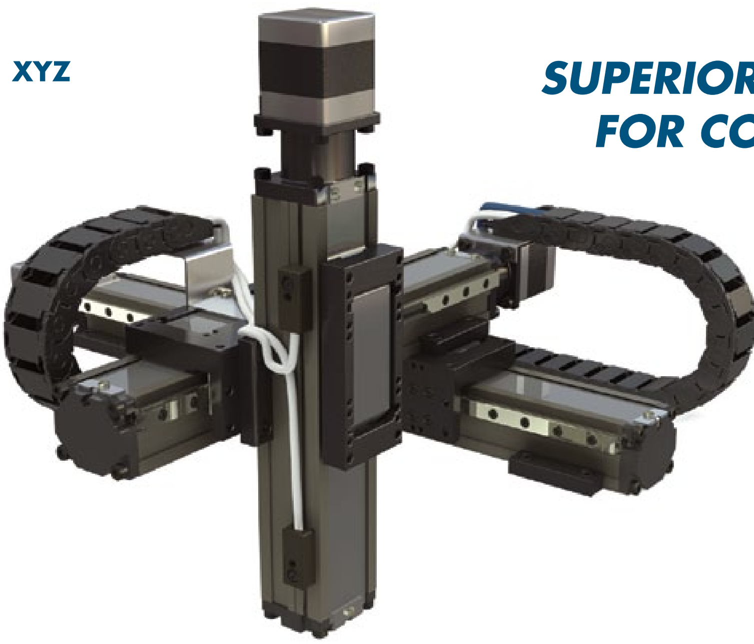
Carriage brackets and special wedge mounting clamps allow for precise and rigid mounting arrangements. Linear guides can be installed on one or both sides of the actuator with one or two runner blocks on each rail for greater rigidity in gantry applications.

Multi-axis gantries can also be created by combining the ML with other PBC's actuators such as the PL or MT Series.

**XZ**



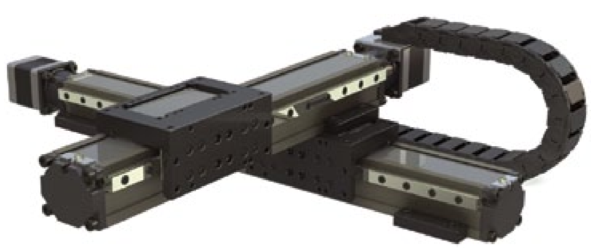
**XYZ**



## *SUPERIOR MULTI-AXIS MOUNTING FOR COMPACT APPLICATIONS*

- **Medical**
- **Biotech**
- **Instrument Automation**
- **Packaging**
- **Pick and Place**
- **Semi-conductor**
- **Scanning**

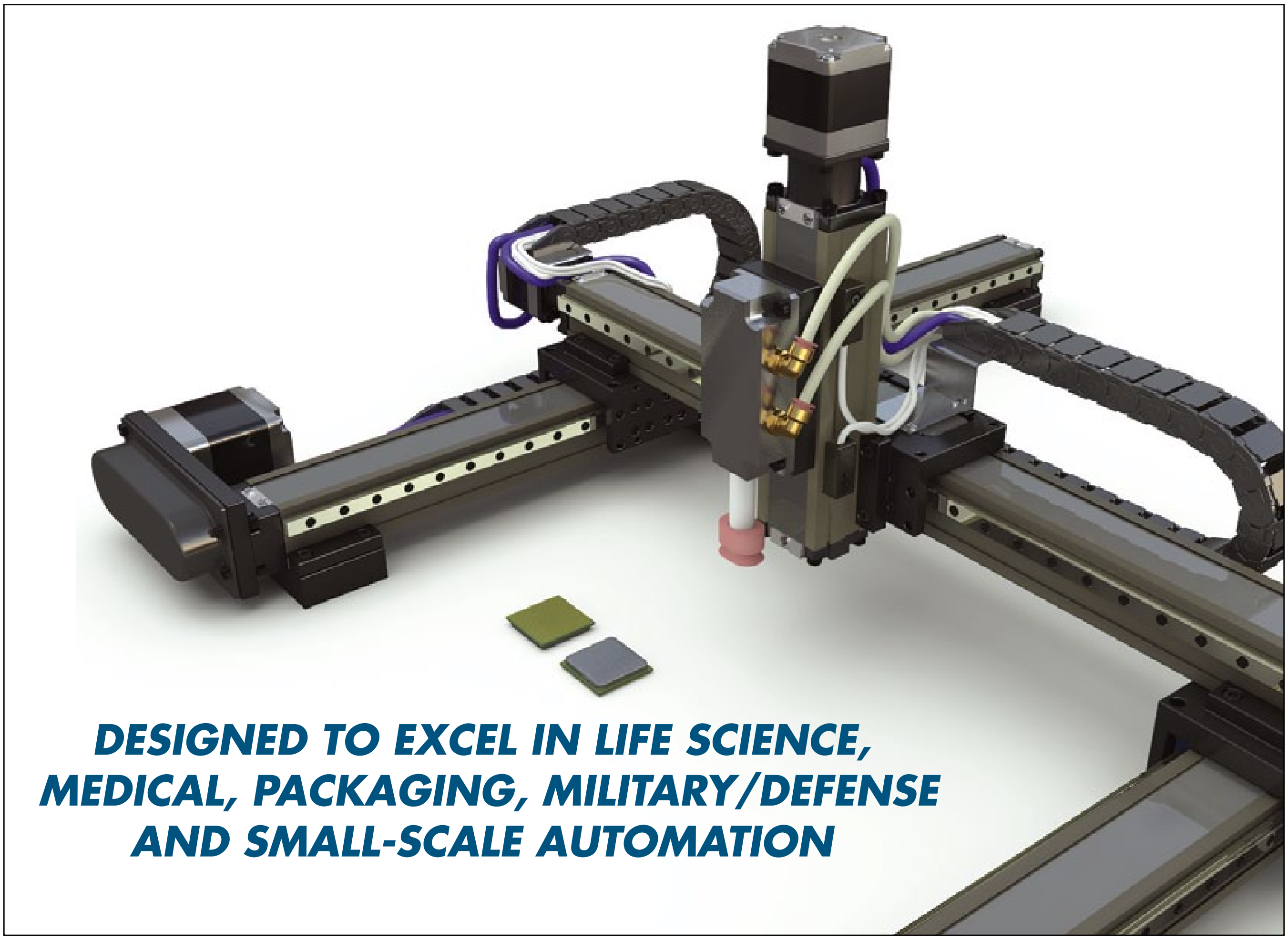
**XY**

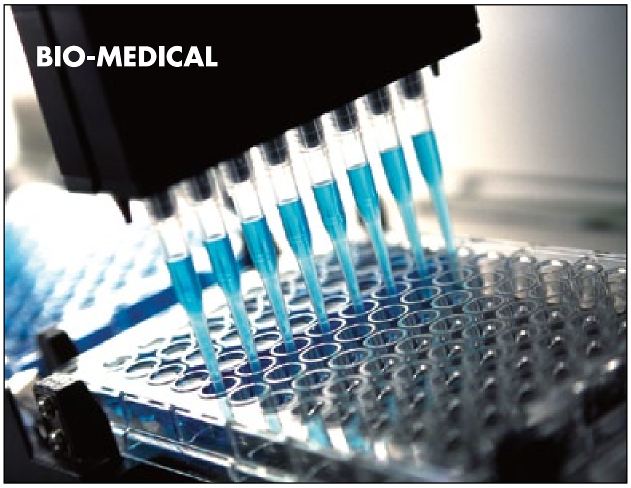


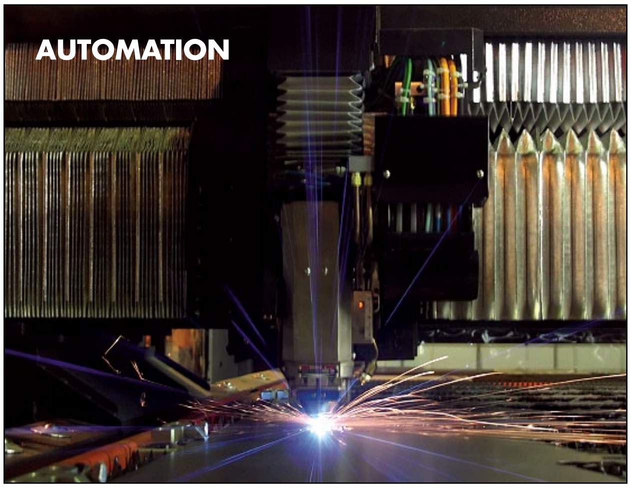
**MULTI-AXIS**
**MTB Series with MLB**

# **ML** Applications

The ML miniature actuator has surpassed expectations and left the competition in the dust. Its combination of compactness and (60 lbf) 265 N pound thrust power gives this actuator an edge for automation applications where space is critical. Plus, the SIMO™ machined rail surface and zero backlash lead screw assembly ensures accuracy and precision for syringe pump and optical control applications.



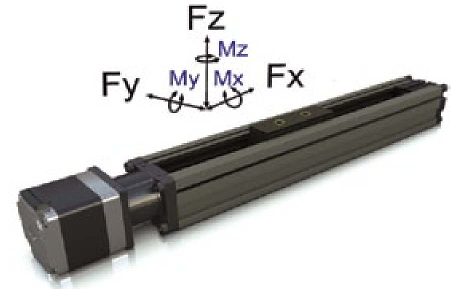



# **Technical** Data

| **ML SERIES** - Carriage only | | | | | |
|---|---|---|---|---|---|
| Size | | mm | 28 x 32 | in | 1.10 x 1.26 |
| Max. Load<br>- Lite Preload - *anti-backlash*<br>- Normal Preload - *anti-backlash*<br>- Standard | **Fx** | N | 44<br>89<br>267 | lbf | 10<br>20<br>60 |
| | **Fy** | N | 107 | lbf | 24 |
| | **Fz** | N | 178 | lbf | 40 |
| Max. Moments | **Mx** | Nm | 1.4 | lbf-in | 12.4 |
| | **My** | Nm | 1.4 | lbf-in | 12.4 |
| | **Mz** | Nm | 1.4 | lbf-in | 12.4 |
| Bending Moment of Inertia<br>(second moment of area) | **Iy** | $cm^4$ | 2.4 | $in^4$ | 0.058 |
| | **Iz** | $cm^4$ | 4.4 | $in^4$ | 0.106 |
| See page 24 for technical data on linear guide supports | | | | | |
| Base Weight without Motor | | Kg | 0.06 | lbf | 0.13 |
| Add for 100 mm of stroke | | Kg | 0.15 | lbf | 0.34 |
| Total Carriage Mass | | Kg | 0.020 | lbf | 0.044 |
| Total Carriage Mass & Top Plate | | Kg | 0.059 | lbf | 0.130 |
| Coefficient of Friction | | | 0.19 | | |
| Max. Speed | | m/s | 1.9 | in/s | 75 |
| Max. Stroke Length | | mm | 650 | in | 25.6 |
| Min. Stroke Length | | mm | 5 | in | 0.2 |
| Nominal Screw Diameter | | mm | 10.0 | in | 0.375 |
| Max RPM | | | 3000 | | |
| No Load Torque<br>Nut - Lite Preload - *anti-backlash*<br>- Normal Preload - *anti-backlash*<br>- Standard | | Nm | 0.0565<br>0.106<br>0.007 | lbf-in | 0.50<br>0.94<br>0.062 |
| Linear Guide Supports<br>- Single Linear Guide<br>- Dual Linear Guides | | Nm | .017<br>.034 | lbf-in | 0.15<br>0.30 |
| Seal Strip<br>- with Seal Strip<br>- without Seal Strip | | Nm | .028<br>0 | lbf-in | 0.25<br>0 |
| Screw Lead Accuracy* | | mm/mm | .0006 | in/in | .0006 |
| Normal Operating Temperature<br>*(Wider ranges available)* | min | °C | 98 | °F | 32 |
| | max | °C | 18 | °F | 176 |

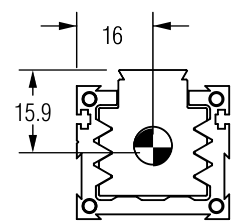
*Higher accuracies are available to .0001 mm/mm (in/in). Contact manufacturer for details.
Specifications are subject to change without notice.



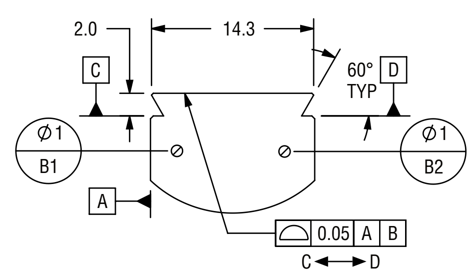

*For combined loads, loading cannot exceed the following formula.*

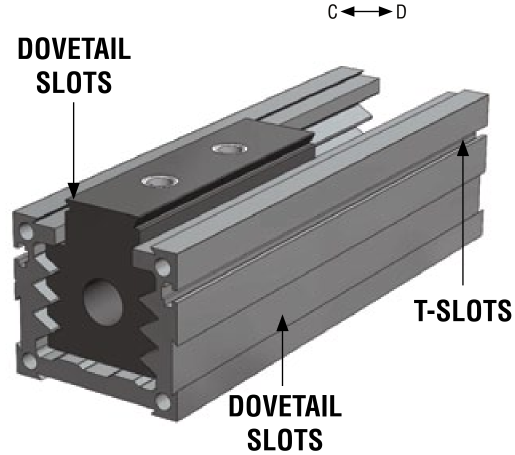
$$\frac{Fy_A}{Fy}+\frac{Fz_A}{Fz}+\frac{Mx_A}{Mx}+\frac{My_A}{My}+\frac{Mz_A}{Mz}<=1$$

**CENTER OF GRAVITY FOR MOMENT CALCULATIONS**

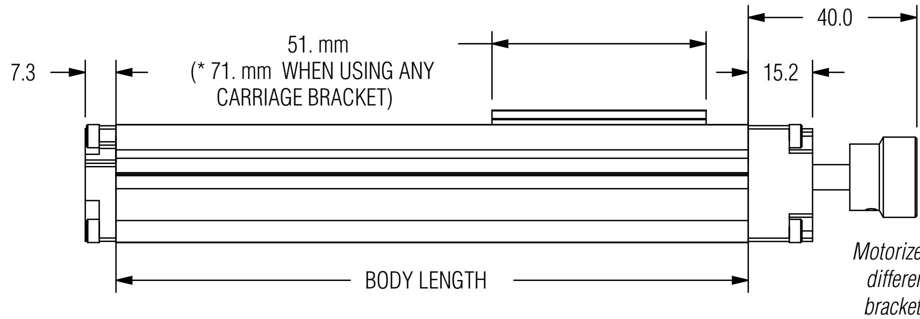



**EXTERNAL DOVETAIL EASY SKETCH**



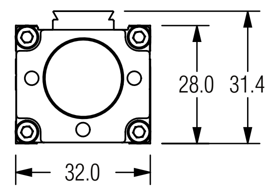
# **Dimensional** Data

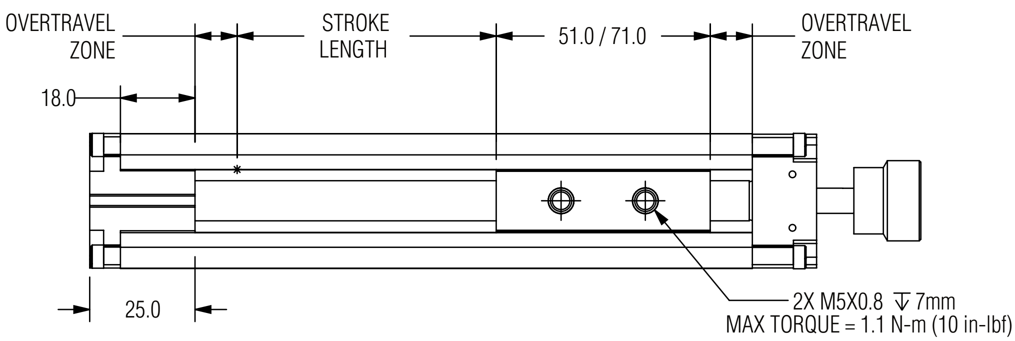



*Motorized units use a different drive end bracket. See motor section for more details.*

**NOTE:** BODY LENGTH = STROKE + *CARRIAGE LENGTH + (2X OVER TRAVEL) + 18mm

**CARRIAGE WITH DOVETAIL**




**RECOMMENDED OVERTRAVEL PER SIDE**

Knob or Hand Crank = 5mm
Stepper Motor = 10mm
Servo Motor = 20mm

## HOW TO CALCULATE BODY LENGTH

**1)** Enter 19mm

**2)** Select (5, 10 or 20mm) for overtravel on idle end *(See recommended overtravel above.)*

**3)** Specify stroke length in mm

**4)** Select (51 or 71mm) for carriage length

**5)** Select (5, 10 or 20mm) for overtravel on idle end *(See recommended overtravel above.)*

**6)** Add amounts together and enter SUBTOTAL

**7)** Enter TOTAL BODY LENGTH *(Round to nearest 10mm)*

**8)** When ORDERING enter TOTAL BODY LENGTH in BODY LENGTH column.

| BODY LENGTH CALCULATION TABLE | | Example | |
|---|---|---|---|
| IDLE END CAP = 19mm | 19 | 19 | 1 |
| OVERTRAVEL IDLE END (5, 10 or 20mm) | | 10 | 2 |
| STROKE LENGTH | | 155 | 3 |
| CARRIAGE LENGTH (51 or 71mm) | | 71 | 4 |
| OVERTRAVEL DRIVE END (5, 10 or 20mm) | | 10 | 5 |
| (Add Amounts 1-5) + ENTER SUBTOTAL (mm) = | | 265 | 6 |
| TOTAL BODY LENGTH *(Round Subtotal to nearest 10mm)* | | 270 | 7 |

8

**ORDERING GUIDE**

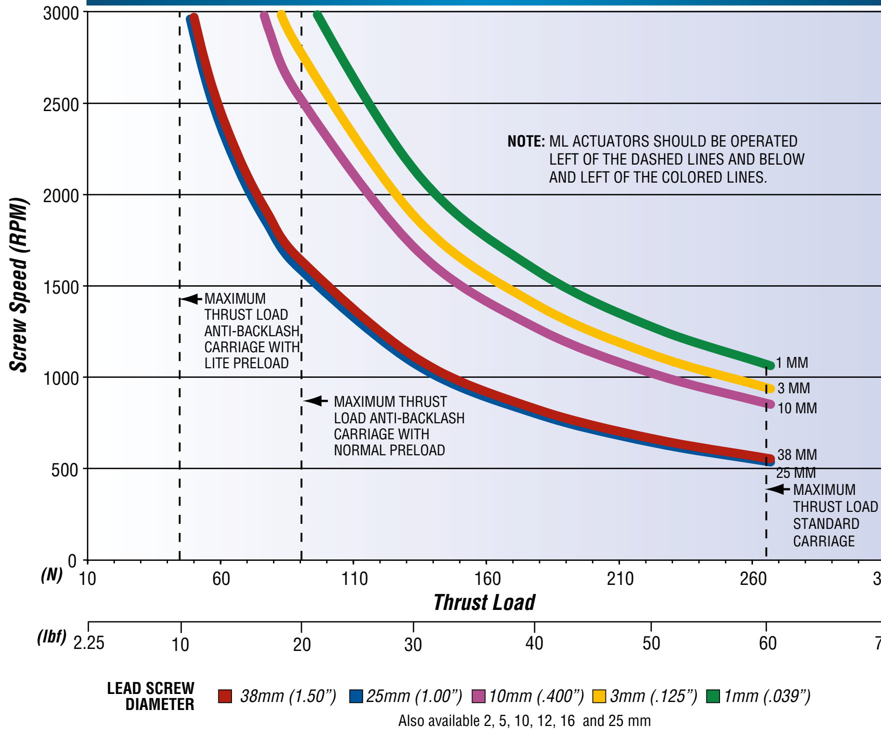
| Series | Linear Guide Supports | Leads | Nut Type | Seal Strip | # of Carriages | Body Length | Motor Location | Configuration |
|---|---|---|---|---|---|---|---|---|
| MLC028D - | X | XX | X | X | X | - 0270 - | X | X |
| ML Series with motor lead screw driven 28 x 32 mm | 0 No external Rail<br>1 1 Rail + 1 Runner Block*<br>2 1 Rail + 2 Runner Block*<br>3 2 Rail + 1 Runner Block/rail<br>4 2 Rail + 2 Runner Block/rail | AH 1 MM<br>AG 2 MM<br>AX 5 MM<br>AJ 10 MM<br>BD 12 MM | 2 Standard Nut<br>4 Anti-backlash (light preload)<br>6 Anti-backlash (normal preload) | 0 None<br>1 With Seal strip | 1 1 Carriage<br>2 2 Carriages<br>3 3 Carriages<br>4 4 Carriages | mm | S Straight (in-line)<br>L Left<br>R Right<br>B Bottom<br>T Top | 0 Standard |

# **Performance** Data

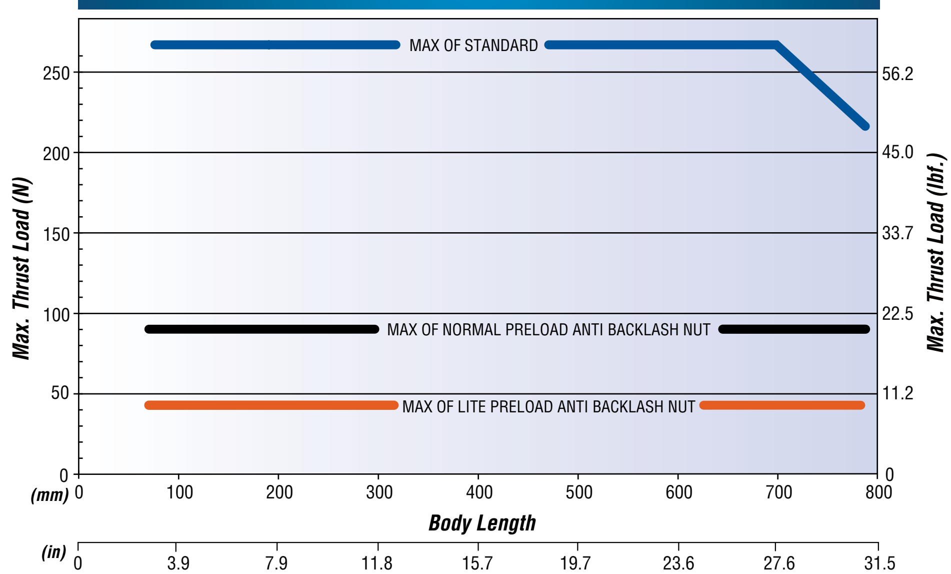
The load rating and system speed must both be accounted for when sizing a lead screw system. The nut threads and screw threads form a plane bearing system.

The PV limit of a polymer material is the point at which friction-generated heat can no longer be expelled at a rate to prevent the material from overheating. Such overheating while under stress can cause permanent deformation of the material. Ignoring how the system's speed and loading relate to the nut material's PV rating can lead to dramatically shorter thread life. The primary modes of failure for lead screw systems are wear and PV. By staying within the PV envelope of the screw and nut, one can ensure long life of the nut without premature wear.

## PV RATING - ML LEAD SCREW & NUT




## MAXIMUM THRUST LOAD BASED ON NUT CAPACITY & COLUMN LOADING



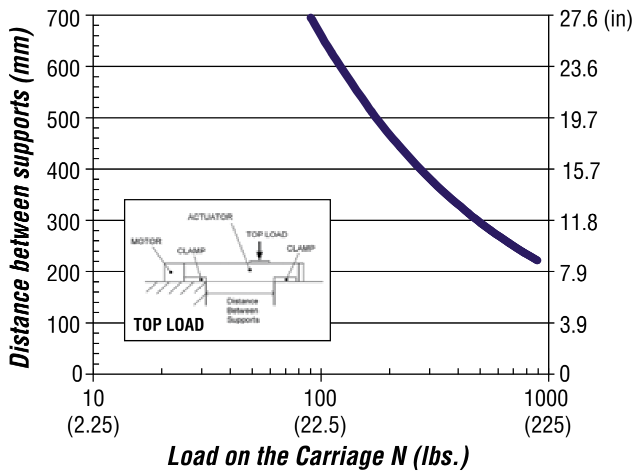

**Torque to Raise Load**

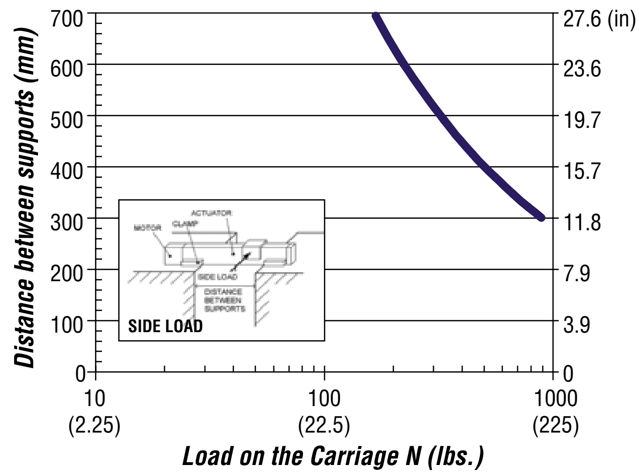
$$T_L \text{ (Nm)} = \frac{\text{Load (N)} \times \text{Lead (mm)}}{2\pi \times \text{Efficiency} \times 1000}$$

$$T_L \text{ (in-lbf)} = \frac{\text{Load (lbf)} \times \text{Lead (in)}}{2\pi \times \text{Efficiency}}$$

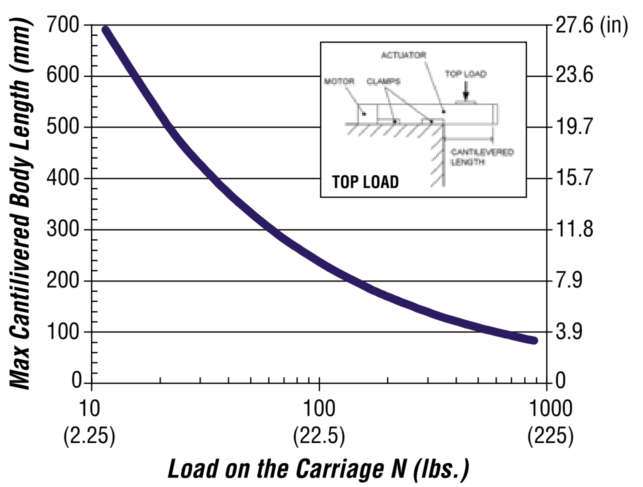
| PERFORMANCE CHARACTERISTICS | LEAD SCREW mm *(in)* | | | | |
|---|---|---|---|---|---|
| | **38 (1.50)** | **25 (1.00)** | **10 (.400)** | **3 (.125)** | **1 (.039)** |
| Max, Travel Speed mm/s (in/s) | 1905 (75) | 1270 (50) | 508 (20) | 159 (6.25) | 50 (1.95) |
| Screw Diameter mm (in) | 10 (0.375) | 10 (0.375) | 10 (0.375) | 10 (0.375) | 10 (0.375) |
| Screw Efficiency (See formula to left) | 81% | 82% | 77% | 57% | 26% |

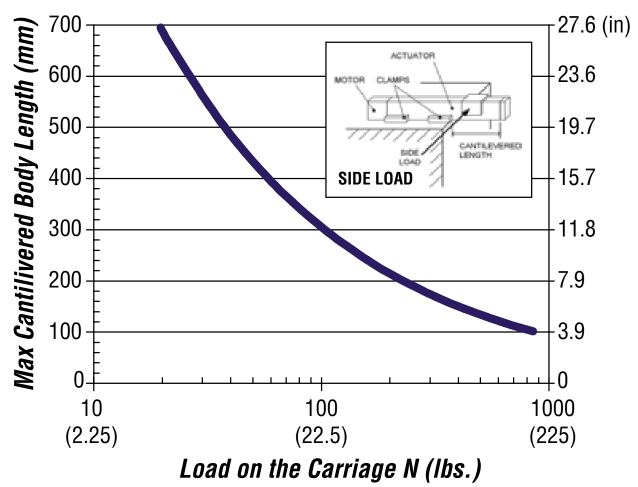
## DISTANCE BETWEEN SUPPORTS



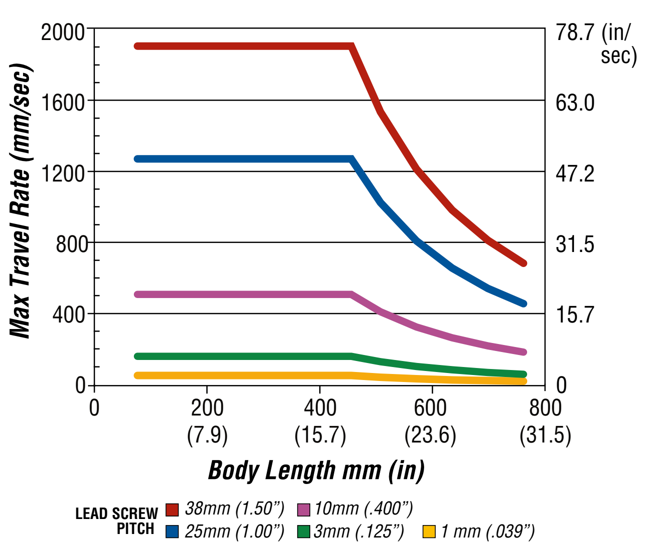




## MAXIMUM CANTILEVERED LENGTH

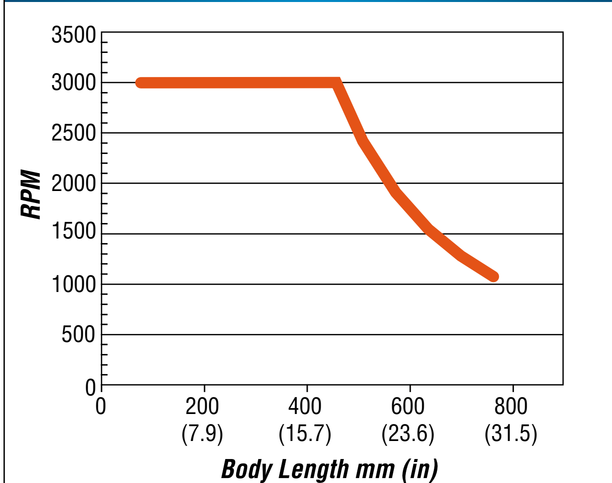



## MAXIMUM TRAVEL SPEEDS




## 80% OF CRITICAL SPEED



# **MLB** Series (Integrated Motor)

- **Includes motor, coupling and motor assembly**
- **Full stock of open and closed loop stepper motors and servo motors**
- **Available in NEMA 11,14,17,23**
- **Precision machined body**
- **Small, compact design**
- **High acceleration, speed and rigidity**
- **Pre-engineered and assembled for easy installation**

## MLB ORDERING GUIDE

| MLB028D – | X | XX | X | X | X – | #### |
|---|---|---|---|---|---|---|
| **Series** | **Linear Guide Supports*** | **Lead** | **Nut Type** | **Seal Strip** | **# of Carriages** | **Body Length** |
| Motor or Lead Screw Driven 28 x 32 mm | 0 No External Rail<br>1 (1) Rail, (1) Runner Block - XY-2 Brkt (R)<br>2 (1) Rail, (2) Runner Blocks - XY-2 Brkt (R)<br>3 (2) Rail, (1) Runner Block - XY-3 Brkt<br>4 (2) Rail, (2) Runner Blocks - XY-3 Brkt<br>5 (1) Rail, (1) Runner Block - XY-2 Brkt (L)<br>6 (1) Rail, (2) Runner Blocks - XY-2 Brkt (L)<br>7 No Seal Strip - XY-1 Brkt | AH 1mm<br>AG 2mm<br>AX 5mm<br>AJ 10mm<br>BD 12mm<br>AF 16mm<br>AW 25mm<br>AS 1.5 in | 2 **Standard Nut**<br>4 Anti-backlash (light preload) | 0 **None**<br>1 With Seal Strip & XY Bracket | 1 **1 Carriage**<br>2 2 Carriages<br>3 3 Carriages<br>4 4 Carriages<br>NOTE: Contact manufacturer before ordering multiple carriages. | (mm)<br>See page 11 for body length calculation table<br>EX: 90mm = 0090<br>250mm = 0250 |

*(L) = Left (R) = Right

| X | X | X | X | XX | 0 |
|---|---|---|---|---|---|
| **Motor Location** | **Motor Make** | **Motor Frame Size** | **Motor Power** | **Motor Features** | **Configuration** |
| S Straight<br>L Left<br>R Right<br>B Bottom<br>T Top | 1 PBC Linear™<br>Open loop stepper motor | B NEMA 11 (28mm)<br>C NEMA 14 (35mm)<br>F NEMA 17 (42mm)<br>G NEMA 23 (56mm) | B Single Stack<br>C Double Stack*<br>D Triple Stack<br>* not available with NEMA 14 | 00 Hybrid wiring (8 wires), flying leads, no encoders [hybrid wiring can be bi-polar or uni-polar] | 0 Standard |
| | 3 FASTech® EZI-Step BT with integral drive. Open loop stepper motor | F NEMA 17 (42mm)<br>G NEMA 23 (56mm) | A 1/2 Stack<br>B Single Stack<br>C Double Stack<br>D Triple Stack | 00 Bi-polar wiring, flying leads, no encoder | |
| | 4 FASTech® EZI-Servo Closed loop stepper motor | B NEMA 11 (28mm) | | 01 2,000 resolution (pulse/rev) encoder (std)<br>03 16,000 resolution (pulse/rev) encoder | |
| | | F NEMA 17 (42mm)<br>G NEMA 23 (56mm) | | 02 10,000 resolution (pulse/rev) encoder (std)<br>04 20,000 resolution (pulse/rev) encoder<br>05 32,000 resolution (pulse/rev) encoder | |
| | 5 Omron®<br>A/C, brushless servo motor | E Metric 40mm | F 50W<br>G 100W | 01 120V input, INC encoder, NO brake<br>02 120V input, INC encoder, with brake<br>03 120V input, ABS encoder, NO brake<br>04 120V input, ABS encoder, with brake<br>05 240V input, INC encoder, NO brake<br>06 240V input, INC encoder, with brake<br>07 240V input, ABS encoder, NO brake<br>08 240V input, ABS encoder, with brake | |

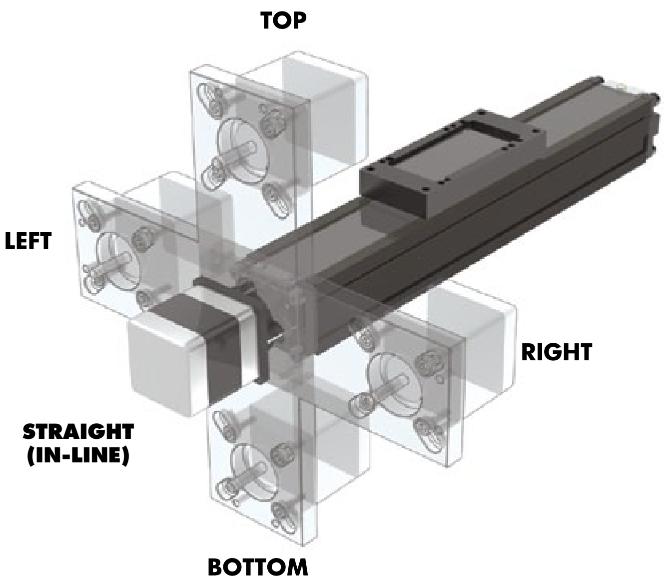
**FINAL PART #**

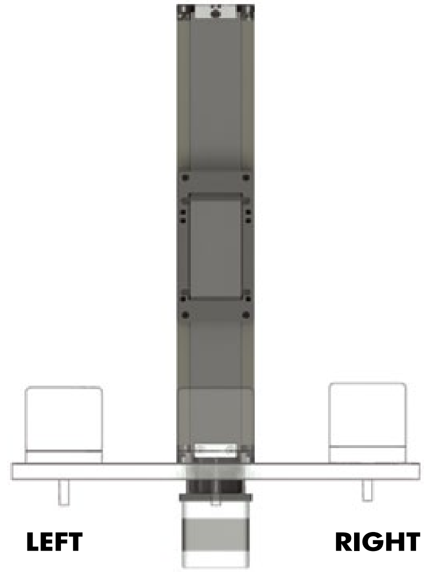
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MLB028D | - | X | XX | X | X | X | - | XXXX | - | X | X | X | X | XX | 0 |

**NOTE:** Not all combinations are possible. Contact manufacturer for available combinations. Body lengths are available in 1mm increments up to 701mm. Standard lengths are multiples of 10mm. When possible round up to nearest multiple of 10mm. Longer lead times apply to non-standard lengths. NEMA 11 stepper motors typically do not have enough torque to drive the anti-backlash nuts. Customers are responsible for doing torque calculations to ensure the motor is properly sized. Specifications are subject to change without notice.

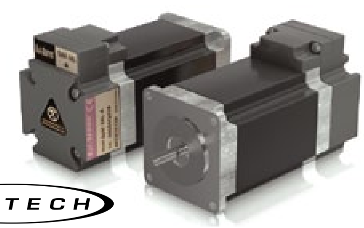
# **Motor** Locations

Using universal motor mounts, PBC Linear's ML series mini-actuators give our customers the freedom for limitless mounting options. Straight (in-line), top, bottom or side motor mounting allows the ML series to fit seamlessly into any specified application.



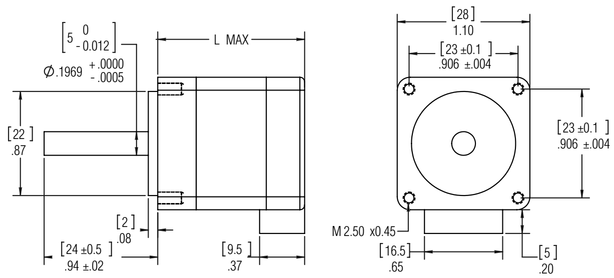

# **Motor** Options

| STEPPER MOTORS | |
|---|---|
| **PBC Linear™** brand stepper motors are designed to reduce length in the ML actuator. Other stepper motor brands have a longer shaft and require a spacer to ensure all motors will be compatible. Single, double and triple stack motors are available in each size. See page 16 for dimensional data. | PBC LINEAR A PACIFIC BEARING CO.  |
| **FASTech®** applies state-of-the-art monitoring and drive advancements into their EZi-Step™ motor for precision, speed and power. Built with an internal unique algorithm and sensorless stall detection, these stepper motors assure faultless control. The EZi-Step also employs digital signal processors to guarantee high precision and high speed drive. Available in open or closed loop designs. Contact PBC Linear's for FASTech motor options and availability. | FASTECH  |
| **SERVO MOTORS** | |
| **OMRON** servo motors provide a large variety of functions featuring high-precision positioning with improved response and vibration control, making it suitable for a wide range of application. Contact PBC Linear's Application Engineers for Omron motor options and availability. | OMRON  |

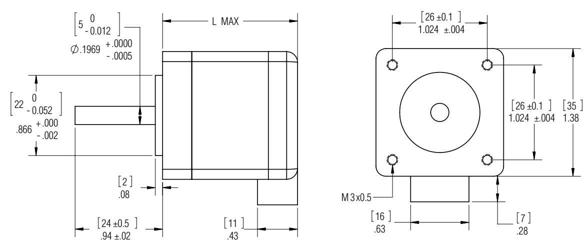
# **Stepper** Motor

PBC LINEAR
A PACIFIC BEARING CO.

## NEMA 11 (28mm)

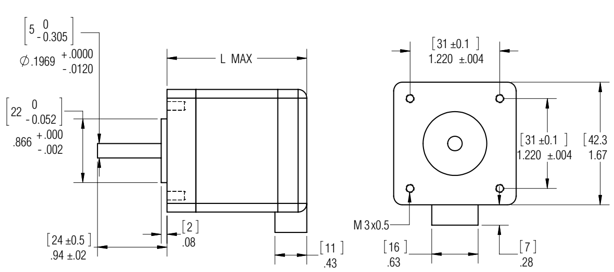


## NEMA 14 (35mm)

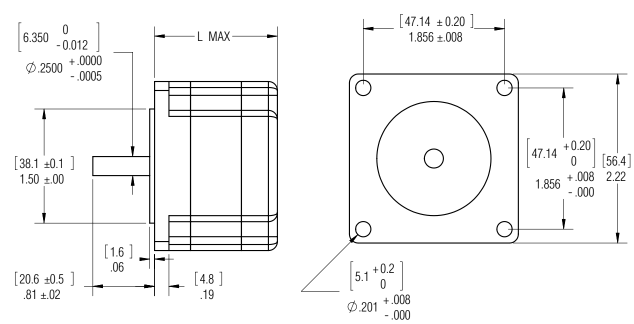


| NEMA Rating | Motor Power | Current per Phase | Holding Torque | | Detent Torque | | Rotor Intertia | | Length mm (in) | Weights kg (lb) | Model P/N # |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | mN • m | oz-in | mN • m | oz-in | g-cm² | oz-in² | | | |
| NEMA 11 | Single | 1 | 50 | 7.08 | 5 | 0.71 | 9 | 0.05 | 31 (1.21) | 0.10 (0.22) | **6200297** |
| NEMA 11 | Double | 0.67 | 90 | 12.75 | 6 | 0.85 | 12 | 0.07 | 40 (1.56) | 0.15 (0.33) | **6200298** |
| NEMA 11 | Triple | 1 | 100 | 14.16 | 8 | 1.13 | 18 | 0.1 | 51 (2.01) | 0.20 (0.44) | **6200299** |
| | | | | | | | | | | | |
| NEMA 14 | Single | 0.4 | 60 | 8.5 | 10 | 1.42 | 12 | 0.07 | 26 (1.01) | 0.15 (0.33) | **6200300** |
| NEMA 14 | Triple | 0.85 | 100 | 14.16 | 15 | 2.12 | 20 | 0.11 | 37 (1.44) | 0.21 (0.46) | **6200302** |
| | | | | | | | | | | | |
| NEMA 17 | Single | 1.5 | 360 | 50.99 | 15 | 2.12 | 57 | 0.31 | 39.8 (1.57) | 0.28 (0.62) | **6200303** |
| NEMA 17 | Double | 1.5 | 490 | 69.41 | 25 | 3.54 | 82 | 0.45 | 48.3 (1.90) | 0.36 (0.79) | **6200304** |
| NEMA 17 | Triple | 1.5 | 630 | 89.24 | 30 | 4.25 | 123 | 0.68 | 62.8 (2.47) | 0.60 (1.32) | **6200305** |
| | | | | | | | | | | | |
| NEMA 23 | Single | 1.5 | 500 | 70.82 | 22 | 3.12 | 135 | 0.74 | 41 (1.61) | 0.42 (0.93) | **6200306** |
| NEMA 23 | Double | 1.5 | 1000 | 141.64 | 40 | 5.66 | 260 | 1.43 | 54 (2.13) | 0.60 (1.32) | **6200307** |
| NEMA 23 | Triple | 1.4 | 1650 | 233.71 | 70 | 9.91 | 460 | 2.53 | 76 (2.99) | 1.00 (2.20) | **6200308** |

## NEMA 17 (42mm)



## NEMA 23 (56mm)



# **Stepper** Motor

FASTECH

**FASTech** applies state-of-the-art monitoring and drive advancements into their Ezi-SERVO® motor for precision, speed and power. Built with an internal unique algorithm, no hunting and sensorless stall detection, these stepper motors assure faultless control. The Ezi-SERVO® also employs digital signal processors to guarantee high precision and high speed drive. Available in closed or open loop designs (Ezi-STEP®).

Ezi-SERVO®
Closed Loop Stepping System

***Ezi-SERVO* - Closed Loop Stepping System**
- High Resolution Optical Encode
- No Gain Tuning or Hunting
- High Speed Operation using Internal DC-DC Converter (24VDC - 40VDC)
- Short Settling Time (Fast in-position) signal
- Software Dampening (Smooth Operation)

Ezi-SERVO® Plus-R
Closed Loop Stepping System
with Network based Motion Controller

***Ezi-SERVO Plus-R* - Closed Loop Stepping System with Network based Motion Controller**
- Integrated Motion Controller
- Powerful and Various motion control functions
- No Gain Tuning or Hunting
- High Resolution
- Short Settling Time (Fast in-position) signal
- Software Dampening (Smooth Operation)

Ezi-STEP® BT
Integrated Drive

***Ezi-STEP BT***
- Integrated Drive
- Sensorless Stall Detection (400 rpm)
- Software Dampening
- Run/Stop Signal Output

Ezi-STEP® ST
Micro Stepping System

***Ezi-STEP ST***
- High Precision Microstep Operation
- Sensorless Stall Detection (400 rpm)
- Software Dampening
- Run/Stop Signal Output
- Drive sold separately

Ezi-STEP® Plus-R
Micro Stepping Drive

***Ezi-STEP Plus-R* with Network based Motion Controller**
- Integrated Micro-stepping (50,000 step/rev.)
- Sensorless Stall Detection (400 rpm)
- Software Dampening
- Run/Stop Signal Output
- Motor sold separately *(MLB excluded.)*

## CHOOSING THE RIGHT STEPPER MOTOR

### DO YOU NEED AN ENCODER?

**DO YOU NEED A NETWORK CONTROLLER?**

| | YES- CLOSED LOOP | NO - OPEN LOOP |
|---|---|---|
| YES | Ezi-SERVO® Plus-R Closed Loop Stepping System with Network based Motion Controller | PBC LINEAR MOTORS + Ezi-STEP® Plus-R Micro Stepping Drive |
| NO | Ezi-SERVO® Closed Loop Stepping System | PBC LINEAR MOTORS + Ezi-STEP® ST Micro Stepping System |
| | | Ezi-STEP® BT Integrated Drive |

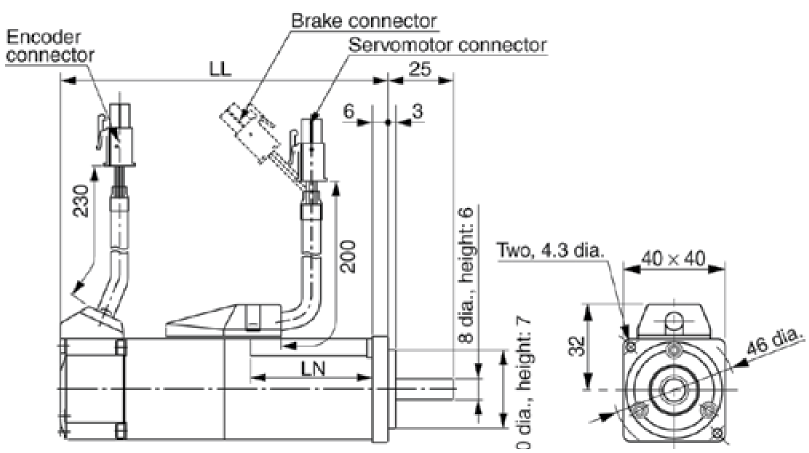
# **Servo Motors** - OM-R88M-G

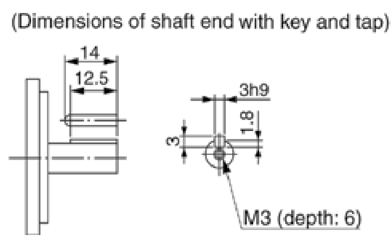
Omron Servo Motors deliver smooth performance for accurate positioning combined with Servo Drivers OM-R7D-B and OM-R88D-G. They meet international standards for use in machinery worldwide. All models have a shaft key and top.

### OM-R88M-G Servo Motors

| SERVO MOTOR DATA | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Voltage** | **Rated Power** | **RPM** | **Encoder** | **Brake** | **LL** | **LN** | **Drive Compatibility** |
| 100V/200V | 50W | 3000 | Incremental | Yes | 102 | 26.5 | OM-R7D-B, OM-R88D-G |
| 100V/200V | 50W | 3000 | Incremental | No | 72 | 26.5 | OM-R7D-B, OM-R88D-G |
| 100V/200V | 50W | 3000 | Absolute | Yes | 102 | 26.5 | OM-R88D-G |
| 100V/200V | 50W | 3000 | Absolute | No | 72 | 26.5 | OM-R88D-G |
| 100V | 100W | 3000 | Incremental | Yes | 122 | 46.5 | OM-R7D-B, OM-R88D-G |
| 100V | 100W | 3000 | Incremental | No | 92 | 46.5 | OM-R7D-B, OM-R88D-G |
| 100V | 100W | 3000 | Absolute | Yes | 122 | 46.5 | OM-R88D-G |
| 100V | 100W | 3000 | Absolute | No | 92 | 46.5 | OM-R88D-G |
| 200V | 100W | 3000 | Incremental | Yes | 122 | 46.5 | OM-R7D-B, OM-R88D-G |
| 200V | 100W | 3000 | Incremental | No | 92 | 46.5 | OM-R7D-B, OM-R88D-G |
| 100V | 100W | 3000 | Absolute | Yes | 122 | 46.5 | OM-R88D-G |
| 100V | 100W | 3000 | Absolute | No | 92 | 46.5 | OM-R88D-G |

### Dimensional Data



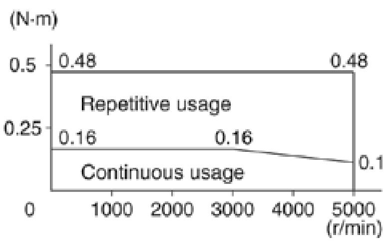




| KEY SPECIFICATIONS | |
|---|---|
| **Part #** | **OM-R88M-G** |
| Structure | Totally enclosed, self-cooling; rated IP 65 |
| Operating Position | All Directions |
| Insulation G | Type B |
| Ambient operating temperature and humidity | 0 to 40°C, 85% RH max. |
| Vibration Resistance | 10 to 2,500 Hz and acceleration of 49 $m/s^2$ max. in the X, Y, and Z directions |
| Impact Resistance | Acceleration of 98 $m/s^2$ max. 3 times each in the X, Y, and Z directions |
| International Standards | EMC Directive: EN 55011 class A group 1, EN 61000-6-2, IEC 61000-4-2/-3/-4/-5/-6/-11<br>Low voltage Directive: IEC 60034-1/-5 UL standards: UL 508C cUL standards: CSA 22.2 No.100 |

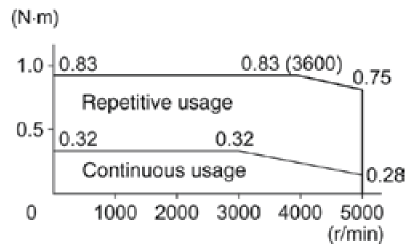
# **Speed** - Torque Performance - 3,000-r/min Cylindrical Servomotors

## (OM-R88D-G DRIVES) - 100-VAC POWER INPUT

### OM-R88M-G05030H/T (50 W)

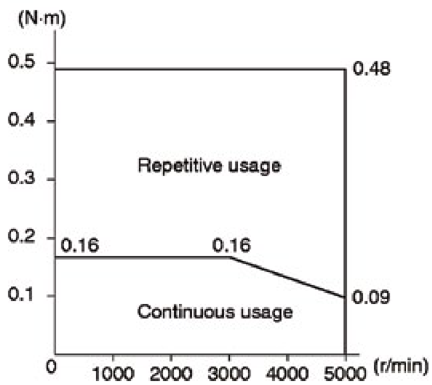



### OM-R88M-G10030L/S (100 W)

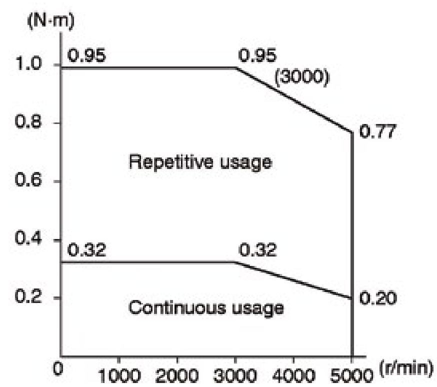



## (OM-R7D-B DRIVES) - 100-VAC POWER INPUT

### OM-R88M-G05030H

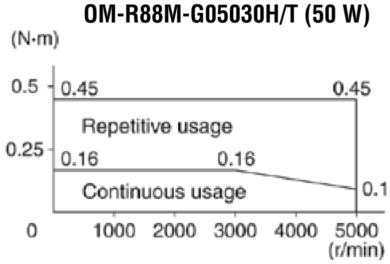



### OM-R88M-G10030L

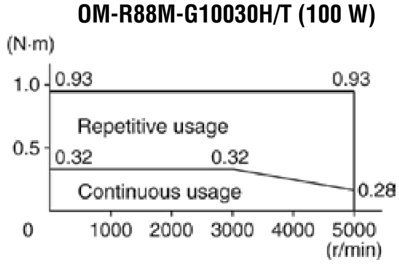



## (OM-R88D-G DRIVES) - 200-VAC POWER INPUT

### OM-R88M-G05030H/T (50 W)

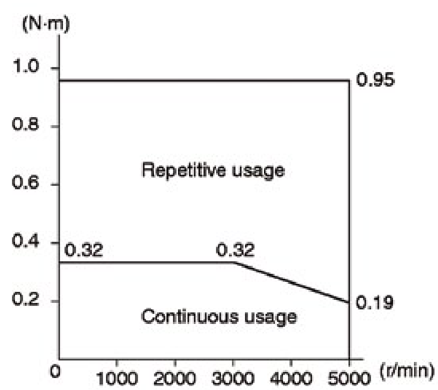



### OM-R88M-G10030H/T (100 W)




## (OM-R7D-B DRIVES) - 200-VAC POWER INPUT

### OM-R88M-G10030H




**FOR MORE INFORMATION CONTACT AN APPLICATION ENGINEER AT 888-777-0556**

# **Servo Drives** - OM-R7D

Omron's OM-R7D-B provides high-speed pulse train output to OM-R88M-G servomotors for straightforward control applications. Simple real-time auto-tuning continuously sets optimum gain and eliminates the need for complicated adjustments. Vibration caused by resonance is suppressed to improve positioning accuracy even in systems with low mechanical rigidity.

In addition to conventional CW/CCW inputs (2 pulses) and SIGN/PULS inputs (1 pulse), the OM-R7D-B servo drive supports 90° phase difference input. This makes it possible to input encoder output signals directly into the Servo Drive for simplified synchronization control.

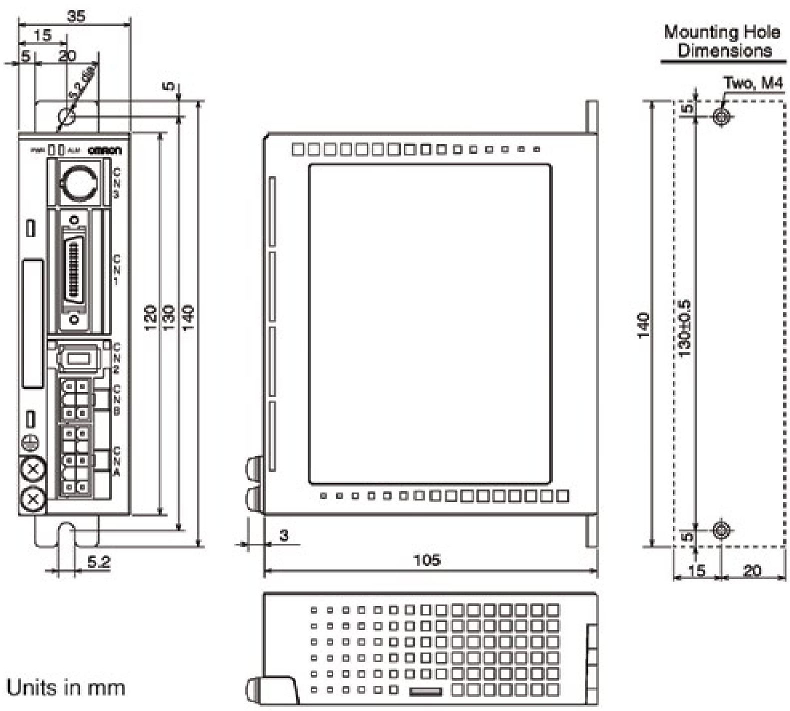

### OM-R7D Servo Drive

| SERVO DRIVE | | | |
|---|---|---|---|
| **Part #** | **Voltage** | **Servomotor Capacity** | **Motor Compatibility** |
| OM-R7D-BPA5L | 100V, single-phase | 50W | OM-R88M-G05030H |
| OM-R7D-BP01L | 100V, single-phase | 100W | OM-R88M-G10030L |
| OM-R7D-BP01H | 200V, single-phase /three-phase | 100W | OM-R88M-G10030H |

| POWER SUPPLY CABLES | | |
|---|---|---|
| **Part #** | **Voltage** | **Length** |
| OM-R7A-CLB002S2 | Single-phase | 2m |
| OM-R7A-CLB002S3 | Three-phase | 2m |

| MOTOR TO DRIVE CABLES | | |
|---|---|---|
| **Part #** | **Motor Brake** | **Length** |
| OM-R7A-CAB003S | Power cable | 3m |
| OM-R7A-CAB005S | Power cable | 5m |
| OM-R7A-CAB010S | Power cable | 10m |
| OM-R7A-CAB015S | Power cable | 15m |
| OM-R7A-CAB020S | Power cable | 20m |
| OM-R88A-CAGA003B | Power and Brake cable | 3m |
| OM-R88A-CAGA005B | Power and Brake cable | 5m |
| OM-R88A-CAGA010B | Power and Brake cable | 10m |
| OM-R88A-CAGA015B | Power and Brake cable | 15m |
| OM-R88A-CAGA020B | Power and Brake cable | 20m |
| OM-R88A-CRGB003C | Encoder cable | 3m |
| OM-R88A-CRGB005C | Encoder cable | 5m |
| OM-R88A-CRGB010C | Encoder cable | 10m |
| OM-R88A-CRGB015C | Encoder cable | 15m |
| OM-R88A-CRGB020C | Encoder cable | 20m |

### Dimensional Data

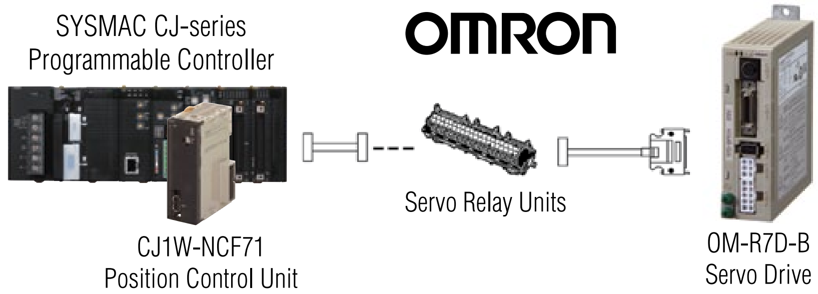



| SERVO DRIVE SPECIFICATIONS | | | |
|---|---|---|---|
| **Part #** | **OM-R7D-BPA5L** | **OM-R7D-BP01L** | **OM-R7D-BP01H** |
| Input power supply voltage | Single-phase 100 to 115 VAC(85 to 127 V), 50/60 Hz | | Both single-phase and three-phase 200 to 240 VAC (170 to 264 V), 50/60 Hz |
| Maximum response frequency | Command pulses: Line drive: 500 kpps, Open collector: 200 kpps | | |
| Operating ambient | 0 to 55°C, 90% RH max. | | |
| Vibration resistance | 10 to 60 Hz; acceleration: 5.9 m/s2 (0.6 G) max. | | |
| Impact resistance | Acceleration of 19.6 m/s2 max. 3 times each in X, Y, and Z directions. | | |
| International standards | EMC Directive: EN 55011 class A group 1, EN 61000-6-2<br>Low Voltage Directive: EN 50178 UL/cUL standards: UL 508C, cUL C22.2 No.14 | | |

# **Terminal Blocks** & Cables - OM-R7D



Select the Servo Terminal Block (Relay Unit) and cable according to the part number of the Position Control Unit being used.




**Use With OM-R7D Servo Drives**

**TERMINAL BLOCK (RELAY UNITS) & CABLES**

| Position Control Unit | Position Control Unit Cable | Servo Terminal Block (Relay Unit) | Servo Drive Cable* |
|---|---|---|---|
| OM-CJ1W-NC133 | OM-XW2Z-050J-A18<br>OM-XW2Z-100J-A18 | OM-XW2B-20J6-1B | OM-XW2Z-100J-B29<br>OM-XW2Z-200J-B29 |
| OM-CJ1W-NC233 | OM-XW2Z-050J-A19<br>OM-XW2Z-100J-A19 | OM-XW2B-40J6-2B | |
| OM-CJ1W-NC433 | | | |
| OM-CS1W-NC133 | OM-XW2Z-050J-A10<br>OM-XW2Z-100J-A10 | OM-XW2B-20J6-1B | |
| OM-CS1W-NC233 | OM-XW2Z-050J-A11<br>OM-XW2Z-100J-A11 | OM-XW2B-40J6-2B | |
| OM-CS1W-NC433 | | | |
| OM-CJ1W-NC113 | OM-XW2Z-050J-A14<br>OM-XW2Z-100J-A14 | OM-XW2B-20J6-1B | |
| OM-CJ1W-NC213 | OM-XW2Z-050J-A15<br>OM-XW2Z-100J-A15 | OM-XW2B-40J6-2B | |
| OM-CJ1W-NC413 | | | |
| OM-CS1W-NC113 | OM-XW2Z-050J-A6<br>OM-XW2Z-100J-A6 | OM-XW2B-20J6-1B | |
| OM-C200HW-NC113 | | | |
| OM-CS1W-NC213 | OM-XW2Z-050J-A7<br>OM-XW2Z-100J-A7 | OM-XW2B-40J6-2B | |
| OM-CS1W-NC413 | | | |
| OM-C200HW-NC213 | | | |
| OM-C200HW-NC413 | | | |
| OM-CJ1M-CPU21 | OM-XW2Z-050J-A33<br>OM-XW2Z-100J-A33 | OM-XW2B-20J6-8A<br>OM-XW2B-40J6-9A (for 2 axes)* | OM-XW2Z-100J-B32<br>OM-XW2Z-200J-B32 |
| OM-CJ1M-CPU22 | | | |
| OM-CJ1M-CPU23 | | | |
| OM-CQM1H-PLB21 | OM-XW2Z-050J-A3<br>OM-XW2Z-100J-A3 | OM-XW2B-20J6-3B | OM-XW2Z-100J-B29<br>OM-XW2Z-200J-B29 |

***NOTE:** Two (2) servo drive cables are required if 2-axis control is performed.
Cable Length ( 050 = 0.5 m  100 = 1 m  200 = 2 m)

**FOR CP1H/CP1L OR GENERAL PURPOSE CONTROLLERS**

| Specifications | | Part # |
|---|---|---|
| Connector Terminal Block Cables | 1 m | OM-XW2Z-100J-B28 |
| | 2 m | OM-XW2Z-200J-B28 |
| General-Purpose Control Cables | 1 m | OM-R7A-CPB001S |
| | 2 m | OM-R7A-CPB002S |
| Connector Terminal Block | M3 screw type | OM-XW2B-34G4 |
| | M3.5 screw type | OM-XW2B-34G5 |

# **Servo Drives** - G-Series

Omron's OM-R88D-GT drives offer pulse/analog output for reliable position control. Integrate multiple axes easily with OM-R88D-GN drives with high-speed Mechatrolink-II motion network.

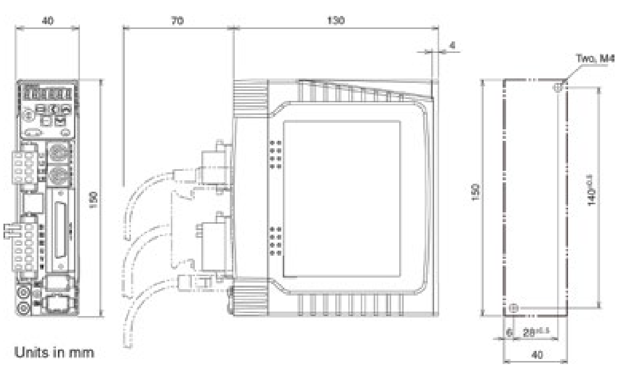
Eight internal speed settings allow you to change the speed easily by using external signals. Command Control Mode lets you switch operations between two of the following control modes for multi-phase processes: Position control, speed control (including internal speed) and torque control. Simple real-time auto-tuning continuously sets optimum gain and eliminates the need for complicated adjustments.

Vibration caused by resonance is suppressed to improve positioning accuracy.

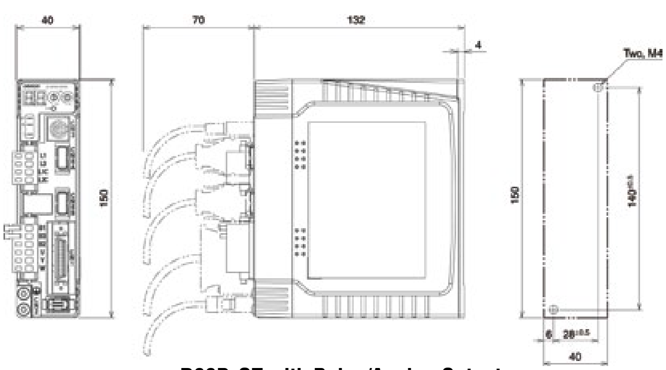
### G-Series Servo Drive

| SERVO DRIVES | | | | |
|---|---|---|---|---|
| **Part #** | **Voltage** | **Servomotor Capacity** | **Output** | **Motor Compatibility** |
| OM-R88D-GTA5L | 120V, single-phase | 50W | Pulse/Analog | OM-R88M-G05030H, OM-R88M-G05030T |
| OM-R88D-GT01L | 120V, single-phase | 100W | Pulse/Analog | OM-R88M-G10030L, OM-R88M-G10030S |
| OM-R88D-GT01H | 240V, single-phase | 100W | Pulse/Analog | OM-R88M-G10030H, OM-R88M-G10030T |
| OM-R88D-GNA5L-ML2 | 120V, single-phase | 50W | Mechatrolink-II | OM-R88M-G05030H, OM-R88M-G05030T |
| OM-R88D-GN01L-ML2 | 120V, single-phase | 100W | Mechatrolink-II | OM-R88M-G10030L, OM-R88M-G10030S |
| OM-R88D-GN01H-ML2 | 240V, single-phase | 100W | Mechatrolink-II | OM-R88M-G10030H, OM-R88M-G10030T |

### Dimensional Data




**R88D-GT with Pulse/Analog Output**



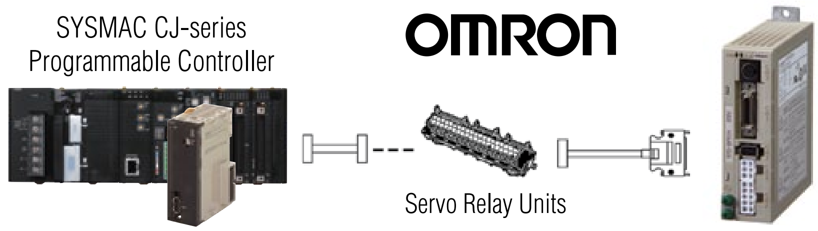

**R88D-GT with Pulse/Analog Output**

| MOTOR TO DRIVE CABLES | | |
|---|---|---|
| **Part #** | **Motor Brake** | **Length** |
| OM-R88A-CAGA003S | Power cable | 3m |
| OM-R88A-CAGA005S | Power cable | 5m |
| OM-R88A-CAGA010S | Power cable | 10m |
| OM-R88A-CAGA015S | Power cable | 15m |
| OM-R88A-CAGA020S | Power cable | 20m |
| OM-R88A-CAGA003B | Power and Brake cable | 3m |
| OM-R88A-CAGA005B | Power and Brake cable | 5m |
| OM-R88A-CAGA010B | Power and Brake cable | 10m |
| OM-R88A-CAGA015B | Power and Brake cable | 15m |
| OM-R88A-CAGA020B | Power and Brake cable | 20m |

| ENCODER CABLES | | |
|---|---|---|
| **Part #** | **Cable Type** | **Length** |
| OM-R88A-CRGB003C | Incremental Encoder cable | 3m |
| OM-R88A-CRGB005C | Incremental Encoder cable | 5m |
| OM-R88A-CRGB010C | Incremental Encoder cable | 10m |
| OM-R88A-CRGB015C | Incremental Encoder cable | 15m |
| OM-R88A-CRGB020C | Incremental Encoder cable | 20m |
| OM-R88A-CRGA003C | Absolute Encoder cable | 3m |
| OM-R88A-CRGA005C | Absolute Encoder cable | 5m |
| OM-R88A-CRGA010C | Absolute Encoder cable | 10m |
| OM-R88A-CRGA015C | Absolute Encoder cable | 15m |
| OM-R88A-CRGA020C | Absolute Encoder cable | 20m |

# **Terminal Blocks** & Cables - G-Series

Select the Servo Terminal Block (Relay Unit) and cable according to the part number of the Position Control Unit being used.




### Use With OM-R88D-GT Servo Drives

| TERMINAL BLOCK (RELAY UNITS) & CABLES | | | |
|---|---|---|---|
| **Position Control Unit** | **Position Control Unit Cable** | **Servo Terminal Block (Relay Unit)** | **Servo Drive Cable** |
| OM-CQM1H-PLB21 | 0.5m = OM-XW2Z-050J-A3<br>1m = OM-XW2Z-100J-A3 | OM-XW2B-20J6-3B | 1m = OM-XW2Z-100J-B25<br>2m = OM-XW2Z-200J-B25 |
| OM-CS1W-NC113 | 0.5m = OM-XW2Z-050J-A6<br>1m = OM-XW2Z-100J-A6 | OM-XW2B-20J6-1B | |
| OM-C200HW-NC113 | | | |
| OM-CS1W-NC213 | 0.5m = OM-XW2Z-050J-A7<br>1m = OM-XW2Z-100J-A7 | OM-XW2B-40J6-2B | |
| OM-CS1W-NC413 | | | |
| OM-C200HW-NC213 | | | |
| OM-C200HW-NC413 | | | |
| OM-CS1W-NC133 | 0.5m = OM-XW2Z-050J-A10<br>1m = OM-XW2Z-100J-A10 | OM-XW2B-20J6-1B | |
| OM-CS1W-NC233 | 0.5m = OM-XW2Z-050J-A11<br>1m = OM-XW2Z-100J-A11 | OM-XW2B-40J6-2B | |
| OM-CS1W-NC433 | | | |
| OM-CJ1W-NC113 | 0.5m = OM-XW2Z-050J-A14<br>1m = OM-XW2Z-100J-A14 | OM-XW2B-20J6-1B | |
| OM0CJ1W-NC213 | 0.5m = OM-XW2Z-050J-A15<br>1m = OM-XW2Z-100J-A15 | OM-XW2B-40J6-2B | |
| OM-CJ1W-NC413 | | | |
| OM-CJ1W-NC133 | 0.5m = OM-XW2Z-050J-A18<br>1m = OM-XW2Z-100J-A18 | OM-XW2B-20J6-1B | |
| OM-CJ1W-NC233 | 0.5m = OM-XW2Z-050J-A19<br>1m = OM-XW2Z-100J-A19 | OM-XW2B-40J6-2B | |
| OM-CJ1W-NC433 | | | |
| OM-CJ1M-CPU21 | 0.5m = OM-XW2Z-050J-A33<br>1m = OM-XW2Z-100J-A33 | OM-XW2B-20J6-8A (for 1 axes)<br>OM-XW2B-20J6-8A (for 1 axes) | 1m = OM-XW2Z-100J-B31<br>2m = OM-XW2Z-200J-B31 |
| OM-CJ1M-CPU22 | | | |
| OM-CJ1M-CPU23 | | | |

### Use With OM-R88D-GT/GN Servo Drives

| CP1H1/CP1L OR GENERAL PURPOSE CONTROLLERS | | | |
|---|---|---|---|
| **Specification** | | **Part #** | |
| Connector Terminal Block Cables | 1 m | R88A-CPG001S | OM-XW2Z-100J-B33 |
| | 2 m | R88A-CPG002S | OM-XW2Z-200J-B33 |
| Control Cables with Connector on One End | 1 m | XW2Z-100J-B24 | - |
| | 2 m | XW2Z-200J-B24 | - |
| Connector Terminal Block | M3 screw type | XW2B-50G4 | OM-XW2B-20G4 |
| | M3.5 screw type | XW2B-50G5 | OM-XW2B-20G5 |
| | M3 screw type | XW2D-50G6 | OM-XW2D-20G6 |

| MOTION CONTROL UNIT CABLE | | |
|---|---|---|
| There are special cables for 1-axis and 2-axis Motion Control Unit operation. Select the appropriate cable for the number of axes to be connected. | | |
| **Motion Control Unit** | **Cable Part #** | |
| OM-CS1W-MC221-V1/421-V1 | For 1 axis | OM-R88A-CPG□□□ M1 |
| | For 2 axes | OM-R88A-CPG□□□ M2 |
| The □□□ digits in the model number indicate the cable length. Motion Control Unit Cables come in four lengths: 1 m, 2 m. 3 m, and 5 m<br>EXAMPLE Part#: for 2-m 1-axis cable: OM-R88A-CPG002M1. | | |

# **MLC** Series (Motor Mount Only)

- **Includes motor mount with coupling**
- **Includes motor spacer (if required)**
- **Precision machined body**
- **Small, compact design**
- **Smooth and quiet operation**
- **High acceleration, speed and rigidity**

PBC Linear's stepper motors do not require a spacer due to the shorter shaft length. A spacer is required for any other manufacturer's motor. The spacer compensates for several dimensions which commonly vary amongst motor manufacturers (shaft diameter, shaft length, pilot diameter, pilot depth, bolt hole diameter, bolt type).

## MLC ORDERING GUIDE

| MLC028D – | X | XX | X | X | X |
|---|---|---|---|---|---|
| **Series** | **Linear Guide Supports*** | **Leads** | **Nut Type** | **Seal Strip** | **# of Carriages** |
| ML Series with motor mount 28 x 32mm | 0 No External Rail<br>1 (1) Rail, (1) Runner Block - XY-2 Brkt (R)<br>2 (1) Rail, (2) Runner Blocks - XY-2 Brkt (R)<br>3 (2) Rail, (1) Runner Block - XY-3 Brkt<br>4 (2) Rail, (2) Runner Blocks - XY-3 Brkt<br>5 (1) Rail, (1) Runner Block - XY-2 Brkt (L)<br>6 (1) Rail, (2) Runner Blocks - XY-2 Brkt (L)<br>7 No Seal Strip - XY-1 Brkt | AH 1mm<br>AG 2mm<br>AX 5mm<br>AJ 10mm<br>BD 12mm<br>AF 16mm<br>AW 25mm<br>AS 1.5in | 2 **Standard Nut**<br>4 Anti-backlash (light preload) | 0 **None**<br>1 With Seal Strip & XY Bracket | 1 **1 Carriage**<br>2 2 Carriages<br>3 3 Carriages<br>4 4 Carriages<br>NOTE: Contact manufacturer before ordering multiple carriages. |

*(L) = Left (R) = Right

| #### – | X | X | X | X | X | 0 |
|---|---|---|---|---|---|---|
| **Body Length** | **Motor Location** | **Motor Frame Size** | **Shaft OD** | **Coupling Material** | **Spacer Config** | **Config.** |
| mm<br>See page 11 for body length calculation table<br>EX: 90mm = 0090<br>250mm = 0250 | S Straight (in-line)<br>L Left<br>R Right<br>B Bottom<br>T Top | A NEMA 8 (20mm)<br>B NEMA 11 (28mm)<br>C NEMA 14 (35mm)<br>E Metric 40<br>F NEMA 17 (42mm)<br>G NEMA 23 (56/58mm) | A 3mm<br>B 0.125 in<br>C 4mm<br>D 0.1875 in<br>E 5mm<br>F 6mm<br>G 0.25 in<br>H 0.3125 in<br>J 8mm | 1 Acetal | A Standard<br>B<br>C<br>D<br>Contact PBC application engineer to specify spacer before ordering | 0 Standard |

At time of order, customer must declare their pilot diameter, shaft length and mounting hole pattern of the matching motor so that the proper spacer can be included.

| FINAL PART # | MLC028D | - | X | XX | X | X | X | - | XXXX | - | X | X | X | X | X | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

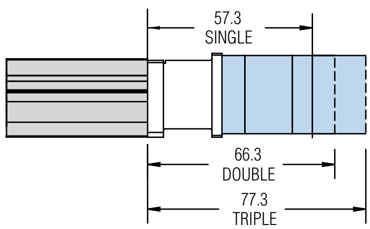
**NOTE:** Not all combinations are possible. Contact manufacturer for available combinations. Body lengths are available in 1mm increments up to 701mm. Standard lengths are multiples of 10mm. When possible round up to nearest multiple of 10mm. NEMA 11 stepper motors typically do not have enough torque to drive the anti-backlash nuts. Customers are responsible for doing torque calculations to ensure the motor is properly sized. Specifications are subject to change without notice.

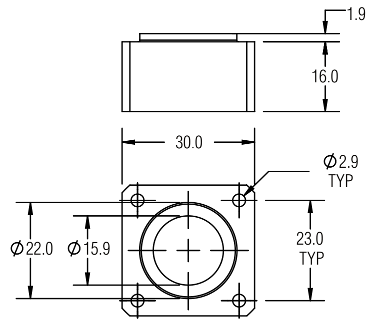
# **Motor** Mount Assembly

ML Series Actuator | Motor Mount & Spacer | PBC Stepper Motor

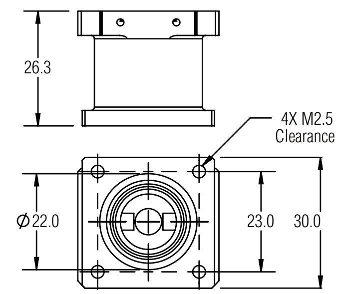
| ASSEMBLY DIMENSIONS | SPACER | MOTOR FRAME SIZE |
|---|---|---|

Recommended for **NEMA 11** Stepper Motor

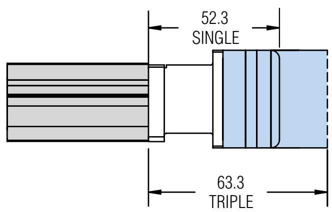


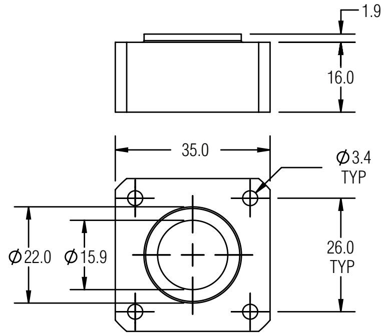




Spacer "A"




Recommended for **NEMA 14** Stepper Motor

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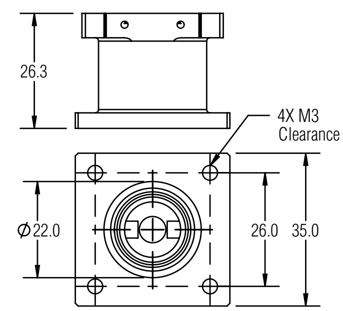
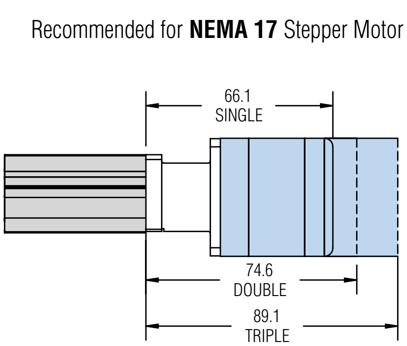
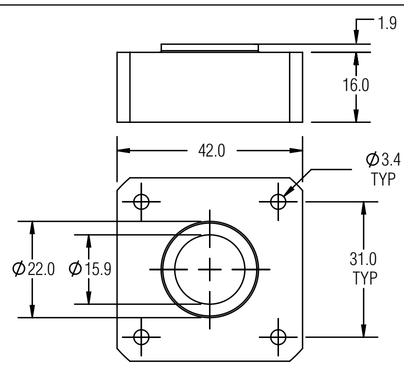
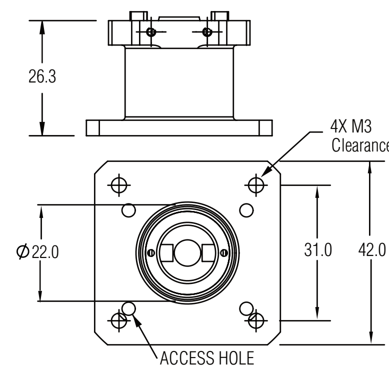



Recommended for **NEMA 17** Stepper Motor

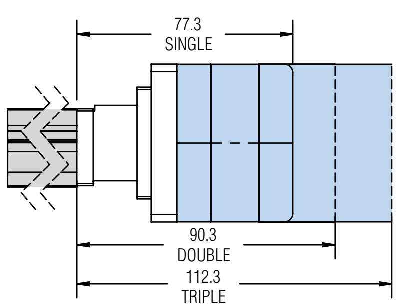


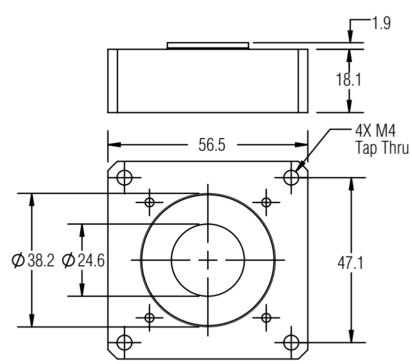




Spacer "A"

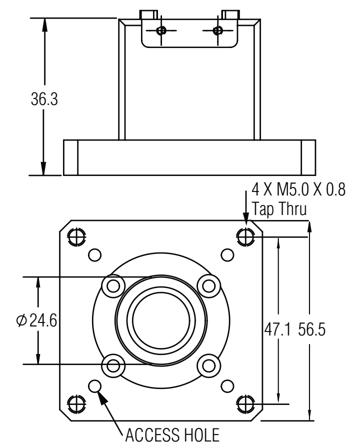



Recommended for **NEMA 23** Stepper Motor




Spacer "A"



# **MLD** Series (Hand Driven shaft or knob)

- **Perfect for hand-operated precision control**
- **Manual brake optional**
- **Textured knob for both positioning and braking**
- **Precision machined body**
- **Small, compact design**
- **Great repeatability**

## MLD ORDERING GUIDE

| MLD028D | – | X | XX | X | X | X |
|---|---|---|---|---|---|---|
| Series | – | Linear Guide Supports | Leads | Nut Type | Seal Strip | # of Carriages |
| ML Series with knob/drive lead screw driven 28 x 32 mm | | 0 No External Rail<br>1 (1) Rail, (1) Runner Block - XY-2 Brkt (R)<br>2 (1) Rail, (2) Runner Blocks - XY-2 Brkt (R)<br>3 (2) Rail, (1) Runner Block - XY-3 Brkt<br>4 (2) Rail, (2) Runner Blocks - XY-3 Brkt<br>5 (1) Rail, (1) Runner Block - XY-2 Brkt (L)<br>6 (1) Rail, (2) Runner Blocks - XY-2 Brkt (L)<br>7 No Seal Strip - XY-1 Brkt | AH 1mm<br>AG 2mm<br>AX 5mm<br>AJ 10mm<br>BD 12mm<br>AF 16mm<br>AW 25mm<br>AS 1.5 in | 2 Standard Nut<br>4 Anti-backlash (light preload)<br>6 Anti-backlash (normal preload) | 0 None<br>1 With Seal Strip & XY Bracket | 1 1 Carriage<br>2 2 Carriages<br>3 3 Carriages<br>4 4 Carriages<br>NOTE: Contact manufacturer before ordering multiple carriages. |

*(L) = Left (R) = Right

| #### | – | X | X | O |
|---|---|---|---|---|
| Body Length | – | (Drive) Knob | Brake | Configuration |
| mm<br>See page 11 for body length calculation table<br>EX: 90mm = 0090<br>250mm = 0250 | | 0 No - shaft only<br>1 Yes - with knob | 0 No<br>1 Yes (at drive end) | 0 Standard |

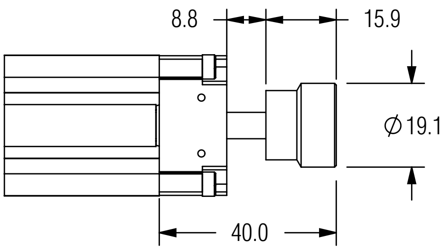
**FINAL PART #**

| MLD028D | - | X | XX | X | X | X | - | XXXX | - | X | X | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

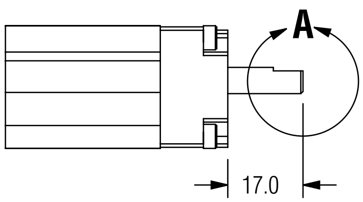
**NOTE:** Not all combinations are possible. Contact manufacturer for available combinations. Body lengths are available in 1mm increments up to 701mm. Standard lengths are multiples of 10mm. When possible round up to nearest multiple of 10mm. Specifications are subject to change without notice.

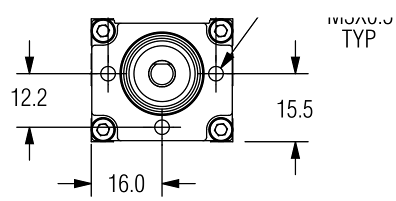
# **Dimensional** Data

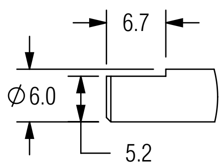
**KNOB**




**SHAFT ONLY.**

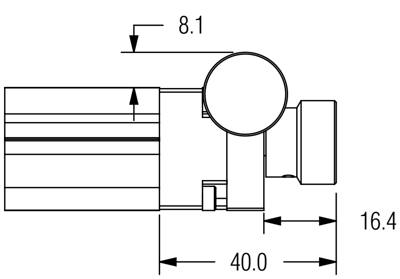


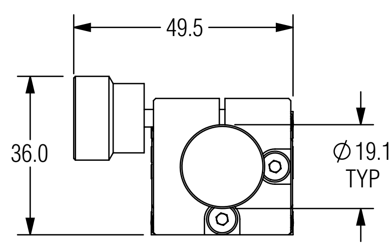




**DETAIL A**

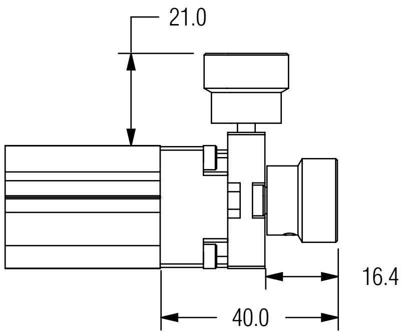
**HAND BRAKE SIDE MOUNT**

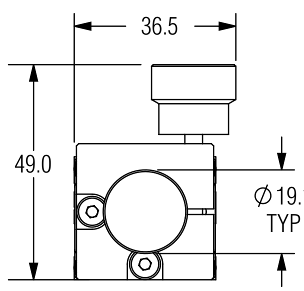



**NOTE:** Brake installed on side as default and can easily be changed to the top by the customer.

**HAND BRAKE TOP MOUNT**



# Build Your ML Actuator

## 6 Easy Steps

Follow these easy-to-follow steps to build your ML Series Actuator

### STEP 1

**Configure Your System Axis**

a. Determine if you need an external linear guide for support *(pg. 30, 31, 37)*
b. Calculate the body length *(pg. 11)*

### STEP 2

**Choose The Drive Method**

a. Motor pre-mounted and tested by PBC? ➡ MLB *(Page 14)*
b. Ready to mount your own motor? ➡ MLC *(Page 24)*
c. Driven by hand? ➡ MLD *(Page 26)*

### STEP 3

**Choose How To Mount The Axis**

a. Choose dovetail clamps or riser plates
(Use riser plates with NEMA 17 and 23 motors) *(Page 23)*

### STEP 4

**Choose end of travel and home limit switches/sensors**

a. Determine mounting type/location (bracket type)
b. Choose from list of compatible sensors

### STEP 5

**Choose The Cable Carrier**

a. List all cables to run through carrier
b. Complete selection calculation
c. Choose mounting type/location (bracket type)

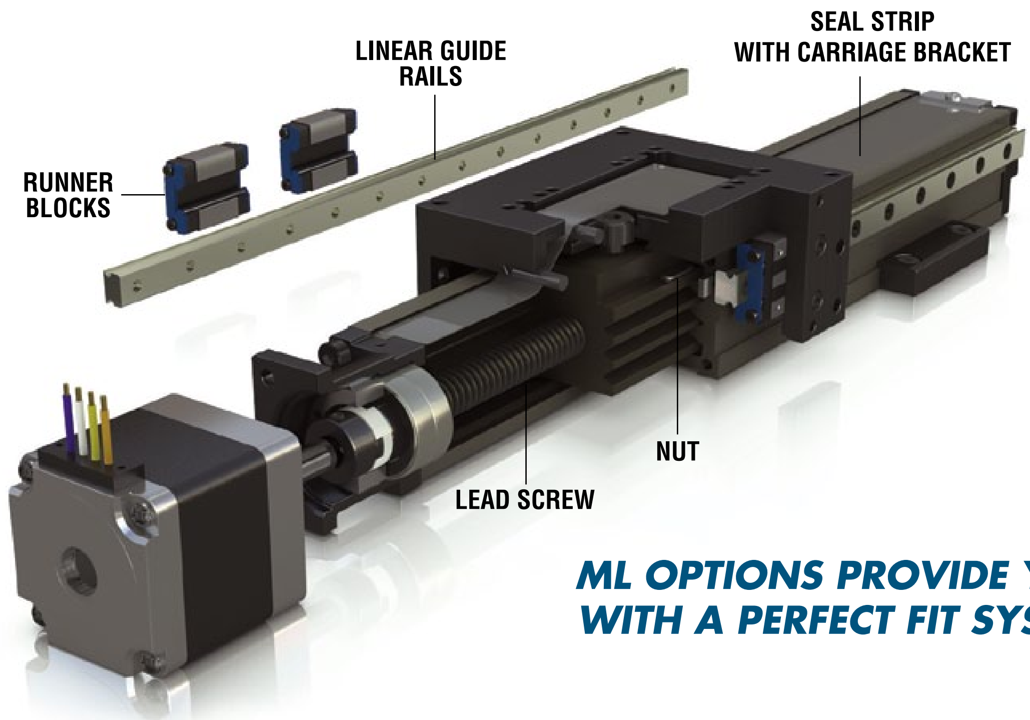
**Repeat 1-5 for each axis**

### STEP 6

**Order Your System**
**1-800-962-8979 or 1-815-389-5600**

Questions? Call an Application Engineer 1-888-777-0556

# **Ordering** Options



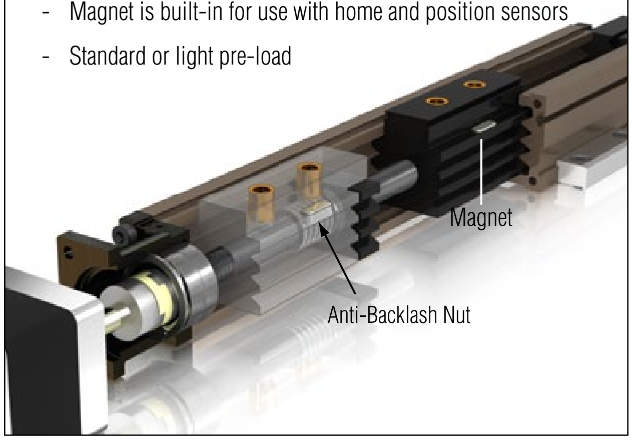

***ML OPTIONS PROVIDE YOU WITH A PERFECT FIT SYSTEM***

## LEAD SCREW

- Large 10mm diameter lead screw reduces whip and increases column strength allowing longer stroke lengths
- Lead options*: 1, 2 , 5 , 10 , 12, 16 and 25 mm.
  3mm (0.125”), 10mm (0.400”), 25mm (1”), 38 (1.5”)
  **Contact manufacturer for other available sizes*
- **Nominal Lead Screw Diameter** = 10mm (0.375”)
- **Screw Interia** = 4.169 x $10^{-6}$ kg-$m^2$/m
  1.5 x $10^{-5}$ oz.-in.sec.$^2$/in.)
- **Lead Screw Length** = Body Length + 32.27mm

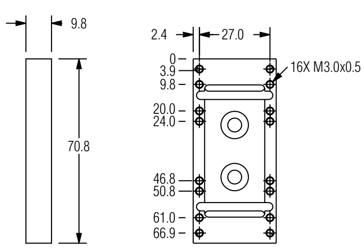
## NUT TYPE

- Standard nut or anti-backlash nut
- Optional anti-backlash nut - ideal in applications requiring high bi-directional accuracy and repeatability
- Magnet is built-in for use with home and position sensors
- Standard or light pre-load



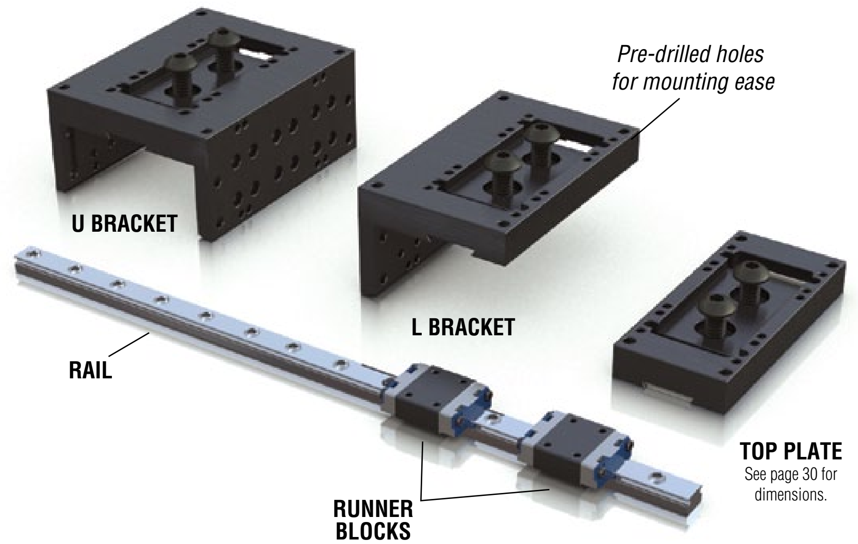

## SEAL STRIP WITH CARRIAGE BRACKET

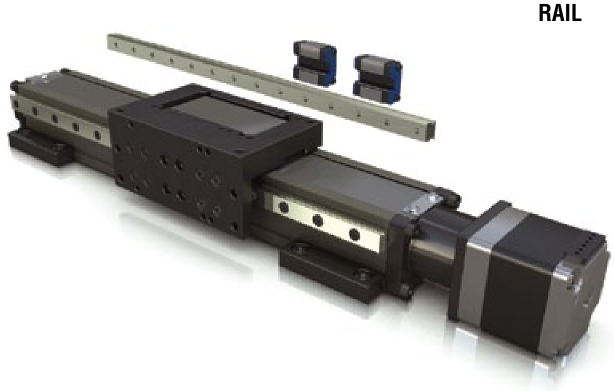
- Ultra wear-resistant molybdenum disulfide impregnated nylon
- Prevents debris from entering or exiting actuator
- Seal strip is 725mm in length *(Can be cut shorter using sharp pair of scissors.)*




# **Linear Guide** Supports

The ML series features the unique option for dual external linear guides (also available with single linear guide option). These re-circulating ball runner blocks assure high speed precision as well as enhanced load capacities and stability.



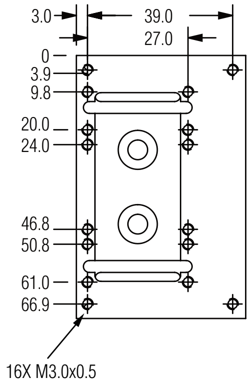
## *SUPPORT OPTIONS TO CREATE VARIABLE LEVELS OF PERFORMANCE*

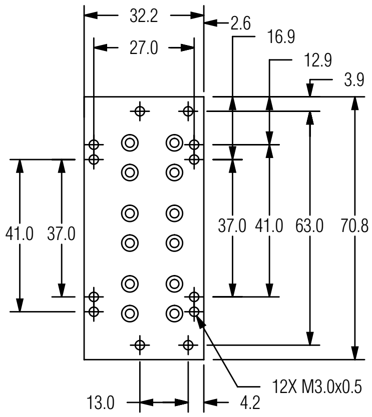
| Technical Data Linear Guide Supports | | | (1) Single | | (2) Dual | | | (1) Single | | (2) Dual | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | # of runner blocks on each guide | | | | | # of runner blocks on each guide | | | |
| | | | 1 | 2 | 1 | 2 | | 1 | 2 | 1 | 2 |
| Max. Load Anti-Backlash - Lite Preload | Fx | N | 44 | 44 | 44 | 44 | lbf | 10 | 10 | 10 | 10 |
| - Normal Preload | Fx | N | 89 | 89 | 89 | 89 | lbf | 20 | 20 | 20 | 20 |
| Standard Nut | Fx | N | 267 | 267 | 267 | 267 | lbf | 60 | 60 | 60 | 60 |
| | Fy | N | 180 | 250 | 445 | 890 | lbf | 40 | 56 | 100 | 200 |
| | Fz | N | 267 | 356 | 445 | 890 | lbf | 60 | 80 | 100 | 200 |
| Max. Moments | Mx | Nm | 1.8 | 3.6 | 8.6 | 18 | lbf-in | 16 | 32 | 76 | 160 |
| | My | Nm | 1.8 | 5 | 3.6 | 10 | lbf-in | 16 | 44 | 32 | 88 |
| | Mz | Nm | 1.8 | 5 | 3.6 | 10 | lbf-in | 16 | 44 | 32 | 88 |
| Bending Moment of Inertia (Second moment of area) | Iy | $cm^4$ | 2.4 | 2.4 | 2.4 | 2.4 | $in^4$ | 0.058 | 0.058 | 0.058 | 0.058 |
| | Iz | $cm^4$ | 4.4 | 4.4 | 4.4 | 4.4 | $in^4$ | 0.106 | 0.106 | 0.106 | 0.106 |
| Base Weight without Motor | | Kg | 0.127 | 0.136 | 0.195 | 0.205 | lbf | 0.28 | 0.30 | 0.43 | 0.45 |
| Add for 100mm of Stroke | | Kg | 0.18 | 0.18 | 0.21 | 0.21 | lbf | 0.40 | 0.40 | 0.46 | 0.46 |
| Total Carriage Mass | | Kg | .109 | .117 | .159 | .175 | lbm | .240 | .257 | .350 | .385 |
| Coefficent of Friction | | | 0.19 | | 0.01 | | | 0.19 | | 0.01 | |

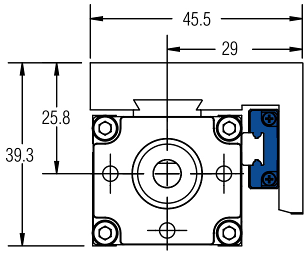
**NOTE:**
1. Moment arms for calculating moments should be measured from the center of the extrusion.
2. Limit switches must be used in order to prevent the carriage from contacting the actuator end blocks, resulting in damage.
3. Servo drive system - Recommended overtravel of 20mm
4. Stepper motors or manual hand cranks system - add 5mm of over-travel.

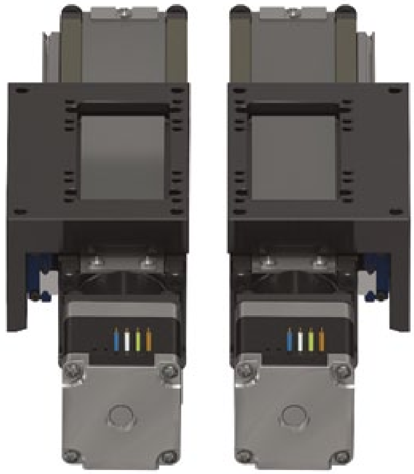
# **Dimensional** Data

## SINGLE LINEAR GUIDE SUPPORTS



LEFT RIGHT

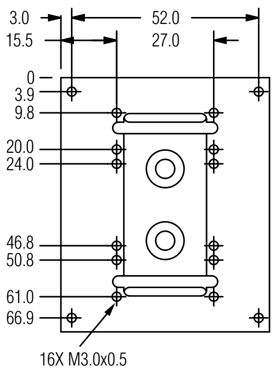
**INCLUDES:**

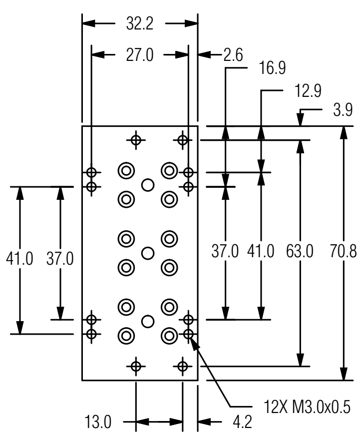
(1) rail, (1) runner block & aluminum alloy L shaped carriage bracket

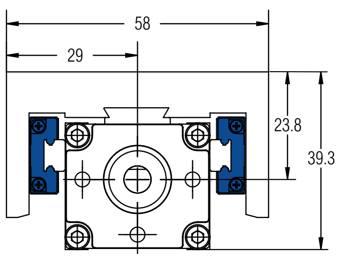
- or -

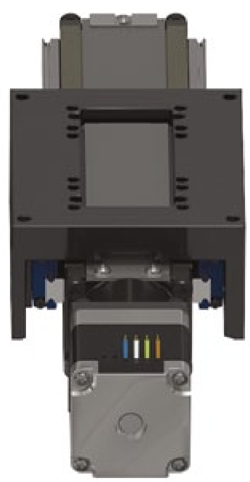
(1) rail, (2) runner blocks & aluminum alloy L shaped carriage bracket

## DUAL LINEAR GUIDE SUPPORTS



**INCLUDES:**

2) rails, (1) runner block & aluminum alloy U shaped carriage bracket

- or -

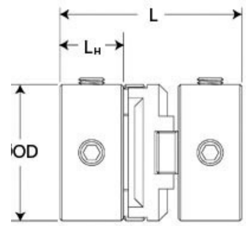
(2) rails, (2) runner blocks & aluminum alloy U shaped carriage bracket

# **Motor** Couplings

## MOTOR COUPLING (HUB & DISK)

- Compensates for motor and screw misalignment
- Electrically isolating
- Balanced design

HUB




DISK

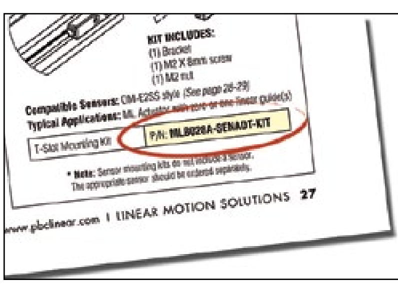
| FOR USE WITH NEMA 11, 14, 17 MOTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HUBS P/N # | BORE* | OD | HUB LENGTH (LH) | COUPLING LENGTH (L) | SHAFT PENETRATION | SET SCREW | MOMENT OF INERTIA (lb-in^2) | MOMENT OF INERTIA (kg x m^2) |
| **6200129** | 3mm | 12.7mm | 5.6mm | 15.9mm | 5.6mm | M3 | 0.0056” | 1.64E-06 |
| **6200286** | 5mm | 12.7mm | 5.6mm | 15.9mm | 5.6mm | M3 | 0.0050” | 1.47E-06 |
| **6200350** | 6mm | 12.7mm | 5.6mm | 15.9mm | 5.6mm | M3 | 0.0047” | 1.37E-06 |
| **6200113** | .125” | 0.500” | .222” | .625” | .222” | M3 | 0.0056” | 1.64E-06 |
| **6200349** | .250” | 0.500” | .222” | .625” | .222” | M3 | 0.0045” | 1.32E-06 |

| FOR USE WITH NEMA 23 MOTORS ONLY. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HUBS P/N # | BORE* | OD | HUB LENGTH (LH) | COUPLING LENGTH (L) | SHAFT PENETRATION | SET SCREW | MOMENT OF INERTIA (lb-in^2) | MOMENT OF INERTIA (kg x m^2) |
| **6200130** | 4mm | 19.1mm | 7.6mm | 22.2mm | 7.6mm | M3 | 0.0069 | 2.02E-06 |
| **6200131** | 5mm | 19.1mm | 7.6mm | 22.2mm | 7.6mm | M3 | 0.0068 | 1.99E-06 |
| **6200132** | 6mm | 19.1mm | 7.6mm | 22.2mm | 7.6mm | M3 | 0.0066 | 1.94E-06 |
| **6200133** | 8mm | 19.1mm | 7.6mm | 22.2mm | 7.6mm | M3 | 0.0061 | 1.79E-06 |
| **6200114** | .1875” | .750” | .300” | .875” | .300” | M3 | 0.0068 | 1.99E-06 |
| **6200115** | .250” | .750” | .300” | .875” | .300” | M3 | 0.0065 | 1.91E-06 |
| **6200116** | .3125” | .750” | .300” | .875” | .300” | M3 | 0.0062 | 1.82E-06 |

*Contact PBC linear if required bore is not listed.

| DISK P/N # | MATERIAL | OD | | TORSIONAL STIFFNESS | | RATED TORQUE | | BRAKE TORQUE | | PARALLEL MISALIGNMENT | | AXIAL MOTION | | MOMENT OF INERTIA (kg x m^2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (mm) | (in) | (Deg/Nm) | (Deg/lb-in) | (Nm) | (lb-in) | (Nm) | (lb-in) | (mm) | (in) | (mm) | (in) | |
| **6200148** | Acetal | 12.7 | 0.5 | 0.636 | 0.072 | 0.69 | 6 | 3.9 | 34 | 0.1 | 0.004 | 0.05 | 0.002 | 2.93E-08 |
| **6200149** | Acetal | 19.1 | 0.75 | 0.38 | 0.043 | 2.25 | 20 | 10.5 | 93 | 0.2 | 0.008 | 0.1 | 0.004 | 5.87E-08 |

**NOTE:** Motor coupling assembly (hubs & disk) are included in MLB & MLC Series actuators. One hub of the coupling is integral to the lead screw drive system. Alternate coupling styles are not available




## **Ordering** Accessories

When ordering ML accessories the part number (P/N) can be located in a yellow box next to the item. The item part number can be given separately when placing your ML actuator order. If you have technical question contact a PBC Application Engineer at at **1-800-962-8979.**

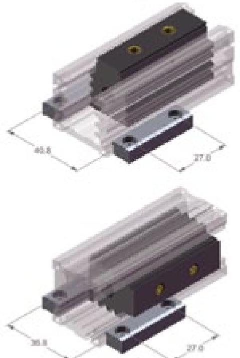
# **Mounting** Hardware (Clamps, Plates & Sensor Kits)

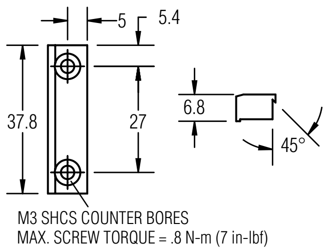
## ACTUATOR MOUNTING

### DOVETAIL CLAMPS

Two screw design helps ensure quick and easy alignment during installation.

**KIT INCLUDES:**
(2) M3 Dovetail Clamp
(4) M3 x 10mm SHCS

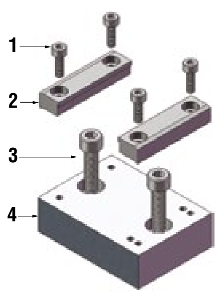


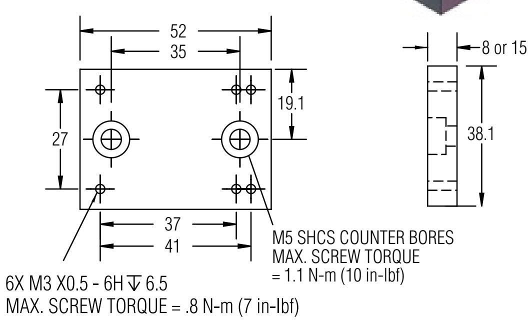



| | |
|---|---|
| Single Dovetail Clamp only. | P/N: **MLA028A-HDC-M3** |
| Dovetail Clamp Kit | P/N: **MLA028A-HDC-M3-KIT** |

### RISER PLATES

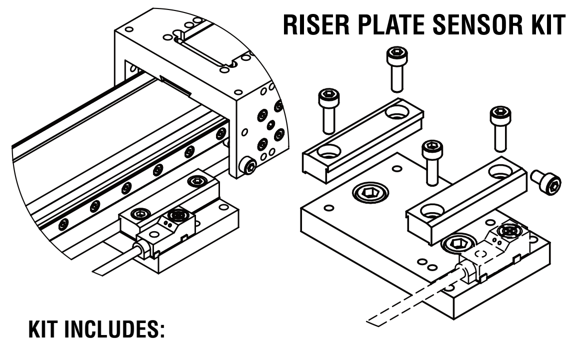
**INCLUDES:**
1. (4) M3 x 10mm SHCS
2. (2) M3 Dovetail Clamp
3. (2) M5 x 16mm SHCS
4. (1) 8mm or 15mm Riser Plate




| RECOMMENDED FOR NEMA 14 & 17 MOTOR | |
|---|---|
| 8mm Riser Plate only | P/N: **MLA028A-RSRPLT-08** |
| 8mm Riser Plate Kit | P/N: **MLA028A-RSRPLT-08 -KIT** |
| | |
| **RECOMMENDED FOR NEMA 23 MOTOR** | |
| 15mm Riser Plate only | P/N: **MLA028A-RSRPLT-15** |
| 15mm Riser Plate Kit | P/N: **MLA028A-RSRPLT-15-KIT** |

### RISER PLATE SENSOR KIT



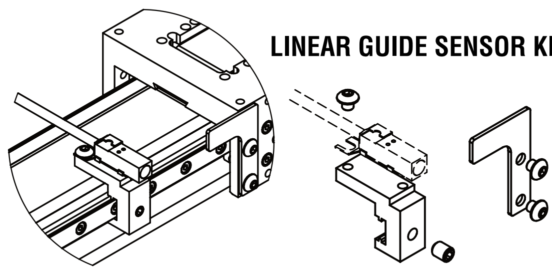
**KIT INCLUDES:**

| | |
|---|---|
| (1) Riser plate (8 or 15mm) | (2) Dovetail clamps |
| (4) M3 x 10mm screws | (1) M3 x 12mm screw |
| (1) M3 x 6mm screw | (2) M5 x 16mm screw (optional) |

**Compatible Sensors:** OM-E2S-W2 style *(See page 34-35)*
**Typical Applications:** ML Actuator gantry's with (2) linear guides

| | |
|---|---|
| Riser Plate Sensor Kit | P/N: **MLA028A-RSRPLT-08A-KIT** |
| Riser Plate Sensor Kit | P/N: **MLA028A-RSRPLT-15A-KIT** |

### LINEAR GUIDE SENSOR KIT



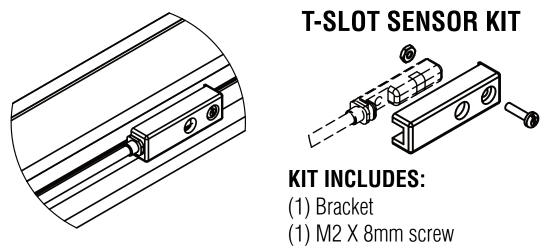
**KIT INCLUDES:**

| | |
|---|---|
| (1) Bracket | (1) OM-Y92E-C1R6 Bracket |
| (3) M3 X 4mm screws | (1) M4 X 5mm set screw |
| (1) Flag, 5mm sensing distance | |

**Compatible Sensors:** OM-E2S-Q1 style *(See page 34-35)*
**Typical Applications:** ML Actuators with one or two linear guide(s)

| | |
|---|---|
| Linear Guide Sensor Kit | P/N: **MLB028A-BRKTA-KIT** |

### T-SLOT SENSOR KIT



**KIT INCLUDES:**
(1) Bracket
(1) M2 X 8mm screw
(1) M2 nut

**Compatible Sensors:** OM-E2SS style *(See page 34-35)*
**Typical Applications:** ML Actuator with zero or one linear guide(s)

| | |
|---|---|
| T-Slot Sensor Kit | P/N: **MLB028A-SENADT-KIT** |

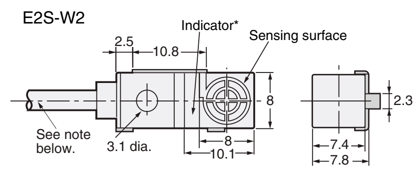
* **Note:** Sensor mounting kits do not include a sensor. The appropriate sensor should be ordered separately.

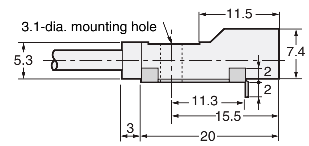
# **Proximity** Sensors

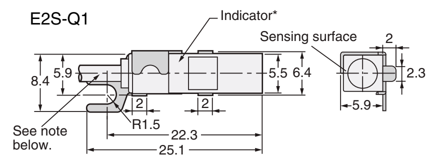
## SUPER COMPACT PROXIMITY SENSORS

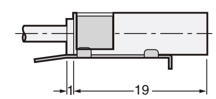
**OM-E2S-W2**
**OM-E2S-Q1**





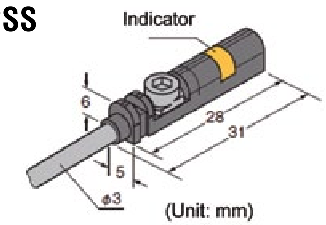



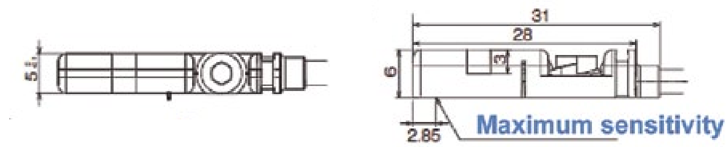




NOTE: 2.9-dia. vinyl-insulated round cable with 2/3 conductors. (Conductor cross section: 0.14 mm$^2$, Insulator diameter: 0.9 mm), Standard length: 1m

OMRON

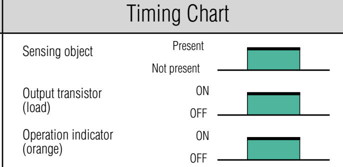
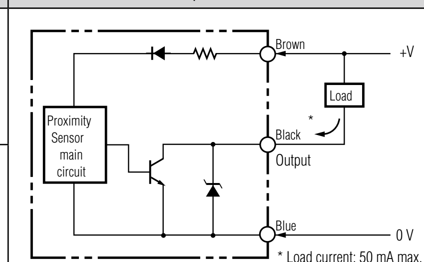
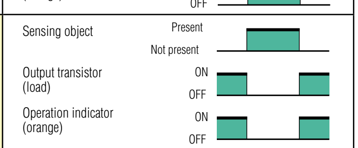
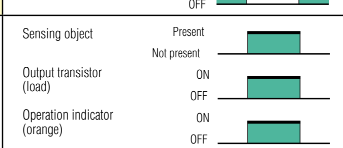
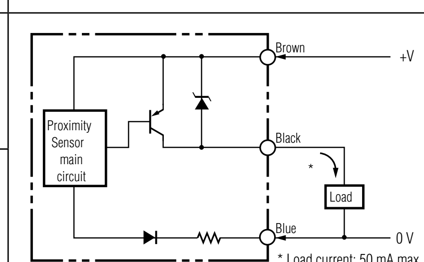
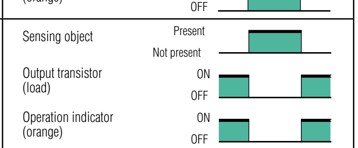
**OM-E2SS**




| Sensing Surface | Sensing Distance | Sensor Series | Output Configuration | Cable: 5m Flying Lead | | Cable: 275mm M8 Quick Disconnect | |
|---|---|---|---|---|---|---|---|
| | | | | Normally Open (NO) | Normally Closed (NC) | Normally Open (NO) | Normally Closed (NC) |
| End | 1.6mm | **OM-E2S-Q** | NPN | OM-E2S-Q13-☐ | **OM-E2S-Q14-5M** | OM-E2S-Q13-U2 | **OM-E2S-Q14-U2** |
| | | | PNP | OM-E2S-Q15-☐ | OM-E2S-Q16-5M | OM-E2S-Q15-U2 | OM-E2S-Q16-U2 |
| Front/Top | 2.5mm | **OM-E2S-W** | NPN | OM-E2S-W23-☐ | **OM-E2S-W24-5M** | OM-E2S-W23-U2 | **OM-E2S-W24-U2** |
| | | | PNP | OM-E2S-W25-☐ | OM-E2S-W26-5M | OM-E2S-W25-U2 | OM-E2S-W26-U2 |
| Bottom | n/a | **OM-E2SS** | NPN | Contact manufacturer to order. | | | |
| | | | PNP | Contact manufacturer to order. | | | |

**NOTE:** Omron and FASTtech drives require NPN sensors. Omron drives require NC sensors. If in doubt, order one of the sensors highlighted above in **yellow.**
☐ = length of cable 5M" = 5 meters with flying lead; U2 = 275mm with quick disconnect

| Operation Status | Output Configuration | P/N # | Timing Chart | Output Circuits |
|---|---|---|---|---|
| NO | NPN | OM-E2S-W23-☐<br>OM-E2S-Q13-☐ |  |  |
| NC | NPN | OM-E2S-W24-☐<br>OM-E2S-Q14-☐ |  | |
| NO | PNP | OM-E2S-W25-☐<br>OM-E2S-Q15-☐ |  |  |
| NC | PNP | OM-E2S-W26-☐<br>OM-E2S-Q16-☐ |  | |

| Model P/N: | OM-E2S-W13<br>OM-E2S-W14 | OM-E2S-W23<br>OM-E2S-W24 | OM-E2S-Q15<br>OM-E2S-Q16 | OM-E2S-W25<br>OM-E2S-W26 | OM-E2SS |
|---|---|---|---|---|---|
| Sensing surface | Front | Top | Front | Top | N/A |
| Sensing distance | 1.6mm ± 15% | 2.5mm ± 15% | 1.6mm ± 15% | 2.5 mm ± 15% | N/A |
| Set distance | 0 to 1.2mm | 0 to 1.9mm | 0 to 1.2mm | 0 to 1.9mm | N/A |
| Differential travel | 10% max of sensing distance | | | | N/A |
| Detectable object type | Ferrous metal | | | | N/A |
| Standard target object | Iron, 12 x 12 x 1 mm | Iron, 15 x 15 x 1 mm | Iron, 12 x 12 x 1 mm | Iron, 15 x 15 x 1 mm | N/A |
| Response frequency (see note) | 1 kHz min. | | | | 1 kHz max. |
| Power supply voltage (operating voltage range) | 12 to 24V DC, ripple (p-p): 10% max., (10 to 30V DC) | | | | 10 to 30V DC ripple 10% max |
| Current Consumption | 13 mA max. at 24 VDC (no-load) | | | | 15mA max |
| Operation Mode (with sensing object approaching) | OM-E2S-_ _ 3 models: NO<br>OM-E2S-_ _ 4 models NC | | | | N/A |
| Control Output – Load Current | NPN open collector output 50 mA max. (30 V DC max) | | PNP open collector output 50 mA max. (30 V DC max.) | | 150mA max. |
| Control Output – Residual voltage | 1.0 V max. with a load current of 50 mA and a cable length of 1 m | | | | 2V max. (at 150mA load current 2m cable) |
| Indicator | Operation indicator (orange) | | | | (yellow) |
| Protection Circuits | Reverse polarity connection and surge absorber | | | | Output short-circuit, Output reverse polarity, Power supply reverse polarity |
| Ambient temperature – Operating | -25°C to 70°C (-13°F to 158°F) with no icing or condensation | | | | |
| Ambient temperature – Storage | -40°C to 85°C (-40°F to 185° F) with no icing or condensation | | | | -25 to 70°C (No Freezing) |
| Ambient humidity – Operating | 35% to 90% (with no condensation) | | | | 35 to 95%RH |
| Ambient humidity – Storage | 35% to 95% (with no condensation) | | | | 35 to 95%RH |
| Temperature influence | ± 15% max. of sensing distance at 23° in the temperature range of -25 to 70° C | | | | N/A |
| Voltage Influence | ± 2.5% max. of sensing distance in rated voltage range ± 10% | | | | N/A |
| Insulation resistance | 50 M min. (500V VDC) between current carry parts and case | | | | |
| Dielectric strength | 1,000 VAC, 50/60 Hz for 1 min between current carry parts and case | | | | 500 VAC, 50/60 Hz |
| Vibration resistance | Destruction: 10 to 55 Hz, 1.0 mm double amplitude for 2 hours each in X, Y and Z directions | | | | |
| Shock resistance | Destruction: 500 $m/s^2$ (1640 $ft/s^2$) 3 times each in X, Y and Z directions | | | | Mechanical durability; 300m/s2 |
| Connection Method | Pre-wired standard length 1 m (39.37 in) | | | | Normal: Pre-wire (standard 2m) -M`J:M12 Connector with Cable (Cable: 0.3m) |
| Weight (packed state) | Approx. 10 g (0.35 oz) | | | | N/A |
| Material/Case | Polyarylate resin | | | | Case: PP, Code: PUR |
| Magnetic sensitivity | | | | | 2.8mT max. |
| Hysteresis | | | | | 1mm max. |
| Repeatability | | | | | ±0.1mm max. |
| Pass speed | | | | | 10 m/s |

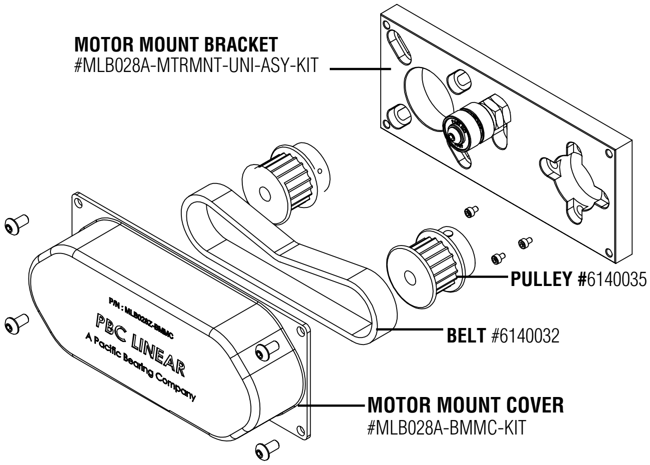
## SENSOR IO CONNECTOR

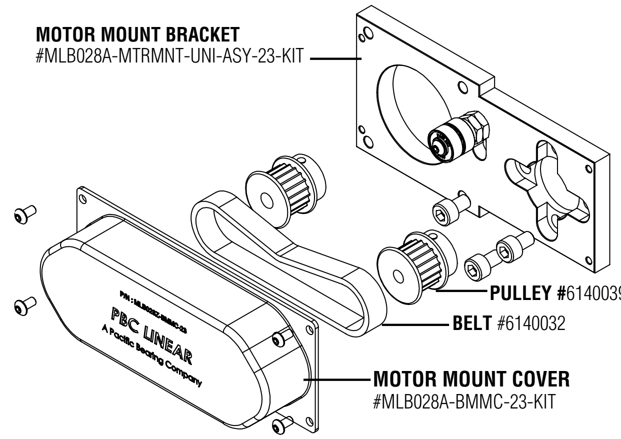
- Extension cables for M8 quick disconnect sensor.
- Simplifies maintenance and reduces downtime.

- Single-end I/O connector with female socket with attached cable.

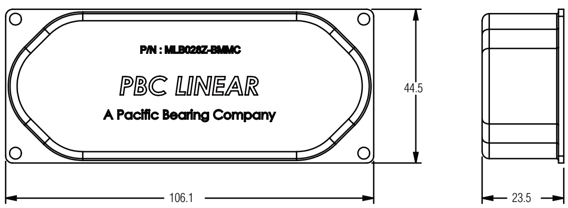
| Length | Regular Flex P/N: | High/Robotic Flex P/N: |
|---|---|---|
| 2m | **OM-XS3F-M421-402-A** | **OM-XS3F-M421-402-R** |
| 5m | **OM-XS3F-M421-405-A** | **OM-XS3F-M421-405-R** |
| 10m | **OM-XS3F-M421-410-A** | **OM-XS3F-M421-410-R** |

# **Motor Mount Assembly** - Replacement Parts



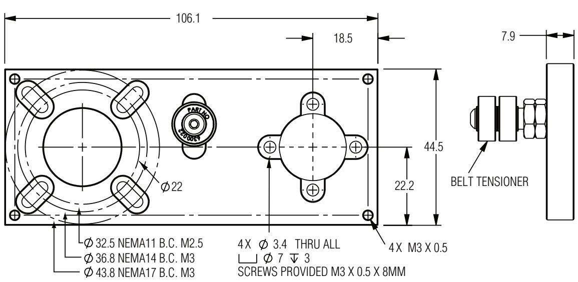




## **MOTOR MOUNT ASSEMBLY** - NEMA 11/14/17



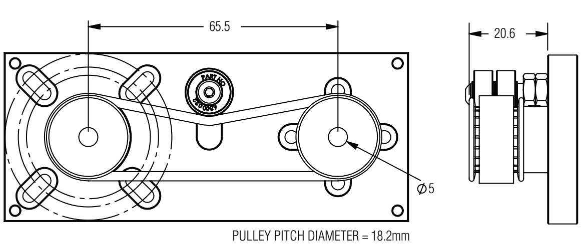

**INCLUDES:**

| | |
|---|---|
| (1) Motor Mount Cover<br>(4) BHCS M3 x 0.5 x 6mm | P/N: **MLB028A-BMMC-KIT** |



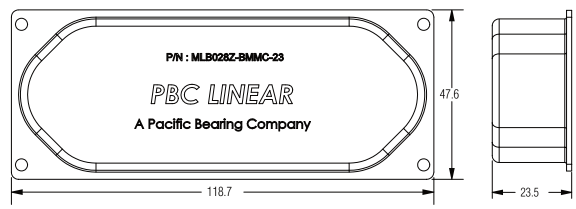

**INCLUDES:**

| | |
|---|---|
| (1) Motor Mount Bracket<br>(3) SHCS M3 x 0.5 x 8mm | P/N: **MLB028A-MTRMNT-UNI-ASY-KIT** |



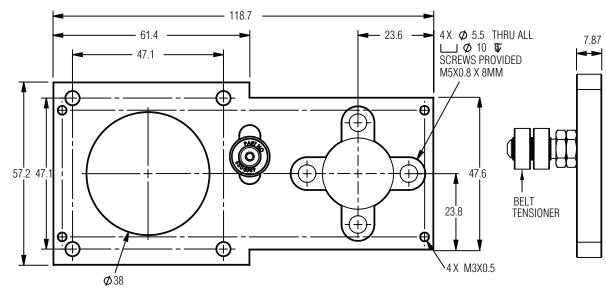

| | |
|---|---|
| (1) Pulley Belt (3mm pitch) | P/N: **6140032** |
| (2) Timing Pulley, 9mm x 5mm | P/N: **6140035** |

## **MOTOR MOUNT ASSEMBLY -** NEMA 23



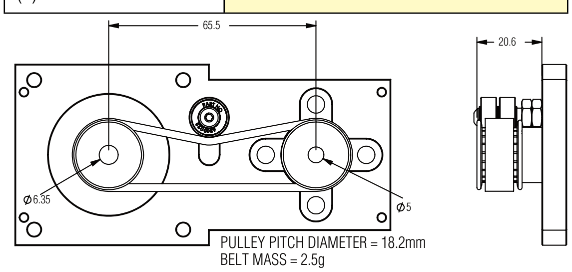

**INCLUDES:**

| | |
|---|---|
| (1) Motor Mount Cover<br>(4) BHCS M3 x 0.5 x 8mm | P/N: **MLB028A-BMMC-23-KIT** |




**INCLUDES:**

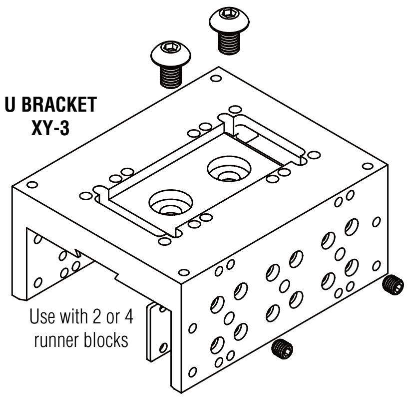
| | |
|---|---|
| (1) Motor Mount Bracket<br>(3) SHCS M5 x 0.8 x 8mm | P/N: **MLB028A-MTRMNT-UNI-ASY-23-KIT** |

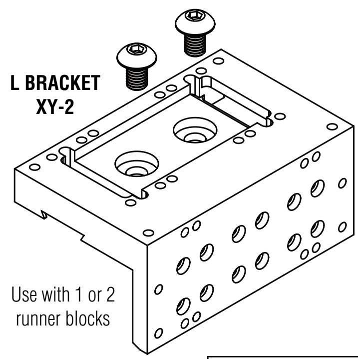


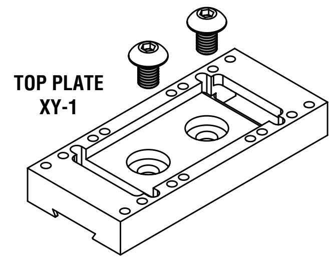

| | |
|---|---|
| (1) Pulley Belt (3mm pitch) | P/N: **6140032** |
| (1) Timing Pulley, 9mm x 6.35mm | P/N: **6140039** |
| (1) Timing Pulley, 9mm x 5mm | P/N: **6140035** |

# **Upgrade** System Parts

## CARRIAGE BRACKET KIT (For use with linear guide supports or seal strip)



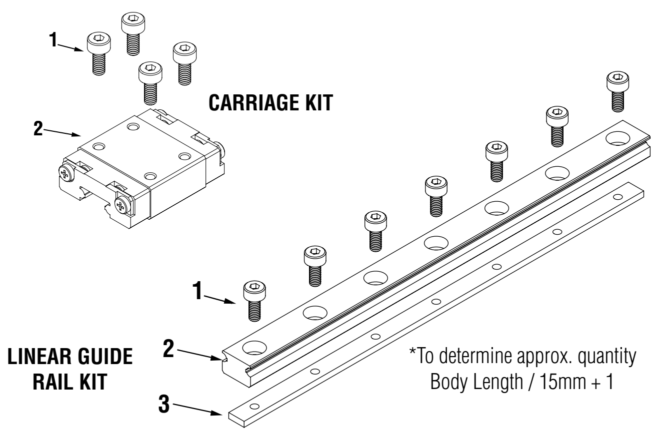




**INCLUDES:** Bracket & (2) BHCS M5 x 0.8 x 8mm LG
*Linear guide supports sold separately.*

| | |
|---|---|
| U Bracket (XY-3) | P/N: **MLB028A-XY-3BRKT-KIT** |
| L Bracket (XY-2) | P/N: **MLB028A-XY-2BRKT-KIT** |
| Top Bracket (XY-1) | P/N: **MLB028A-XY-1BRKT-KIT** |

## LINEAR GUIDE KITS




**CARRIAGE KIT INCLUDES:** *(rail sold separately.)*
1. (4) SHCS M2 x 0.4 x 5mm
2. (1) Runner Block

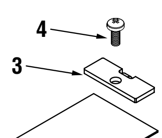
**LINEAR GUIDE RAIL KIT INCLUDES:** *(Carriage sold separately.)*
1. (##)* SHCS M2 x 0.4 x 5mm
2. (1) Rail
3. (1) Mounting Bar

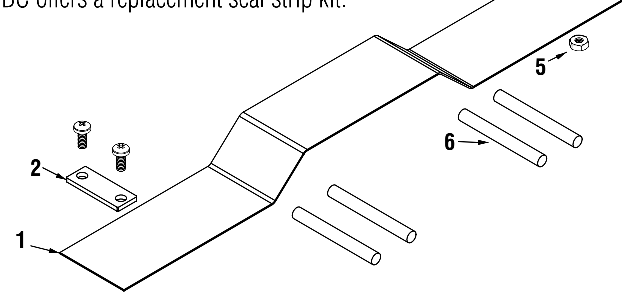
| | |
|---|---|
| Linear Carriage Kit | P/N: **MLA028A-NBC-KIT** |
| Linear Guide Rail Kit | P/N: **MLA028A-NBR-XXXX-KIT** |

**XXXX** = Body Length of Actuator - 1mm

## SEAL STRIP KIT

Seal strips are engineered to last the life of the system. In the event that the strip becomes damaged by environmental contamination, PBC offers a replacement seal strip kit.




**KIT INCLUDES:** *(Carriage bracket sold separately.)*
1. (1) Seal Strip - Ultra-wear resistant MDS nylon
2. (1) Retainer Bracket
3. (1) Adjuster Bracket
4. (3) PHC M2 x 0.4 x 5mm
5. (1) Hexagon Nut, M2 x 0.4
6. (4) Bearings

| | |
|---|---|
| Seal Strip Kit | P/N: **MLA028A-SSAR-KIT** |

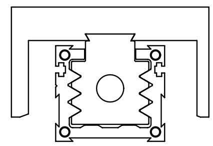
*Seal strip is 725mm in length and can be cut shorter using sharp pair of scissors.*

# **Cable Carrier** Brackets

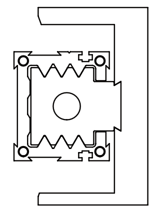
Cable carrier brackets vary depending on actuator orientations. Contact Application Engineering for assistance with selection of brackets.

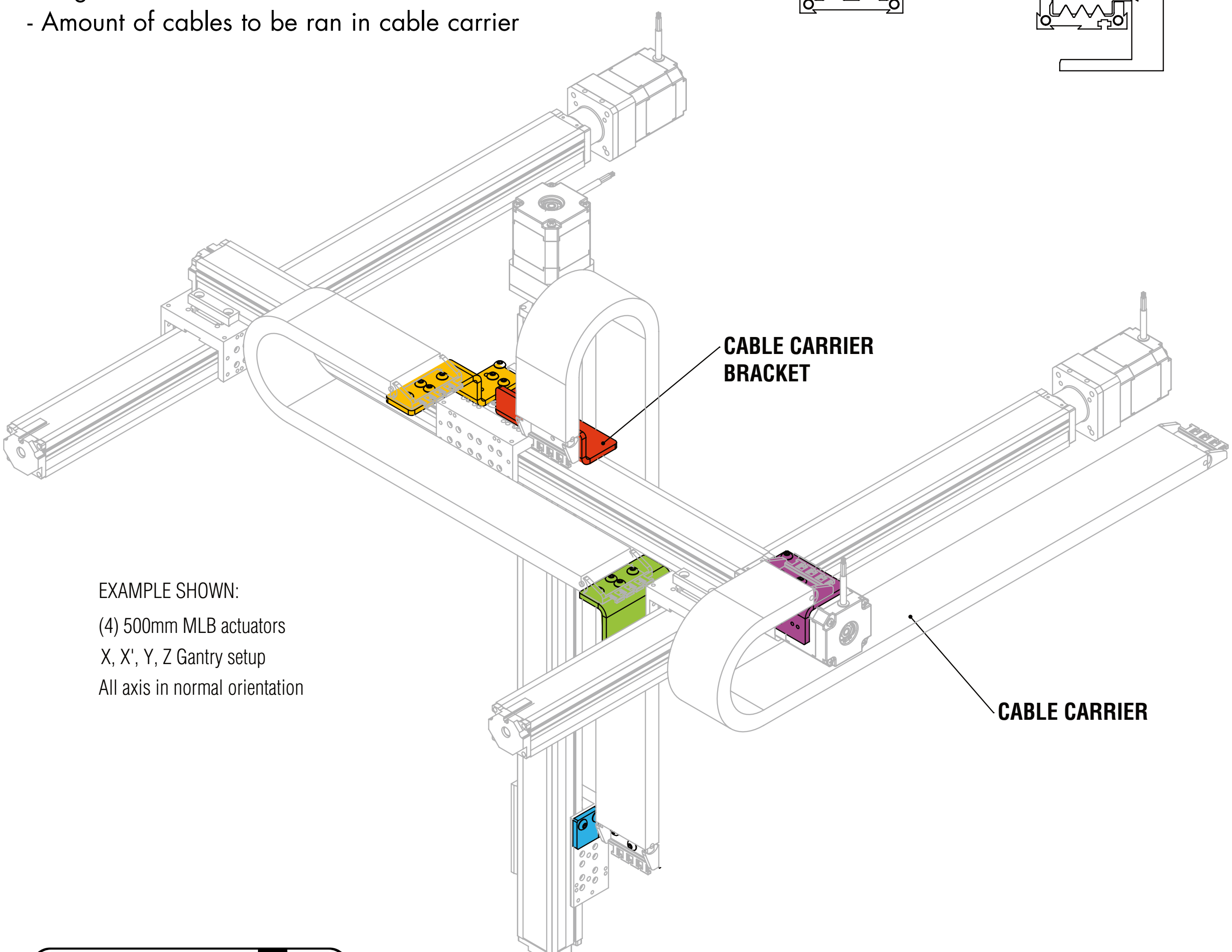
**Please provide as much of the following as possible:**
- Actuator part number
- Gantry Layout (X, Y, Z)
- Axis orientation (normal or lateral) for each axis
- Largest diameter cable to be used in cable carrier
- Amount of cables to be ran in cable carrier

NORMAL ORIENTATION



LATERAL ORIENTATION





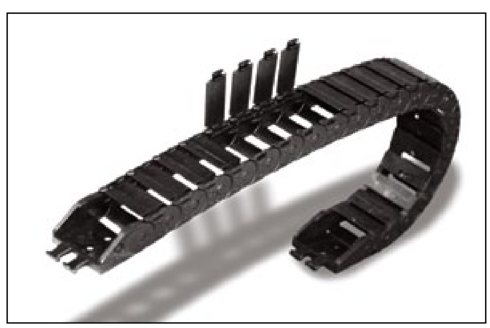

KABELSCHLEPP

## Cable Carriers

Recommended cable carrier sizes for ML actuators:

- 0130.10/0132.10
- 0130.15/0132.15
- 0130.20/0132.20
- 0130.30/0132.30

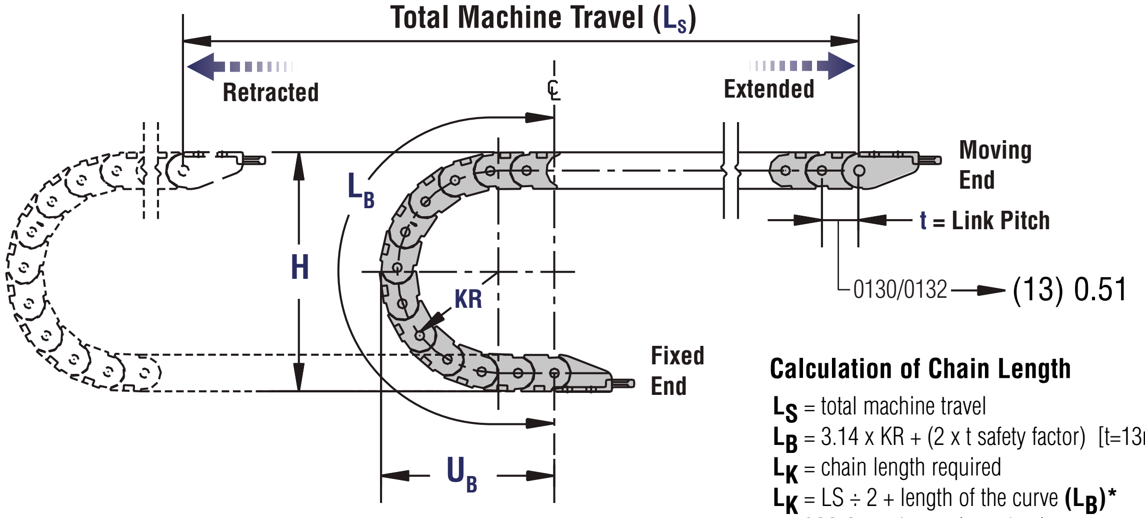
*See page 33 for cable carrier ordering information.*



# KABELSCHLEPP Cable Carriers

- Smallest cable carriers for smooth and quiet operation in tight spaces
- End brackets with integral strain relief
- Light-weight and rugged fiber-reinforced nylon material
- Simple snap-together links make assembly and modifications to chain length effortless
- Links available with hinged-opening cavity lids for quick and simple installation of cables and hoses

SERIES 0130 - SNAP OPENING LINK




### Calculation of Chain Length

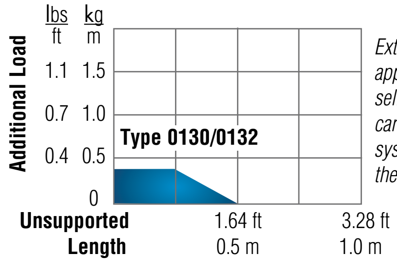
$L_S$ = total machine travel
$L_B$ = 3.14 x KR + (2 x t safety factor) [t=13mm]
$L_K$ = chain length required
$L_K$ = LS ÷ 2 + length of the curve **($L_B$)***
**# of Links** = $L_K$ ÷ t (round up)

** Assumes the Fixed Point is located at the Center of the Total Machine Travel.*

| Series 0130/0132 | Mounting Height | Bend Radius | Depot | Loop Length |
|---|---|---|---|---|
| | H | KR | $U_B$ | $L_B$ |
| Option A* | 52.5 (2.07) | 20 (0.79) | 40 (1.57) | 89 (3.50) |
| Option B | 68.5 (2.70) | 28 (1.10) | 48 (1.89) | 114 (4.49) |
| **Option C (Std)** | **86.5 (3.41)** | **37 (1.46)** | **57 (2.24)** | **142 (5.59)** |

**0130.40 is only available in bend radius KR20. Dimensions in mm (in).*

### Self-Supporting Lengths



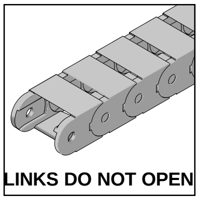

*Extended Travel: When application travel exceeds the self-supporting length of the carrier, MICROTRAK™ carrier systems are designed to glide on themselves in a guide channel.*

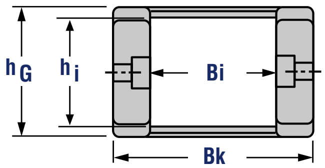
## ORDERING GUIDE

EX: 4-KS0132-06KR20-1000+FI/MA

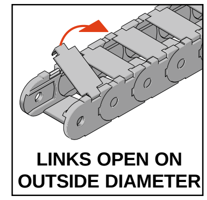
| 4 | - | KS | XXXX | - | XX | KR | XX | - | XXXX | + | FI/MA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| # of Systems Required | | Kabel Schlepp® | Carrier ype | | Inner Width **($B_i$)** | | Bend Radius **(KR)** | | # of Links Length | | Type of Position Brackets |

# KabelSchlepp Links



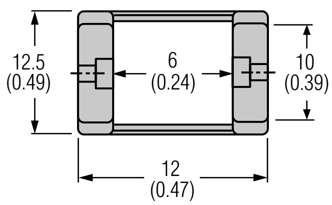




$B_k$ = Outer Width
$B_i$ = Inner Width
$h_G$ = Outer Height
$h_i$ = Inner Height

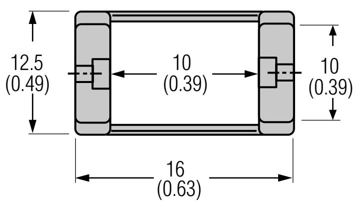



## NON-OPENING LINKS

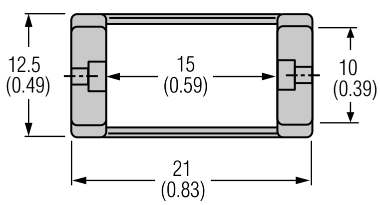
### 0132.06
Chain Weight:
0.09 lbs/ft
(0.13 kg/m)



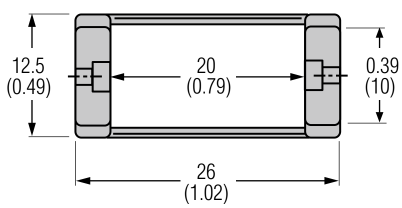

### 0132.10
Chain Weight:
0.09 lbs/ft
(0.14 kg/m)



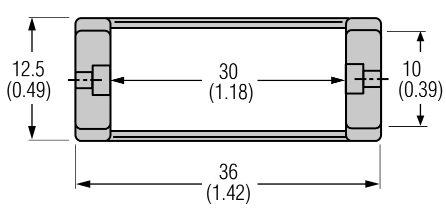

### 0132.15
Chain Weight:
0.10 lbs/ft
(0.15 kg/m)



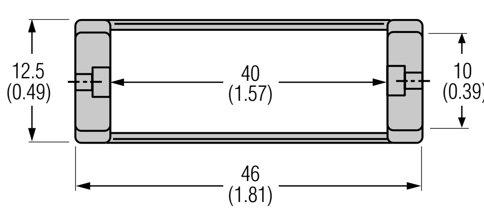

### 0132.20
Chain Weight:
0.11 lbs/ft
(0.16 kg/m)




### 0132.30
Chain Weight:
0.12 lbs/ft
(0.18 kg/m)

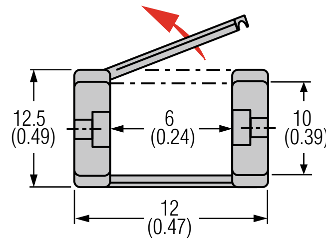



### 0132.40
Chain Weight:
0.13 lbs/ft
(0.20 kg/m)



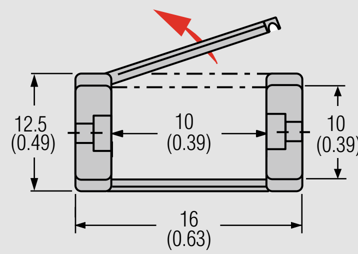

## SNAP OPENING LINKS

### 0130.06
Chain Weight:
0.09 lbs/ft
(0.13 kg/m)

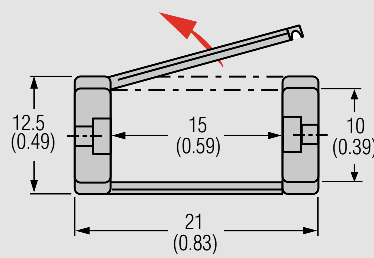



RECOMMENDED FOR ML SERIES

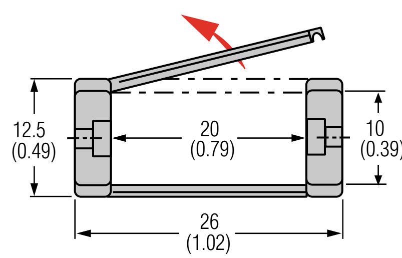
### 0130.10
Chain Weight:
0.09 lbs/ft
(0.14 kg/m)




### 0130.15
Chain Weight:
0.10 lbs/ft
(0.15 kg/m)

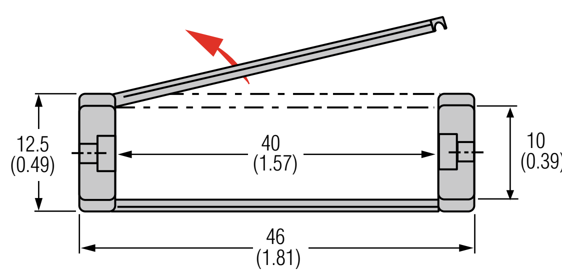



### 0130.20
Chain Weight:
0.11 lbs/ft
(0.16 kg/m)

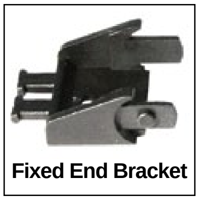



### 0130.40
Chain Weight:
0.13 lbs/ft
(0.20 kg/m)

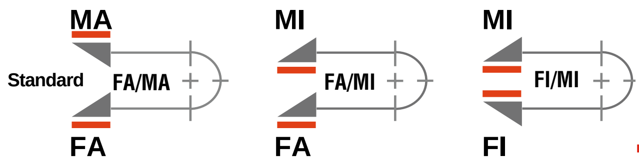
*Note: 0130.40 is only available in bend radius KR20*



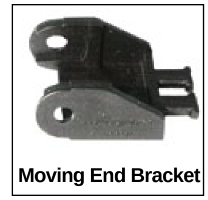
# KabelSchlepp End Bracket




MALE



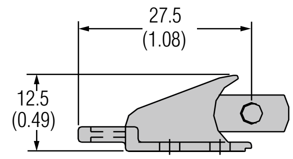

M = Moving End
F = Fixed End
A = O.D. Mount
I = I.D. Mount
▬ = Mounting Surface



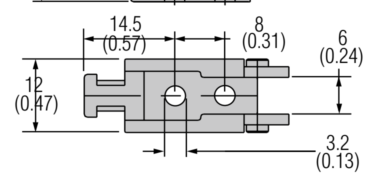

FEMALE

## FIXED END BRACKET - WITH PIN

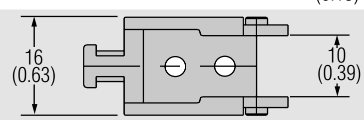
**0130/0132**
**FIXED END**



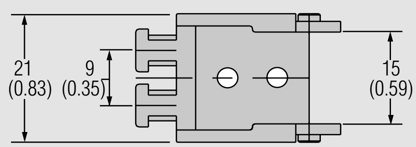

**0130/32.06**
PN: KS52301



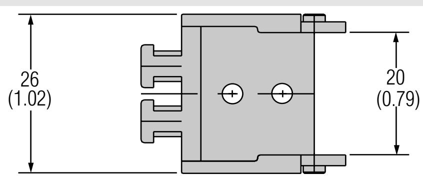

**0130/32.10**
PN: KS52303



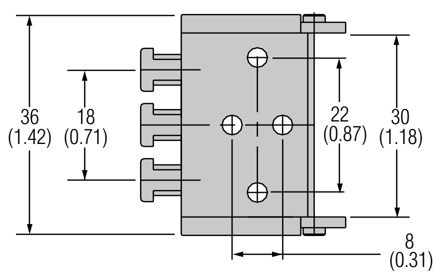

**0130/32.15**
PN: KS52305



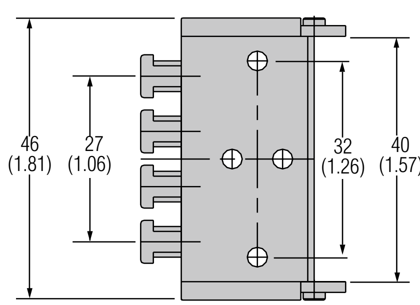

**0130/32.20**
PN: KS52307




**0132.30**
PN: KS53376

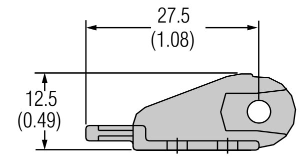



**0130/32.40**
PN: KS53378

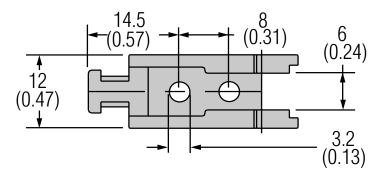



## MOVING END BRACKET - WITH HOLE

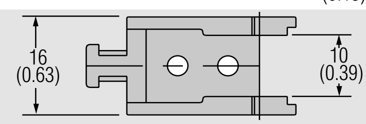
**0130/0132**
**MOVING END**



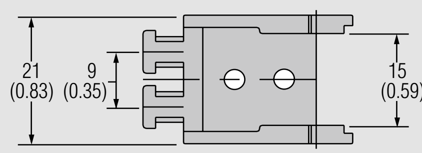

**0130/32.06**
PN: KS52300




**0130/32.10**
PN: KS52302

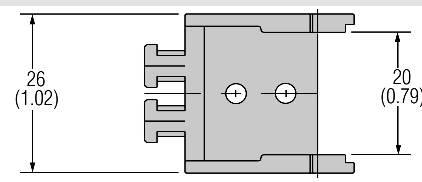



**0130/32.15**
PN: KS52304

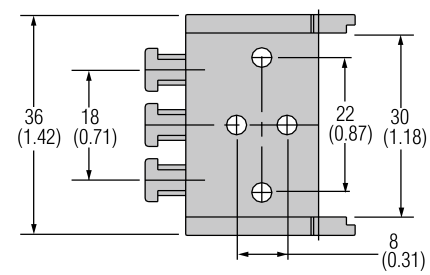



RECOMMENDED FOR ML

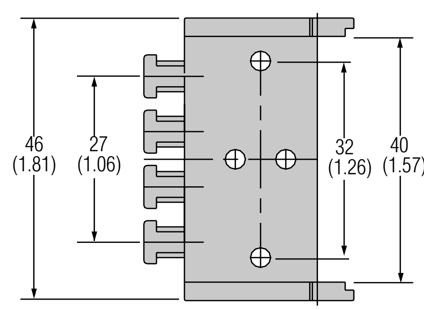
**0130/32.20**
PN: KS52306




**0132.30**
PN: KS53377




**0130/32.40**
PN: KS53379



# **Technical** Selection Guide

Before the selection process can begin, a few preliminary steps must be completed:

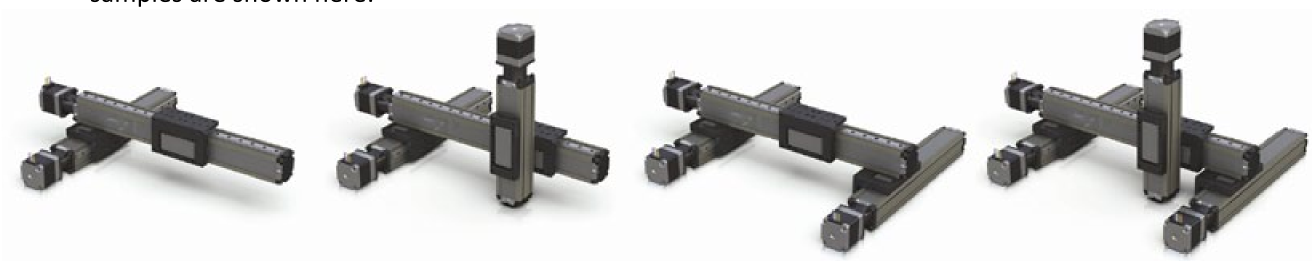
1. **Define the payload and end effector (including wires, cables, hoses, etc)**

2. **Determine required Stroke for each axis**

    Stroke – X = ____________ mm or in (if mm is chosen, convert to meters = ____________m)
    Stroke – Y = ____________ mm or in (if mm is chosen, convert to meters = ____________m)
    Stroke – Z = ____________mm or in (if mm is chosen, convert to meters = ____________m)

3. **Determine the basic system shape**

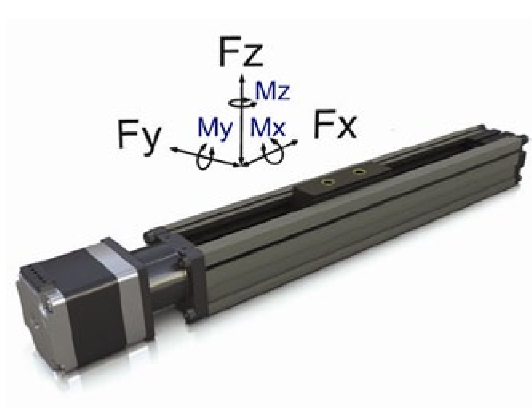
    With the MLA, any configuration is possible. Choose a basic style which will meet your needs. Some samples are shown here:



Now that the basic system information has been established, the configuration process begins. The following steps should be repeated for each axis. Start with the Z-Axis (aka the top axis or the axis which is farthest away from the fixed axis). Once the Z-Axis is finalized, move on to the Y-Axis (middle axis) and then the X-Axis.

1. **Complete a Force Diagram for Your System's <u>Static</u> Loads**

    A force diagram should be completed for each axis. Assume the system is statically loaded. The system will encounter additional forces as a result of acceleration/deceleration and these will be accounted for in a later step. If the actuator must support a cantilevered load, do not forget to include moment as a result of acceleration/deceleration.




Fx = _____________ N or lbf

Fy = _____________ N or lbf

Fz = _____________ N or lbf

Mx = _____________ Nm or lbf-in

My = _____________ Nm or lbf-in

Mz = _____________ Nm or lbf-in

For each moment (Mx, My, Mz), write down the moment arm distance (meters or inches) in the spaces below. Be sure to measure from the <u>center of the screw</u>.

Dx = ________ m *or* in    Dy = ________ m *or* in    Dz = _________ m *or* in

**2. Determine if External Linear Guides are Necessary**

Compare your results with the Load chart shown on page 24 to determine if external linear guide supports are necessary. It's important to remember that it is not possible to maximize the loads and moments in all directions and that the applied forces and moments should conform to the formula shown below.

Equation 1. :
$$\frac{F_{y,applied}}{F_{y,max}} + \frac{F_{z,applied}}{F_{z,max}} + \frac{M_{x,applied}}{M_{x,max}} + \frac{M_{y,applied}}{M_{y,max}} + \frac{M_{z,applied}}{M_{z,max}} \leq 1$$

***TIP: IF the axis being designed is in the middle or at the bottom of a multi-axis assembly, choose at least 1 external linear guide, even if the force diagram says that it is not necessary. Without the linear guides, the system may not have the necessary rigidity for your application.***

**3. Determine the Velocity/Acceleration Needed.**

Equation 2.
$$n = number\ of\ equal\ time\ segments$$

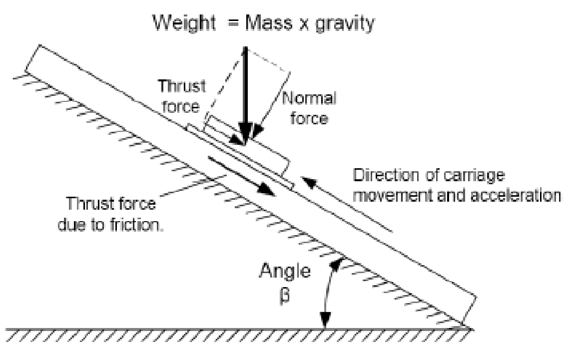
Equation 3.
$$V_{MAX} = \frac{n}{n-1} * \frac{\Delta x}{\Delta t} = \frac{n}{n-1} * \frac{(distance)}{(move\ time)}$$

Equation 4.
$$A_{ACCEL} = A_{DECEL} = \frac{\Delta v}{\Delta t} = \frac{(V_{MAX})}{\frac{(move\ time)}{n}} = n * \frac{(V_{MAX})}{(move\ time)}$$

**$V_{MAX}$ = ___________ m/s or in/s** **$A_{ACCEL}$ = __________ m/s$^2$ or in/s$^2$**

Start with n=2, which is the triangular motion profile. The triangular motion profile is generally the most efficient and has the highest velocity, but the lowest acceleration. If you want a trapezoidal with three equal time segments, use n=3. With this profile, the system will spend 1/3 of the time accelerating, 1/3 of the time at a constant velocity and 1/3 of the time decelerating. The trapezoidal profile will lower the maximum velocity by 25% and increase the acceleration by only 12.5%. For now, ignore any trajectory smoothing algorithms (i.e. S-curves, jerk reduction, etc) and consider only the "theoretical" values calculated here. If you need to account for the extra time necessary for the S-curves, reduce the move time by 10% and re-calculate.

Once the maximum velocity has been calculated, double check that $V_{MAX}$ falls within the allowable travel speed shown in the chart on page 13 (*Maximum Travel Speeds*, lower left-hand corner)



## 4. Calculate the Applied Thrust Load (see diagram on previous page)

Equation 5. $F_{Thrust,total} = \sum F_{external} + \sum F_{weight\ and\ friction} + \sum F_{Accel}$

Equation 6. $F_{Thrust,total} = \sum F_{external} + \sum F_{mass\ (gravity)} + \sum F_{Thrust\ (friction)} + \sum F_{Accel}$

Equation 7. $\sum F_{external} = Sum\ of\ all\ other\ external\ forces\ (except\ load)$

Equation 8. $\sum F_{mass\ (gravity)} = \sum mass \times gravity \times \sin\beta$

Equation 9. $\sum F_{Thrust\ (friction)} = \sum mass \times gravity \times \cos\beta \times \mu$

*Per the chart on page 10, μ = 0.19 for 0 or 1 external linear guide; μ = 0.01 for 2 external linear guides*

Equation 10. $\sum F_{Accel} = \sum mass \times acceleration$

Equation 11. $Weight = W = mass \times gravity = m \times g$ (mass = kg or lbm)

Equation 12. $Gravity = g \cong 9.81 \frac{m}{s^2} \cong 32.174 \frac{ft}{s^2}$

Equation 13. $\beta = angle\ of\ incline\ from\ horizontal\ (degrees)$

After the thrust load has been calculated, compare this to the *Maximum Column Loading* chart on page13. Be sure that the calculated value is within the acceptable range.

* Don't forget to include the weight of the carriage in the total mass of the system!
* Unit for mass is "lbm" or "kg", not to be confused with "lbf" or "kgf"!
*** BE SURE TO DOUBLE CHECK THE UNITS OF MEASURE!**

## 5. Compare to PV Rating Chart & Critical Speed (whip) Chart (Page 12-13)

The next step is to calculate the actual rotations per minute (RPM) of the screw and to verify that the PV Value and thrust capacity of the nut have not been exceeded. To do this, use one of the formulas in Equation 15, below, to calculate the RPM of the screw. Once the RPM has been calculated, plot the location on the *PV Rating* chart (page 12). Once the point has been plotted, ensure that the selected lead's colored line is above and to the right of the plotted point. If it is not, the Thrust Load or the Maximum Velocity must be reduced or the lead must be increased so that the RPM can be reduced.

Equation 14. $RPM = \frac{rotations}{minute} = \left[V_{max}\left(\frac{m}{s}\right)\right] \times \left[\frac{60}{1}\left(\frac{s}{min}\right)\right] \times \left[\frac{1000}{1}\left(\frac{mm}{m}\right)\right] \times \left[\frac{1}{(LEAD)}\left(\frac{rot}{mm}\right)\right]$

Equation 15. $RPM = \frac{rotations}{minute} = (metric)\frac{\left[V_{max}\left(\frac{m}{s}\right)\right] \times 60{,}000}{screw\ lead\left(\frac{mm}{rot}\right)} = (imperial)\frac{\left[V_{max}\left(\frac{in}{s}\right)\right] \times 60}{screw\ lead\ \left(\frac{in}{rot}\right)}$

Optional leads: Units = mm (in): **38.1**(1.50), **25.4** (1.00), **10.16**(0.40), **3.18**(0.125), **1**(0.039)
** Additional leads are available, contact factory for more information*

## 6. Double Check All Values

Double check all charts and graphs on page 12-13 to ensure the selected system will perform as needed.

**7. Determine the Required Motor**

In order to determine the required motor, the maximum torque must be calculated.

Equation 16. $$Torque_{total} = \sum torque_{load} + \sum torque_{actuator\ components}$$

Equation 17. $$\sum torque_{load}\ (Nm) = \frac{\sum F_{Thrust\ (friction)}\ (N) \times lead\ (m)}{2 \times \pi \times Efficiency\ (\%)}$$

Equation 18. $$\sum torque_{actuator\ components} = No\ Load\ Torque\ (Nm) + Torque_{rot.inertia}$$

Equation 19. $$No\ Load\ Torque\ (Nm) = Nut\ Torque + Seal\ Strip\ Torque + Linear\ Guide\ Torque$$

**Nut torque:**
standard nut = .007 Nm (0.06 in-lbf)
light preload nut = .057 Nm (.50 in-lbf)
normal preload nut = .106 Nm (0.94 in-lbf)

**Seal strip torque:**
without seal strip = 0 Nm (0 in-lbf)
with seal strip = .028 Nm (0.25 in-lbf)

**Linear guide torque:**
Single linear guide = .017 Nm (0.15 in-lbf)
Dual Linear guides = .034 Nm (0.30 in-lbf)

Equation 20. $$Torque_{rot.inertia}(Nm) = screw\ rot.intertia\ x\ angular\ acceleration$$

Equation 21. $$screw\ rot.intertia = 4.169\ x\ 10^{-9}\ \frac{(kg\ x\ m^2)}{mm}\ x\ (body\ length\ (mm) + 32mm)$$

Equation 22. $$angular\ acceleration = \frac{A_{accel}\left(\frac{m}{s^2}\right)}{(screw\ lead\ (mm))\ x\ \left(\frac{1\ m}{1000\ mm}\right)}$$

Once you have calculated the required torque, a comparison must be made to the speed-torque curves for each specific motor. Don't forget to include a safety margin of at least 30%, i.e. the required toque must be at least 30% below the plotted torque curve.

A gear box may be required if the total inertia of the system is too far mismatched from the inertia of the motor. Each motor manufacturer will publish the maximum mismatch allowed for their motor. A general guideline is that stepper motors will allow up to a 10:1 mismatch. Servo's are capable of handling a much higher mismatch; however, the higher the mismatch, the more time will be spent tuning the servo during installation. Manufacturers will typically recommend staying under 6:1 mismatch and definitely under 10:1 mismatch[1]. Please contact a PBC Application Engineer for assistance with selecting a gearbox.

*For Torque charts, refer to the "Stepper Motor" section of the main LAT Catalog or www.pbclinear.com*
*For servo motor driven applications, please contact our Applications Engineers at 1-800-962-8979.*

1. LEGAL DISCLAIMER: The ratios presented on this page should be used as a GUIDELINE ONLY. Users should refer to the specifications published by each motor manufacturer as the numbers listed herein are likely to change and will vary from manufacturer to manufacturer.

8. **Choose Dovetail Clamps (Mounting Type)**

   The mounting feet kits are listed on page 33. IF this axis will be mounted to another MLA axis underneath it, one (1) MLA028A-HDC-M3-KIT is necessary. If this is a single axis, or a bottom axis of a multiple axis gantry, then there are 3 choices. The basic kit is the MLA028A-HDC-M3-KIT and a minimum of (2) two kits are necessary. Use the *Distance Between Supports* chart on page 13 to determine the minimum number of supports based upon the body length and load of the specified system. (Extra supports can always be added to increase the rigidity of the system)

   If a NEMA17 or NEMA23 motor are specified, the design may call for a Riser Plate to be used. The Riser Plate will raise the actuator off the mounting surface, which allows for the larger motor size to not interfere with the mounting surface. The 8 mm Riser Plate should be used with NEMA17 (or equivalent metric frame sizes) motors and the 15 mm Riser Plate should be used with NEMA23 (or equivalent metric frame sizes) motors. Multiple Riser Plate kits may be necessary.

9. **Choose Sensors/Limit Switches**

   Now that the axis has been specified, choose the switches/sensors which will be mounted along the axis. PBC recommends that a minimum of two (2) sensors are used (one at each end of the axis) in order to prevent overtravel. Additional sensors may be necessary, depending upon the application. The most common reason for the additional sensors is to set a "home" and/or "target" positions.

10. **Choose Cable Carrier**

   The last step in completing the system is to specify the cable carrier. This can only be done once all of the cables which will run through it have been defined. For most applications, this means a minimum of a power cable for the motor, 2 sensor cables and whatever cables/hoses are required for the payload. Servo and closed loop stepper motors will have a sensor cable and motors with a brake will also have a cable for the brake. Once a list of all of the cables has been compiled, visit the Cable Carrier section of the main LAT Catalog (or visit www.pbclinear.com) to complete the step by step selection guide for the cable carriers.

11. **Place order**

**PBC Linear™, A Pacific Bearing Co.**
6402 E. Rockton Road
Roscoe, IL 61073 USA

Toll-Free: 1.800.962.8979
Fax: 1.815.389.5790

sales@pbclinear.com
www.pbclinear.com

**European Branch**
**PBC Lineartechnik GmbH,**
**A Pacific Bearing Co.**

Niermannsweg 11-15
D-40699
Erkrath, Germany

Office: +49.211.416073.10
Fax: +49.211.416073.11

sales_gmbh@pbclinear.de
www.pbclinear.de

# **Application** Data Sheet

**FAX COMPLETE FORMS TO:**
**1(815) 389-5790**

RFQ:______________________________________

Date:______________________________________

Company:___________________________________

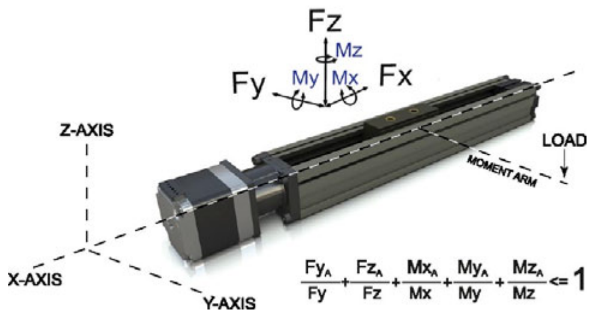
Contact:____________________________________

Address:____________________________________

___________________________________________

Phone:_____________________________________

E-mail:_____________________________________




**APPLICATION DESCRIPTION –** *Sketch if available.*

Project Name:_______________________________ Project Status: ❑ Concept ❑ Design ❑ Prototype ❑ Existing

Project Description: ________________________________________________________________

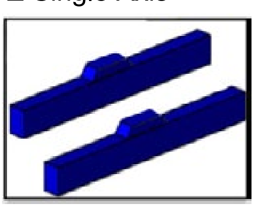
Project Timing:_____________________________ Target Pricing:______________________________

Quantity:__________________________________ Components: ❑ Actuator Only ❑ Actuator/Motor ❑ Accessories__________________

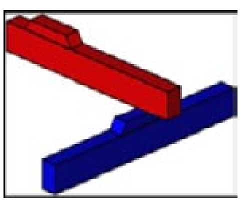
Environment: ❑ Clean Room ❑ General Shop ❑ Heavy Industrial ❑ Food/Washdown ❑ High Vibration ❑ Other________________________________________________

**SYSTEM TYPE**

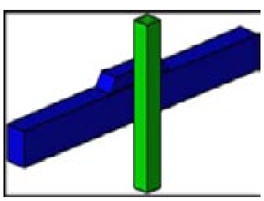
❑ Single Axis



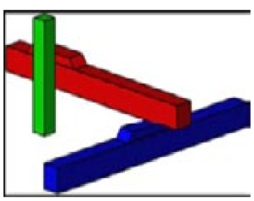
❑ X-Y Axis



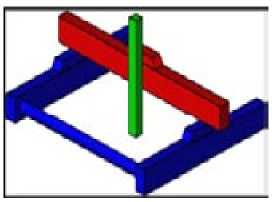
❑ Y-Z Axis



❑ X-Y-Z Axis



❑ X1/X2-Y-Z Axis



Axi $\frac{Fy_A}{Fy}+\frac{Fz_A}{Fz}+\frac{Mx_A}{Mx}+\frac{My_A}{My}+\frac{Mz_A}{Mz}<=1$ s Orientation: ❑ Vertical ❑ Horizontal ❑ Inverted ❑ Angled

| | AXIS | | |
|---|---|---|---|
| | X | Y | Z |
| Load N (lbf) | | | |
| Moment Nm (lbf-in) | | | |
| Stroke mm (in) | | | |
| Velocity mm/s (in/s) | | | |
| Acceleration $m/s^2$ ($ft/s^2$) | | | |
| Deceleration $m/s^2$ ($ft/s^2$) | | | |

Comments:

________________________________

________________________________

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________________________________

________________________________

LAT

**Worldwide Headquarters**
**PBC Linear, A Pacific Bearing Co.**

6402 E. Rockton Road
Roscoe, IL 61073 USA

Toll-Free: 1.800.962.8979
Fax: 1.815.389.5790

sales@pbclinear.com
www.pbclinear.com

**European Branch**
**PBC Lineartechnik GmbH,**
**A Pacific Bearing Co.**

Röntgenstr. 8
40699 Erkrath, Germany

Telefon: 0049 2104 957440 0
Fax: 0049 2104 957440 91

info@pbclinear.de
www.pbclinear.de

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