ELECTRIC ACTUATORS

No Need for Pneumatic System Components

DIGITAL POSITIONER
- Easy zero/span adjustment
- Programmable opening/closing speed

STEPPING MOTOR
Precise control with 1/1000 resolution

DC POWER DRIVE
Failsafe function by backup battery operation is optional.

Lloyd's Register approved

Transparent image of model PRP

<table>
<thead>
<tr>
<th>TYPE</th>
<th>LINEAR MOTION</th>
<th>ROTARY MOTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERIES</td>
<td>MSP Series *¹</td>
<td>PSN</td>
</tr>
<tr>
<td>MODEL</td>
<td>MSP4 150 to 700 N</td>
<td>MSP5 150 to 700 N</td>
</tr>
<tr>
<td></td>
<td>CE</td>
<td>CE</td>
</tr>
<tr>
<td>THRUST</td>
<td>CONSULT M-SYSTEM</td>
<td>CONSULT M-SYSTEM</td>
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<tr>
<td>TORQUE</td>
<td>5 N-m 10 N-m 10 to 33 N-m</td>
<td>100 to 200 N-m</td>
</tr>
<tr>
<td>OPEN NETWORK</td>
<td>CC-Link DeviceNet</td>
<td>CC-Link DeviceNet</td>
</tr>
</tbody>
</table>

*¹ CE marking is available with selected models. Please consult M-System for detailed information.
Pneumatic actuator requires a complex system and high electricity cost.

Before

In addition to the high equipment costs, the electricity bill is a headache. Compressor air leaks waste energy and cause system pressures.

Here is the mechanism that achieves high precision and high resolution control.

Micro-processor based Electronic Motor Driver Circuit
Precisely tracking target position by feedback control in combination with predictive control.

High Precision Position Sensor

High torque
1/1000 high resolution

Stepping Motor
Motor rotation control resolution of 1.8 degrees per pulse

3-step Reduction Gear Mechanism
High precision gear system with minimum backlash

Worm Gear Mechanism
High reduction ratio despite the compact size
Electric actuators consume less energy, without needing auxiliary equipment

Open network type is available for selected models.
Open networks including DeviceNet and CC-Link, are available.
Consult with M-System for other network protocols.

Emergency failsafe operation at power loss can be chosen with selected models using a backup battery (full-open, full-close, hold or specific position).

Features of Stepping Motor
See Page 8

Comparing to an induction motor

A stepping motor has the following advantages compared to an induction motor. It is most suitable as an actuating drive for small mechanisms including control valves.

- High torque for small size (approx. 10 times greater than an induction motor of the same mass)
- High torque at startup; with little torque variation during acceleration
- Variable rotating speed
- Rotating speed unaffected by load changes
- High precision positioning by acceleration/deceleration control
- Unaffected by voltage or frequency variations by the power source

Predictive control enabling the motor to stop without overshooting

Basic rotating step per pulse of the two-phase stepping motor employed by the electric actuators is 1.8 degrees, thus requiring 200 pulses to complete a full 360-degree rotation.
The exact number of pulses is controlled by a micro-processor.
The “Predictive Control” employed as a part of its control algorithm enables the actuator to smoothly stop at an exact position (angle) without overshooting.
**STEEL**  
Water Flow Control in Continuous Casting Line

**CEMENT**  
Fuel Flow Control in Rotary Kiln

**PAPER**  
Basis Weight Control

**CHEMICAL**  
Batch Control

**PAPER**  
Paper Profile Control

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**STEEL**
- Ladle
- Tundish
- Mold
- Spray Water Flow Control
- PSN
- Water

**CEMENT**
- Material
- Rotary kiln
- Combustion Control
- MRP
- Fuel oil

**PAPER**
- Paper machine
  - Stock Box
  - Thick pulp
  - Stock valve
- Pulp dilution
- Headbox
- Pulp dilution
- outlet (jet)

**CHEMICAL**
- Batch controller 1
  - PV
  - FICQ
  - MV
- Batch controller 2
  - PV
  - FICQ
  - MV
- MRP
  - Material 1
  - Flowmeter
  - Control valve
- MRP
  - Prebatch/Batch
  - two-stage closure
- Reactor
- Outlet

**PAPER**
- CP Control:
  - Basis weight control applied in CP (Cross Paper) direction.
  - Called also CD (Cross Direction) profile control.
- MSP4C
- PLC
- CPU
- Module
- Single daisy chained cable only

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**Note:** Specifications are subject to change without notice. The PRP-2 is under development as of October 2016.
Proven Reliability. For over 30 years
Electric actuators are used in various demanding process fields.

**MSP Series**
Open network capable electric actuators using stepping motors. Compact size, long life and high resolution 1/1000.

**MRP Series**
Open network capable electric actuators using stepping motors. Compact size, long life and high resolution 1/1000.
and more than 56,000 units installed. Various demanding process fields.

### PSN Series
Stepping motor realizing high resolution of 1/1000. Opening/closing speed programmable. Brushless angle sensor.

<table>
<thead>
<tr>
<th>PSN1</th>
<th>1800 N</th>
<th>2500 N</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSN3</td>
<td>1500 N</td>
<td>3000 N</td>
</tr>
<tr>
<td>PSN3</td>
<td>1500 N</td>
<td>3000 N</td>
</tr>
<tr>
<td>MRP</td>
<td>1800 N</td>
<td>2500 N</td>
</tr>
<tr>
<td>MRP</td>
<td>3000 N</td>
<td></td>
</tr>
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<td>MRP</td>
<td>5000 N</td>
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<table>
<thead>
<tr>
<th>100 N·m</th>
<th>200 N·m</th>
<th>600 N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRP-0, PRP-1</td>
<td>PRP-2</td>
<td>NEW</td>
</tr>
</tbody>
</table>

### PRP Series
Stepping motor realizing high resolution of 1/1000. Opening/closing speed programmable (8.5 to 125 sec/90°).

- PRP-0, PRP-1
- PRP-2
- NEW

Specifications are subject to change without notice.

The PRP-2 is under development as of October 2016.
MECHANISM OF STEPPING MOTOR

The below illustrations show cross section images of a stepping motor, called also “stepper motor” or “step motor.”

The stepping motor consists of two major components: a stator (stationary part) and a rotor (rotating part). The rotor is a permanent magnetic rotating shaft, surrounded by eight electromagnets or coils of two phases (A and B). Each electromagnet is energized in turn, attracting and repulsing the rotor to rotate its shaft. The motor shaft is connected to a damper that enhances the torque characteristics of the motor at high speed.

HOW STEPPING MOTOR WORKS 1/1000 Resolution

The N pole and S pole toothed gears are engaged with an offset of half tooth. The bottom of a N pole tooth is aligned with the top of a S pole tooth. Each pulse moves the shaft by a quarter (1/4) tooth pitch while the N pole teeth and the S pole teeth are attracted and repulsed in turn. Each of those rotations is called a “step.” The motor has 50 teeth around the wheel, turning 1.8 degrees per step, requiring 200 pulses to make a complete rotation with an integer number of steps. In this way the motor can be turned by a precise mechanical angle in high resolution. The motor shaft rotates more than 100 times while the actuator travels the entire stroke/span. The calculated resolution is greater than 1/20000*.

Simplified Stepping Motor Operation

The actuator rotor has 50 teeth. The above is a simplified example with 15 teeth.

* The nominal resolution described in the actuator data sheet is 1/1000, considering additional influencing factors such as the accuracy of the position detecting sensor, backlash of the reducing gear mechanism.