2MA Series
Linear Position Sensor Option

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Linear Position Sensor Option for 2MA Series Cylinder

Precise Position Feedback

Non-Contact Sensing

Analog or Digital Outputs

Bore Sizes 2" - 8"

Available in Eleven Mounting Styles
Linear transducers offer features which assure reliable operation in many areas of automation and process technology, even under extreme ambient conditions.

- pneumatic cylinders
- tooling and tool handling
- presses
- casting and rolling mills
- foundries
- injection molding
- leveling machines
- transport systems
- lift controls
- level monitoring
- tunnel boring equipment
- die casting
- portal robots
- woodworking machinery
- flight simulators
- cutting/slitting machinery
- conveying
- packaging machines
- windmills
- elevators
- X-Y tables
- anywhere linear motion must be monitored!

Linear transducers offer features which assure reliable operation in many areas of automation and process technology, even under extreme ambient conditions.
Principles of Operation

The measuring element ("waveguide"), consists of a special nickel-alloy tube. A copper conductor is introduced through the length of this tube. The start of measurement is initiated by a short current pulse. This current generates a circular magnetic field which rotates around the waveguide. A permanent magnet at the point of measurement is used as the marker element, whose lines of field run at right angles to the electromagnetic field. In the area on the waveguide where the two fields intersect, a magnetostrictive effect causes an elastic deformation of the waveguide, which propagates along the waveguide in both directions in the form of a mechanical wave. The propagation velocity of this wave in the waveguide is 2830 m/s, and is nearly insensitive to environmental effects (e.g., temperature, shock, contamination). The component of the wave which reaches the far end of the waveguide is damped there, whereas the component which arrives at the signal converter is changed into an electrical signal by reversing the magnetostrictive effect. The wave travel time from its point of origin to the signal converter is directly proportional to the distance between the permanent magnet and the signal converter. A time measurement then allows the distance to be determined with extremely high accuracy.

Design

The transducers are made to the same safety and reliability standards for use in the harshest conditions:
- The electronics unit is compactly designed using SMD technology. The boards are protected in a space-saving, rugged aluminum extruded housing.
- The waveguide is protected in the extruded aluminum housing.

Quality

Each and every transducer undergoes a specially designed, computer-controlled testing procedure which includes 100% checking of all specified data.
The drawings below show that the Linear Position Sensor is longer than the cylinder of the same stroke length. The sensor overhang on the head end of the cylinder, as indicated by dimension A, may be eliminated by adding stop tubing, which effectively increases the gross stroke of the cylinder. The recommended stop tube lengths are provided in the table below for each bore size. The examples show that the electrical stroke of the sensor will always match the net stroke of the cylinder.

As a result of the limited sensing range of the sensor, it will overhang at the cap end of the cylinder by the amount of dimension B.

### Dimensions

<table>
<thead>
<tr>
<th>Bore</th>
<th>Rod Code</th>
<th>Rod Diameter</th>
<th>A</th>
<th>B</th>
<th>Stop Tube Length</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>5/8</td>
<td>.95</td>
<td>1.3</td>
<td>1.0</td>
<td>0</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>.90</td>
<td>1.25</td>
<td>1.0</td>
<td>0</td>
<td>1.25</td>
</tr>
<tr>
<td>2 1/2</td>
<td>1</td>
<td>5/8</td>
<td>.64</td>
<td>1.0</td>
<td>.75</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>.63</td>
<td>.99</td>
<td>.75</td>
<td>0</td>
<td>.99</td>
</tr>
<tr>
<td>3 1/4</td>
<td>1</td>
<td>1 3/8</td>
<td>.55</td>
<td>.79</td>
<td>.625</td>
<td>0</td>
<td>.79</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1 3/8</td>
<td>.47</td>
<td>.46</td>
<td>.50</td>
<td>0</td>
<td>.45</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1 3/8</td>
<td>.28</td>
<td>.44</td>
<td>.375</td>
<td>0</td>
<td>.44</td>
</tr>
</tbody>
</table>

Example A: 12" Stroke cylinder without stop tube equals 12" Electrical Stroke for the Sensor.

Example B: To eliminate sensor overhang on the head end of a 2.0" bore cylinder, add 1.0" of recommended stop tube length. The cylinder gross stroke becomes 13" and the net stroke remains 12". Specify a sensor with an electrical stroke of 12". Note that the electrical stroke equals cylinder net stroke length.

Example C: To eliminate sensor overhang on the head end of a 5.0" bore cylinder, add .625" of recommended stop tube length. The cylinder gross stroke becomes 12.625" and the net stroke remains 12". Specify a sensor with an electrical stroke of 12". Note that the electrical stroke equals cylinder net stroke length.
Linear Position Sensor Option

2MA Series

Parker Hannifin Corporation
Actuator Division
Wadsworth, Ohio  USA

Output signal: analog
Transducer interface: A
Input interface: analog

Ordering code:

Output voltage: 0...10 V
Output current: max. 10 mA
max. ripple: ≤ 5 mV
Load current: max. 10 mA
Load resistance: ≤ 0.1 mV
System resolution: ≤ 0.2 µA
Hysteresis: ≤ 4 µm
Repeatability: ≤ 6 µm (hysteresis + resolution)
Output update rate: STANDARD = 1 ms ≤1400 mm
max. non-linearity: ±0.02 % 501...3606 mm stroke
Temperature coefficient: Voltage output
Voltage output: [150 µV/°C + (5 ppm/°C x P x U/L)] x DT
Current output: [0.6 µA/°C + (10 ppm/°C x P x I/L)] x DT
Shock loading: 100 g/11 ms per IEC 68-2-27
Vibration: 12 g, 10...2000 Hz per IEC 68-2-6
Traverse velocity of magnet: any
Operating voltage: 24 V DC ± 20%
Current draw: ≤ 150 mA
Polarity reversal protected: yes
Overvoltage protection: Transzorb protection diodes
Dielectric constant: 500 V (Ground to housing)
Operating temperature: -40...185 °F (-40...85°C)
Storage temperature: -40...212 °F (-40...100°C)

S32 Pin assignments

| Pin | Color | BTL5-A11-M | BTL5-E1
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YE</td>
<td>not used</td>
<td>4...20 mA</td>
</tr>
<tr>
<td>2</td>
<td>GY</td>
<td>signal GND</td>
<td>20...4 mA</td>
</tr>
<tr>
<td>3</td>
<td>PK</td>
<td>10...0 V</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>GN</td>
<td>0...10 V</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BU</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>BN</td>
<td>+24 V DC</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>WH</td>
<td>(GND)</td>
<td></td>
</tr>
</tbody>
</table>

Connect shield to housing.

Please enter code for output signal and nominal stroke in ordering code.

BTL transducers with analog outputs are available in the ranges of 0...10V, 4...20mA with rising or falling signal.
M Interface
Differential START/STOP control-specific interface.

P Interface
Compatible with BTA processors and various OEM controls. Reliable signal transmission, even over cable lengths up to 500 m (1640 ft.) between BTA and BTL, is assured by the especially noise-immune RS485 differential drivers and receivers. Noise signals are effectively suppressed.

Series
Transducer interface
User interface

Ordering code
BTL5 Low Profile pulse M
BTL5 Low Profile pulse P

Ordering Sample:
BTL5-P1-M_ _ _ _-R-S 32

Specifications subject to change.

Ordering code
BTL5-M1-M_ _ _ _-R-S 32

Process-dependent/control dependent
Hysteresis + Resolution
≤ 2 µm
≤ 4 µm
fSTANDARD = 1 kHz ≤1400 mm
±100 µm to 500 mm nominal stroke
±0.02 % 501...3750 mm nominal stroke
(6 µm + 5 ppm x L)/°C
any

24 V DC ±20 % or ±15 V DC ±2 % (optional)
≤ 100 mA
−40...185 °F (-40...85 °C)
−40...212 °F (-40...100 °C)

Standard stroke lengths (mm)

Please enter code for nominal stroke in ordering code.

<table>
<thead>
<tr>
<th>S32 Pin assignments</th>
<th>Pin</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input/output signals</td>
<td>Input</td>
<td>YE</td>
</tr>
<tr>
<td></td>
<td>Output</td>
<td>GY</td>
</tr>
<tr>
<td></td>
<td>Input</td>
<td>PK</td>
</tr>
<tr>
<td></td>
<td>Output</td>
<td>GN</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>6</td>
<td>BU</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>BN</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>WH</td>
</tr>
</tbody>
</table>

Shield connected to housing
Transducer - Linear

Generation 5

Output Signal

A = 0...10V  
E = 4...20 mA  
M = differential Start/Stop - leading edge active  
P = differential Start/Stop - trailing edge active

Supply Voltage

1 = 24 V ±20%

Output Signal (analog only)

If A in position 7

1 = Vmin or Vmax at connector end, i.e. user selectable rising or falling

If E in position 7

0 = Imin at connector end (rising towards opposite end)  
7 = Imax at connector end (falling towards opposite end)

Nominal stroke in mm

0 3 0 5 = 305 mm active electrical stroke

Housing geometry

R = Low Profile extrusion

Connection type

S 3 2 = 8 pin quick disconnect metal connector  
K A 0 5 = integral axial cable (with 5 m cable; specify length)

Note: Electrical stroke = Net Cylinder Stroke

Standard Lengths

<table>
<thead>
<tr>
<th>inches</th>
<th>mm</th>
<th>inches</th>
<th>mm</th>
<th>inches</th>
<th>mm</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>0051</td>
<td>15</td>
<td>0381</td>
<td>42</td>
<td>1067</td>
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<td>3</td>
<td>0077</td>
<td>16</td>
<td>0407</td>
<td>48</td>
<td>1220</td>
</tr>
<tr>
<td>4</td>
<td>0102</td>
<td>18</td>
<td>0457</td>
<td>50</td>
<td>1270</td>
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<tr>
<td>5</td>
<td>0127</td>
<td>20</td>
<td>0508</td>
<td>60</td>
<td>1524</td>
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<td>6</td>
<td>0152</td>
<td>22</td>
<td>0560</td>
<td>70</td>
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<td>7</td>
<td>0178</td>
<td>24</td>
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<td>0203</td>
<td>26</td>
<td>0661</td>
<td>90</td>
<td>2286</td>
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<td>9</td>
<td>0230</td>
<td>28</td>
<td>0711</td>
<td>100</td>
<td>2540</td>
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<tr>
<td>10</td>
<td>0254</td>
<td>30</td>
<td>0762</td>
<td>110</td>
<td>2794</td>
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<tr>
<td>11</td>
<td>0280</td>
<td>32</td>
<td>0813</td>
<td>120</td>
<td>3048</td>
</tr>
<tr>
<td>12</td>
<td>0305</td>
<td>36</td>
<td>0914</td>
<td></td>
<td></td>
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<tr>
<td>13</td>
<td>0330</td>
<td>40</td>
<td>1016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to Order 2MA Series with Linear Position Sensor Option

Parker 2MA Series pneumatic cylinders can be specified by model number by using the table below.

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>C</th>
<th>K</th>
<th>J</th>
<th>2MA</th>
<th>U</th>
<th>S</th>
<th>1</th>
<th>4</th>
<th>A</th>
<th>C</th>
<th>6.000</th>
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<td></td>
<td>2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 1/2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 1/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specify: Bore Size
Specify: "2MA" for air service.

Specify: "2MA" for air service.

Leave blank except for Bumpers Seal and/or Magnetic Piston. Specify: 3 = Magnet only
Specify: 4 = Bumper seal only
Specify: 6 = Magnet and Bumper Seal

Specify: Mounting style code. (See mounting style Table A and B below)

Specify: Special Modification
Specify: Piston Rod Number
Specify: Piston Rod Thread Style
Specify: Piston Rod Thread Type
Specify: Cylinder Mounting Style
Specify: Stroke

* When specifying the Linear Position Sensor Option, the Piston field must be 3 or 6 for magnetic piston.

Please include the following information in the Special Modifications:
1. Sensor part number from previous page
2. Sensor position
3. Port position (if other than position 1)
4. Length of stop tubing, gross stroke and net stroke (if required)

Table A – Cylinder Mounting Styles without Stop Tube Option

<table>
<thead>
<tr>
<th>Mounting Style Code</th>
<th>N.F.P.A. Style</th>
<th>Mounting Description</th>
<th>Mounting Style Code</th>
<th>N.F.P.A. Style</th>
<th>Mounting Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>MX0</td>
<td>No Mount (Basic)</td>
<td>D</td>
<td>MT1</td>
<td>Head Trunnion</td>
</tr>
<tr>
<td>C</td>
<td>MS2</td>
<td>Side Lug</td>
<td>DB</td>
<td>MT2</td>
<td>Cap Trunnion</td>
</tr>
<tr>
<td>CB</td>
<td>MS1</td>
<td>Single End Angle</td>
<td>BE†</td>
<td>MP4</td>
<td>Detachable Pivot Eye</td>
</tr>
<tr>
<td>F</td>
<td>MS4</td>
<td>Side Tapped</td>
<td>BB†</td>
<td>MP1</td>
<td>Cap Fixed Clevis</td>
</tr>
<tr>
<td>G</td>
<td>MS7</td>
<td>End Lug Mount</td>
<td>BC†</td>
<td>MP2</td>
<td>Cap Detachable Clevis</td>
</tr>
<tr>
<td>H</td>
<td>MF2</td>
<td>Cap Rectangular Flange (6&quot;-8&quot; only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† For rear clevis mounts BE, BB and BC, rotation is limited due to sensor interference.

Table B – Cylinder Mounting Styles with Stop Tube Option

<table>
<thead>
<tr>
<th>Mounting Style Code</th>
<th>N.F.P.A. Style</th>
<th>Mounting Description</th>
<th>Mounting Style Code</th>
<th>N.F.P.A. Style</th>
<th>Mounting Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>MX0</td>
<td>No Mount (Basic)</td>
<td>J</td>
<td>MF1</td>
<td>Head Rectangular Flange (2&quot;-6&quot;)</td>
</tr>
<tr>
<td>TB</td>
<td>MX3</td>
<td>Tie Rods Extended Head End</td>
<td>H</td>
<td>MF2</td>
<td>Cap Rectangular Flange (6&quot;-8&quot; only)</td>
</tr>
<tr>
<td>TE</td>
<td>MX5</td>
<td>Sleeve Nut Mount</td>
<td>D</td>
<td>MT1</td>
<td>Head Trunnion</td>
</tr>
<tr>
<td>C</td>
<td>MS2</td>
<td>Side Lug</td>
<td>DB</td>
<td>MT2</td>
<td>Cap Trunnion</td>
</tr>
<tr>
<td>CB</td>
<td>MS1</td>
<td>Side End Angle</td>
<td>BE†</td>
<td>MP4</td>
<td>Detachable Pivot Eye</td>
</tr>
<tr>
<td>F</td>
<td>MS4</td>
<td>Side Tapped</td>
<td>BB†</td>
<td>MP1</td>
<td>Cap Fixed Clevis</td>
</tr>
<tr>
<td>G</td>
<td>MS7</td>
<td>End Lug Mount</td>
<td>BC†</td>
<td>MP2</td>
<td>Cap Detachable Clevis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JB</td>
<td>ME3</td>
<td>Head Square (8&quot;)</td>
</tr>
</tbody>
</table>

† For rear clevis mounts BE, BB and BC, rotation is limited due to sensor interference.