Micropulse Linear Transducer
Absolute Quadrature Outputs
Rod Style and Profile Style Housings
Introduction

The Micropulse Absolute Quadrature Output linear transducer is a magnetostrictive linear displacement transducer that provides electrical output signals in ABZ quadrature format.

In addition to providing industry-standard quadrature output signals, the Micropulse Absolute Quadrature transducer provides absolute position information through its innovative BURST function. Upon request from the PLC or controller, the transducer sends a burst of pulses equal to absolute position of the marker magnet. This eliminates any need to perform a physical re-homing procedure after a power loss (see p. 8 for details on using BURST mode).

The Micropulse Absolute Quadrature transducer is available in two form factors:

The Z rod style is designed for use in hydraulic and pneumatic cylinders. The stainless steel pressure tube is rated for 8700 psi, and the mounting threads (3/4-16 UNF or M18 x 1.5) allow the Z style to be integrated into specially prepared cylinders. A donut-shaped or slotted magnet, attached to the piston face, provides position feedback. The Z style can also be used for external-mount applications.

The P profile style’s rugged extruded aluminum housing makes it a perfect choice for external-mount applications. Either a free-floating magnet or a captive, sliding magnet can be used – offering maximum flexibility to meet the needs of a wide variety of applications.

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Fast transients (Burst)                                      EN 61000–4–4  Severity level 3
Surge                                                         EN 61000–4–5  Severity level 2
Line-induced noise induced by high-frequency fields
Fast transients (Burst)                                      EN 61000–4–4  Severity level 3
Magnetic fields                                              EN 61000–4–8  Severity level 4

The CE Mark verifies that our products meet the requirements of EC Directive 89/336/EEC (EMC Directive) and the EMC Law. Testing in our EMC Laboratory, which is accredited by DAtech for Testing Electromagnetic Compatibility, has confirmed that Balluff products meet the EMC requirements of the following Generic Standards:

- EN 50081–2 (emission)
- EN 61000–6–2 (noise immunity)
- Emission tests:
  - RF Emission
  - EN 55011 Group 1, Class A
- Noise immunity tests:
  - Static electricity (ESD)
  - EN 61000–4–2  Severity level 3
  - Electromagnetic fields (RF)
  - EN 61000–4–3  Severity level 3
Micropulse Linear Position Transducer
Absolute Quadrature Output
Rod Style & Profile Style Housings

Electrical Data

<table>
<thead>
<tr>
<th>Electrical Data</th>
<th>Z Rod Style Housing</th>
<th>Profile Style Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>RS422-level A &amp; B Quadrature with Z marker pulse</td>
<td></td>
</tr>
<tr>
<td>Fixed Pulse Frequency (selectable via ordering code)</td>
<td>833 kHz (3.33 MHz quadrature)</td>
<td>416 kHz (1.66 MHz quadrature)</td>
</tr>
<tr>
<td></td>
<td>208 kHz (833 kHz quadrature)</td>
<td>10 kHz (40 kHz quadrature)</td>
</tr>
<tr>
<td>Output Update Rate:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free-Running Mode</td>
<td>1 ms, 2 ms, or 4 ms</td>
<td></td>
</tr>
<tr>
<td>(selectable via ordering code)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synchronous Mode</td>
<td>User-defined (500 µsec to 10 ms)</td>
<td></td>
</tr>
<tr>
<td>Non-Linearity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For Stroke ≤ 500mm</td>
<td>+/- 100 µm (0.0039&quot;)</td>
<td></td>
</tr>
<tr>
<td>For Stroke &gt;500mm</td>
<td>+/- 0.02% of full scale</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>1, 2, 5, 10, 50 µm or 0.0001, 0.0005, 0.001* (ordering code dependent)</td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>+/- (2x resolution) or 5 µm (whichever is greater)</td>
<td></td>
</tr>
<tr>
<td>Repeat Accuracy</td>
<td>resolution + hysteresis</td>
<td></td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>+ 24 Vdc (+/- 20%)</td>
<td>+10 to +30 Vdc</td>
</tr>
<tr>
<td>Current Draw</td>
<td>&lt; 100 mA</td>
<td>≤ 175 mA @ 10 Vdc</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 to +85° C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 to +100° C</td>
<td></td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>(6 µm + 5ppm x stroke length) / °C</td>
<td></td>
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</tbody>
</table>

Mechanical Data

<table>
<thead>
<tr>
<th>Mechanical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing Material</td>
</tr>
<tr>
<td>Rod Material</td>
</tr>
<tr>
<td>Mounting Threads</td>
</tr>
<tr>
<td>Protection Class</td>
</tr>
<tr>
<td>Shock Rating</td>
</tr>
<tr>
<td>Vibration</td>
</tr>
</tbody>
</table>

Wiring

BKS S140— Mating Connector

* Specify cable length in meters or "00" for no cable.

Quadrature (Q)
Micropulse Linear Position Transducer
Absolute Quadrature Output
Rod Style & Profile Style Housings

Mechanical Dimensions/Installation – Rod Style Housing

Mechanical Dimensions

- Z Style = 50.8
- B Style = 30
- Nominal stroke = measuring area

Cylinder Port Dimensions

- Jam Nut
- BTL5-JAM-NUT
- For 3/4" - 16 UNF (Z style)
- Order separately if required

Typical Cylinder Installation

- Null Zone
- 50.8 mm (2"") Standard
- 30 mm (Optional)
- Stroke Length
- 80 mm
- Dead Zone

Notes:
1. Threads machined per AMS4961.1.
2. The threads should be machined to meet the strength requirements of the material.
3. The ports are similar to SAE J1922 I port, with dimensional changes.
Micropulse Linear Position Transducer
Absolute Quadrature Output
Rod Style & Profile Style Housings

Accessories (Order Separately) – Rod Style Housing

Jam Nut
BTL5-JAM-NUT

Ring Magnet
BTL5-P-1013-4R

Slotted Magnet
BTL5-P-1013-4S

Small Diameter Magnet
BTL5-P-1012-4R
Micropulse Linear Position Transducer
Absolute Quadrature Output
Rod Style & Profile Style Housings

Mechanical Dimensions/Installation – Profile Style Housing

Accessories (Order Separately) – Profile Style Housing

Floating Magnet
BTL5-P-3800-2
(Order separately)

Nominal Stroke + 159
73
73

M5x22 ISO 4762
(Supplied with mounting feet)

Captive Sliding Magnet
BTL5-F-2814-1S
(Order separately)

Control Arm
BTL-Z-S-G08-__-__-A
* Specify length in mm

Extended Range
Floating Magnet
BTL5-P-5500-2

Lateral offset:
C = ± 15mm
Vertical distance
of magnet:
D = 5...15mm

Floating Magnet
BTL5-P-3800-2

Lateral offset:
C = ± 2mm
Vertical distance
of magnet:
D = 0.1...4mm

Swivel Eye
BTL5-SWIVEL-EYE

M5x0.8

Mounting Foot
BTL-P-M5-VZ

M5x10

M5x10

M5x10
Operating Instructions

The Micropulse quadrature-output linear transducers produce an AB quadrature output signal. The A and B channels are 90° out of phase depending on the direction of position travel. In addition a programmable Z pulse can be set anywhere within the active stroke to represent a “home” or “zero” position. The RS422/RS485 differential line driver provides each output, along with its complementary signal (A, A, B, B, Z, Z).

Absolute position information from the transducer is used to generate incremental position updates. Any change in linear position causes the appropriate number of pulses to be delivered to the output. In addition, the absolute position value can be delivered to the output at any time by using the STROBE input to create a “burst” of pulses that is equal to the absolute (relative to the “zero” point) position (see STROBE instructions below).

Operating Modes

The Micropulse quadrature-output linear transducer is capable of operating in the following modes, which are selected via the ordering code (see pg. 10):

Free-Run Mode – In this mode, the transducer output updates at a periodic rate determined by the Update Rate parameter in the ordering code. As long as power is applied to the transducer, the transducer provides a position output. This is the most common mode of operation.

Note – Maximum allowable free-running update rate is limited by transducer stroke length.

Use the following table to determine maximum permissible update rate:

<table>
<thead>
<tr>
<th>Stroke Length (mm)</th>
<th>Allowable Update Rates</th>
<th>Ordering Code (see page 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1250 mm</td>
<td>1 ms, 2 ms or 4 ms</td>
<td>Qxxx1, Qxxx2, or Qxxx4</td>
</tr>
<tr>
<td>1251 to 2500 mm</td>
<td>2 ms or 4 ms</td>
<td>Qxxx2 or Qxxx4</td>
</tr>
<tr>
<td>&gt; 2500 mm</td>
<td>4 ms</td>
<td>Qxxx4</td>
</tr>
</tbody>
</table>

Synchronous Mode – (ordering code Qxxx0) In this mode, the transducer synchronizes itself to an external controller via the STROBE input. This mode can only be used in conjunction with motion controllers that support this function, e.g., Allen-Bradley IMC-S class controllers. For more information, please consult factory.
### Strobe Input Functionality

The active-low “Strobe” input of the Micropulse Absolute Quadrature Transducer performs three functions:

<table>
<thead>
<tr>
<th>Function</th>
<th>Active Time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronizing</td>
<td>5 µsec to 5 msec</td>
<td>Valid only with synchronous versions (ordering code Qxxx0). In this mode the internal transducer measurements are synchronized to this input. The most recent quadrature data is sent out on the rising (active-to-inactive) edge of this input.</td>
</tr>
<tr>
<td>Burst (Absolute Position Query)</td>
<td>100 msec to 1000 msec (1 sec)</td>
<td>Causes absolute position pulse train to be output. The rising (active-to-inactive) edge of this input causes a pulse string equal to current magnet position, referenced to the null point, e.g., 2” from flange face, to be sent. The location of the programmable Z pulse (see below) is not considered.</td>
</tr>
<tr>
<td>Store Z</td>
<td>1 sec to 5 sec</td>
<td>This mode allows the location of the home reference (Z) pulse to be changed. The rising edge of this input will cause the current magnet position to be stored as the Z pulse. This setting is stored in non-volatile memory, so it will be retained after power-off.</td>
</tr>
</tbody>
</table>

#### Notes:

1. For all Strobe functions, the input is low-active. It is connected to +5V, through a 3.3 kOhm resistor inside the transducer. The input is active when pulled to 0V (grounded).

2. If the Strobe input is held active (grounded) during transducer power-up, the input is ignored until it goes inactive. This is a safety feature to prevent unwanted effects (particularly overwriting of the Z pulse position) in the event of a problem with this input.

### Absolute Position Output (Burst Mode)

During normal operation, the transducer provides incremental position information. For each position update, the transducer sends out a number of pulses that represents the change in position since the previous update. Upon request, however, the transducer is capable of sending out a pulse string that represents absolute position, relative to the factory-programmed null point. This absolute position request is called the Burst mode. The burst mode can be used at any time, but is typically used at start-up, or to periodically verify absolute position. Using the Burst mode effectively eliminates the need to physically "re-home" a position axis. The Burst mode is activated by holding the STROBE input low for a period of from 100 milliseconds to 1 second.

### Z Pulse Programming

The Z output, sometimes referred to as the marker or index pulse, is only active at one location within the transducer’s active stroke. The factory default location for the Z pulse is at the Null point (the Null point is the beginning of the active stroke). The location of the Z pulse is field-programmable, and can be set anywhere within the active stroke of the transducer. This is accomplished by using the STROBE input. Holding the STROBE input low for a period of from 1 second to 5 seconds will set the Z pulse at the current magnet position.
Speed Constraints

The absolute maximum traverse velocity for the sensing magnet is 10 meters per second or 400 inches per second. However, due to the fixed frequency of the A and B outputs, there are additional restrictions on maximum traverse velocity. Use the following table to determine maximum allowable traverse velocity.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>833 kHz</th>
<th>416 kHz</th>
<th>208 kHz</th>
<th>10 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 µm</td>
<td>3.0 m/sec</td>
<td>1.5 m/sec</td>
<td>0.75 m/sec</td>
<td>0.0375 m/sec</td>
</tr>
<tr>
<td>2 µm</td>
<td>6.0 m/sec</td>
<td>3.0 m/sec</td>
<td>1.5 m/sec</td>
<td>0.075 m/sec</td>
</tr>
<tr>
<td>5 µm</td>
<td>10 m/sec</td>
<td>7.5 m/sec</td>
<td>3.75 m/sec</td>
<td>0.1875 m/sec</td>
</tr>
<tr>
<td>10 µm</td>
<td>10 m/sec</td>
<td>10 m/sec</td>
<td>7.5 m/sec</td>
<td>0.375 m/sec</td>
</tr>
<tr>
<td>50 µm</td>
<td>10 m/sec</td>
<td>10 m/sec</td>
<td>10 m/sec</td>
<td>1.875 m/sec</td>
</tr>
<tr>
<td>0.00001&quot;</td>
<td>300 in/sec</td>
<td>150 in/sec</td>
<td>75 in/sec</td>
<td>3.75 in/sec</td>
</tr>
<tr>
<td>0.00005&quot;</td>
<td>400 in/sec</td>
<td>400 in/sec</td>
<td>375 in/sec</td>
<td>18.75 in/sec</td>
</tr>
<tr>
<td>0.001&quot;</td>
<td>400 in/sec</td>
<td>400 in/sec</td>
<td>400 in/sec</td>
<td>37.5 in/sec</td>
</tr>
</tbody>
</table>

If these speed constraints are exceeded, the transducer will not be able to send all of the necessary pulses to represent a given amount of position change within a single update cycle. Note, however, that pulses are never “discarded”. The transducer will attempt to output the remaining pulses on the next update cycle.
Micropulse Linear Position Transducer
Absolute Quadrature Output
Rod Style & Profile Style Housings

Ordering Information

Rod Style

Supply Voltage
- BTL5-Q
- Mxxxx-Z-S140/KA

Quadrature Frequency
- 0 = 833 kHz
- 1 = 416 kHz
- 2 = 208 kHz
- 6 = 10 kHz

System Resolution
- 0 = 1 µm
- 1 = 2 µm
- 2 = 5 µm
- 3 = 10 µm
- 5 = 50 µm
- 6 = 0.0001"*

Mode/Update Rate
- 0 = Synchronous
- 1 = free-running, 1ms update (stroke ≤ 1250 mm only)
- 2 = free-running, 2ms update (stroke ≤ 2500 mm only)
- 4 = free-running, 4ms update (any stroke length)

Housing/Thread
- Z = Rod Style 3/4-16 UNF Threads, 50.8 mm null point
- B = Rod Style M18x1.5 Threads, 30 mm null point

Connection Type
- KA = Integral cable (specify length in meters, e.g. "05" = 5 meters [standard])

Profile Style

Supply Voltage
- 5 = +10...30 V

Quadrature Frequency
- 0 = 833 kHz
- 1 = 416 kHz
- 2 = 208 kHz
- 6 = 10 kHz

System Resolution
- 0 = 1 µm
- 1 = 2 µm
- 2 = 5 µm
- 3 = 10 µm
- 5 = 50 µm
- 6 = 0.0001"*

Mode/Update Rate
- 0 = Synchronous
- 1 = free-running, 1ms update (stroke ≤ 1250 mm only)
- 2 = free-running, 2ms update (stroke ≤ 2500 mm only)
- 4 = free-running, 4ms update (any stroke length)

Connection Type
- S140 = 10 pin MS connector
- KA = Integral cable (specify length in meters, e.g. "05" = 5 meters [standard])

Standard Stroke Lengths-Rod Style
(consult factory for additional lengths)

<table>
<thead>
<tr>
<th>Inches</th>
<th>mm</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0051</td>
<td>32</td>
<td>0813</td>
</tr>
<tr>
<td>3</td>
<td>0077</td>
<td>36</td>
<td>0914</td>
</tr>
<tr>
<td>3.5</td>
<td>0090</td>
<td>40</td>
<td>1016</td>
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<td>4</td>
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<td>42</td>
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<td>5</td>
<td>0127</td>
<td>48</td>
<td>1220</td>
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<tr>
<td>32</td>
<td>0813</td>
<td>156</td>
<td>3962</td>
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</tbody>
</table>

Standard Stroke Lengths-Profile Style
(consult factory for additional lengths)

<table>
<thead>
<tr>
<th>Inches</th>
<th>mm</th>
<th>Inches</th>
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</tr>
<tr>
<td>32</td>
<td>0813</td>
<td>156</td>
<td>3962</td>
</tr>
</tbody>
</table>

*7 = 0.001"  8 = 0.0005"
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

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 mechanical wave is converted to an electric signal by the signal converter. The propagation time of the mechanical wave is determined by the position of the permanent magnet and can be determined to resolutions down to 1 µm.
Complete Product Range

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