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Technical Description / User's Guide

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

MICROPULSE®

Table of Contents

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.

CE The CE Mark verifies that our products meet the requirements of the current 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 61326-2-3 (immunity and emission)

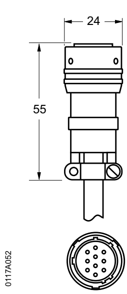
Emission tests:
RF Emission
EN 55011 Group 1, Class A
Noise immunity tests:
Static electricity (ESD)
EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)
EN 61000-4-3 Severity level 3
Fast transients (Burst)
EN 61000-4-4 Severity level 3

Surge
EN 61000-4-5 Severity level 2
Line-induced noise induced by high-frequency fields
EN 61000-4-6 Severity level 3
Magnetic fields
EN 61000-4-8 Severity level 4

Electrical Data

Electrical Data	Z Rod Style Housing	Profile Style Housing
Output	RS422-level A & B Quadrature with Z marker pulse	
Fixed Pulse Frequency (selectable via ordering code)	833 kHz (3.33 MHz quadrature) 416 kHz (1.66 MHz quadrature) 208 kHz (833 kHz quadrature) 10 kHz (40 kHz quadrature)	
Output Update Rate:		
Free-Running Mode (selectable via ordering code)	1 ms, 2 ms, or 4ms	
Synchronous Mode	User-defined (500 µsec to 10 ms)	
Non-Linearity		
For Stroke ≤ 500mm	+/- 100 µm (0.0039")	
For Stroke >500mm	+/- 0.02% of full scale	
Resolution	1, 2, 5, 10, 50 µm or 0.0001, 0.0005, 0.001" (ordering code dependent)	
Hysteresis	+/- (2x resolution) or 5 µm (whichever is greater)	
Repeat Accuracy	resolution + hysteresis	
Supply Voltage	+ 24 Vdc (+/- 20%)	+10 to +30 Vdc
Current Draw	< 100 mA	≤ 175 mA @ 10 Vdc ≤ 100 mA @ 30 Vdc
Operating Temperature	-40 to +85° C	
Storage Temperature	-40 to +100° C	
Temperature Coefficient	(6 µm + 5ppm x stroke length) / °C	
Mechanical Data		
Housing Material	Anodized Aluminum	
Rod Material	316 Ti stainless steel	n/a
Mounting Threads	3/4" -16 UNF	n/a
Protection Class	IP67	
Shock Rating	100 g/6 ms per IEC 60068-2-27	
Vibration	12g, 10 to 2000 Hz per IEC 60068-2-6	

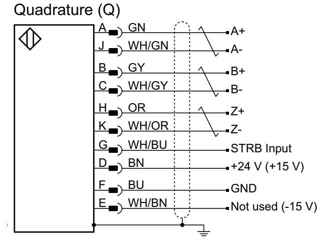
Wiring



BKS S140-__*
Mating Connector

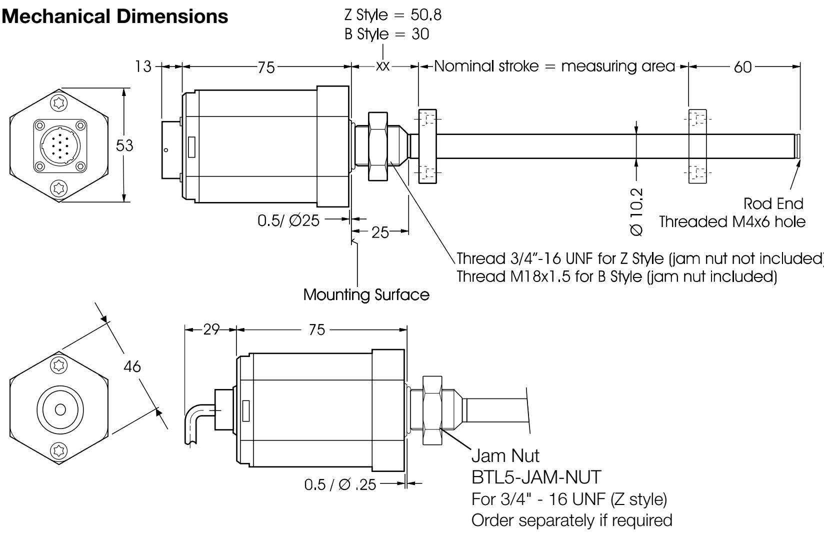
* Specify cable length in meters or "00" for no cable.

Quadrature (Q)

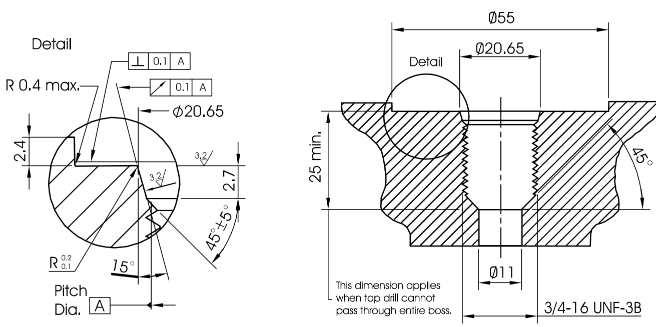


Mechanical Dimensions/Installation – Rod Style Housing

Mechanical Dimensions

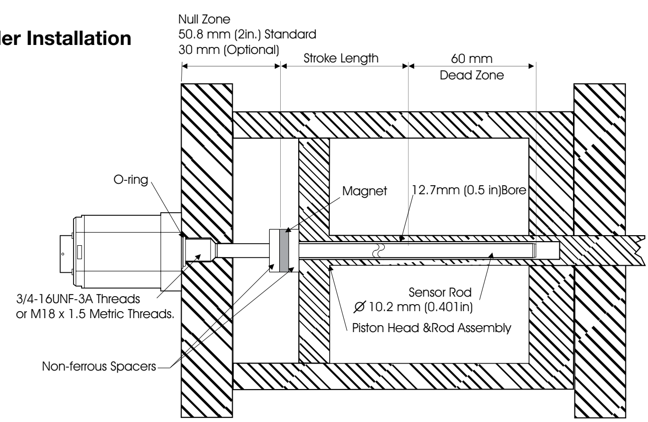


Cylinder Port Dimensions

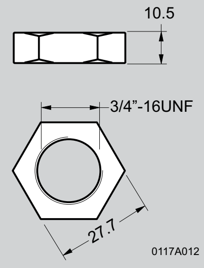


Notes:
1 Threads machined per ANSI/ASME B1.1.
2 The threads should be machined to meet the strength requirements of the material.
3 The port is similar to SAE J1926/1 port hole #8 with dimensional changes.

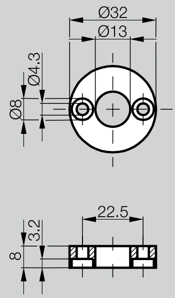
Typical Cylinder Installation



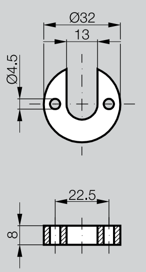
Accessories (Order Separately) – Rod Style Housing



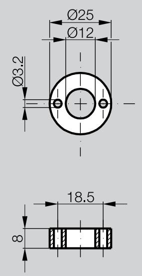
Jam Nut
BTL5-JAM-NUT



Ring Magnet
BTL5-P-1013-4R

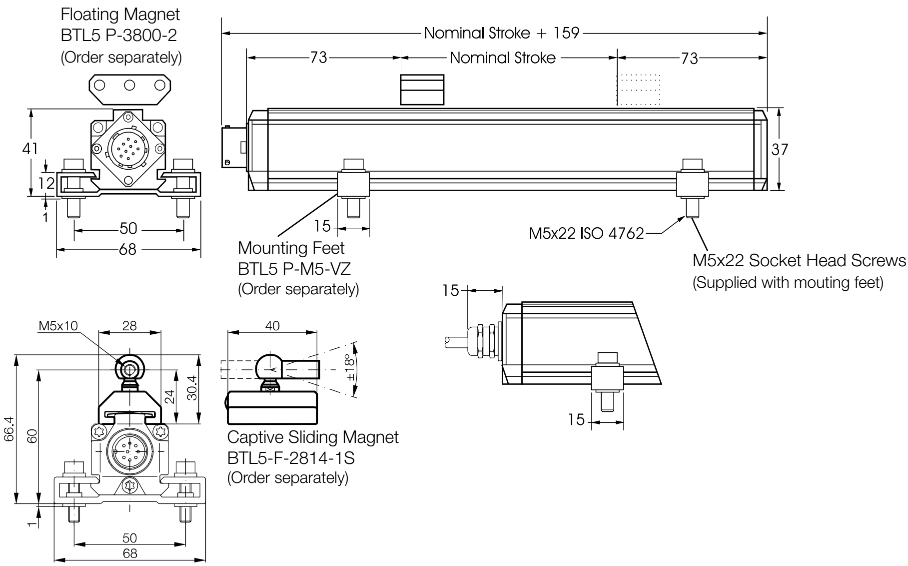


Slotted Magnet
BTL5-P-1013-4S

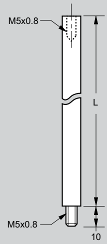


Small Diameter Magnet
BTL5-P-1012-4R

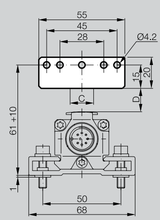
Mechanical Dimensions/Installation – Profile Style Housing



Accessories (Order Separately) – Profile Style Housing

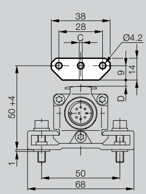


Control Arm
BTL-Z-5-GS08-_ _ _ _*-A
* Specify length in mm



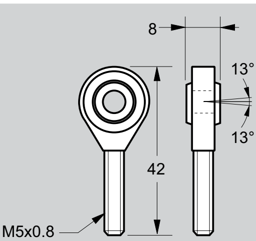
Lateral offset:
C = ± 15mm
Vertical distance of magnet:
D = 5...15mm

Extended Range
Floating Magnet
BTL5-P-5500-2

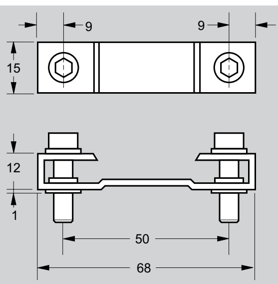


Lateral offset:
C = ± 2mm
Vertical distance of magnet:
D = 0.1...4mm

Floating Magnet
BTL5-P-3800-2



Swivel Eye
BTL5-SWIVEL-EYE

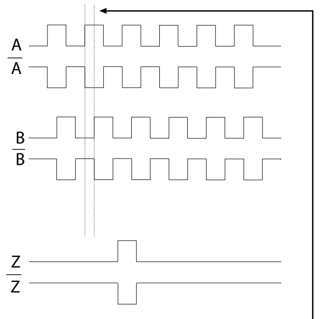


Mounting Foot
BTL-P-M5-VZ

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, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$).

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:

Stroke Length (mm)	Allowable Update Rates	Ordering Code (see page 10)
< 1250 mm	1 ms, 2 ms or 4 ms	Qxxx1, Qxxx2, or Qxxx4
1251 to 2500 mm	2 ms or 4 ms	Qxxx2 or Qxxx4
> 2500 mm	4 ms	Qxxx4

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.

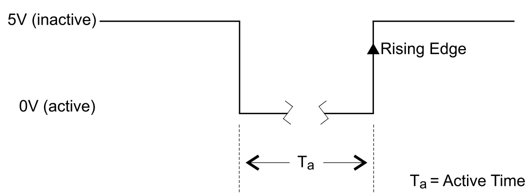
Strobe Input Functionality

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

Function	Active Time	Notes
Synchronizing	5 µsec to 5 msec	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.
Burst (Absolute Position Query)	100 msec to 1000 msec (1 sec)	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.
Store Z	1 sec to 5 sec	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.

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 of the A and B outputs, there are additional restrictions on maximum traverse velocity. Use the following table to determine maximum allowable traverse velocity.

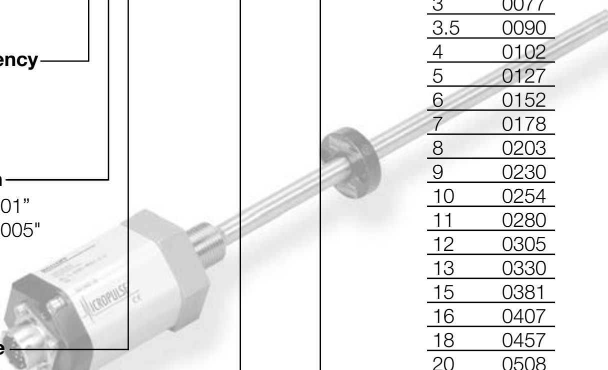
	Pulse Frequency (Fixed)			
Resolution	**833 kHz**	**416 kHz**	**208 kHz**	**10 kHz**
1 µm	3.0 m/sec	1.5 m/sec	0.75 m/sec	0.0375 m/sec
2 µm	6.0 m/sec	3.0 m/sec	1.5 m/sec	0.075 m/sec
5 µm	10 m/sec	7.5 m/sec	3.75 m/sec	0.1875 m/sec
10 µm	10 m/sec	10 m/sec	7.5 m/sec	0.375 m/sec
50 µm	10 m/sec	10 m/sec	10 m/sec	1.875 m/sec
0.0001"	300 in/sec	150 in/sec	75 in/sec	3.75 in/sec
0.0005"	400 in/sec	400 in/sec	375 in/sec	18.75 in/sec
0.001"	400 in/sec	400 in/sec	400 in/sec	37.5 in/sec

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.

Ordering Information

Rod Style

BTL5-Q_ _ _ _-Mxxxx-Z-S140/KA_ _



Supply Voltage
1 = +24 V
2 = ±15 V
xxxx = length in mm
(see chart at right)

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”
7 = 0.001”
8 = 0.0005"

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

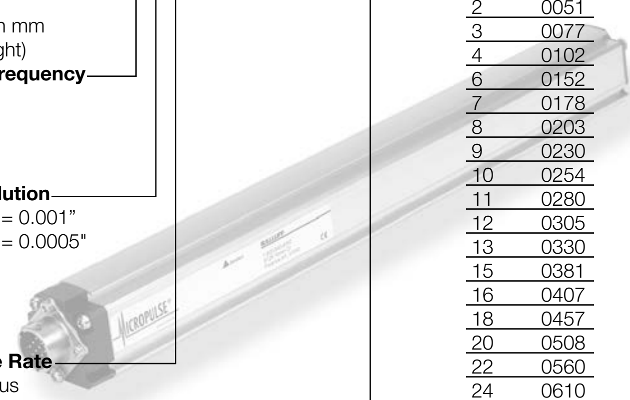
Connection Type
S140 = 10 pin MS connector
KA = Integral cable (specify length in meters, e.g. "05" = 5 meters [standard])

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

inches	mm	inches	mm
2	0051	32	0813
3	0077	36	0914
3.5	0090	40	1016
4	0102	42	1067
5	0127	48	1220
6	0152	50	1270
7	0178	54	1372
8	0203	60	1524
9	0230	66	1676
10	0254	69	1753
11	0280	72	1829
12	0305	78	1981
13	0330	84	2134
15	0381	89	2261
16	0407	98	2490
18	0457	108	2743
20	0508	118	2997
22	0560	126	3200
24	0610	140	3556
26	0661	144	3658
28	0711	148	3759
30	0762	152	3860
		156	3962

Profile Style

BTL5-Q_ _ _ _-Mxxxx-P-S140/KA_ _



Supply Voltage
5 = +10...30 V
xxxx = length in mm
(see chart at right)

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”
7 = 0.001”
8 = 0.0005"

Mode/Update Rate
0 = Synchronous
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Standard Stroke Lengths-Profile Style
(consult factory for additional lengths)

inches	mm	inches	mm
2	0051	30	0762
3	0077	32	0813
4	0102	36	0914
6	0152	40	1016
7	0178	42	1067
8	0203	48	1220
9	0230	50	1270
10	0254	60	1524
11	0280	70	1778
12	0305	80	2032
13	0330	90	2286
15	0381	100	2540
16	0407	110	2794
18	0457	120	3048
20	0508	130	3302
22	0560	142	3606
24	0610	148	3759
26	0661	156	3962
28	0711		

Enhanced Magnetostrictive Technology Overview

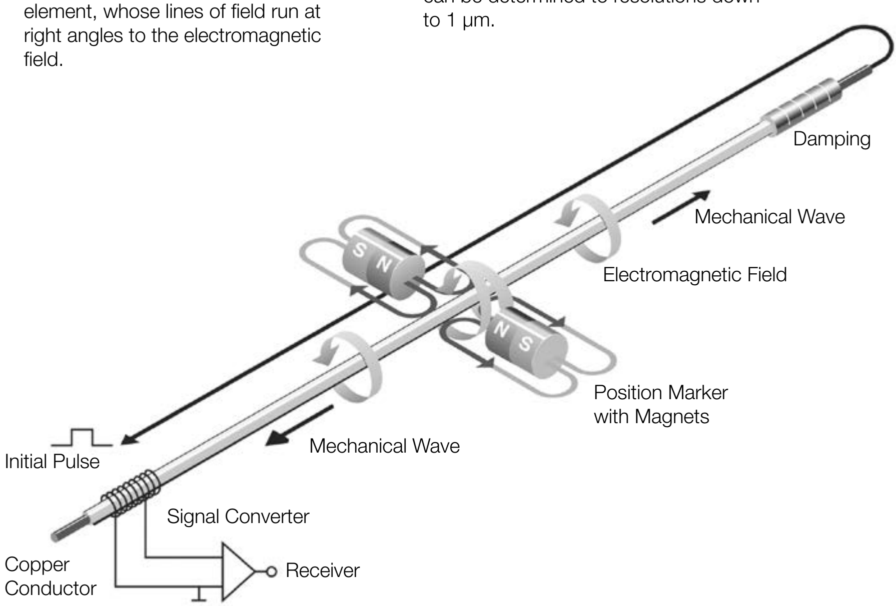
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

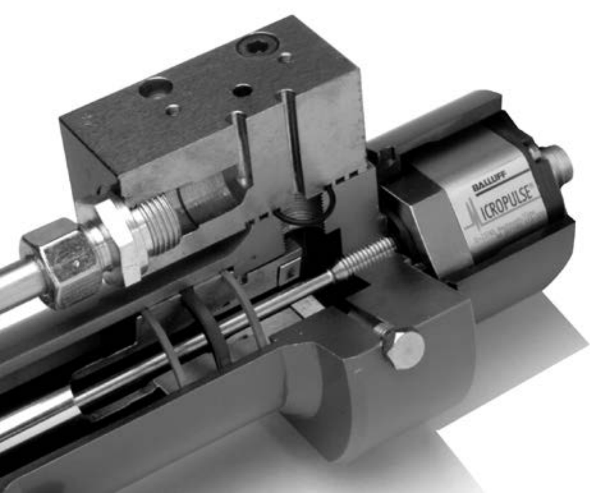
A copper conductor is introduced through the length of this tube. The start of measurement is initiated by a short current pulse. This current generates a circular magnetic field which rotates around the waveguide.

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.





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