BTL **B**

General data

Analog interface

Digital pulse interface

SSI-interface

CANopen interface

PROFIBUS-DP interface

Position recognition in the hydraulics

Magnets and floats

Installation notes

Special series

**Pressure rated to 600 bar, high repeatability, non-contact, rugged**

The BTL Micropulse transducer is the rugged position feedback system for use under extreme ambient conditions measuring between 25 to 5500 mm.

The actual waveguide is protected inside a high-pressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

Series	BTL5 Rod
Shock load	100 g/6 ms per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per IEC 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	Transzorb protection diodes
Dielectric constant	500 V DC (GND to housing)
Enclosure rating per IEC 60529	IP 67 (with BKS-S... IP 67 connector attached)
Housing material	Anodized aluminum/1.4571 stainless tube, 1.3952 stainless investment cast flange
Mounting	Housing B thread M18×1.5, housing Z 3/4"-16UNF
Pressure resistance of the 10.2 mm tube	600 bar installed in hydraulic cylinder
Pressure resistance of the 8 mm tube	250 bar installed in hydraulic cylinder
Connection type	connector or integral cable
EMC testing:	
RF emission	EN 55011 Group 1, Class A
Static electricity (ESD)	IEC 61000-4-2 Severity Level 3
Electromagnetic fields (RFI)	IEC 61000-4-3 Severity Level 3
Fast transients (BURST)	IEC 61000-4-4 Severity Level 4
Line-carried noise, induced by high-frequency fields	IEC 61000-4-6 Severity Level 3
Standard nominal strokes [mm] the max. nominal stroke of the 8 mm tube is 1016 mm	0025, 0050, 0075, 0100, 0125, 0150, 0175, 0200, 0225, 0250, 0275, 0300, 0325, 0350, 0375, 0400, 0425, 0450, 0475, 0500, 0550, 0600, 0650, 0700, 0750, 0800, 0850, 0900, 0950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2250, 2500, 2750, 3000, 3250, 3500, 3750, 3850, 4000 or in 5-mm steps up to 5500 mm (depending on steps) on request

▶ Included
– Transducer (select your interface starting page **B.**4)
– Short user's guide

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
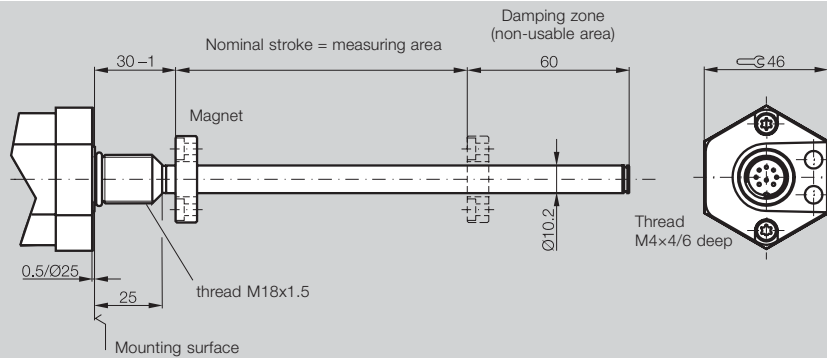Floats page **B.**17
Connectors starting page **BKS.**3

CANopen
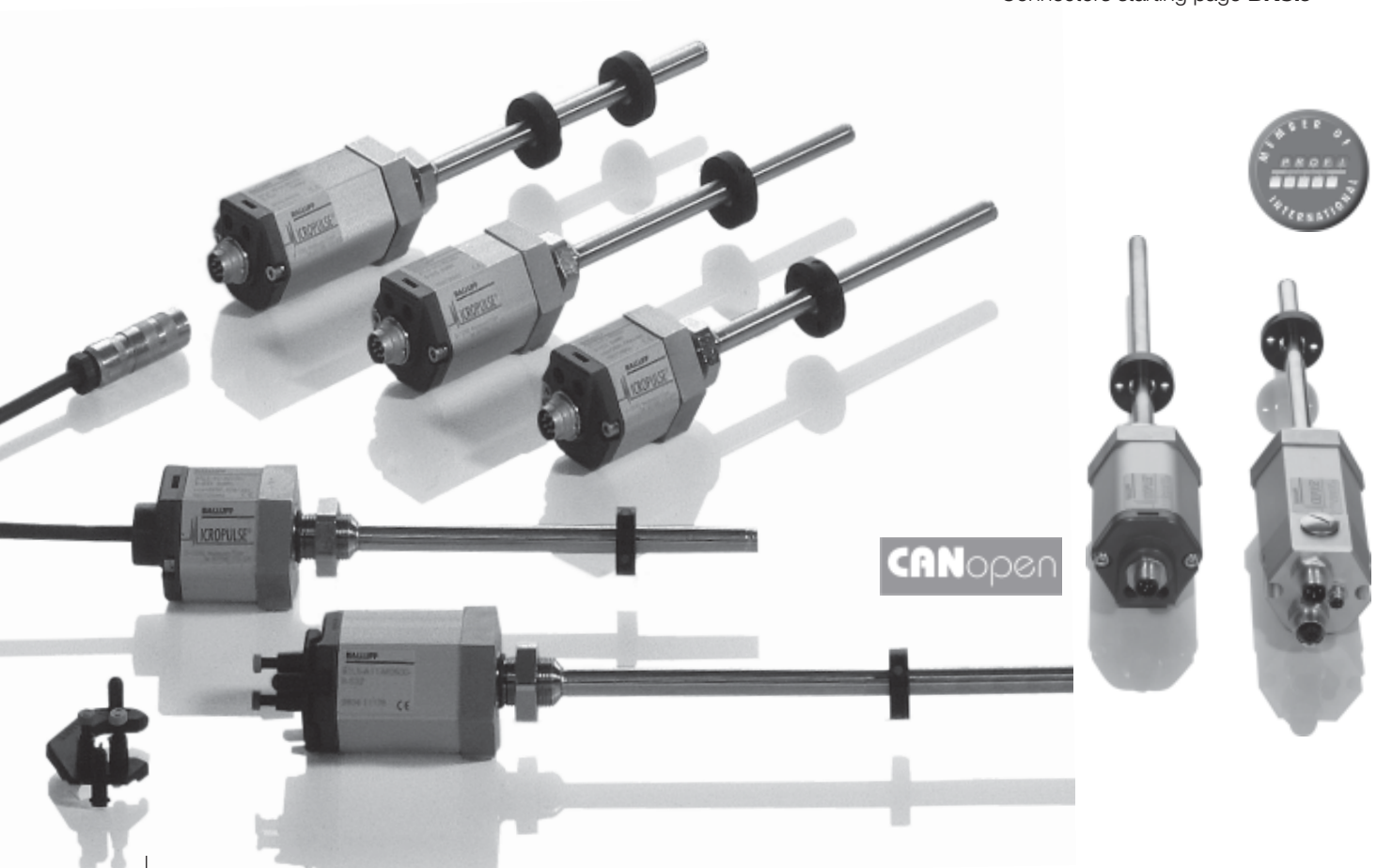
Series	BTL5 Rod

Housing B
BTL5_ _ _ _ -B-_ _ _ _

metric mounting thread M18×1.5

B = Standard Housing

PI0059

Nominal stroke = measuring area

Damping zone (non-usable area)

30 −1 · 60 · ⌀46

Magnet

0.5/Ø25 · 25

Ø10.2

Thread M4×4/6 deep

thread M18x1.5

Mounting surface

Housing Z
BTL5_ _ _ _ -Z-_ _ _ _

3/4" UNF mounting thread

PI0060

Nominal stroke = measuring area

Damping zone (non-usable area)

50.8 −1 · 60 · ⌀46

Magnet

0.5/Ø25 · 25

Ø10.2

Thread M4×4/6 deep

thread 3/4"x16 UNF

Mounting surface
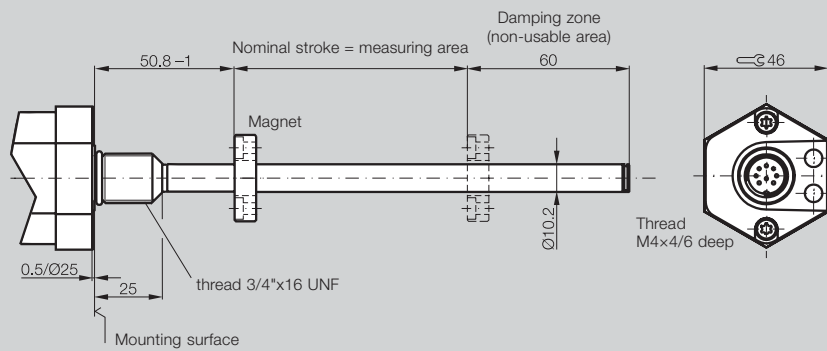
Housing B8
BTL5_ _ _ _ -B8-_ _ _ _

metric mounting thread M18×1.5
8 mm tube
max. 1016 mm nominal stroke

PI0061

Nominal stroke = measuring area

Damping zone (non-usable area)

30 −1 · 60 · ⌀46

0.5/Ø25 · 25

Ø8.2

Thread M4×4/6 deep

thread M18x1.5
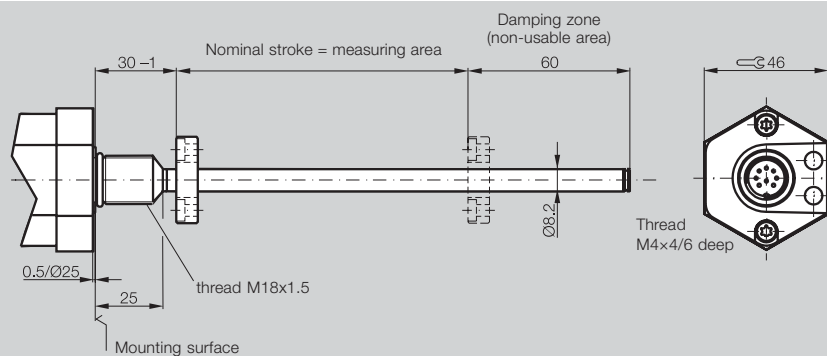
Mounting surface

Housing Z8
BTL5_ _ _ _ -Z8-_ _ _ _

3/4" UNF mounting thread
8 mm tube
max. 1016 mm nominal stroke

PI0061a

Nominal stroke = measuring area

Damping zone (non-usable area)

50.8 −1 · 60 · ⌀46

0.5/Ø25 · 25

Ø8.2

Thread M4×4/6 deep

thread 3/4"x16 UNF
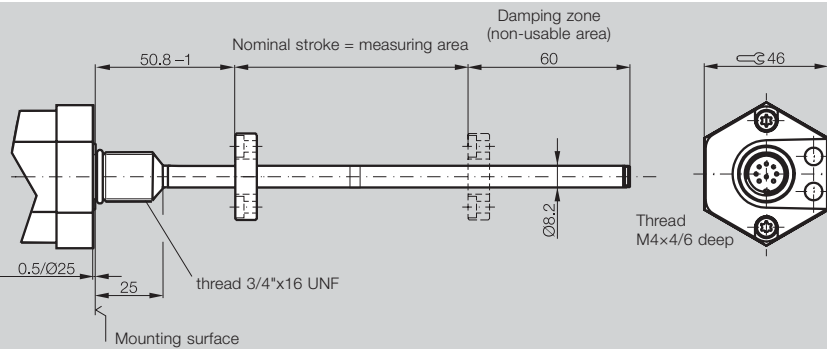
Mounting surface

Housing A
BTL5-_ _ _ _-A-_ _ _ _

metric mounting thread M18×1.5
Flange without 0.5/Ø 25 mm mounting surface

PI0062
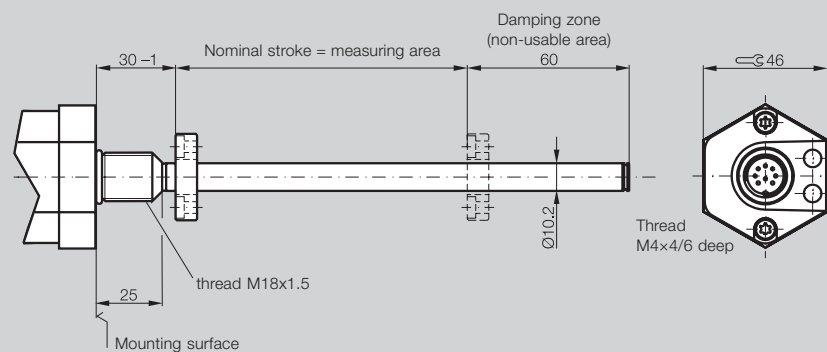
Nominal stroke = measuring area

Damping zone (non-usable area)

30 −1 · 60 · ⌀46

25

Ø10.2

Thread M4×4/6 deep

thread M18x1.5

Mounting surface

BTL B

General data

Analog interface

Digital pulse interface

SSI-interface

CANopen interface

PROFIBUS-DP interface

Position recognition in the hydraulics
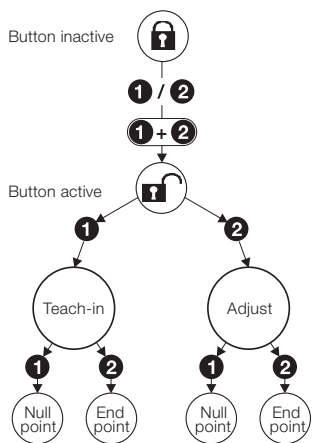
Magnets and floats

Installation notes

Special series

BKS

Page **BKS.**3

Series	
Output signal	
Transducer interface	
Input interface	

100 % Null- and endpoint calibration

Null and endpoint of the analog signal can be button-set to the desired position. Depending on the application, teach-in or adjust mode is used, selectable by pressing a button combination.

Calibration device BTL5-A-EH01

ca. 27   ca. 53

Procedure for teach-in, rising signal

before – – – – –
after ——————

1. Place magnet in new null position.

Store new null value

2. Place magnet at new end position.

Store new end value

3. Newly set measuring area

CE

Ordering code	
Output voltage	
Output current	
Load current	
max. ripple	
Load resistance	
System resolution	
Hysteresis	
Repeatability	
Sampling rate	
max. non-linearity	

Temperature coefficient	Voltage output	
	Current output	
Supply voltage		
Current draw		
Polarity reversal protected		
Overvoltage protection		
Dielectric constant		
Operating temperature		
Storage temperature		

Pin assignments	Pin	Color	
Output signals	1	YE	
	2	GY	
	3	PK	
	5	GN	
Supply voltage	6	BU	
	7	BN	
	8	WH	

Connect shield to housing

Button inactive / Button active

Select calibration method

Button inactive
1 / **2**
1 + **2**
Button active
1 → Teach-in → **1** Null point / **2** End point
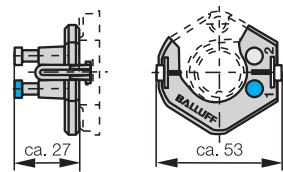**2** → Adjust → **1** Null point / **2** End point

Teach-in

Used for changing the factory set null and end point with a new null and end point. First the magnet must be brought to the new null point and then to the new end position, and the respective values stored by pressing the button.
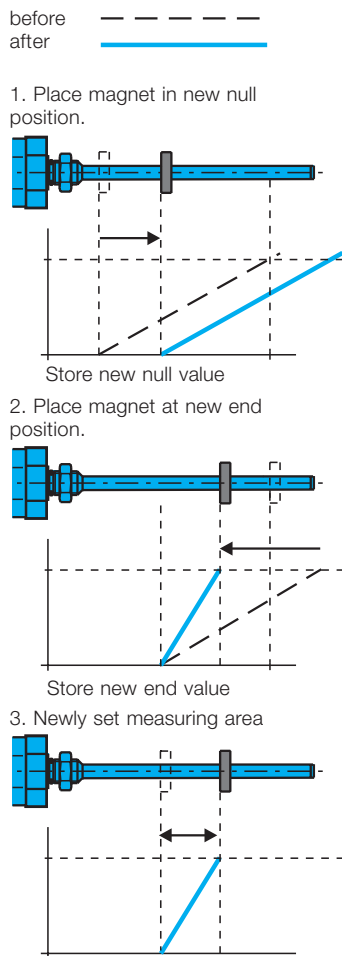
Adjust

Here you can adjust to a new start and end value. This may be required when you cannot physically move the magnet to the standard null and/or end point. Move the magnet to the new start and end position, and adjust the displayed value by pressing the button until the desired output values are reached.
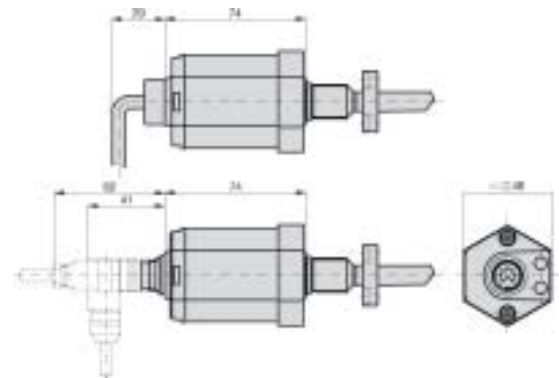
Online setting

This programming function allows you to set the null and end point while in run mode, such as in a closed loop configuration. During the calibration procedure no error signal is output, so that no uncontrolled movement of the hydraulics can occur.
The calibration range is limited to ± 12.5 %.

Features of Micropulse BTL5-A/C/E/G...B

– 100 % adjustment of analog signal
– 3 calibration modes: Teach-in, adjustment for null and end point, and online setting
– Electronics head can be replaced if needed
– Short housing
– Error signal: No magnet in measuring area, transducer in calibration mode

▶ Included:
  – Transducer
  – Calibration device
  – Short user's guide

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
Connectors starting page **BKS.**3

BTL5 Rod	BTL5 Rod	BTL5 Rod	BTL5 Rod
analog	analog	analog	analog
A	**E**	**C**	**G**
analog	analog	analog	analog

BTL5-**A11**-M_ _ _ _-...	BTL5-**E1**_-M_ _ _ _-...	BTL5-**C1**_-M_ _ _-...	BTL5-**G11**-M_ _ _ _-...
0...10 V and 10...0 V			**−10...10 V and 10...−10 V**
	4...20 mA or 20...4 mA	**0...20 mA or 20...0 mA**	
max. 5 mA			max. 5 mA
≤ 5 mV			≤ 5 mV
	≤ 500 Ohm	≤ 500 Ohm	
≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA	≤ 0,33 mV

≤ 5 µm	
System resolution/min. 2 µm	
$f_{STANDARD} = 2$ kHz	
±100 µm up to 500 mm nominal stroke	
±0.02 % 500...4500 mm nominal stroke	
$[150\ \mu V/°C + (5\ ppm/°C \times P \times U/L)] \times \Delta T$	
$[0.6\ \mu A/°C + (10\ ppm/°C \times P \times I/L)] \times \Delta T$	
20...28 V DC	
≤ 150 mA	
yes	
Transzorb protection diodes	
500 V DC (ground to housing)	
−40...+85 °C	
−40...+100 °C	

BTL5-**A11**...	BTL5-E10...	BTL5-E17...	BTL5-**C10**...	BTL5-**C17**...	BTL5-**G11**...
	4...20 mA	20...4 mA	0...20 mA	20...0 mA	
0 V Output	0 V Output		0 V Output		0 V Output
10...0 V					10...−10 V
0...10 V					−10 ... 10V
GND	GND		GND		GND
+24 V DC	+24 V DC		+24 V DC		+24 V DC
(GND)	(GND)		(GND)		(GND)
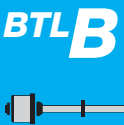
▶ Please enter code for output signal, nominal stroke and connection type in ordering code!

▶ Preferred models
Interfaces A11 and E10
BTL5-A11-M_ _ _ _-B-S 32,
BTL5-E10-M_ _ _ _-B-S 32
highlighted in blue are available from stock.

Ordering example:
BTL5-E1_-M_ _ _ _-_-_ _ _ _

Output signal		Standard nominal strokes [mm]	Housing	Connection type	
1	rising and falling (for A and G)	0025, 0050, 0075, 0100, 0125, 0150, 0175, 0200, 0225, 0250, 0275, 0300, 0325, 0350, 0375,	B = Standard M18×1.5 Further housings page **B.**3	S 32	Connector
0	rising	0400, 0425, 0450, 0475, 0500,		KA02	PUR cable 2 m
7	falling (for C and E)	0550, 0600, 0650, 0700, 0750, 0800, 0850, 0900, 0950, 1000,		KA05	PUR cable 5 m
		1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000,		KA10	PUR cable 10 m
		2250, 2500, 2750, 3000, 3250, 3500, 3750, 3850, 4000, 4250, 4500 or in 5 mm steps on request.		KA15	PUR cable 15 m

■ www.balluff.com

BALLUFF | **B.**5

cost-effective

Series

Transducer interface
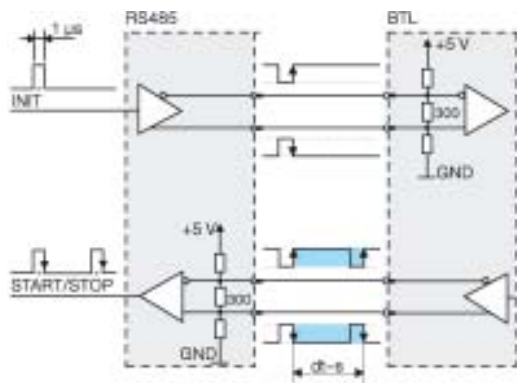Input interface

CE

P Interface

Compatible with BTA/BTM processors and various OEM controls, e.g. Siemens, B & R, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO etc.. Reliable signal transmission, even over cable lengths up to 500 m between BTA and BTL, is assured by the especially noise-immune RS485 differential drivers and receivers. Noise signals are effectively suppressed.
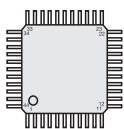
M Interface

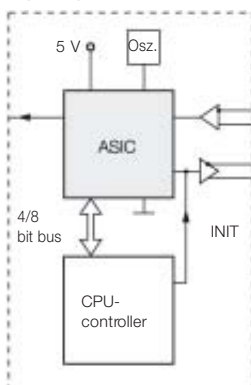The M interface is a controller-specific interface variation.

Ordering code

System resolution	
Repeatability	
Resolution	
Hysteresis	
Sampling rate	
max. non-linearity	
Temperature coefficient of overall system	
Supply voltage	
Current draw	
Operating temperature	
Storage temperature	

Block diagram of P-interface

Pin assignments		Pin	Color
Input/output signals	Input	1	YE
	Ouptut	2	GY
	Input	3	PK
	Ouptut	5	GN
Supply voltage		6	BU
		7	BN
		8	WH

Connect shield to housing

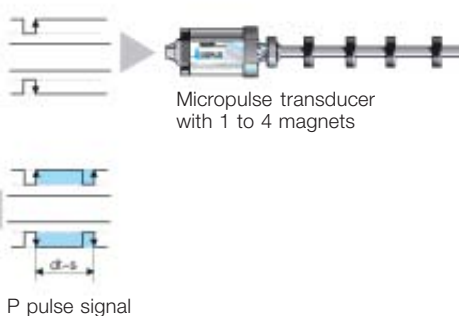## Highly precise digitizing of the P-interface signal

Companies developing their own control and processing electronics can create a highly accurate P-interface cost effectively and with a minimum of effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for the Micropulse P-interface.

Digitizing chip 44QFP

Controller or
Processing electronics

P pulse signal
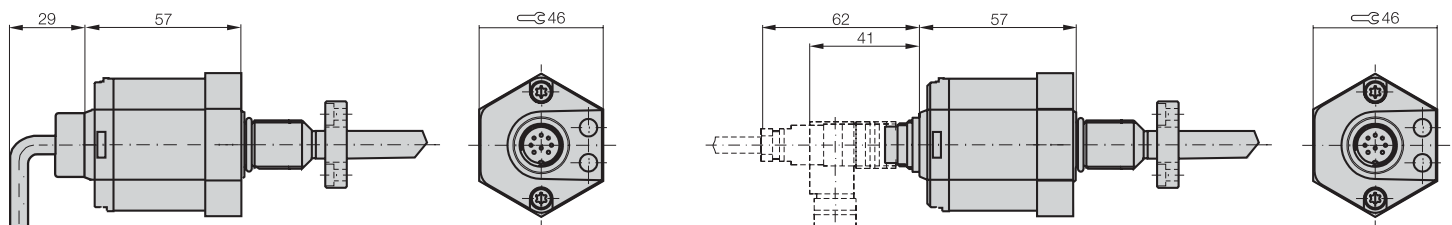
Micropulse transducer
with 1 to 4 magnets

Benefits

– Position resolution 1 µm!
  The 1 µm resolution of the Micropulse positioning system is achieved by the high resolution of the digitizing chip (133 pS). (Clock frequency 2 or 20 MHz)
– Position data from 4 magnets can be processed simultaneously
– 4/8-bit processor interface

ASIC INFO: +49 (0) 71 58/1 73-2 41

BTL5 Rod	BTL5 Rod
Pulse **P**	Pulse **M**
Pulse **P**	Pulse **M**

BTL5-**P**1-M_ _ _ _-...	BTL5-**M**1-M_ _ _ _-...

processing-dependent	
2 µm or ±1 digit depending on processing electronics	
≤ 2 µm	
≤ 4 µm	
$f_{STANDARD}$ = 1 kHz = ≤ 1400 mm	
±100 µm up to 500 mm nominal stroke	
±0.02 % 500...5500 mm nominal stroke	
(6 µm +5 ppm × L)/°C	
20...28 V DC	
≤ 100 mA	
–40...+85 °C	
–40...+100 °C	

BTL5-**P**1-M...	BTL5-**M**1-M...
INIT	INIT
START/STOP	START/STOP
$\overline{INIT}$	$\overline{INIT}$
$\overline{START/STOP}$	$\overline{START/STOP}$
GND	GND
+24 V DC	+24 V DC
(GND)	(GND)
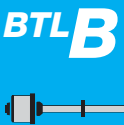
▶ Please enter code for nominal stroke and connection type in ordering code!

▶ Preferred models interface P
BTL5-P1-M_ _ _ _-B-S 32
highlighted in blue are available from stock.

▶ Included:
– Transducer
– Short user's guide

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
Connectors starting page **BKS.**3
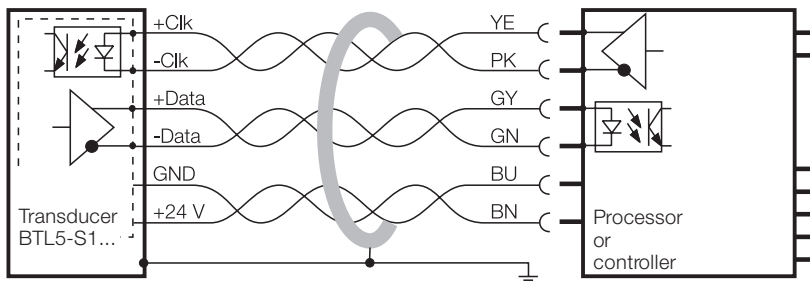
Ordering example:
BTL5-P1-M_ _ _ _-_-_ _ _ _

Standard nominal strokes [mm]

0025, 0050, 0075, 0100, 0125, 0150, 0175, 0200, 0225, 0250, 0275, 0300, 0325, 0350, 0375, 0400, 0425, 0450, 0475, 0500, 0550, 0600, 0650, 0700, 0750, 0800, 0850, 0900, 0950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2250, 2500, 2750, 3000, 3250, 3500, 3750, 3850, 4000, 4250, 4500, 4750, 5000, 5250, 5500 or in 5 mm steps on request.

Housing

B = Standard M18×1.5 further housings page **B.**3

Connection type

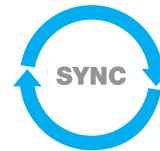|	
S 32	Connector
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Standard SSI interface

Synchronous serial data transmission for controls made by Siemens, Bosch-Rexroth, WAGO, B & R, Parker, Esitron, PEP etc. as well as for Balluff BDD-AM 10-1-SSD and BDD-CC 08-1-SSD display/ controllers.

Reliable signal transmission, even over cable lengths of up to 400 m between control and BTL transducer is assured by especially noise-immune RS485/422 differential line drivers and receivers. Any noise signals are effectively suppressed.

SYNC

Synchronized SSI interface
BTL5-S1_ _**B**-M_ _ _ _-...

Micropulse transducers with the synchronized SSI inter-face are suitable for dynamic control appli-cations. The data acquisition in the transducer is synchronized to the external clock of the controller, permitting an optimum velocity calculation in the controller.
The pre-requirement for this synchronous mode of trans-ducer operation is consistent clock signal timing.

The **maximum sampling frequency f_A**, at which a new current value is generated for each sample, can be derived from the following table:

mm	mm	Hz
nominal stroke ≤	120 :	2500
120 < nominal stroke ≤	475 :	2000
475 < nominal stroke ≤	750 :	1500
750 < nominal stroke ≤	1250 :	1000
1250 < nominal stroke ≤	2600 :	500
2600 < nominal stroke ≤	4000 :	333

BTL5-S1... with processor/controller, wiring example

Clock frequency is a function of cable length

| Cable length	Clock freq.
< 25 m	< 1000 kHz
< 50 m	< 500 kHz
< 100 m	< 400 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

Super-fast 2,5 kHz Sampling rate
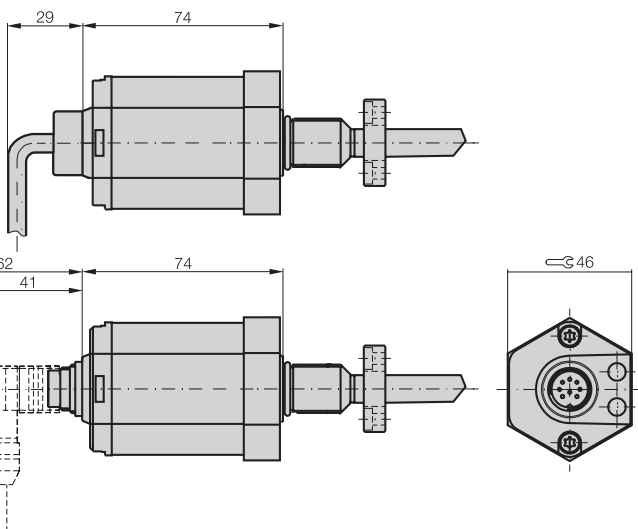
▶ Please enter code for coding, system resolution, nominal stroke and connection type in ordering code!

▶ Included:
– Transducer
– Short user's guide

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
Floats page **B.**17
Connectors starting page **BKS.**3

Series	**BTL5 Rod**
Output signal	synchronous serial
Transducer interface	**S**
Input interface	synchronous serial

CE

Clock sequence
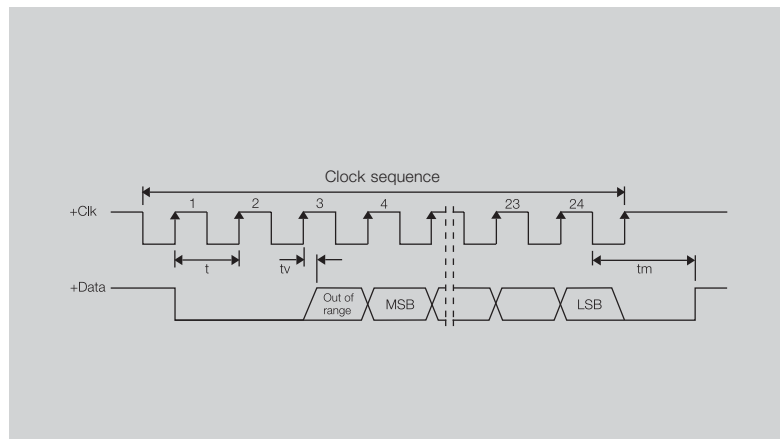
Ordering code	BTL5-**S**1_ _-M_ _ _ _-...
	BTL5-**S**1_ _B-M_ _ _ _-...

Repeatability	± 1 digit
System resolution depending on version (LSB)	1, 5, 10, 20 or 40 μm
Hysteresis	≤ 1 digit
Sampling rate	$f_{STANDARD}$ = 2 kHz
max. non-linearity	±30 μm at 5 and 10 μm resolution or ≤ ±2 LSB
Temperature coefficient of overall system	(6 μm +5 ppm × L) /°C
Supply voltage	20...28 V DC
Current draw	≤ 80 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

Pin assignments	Pin	Color	
Control and	1	YE	+Clk
data signals	2	GY	+Data
	3	PK	–Clk
	5	GN	–Data
Supply	6	BU	GND
voltage (external)	7	BN	+24 V DC
	8	WH	must remain unconnected

Ordering example:

BTL5-S1_ _-M_ _ _ _-_-_ _ _

Coding

0 Binary code rising (24 bits)
1 Gray code rising (24 bits)
6 Binary code rising (25 bits)
7 Gray code rising (25 bits)

System resolution

1 1 μm
2 5 μm
3 10 μm
4 20 μm
5 40 μm
6 100 μm
7 2 μm

Standard nominal strokes [mm]

0025, 0050, 0075, 0100, 0125, 0150, 0175, 0200, 0225, 0250, 0275, 0300, 0325, 0350, 0375, 0400, 0425, 0450, 0475, 0500, 0550, 0600, 0650, 0700, 0750, 0800, 0850, 0900, 0950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2250, 2500, 2750, 3000, 3250, 3500, 3750, 3850, 4000 or in 5 mm increments on request

Housing

B = Standard M18×1.5 Further housings page **B.**3

Connection type

S 32 Connector
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m

Ordering code for SSI interface with synchronization to clock (dynamic control applications) insert the letter B!
BTL5-S1_ _**B**-M_ _ _ _-B-S 32

BTL B

General data
Analog interface
Digital pulse interface
SSI interface
CANopen interface
PROFIBUS-DP interface
Position recognition in the hydraulics
Magnets and floats
Installation notes
Special series

BKS

Page **BKS.**3

User-friendly hardware and software set-up

CANopen interface

Based on CAN (ISO/IEC 7498 and DIN ISO 11898), CANopen provides a Layer-7 implementation for industrial CAN networks. The serial data protocol of the CAN specification is defined according to the producer-consumer principle as opposed to most other fieldbus protocols. This eliminates target addressing of the process data. Each bus station decides for itself how the received data are processed.

The CANopen interface of the Micropulse transducer is compatible with CANopen conforming with CiA Standard DS301 Rev. 3.0, and with CAL and Layer 2 CAN networks.

CAN-BUS features

– Line topology,
  star structure also
  possible using repeaters
– Cost-effective 2-wire
  cabling
– Fast response times, high
  data integrity using CRC,
  hamming distance of 6
– 1 Mbps at cable lengths
  < 25 m
– Number of stations
  protocol-limited to 127
– Using multiple magnets:
  A minimum spacing
  of > 65 mm must be
  maintained.

CANopen offers a high level of flexibility with respect to functionality and data exchange. Using a standard data sheet in the form of an EDS file it is easy to link the Micropulse transducers to any CANopen system.

Process Data Object (PDO)

12 Micropulse transducers send their position information optionally in one or two PDOs with 8 bytes of data each. The contents of the PDO is freely configurable. The following information can be sent:

– Current magnet position
  with resolution in 5 μm
  steps
– Current velocity of the
  magnet with resolution
  selectable in 0.1mm/s
  steps
– Current status of the four
  freely programmable cams
  per magnet.

Synchronization Object (SYNC)

Serves as a net-wide trigger for synchronizing all network participants. When the SYNC object is received, all Micropulse transducers active on the bus store their current position and velocity information and then send it sequentially to the control. This assures time-synchronous capture of the measured values.

LED

Display of the CANopen status to DS303-3

FMM

The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active. So if only two magnets are positioned in the measurement range, a valid value is output for the first two positions and a defined error value for positions 3 and 4.

Emergency Object

This object is sent with the highest priority. This is used for example for error messages when cam states change.

Service Data Object (SDO)

Service Data Objects transmit the parameters for the transducer configuration. The transducer configuration may be carried out on the bus by the controller, or offline using a PC with a configuration tool which runs under Windows. The configuration is stored in the transducer in a non-volatile memory.
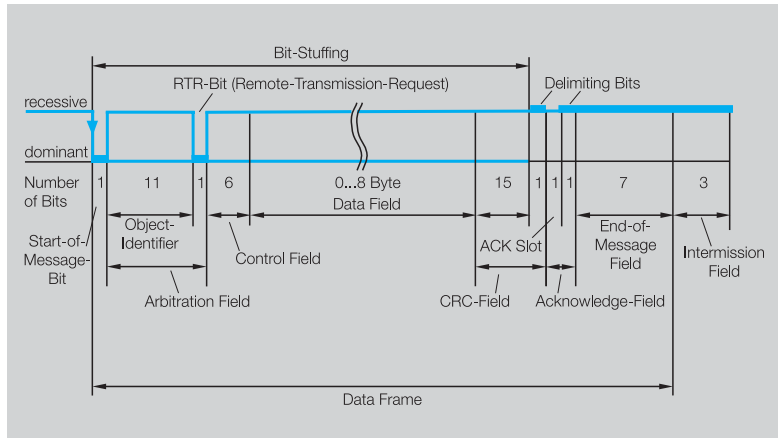
CANopen
certified

CiA 199911-301v30/11-009

Use of multiple magnets

A minimum spacing of > 65 mm must be maintained.

BTL5-H1_ _-M_ _ _ -B-S 92

BTL5-H1_ _-M_ _ _ -B-S 94
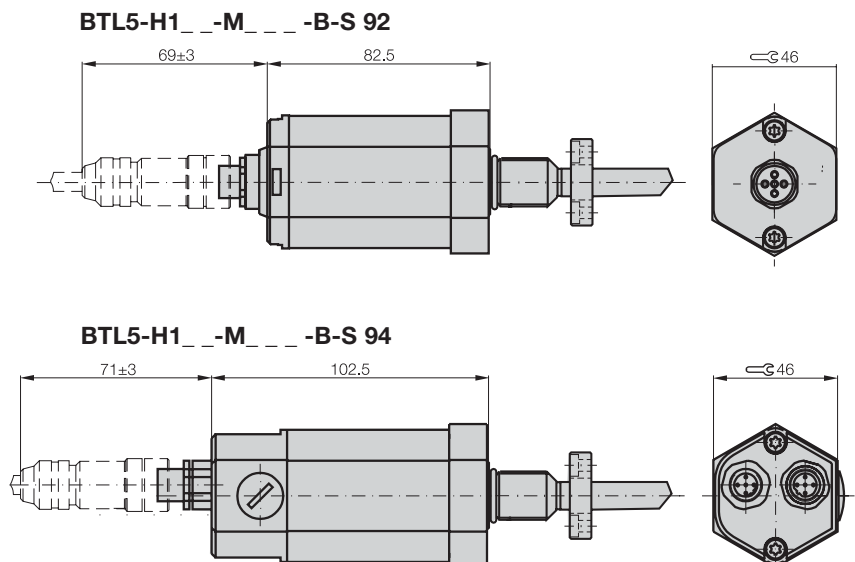
Node ID can be set by DIP switch.

Series	**BTL5 Rod**
Output signal	CANopen
Transducer interface	**H**
Input interface	CANopen

Ordering code	BTL5-**H**1_ _-M_ _ _ _-...
CANopen interface	potential-free
Repeatability	± 1 digit
System resolution Position	5 µm increments
configurable Velocity	0.1 mm/s increments
Hysteresis	≤ 1 digit
Sampling rate	$f_{STANDARD}$ = 1 kHz
max. non-linearity	±30 µm at5 µm resolution
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C
Supply voltage	20...28 V DC
Current draw	≤ 100 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

Cable length [m] per CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500
Baud rate [kBaud] per CiA DS301	1000	800	500	250	125	100	50	20/10

Pin assignments	Pin	Color	
Control and	1	WH	CAN_GND
data signals	2	BN	+24 V
	3	BU	0 V (GND)
	4	GY	CAN_HIGH
	5	GN	CAN_LOW

Using the CANopen interface and cable lengths up to 2500 m, the signal is sent at a length-dependent baud rate to the control. The high noise immunity of the connection is achieved using differential drivers and by the data monitoring scheme.

▶ Included:
– Transducer
– Short user's guide

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
Floats page **B.**17
Connectors starting page **BKS.**4

▶ Please enter code for software configuration, baud rate and nominal stroke length in order code. Cable upon request.

Ordering example:
BTL5-H1_ _-M_ _ _ _-_-S 92
BTL5-H1_ _-M_ _ _ -_-S 94

Software configuration		Baud rate		Standard nominal strokes [mm]	Housing
1	1 × Position and 1 × Velocity	0	1 MBaud	0025, 0050, 0075, 0100,	B = Standard M18×1.5 Further housings page **B.**3
2	2 × Position and 2 × Velocity	1	800 kBaud	0125, 0150, 0175, 0200,	
		2	500 kBaud	0225, 0250, 0275, 0300,	
		3	250 kBaud	0325, 0350, 0375, 0400,	
		4	125 kBaud	0425, 0450, 0475, 0500,	
		5	100 kBaud	0550, 0600, 0650, 0700,	
		6	50 kBaud	0750, 0800, 0850, 0900,	
		7	20 kBaud	0950, 1000, 1100, 1200,	
		8	10 kBaud	1300, 1400, 1500, 1600,	
				1700, 1800, 1900, 2000,	
				2250, 2500, 2750, 3000,	
				3250, 3500, 3750, 3850,	
				4000 or in 5 mm increments on request.	

BTL B

- General data
- Analog interface
- Digital pulse interface
- SSI-interface
- **CANopen interface**
- PROFIBUS-DP interface
- Position recognition in the hydraulics
- Magnets and floats
- Installation notes
- Special series

BKS

Page **BKS.**4

User-friendly hardware and software set-up

As the market leading standard for serial data transmission for process automation, PROFIBUS-DP is the ideal choice for implementing automation tasks with cycle times of > 5 ms.

Data transmission
A PROFIBUS telegram can contain up to 244 bytes of user data per telegram and station. The BTL5-T uses max. 32 bytes (max. 4 position values and max. 4 velocity values) for process data transmission. Up to 126 active stations (Address 0...125) can be connected on PROFIBUS-DP. User data cannot be sent with station address 126. This address is used as the default address for bus stations that have to be parameterized by a Class 2 master (for setting the device address if there are no mechanical switches available).
Each PROFIBUS station has the same priority. Prioritizing of individual stations is not intended, but can be done by the master since the bus transmission only makes up a fraction of the process cycle anyway.
At a transmission rate of 12 Mbps, the transmission time for an average data telegram is in the 100 µs range.

Master
There are two types of possible masters for PROFIBUS-DP. Master Class 1 carries out the user data interchange with the connected slaves. Master Class 2 is intended for startup and diagnostic purposes and may be used to briefly assume control of a slave.

GSD (Device Master Data)
The length of the data exchangeable with a slave is defined in the Device Master Data file (GSD) and is checked by the slave with the configuration telegram and confirmed for correctness.
In modular systems, various configurations are defined in the GSD file. Depending on the desired functionality, one of these configurations can be selected by the user when the system is configured. The BTL5-T is a modular device with the possibility of selecting the number of magnets (position values).

Use of multiple magnets
A minimum spacing of > 65 mm must be maintained.

Slave
Once a PROFIBUS master has received the parameter set defined for the slave, it is able to exchange data. The parameter set consists of slave parameters and configuration data.
The parameter data contain the description of the slave settings (e.g. resolution of a position value). The configuration data describe the length and structure of the data telegram.

Process data
Under PROFIBUS-DP the default is for process data to be sent from the master to slaves acyclically and for the slave data to then be queried. To ensure synchronization of multiple devices, the master may use the SYNC and FREEZE services.

DP/V1 and DP/V2

Isochronic mode
Isochronic mode enables quick and deterministic data exchange by means of clock synchronicity on the bus system. A cyclic equidistant clock signal is sent by the master to all bus devices. This signal allows master and slaves to be synchronized irrespective of application – with an accuracy < 1 µs.

Cross traffic between slaves
Cross traffic permits two DP slaves to exchange data directly with each other: the master ensures that the slave publishes its data on the bus with a request for "Data-eXchange-Broadcast" (DXB-Request) and thus makes it available to other slaves. Since the process data is available in the process periphery without being diverted through the master application, cross-traffic permits very fast control system responses.

Acyclic services
The DP functions for prioritized communication permit acyclic read and write functions to be sent between master and slaves, independently of the cyclic user data traffic. The transfer of acyclic data is performed at a lower priority in parallel to the high speed cyclic data exchange – as if in the background. The background / foreground split means the ratio of cyclic to acyclic data can be adjusted if required.

FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active. So if only two magnets are positioned in the measurement range, a valid value is output for the first two positions and a defined error value for positions 3 and 4.
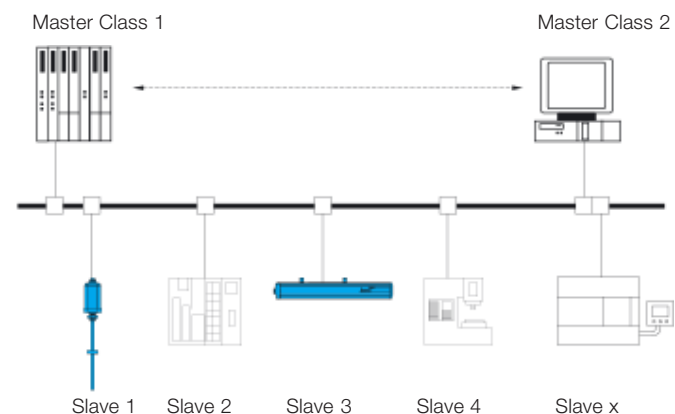
Device address can be set by DIP switch

Address can be set by DIP switch.

Master Class 1

Master Class 2

Slave 1   Slave 2   Slave 3   Slave 4   Slave x
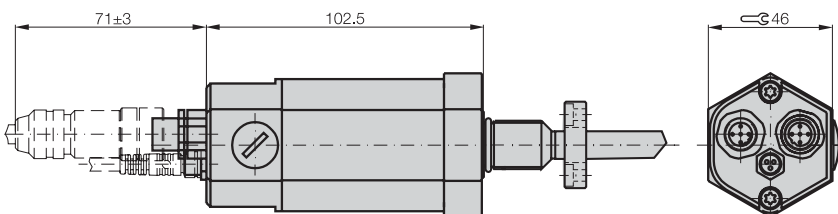
Series	**BTL5 Rod**
Output signal	PROFIBUS-DP
Transducer interface	**T**
Input interface	PROFIBUS-DP

SRD-Request, variable lenght of user data

| SYN | SD2 | LE | LEr | SD2 | DA | SA | FC | DU | FCS | ED |

SRD-Response, variable lenght of user data

| SD2 | LE | LEr | SD2 | DA | SA | FC | DU | FCS | ED |

DP- Master / DP- Slave
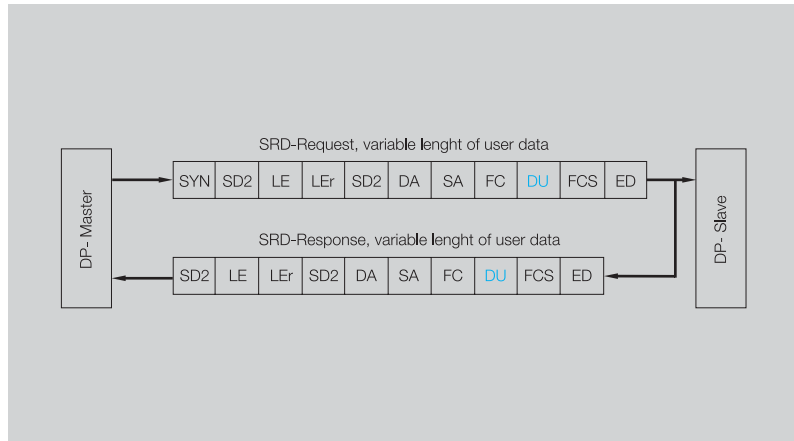
Ordering code Connector version S103	BTL5-**T**1_ 0-M_ _ _ _-_-S103
Profibus-Version	EN 50170, Encoder profile
Profibus-interface	potential-free
Repeatability	±1 digit
System resolution Position	5 µm increments configurable
configurable Velocity	0.1 mm/s increments configurable
Hysteresis	≤ 1 digit
Sampling rate	$f_{STANDARD}$ = 1 kHz
max. non-linearity	±30 µm at 5 µm resolution
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C
Magnet traverse velocity	any
Supply voltage	20...28 V DC
Current draw	≤ 120 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C
GSD file	BTL504B2.GSD
Address assignment	mechanical switches and Master Class 2

Cable length [m]	< 100	< 200	< 400	< 1000	< 1200
Baud rate [Kbps]	12000	1500	900	187.5	93.7/19.2/9.6

Pin assignments		S103 5-pin	S103 3-pin
Control and	Data GND	3	
data signals	R×D/T×D-N (A)	2	
	R×D/T×D-P (B)	4	
	VP +5 V	1	
Supply voltage	+24 V		1
and shield	0 V (GND)		3
	Ground PROFIBUS-DP	5	
	Shield Supply		4

▶ Please enter code for software configuration and nominal stroke length in ordering code!

▶ Included:
– Transducer
– Short user's guide

Please order separately:
Magnets starting page **B.**16
Mounting nuts page **B.**16
Connectors starting page **BKS.**6
GSD file BTL5TGSD 119399 (free of charge)
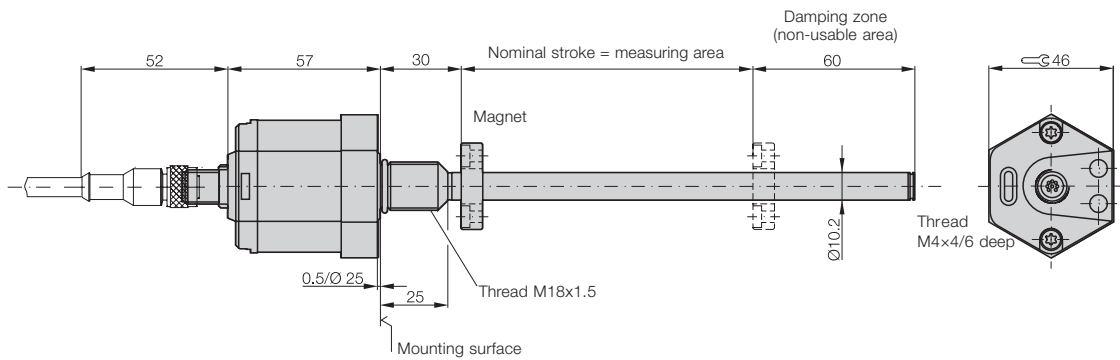
Ordering example:
BTL5-T1_ 0-M_ _ _ _-_-S103

Software configuration

1   1 magnet
2   2 magnets

Standard nominal strokes [mm]

0025, 0050, 0075, 0100, 0125,
0150, 0175, 0200, 0225, 0250,
0275, 0300, 0325, 0350, 0375,
0400, 0425, 0450, 0475, 0500,
0550, 0600, 0650, 0700, 0750,
0800, 0850, 0900, 0950, 1000,
1100, 1200, 1300, 1400, 1500,
1600, 1700, 1800, 1900, 2000,
2250, 2500, 2750, 3000, 3250,
3500, 3750, 3850, 4000 or
in 5 mm increments on request.

Housing

B = Standard
M18×1.5
Further housings
page **B.**3

ProSet4

Damping zone (non-usable area)

52   57   30   Nominal stroke = measuring area   60   46

Magnet

Thread M4×4/6 deep

Ø10.2

0.5/Ø 25   25   Thread M18x1.5

Mounting surface

PI0020e

**Single position measurement between the piston limits of travel on standard cylinder series**

Advantages:
– no special design of piston or piston rod necessary
– no permanent magnet required between the piston seals
– easy to program
– no time-consuming adjustment
– high resolution and repeatability
– Switch points freely programmable using calibration device or programming inputs

Calibration device BTL5-A-EH01 for programming the outputs

ca. 27   ca. 53

1
2
3
4
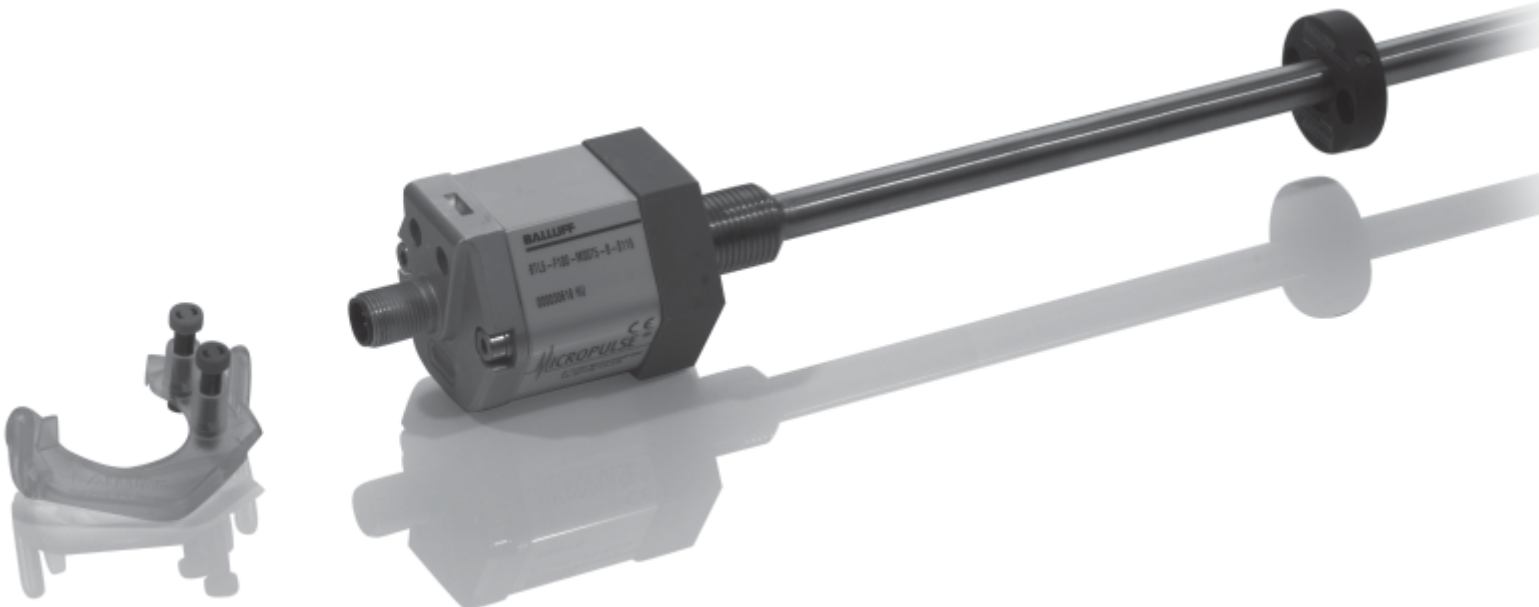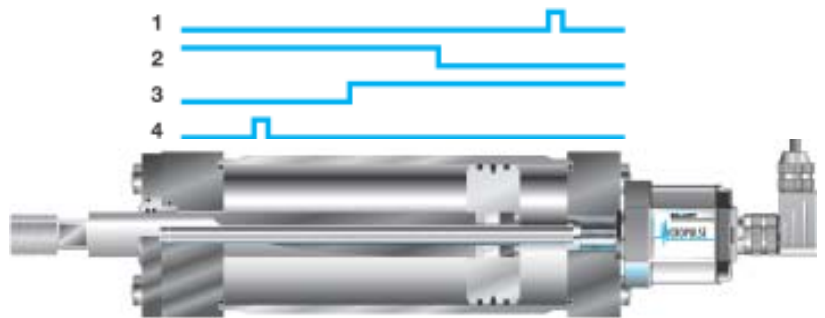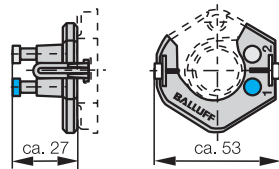
Series	BTL5 Rod
Transducer interface	F
Input interface	digital

Ausgang **1**
Ausgang **2**
Ausgang **3**
Ausgang **4**
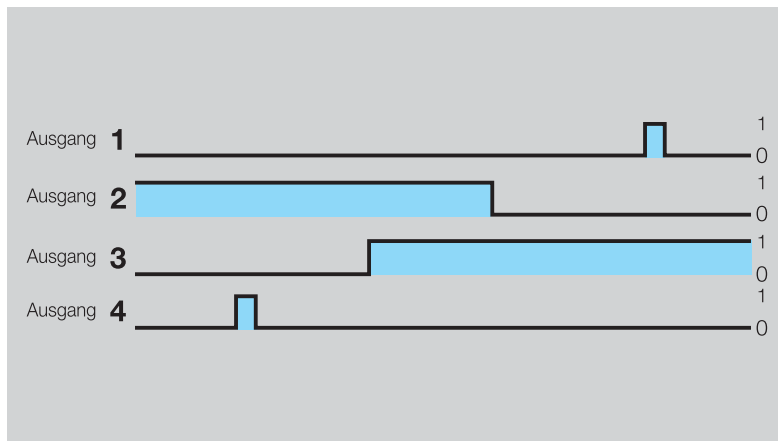
Ordering code	BTL5-**F1_0**-M_ _ _ _-_-S115
Output signals	4 switched outputs
max. current rating per output	100 mA
max. current rating for 4 outputs	200 mA
Repeatability	±0.1 mm
Sampling rate	$f_{STANDARD}$ = 1 kHz = ≤ 1400 mm
Supply voltage	24 V DC ±20 %
No-load current consumption	≤ 100 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C
Pin assignments	Pin 1	Output 1
	Pin 2	Output 2
	Pin 3	Output 3
	Pin 4	Output 4
	Pin 5	La; Programming input (low-active)
	Pin 6	GND
	Pin 7	+24 V DC
	Pin 8	Lb; Programming input (low-active)
Shock load	100 g/6 ms per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per IEC 60068-2-6
Dielectric constant	500 V DC (GND to housing)
Enclosure rating per IEC 60529	IP 67 (with BKS-S... IP 67 connector attached)
Housing material	Anodized aluminum/1.4571 stainless tube, 1.3952 stainless investment cast flange
Mounting	thread M18×1.5, 3/4"-16UNF on request
Pressure rating	600 bar installed in hydraulic cylinder
Connection type	Connectors

▶ Included:
– Transducer
– Short user's guide
– Calibration device

Please order separately:
Magnets page **B.**16
Mounting nuts page **B.**16
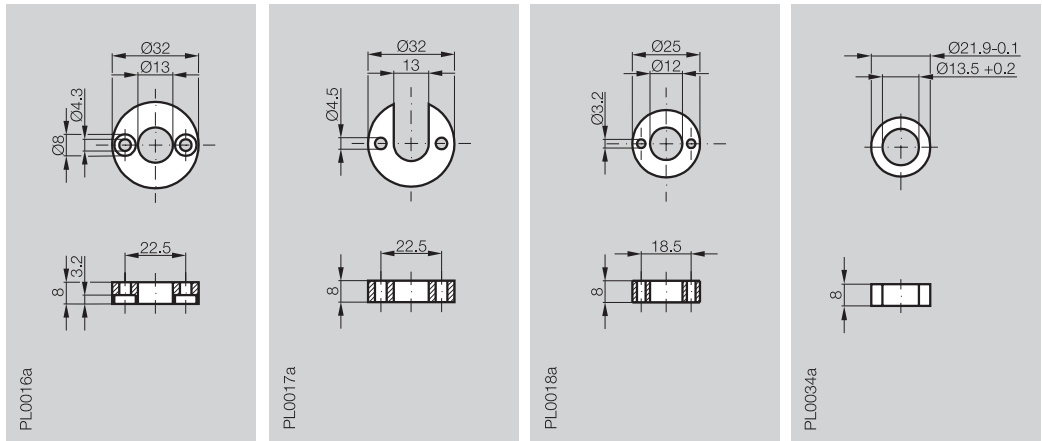Connectors starting page **BKS.**3

Ordering example:
BTL5-F1_0-M_ _ _ _-_-S115

| Output	Standard nominal strokes [mm]	Housing
0 Output NPN switching	0025, 0050, 0075, 0100, 0125, 0150, 0175, 0200, 0225, 0250, 0275, 0300, 0325, 0350, 0375, 0400, 0425, 0450, 0475, 0500, 0550, 0600, 0650, 0700, 0750, 0800, 0850, 0900, 0950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2250, 2500, 2750, 3000, 3250, 3500, 3750, 3850, 4000 or in 5 mm increments on request.	B = Standard M18×1.5 Further housings page **B.**3
1 Output PNP switching		

BTL ***B***

General data
Analog interface
Digital pulse interface
SSI-interface
CANopen interface
PROFIBUS-DP interface
Position recognition in the hydraulics
Magnets and floats
Installation notes
Special series

BKS

Page **BKS.**6

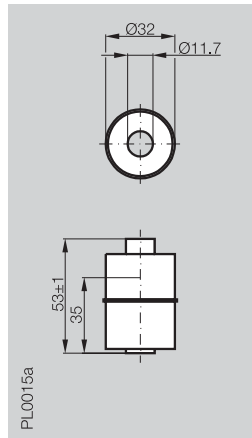| Description for series	**Magnet** BTL5 Rod	**Magnet** BTL5 Rod	**Magnet** BTL5 Rod	**Magnet** BTL5 Rod
	PL0016a	PL0017a	PL0018a	PL0034a
Ordering code	BTL-P-1013-4R	BTL-P-1013-4S	BTL-P-1012-4R	BTL-P-1014-2R
Material	Al	Al	Al	Al
Weight	approx. 12 g	approx. 12 g	approx. 12 g	approx. 10 g
Magnet traverse velocity	any	any	any	any
Operating temperature/Storage temperature	−40...+100 °C	−40...+100 °C	−40...+100 °C	−40...+100 °C
Ordering code PA 60 glass fiber reinforced	BTL-P-1013-4R-PA		BTL-P-1012-4R-PA	
Material	PA 60 glass fiber reinforced		PA 60 glass fiber reinforced	
Weight	approx. 10 g		approx. 10 g	
Magnet traverse velocity	any		any	
Operating temperature/Storage temperature	−40...+100 °C		−40...+100 °C	
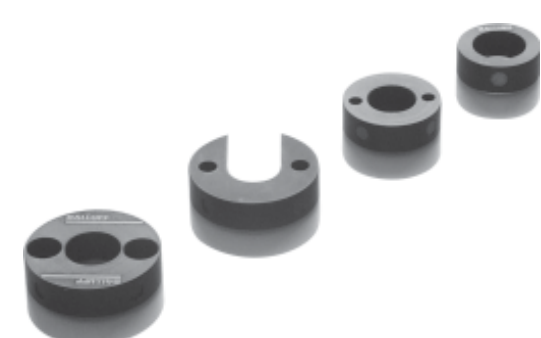
M18×1.5 mounting nut
Order designation:
BTL-A-FK01-E-M18×1.5

3/4"-16 UNF mounting nut
Order designation:
BTL-A-FK01-E-3/4"-16 UNF

Description	**Float**	**Float**	**Float**	**Float**
for series	BTL5 Rod	BTL5 Rod	BTL5 Rod	BTL5 Rod

	Ø32 Ø11.7	Ø44 Ø13	Ø62 Ø16	Ø50.9 Ø13
	53±1 / 35	49±0.5 / 31	80±0.5 / 41	52 / 45
	PL0015a	PL0014a	PL0013a	PL0032a
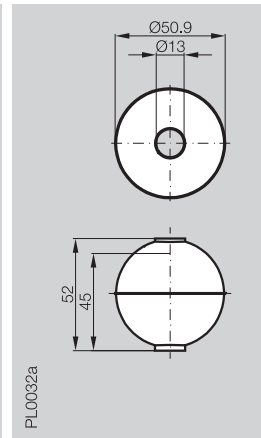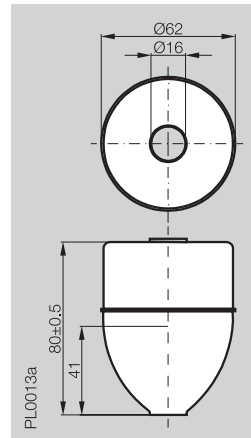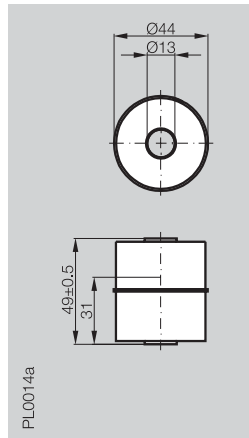
Ordering code	BTL2-S-3212-4Z	BTL2-S-4414-4Z	BTL2-S-6216-8P	BTL2-S-5113-4K
Material	Stainless 1.4571	Stainless 1.4571	Stainless 1.4541	Stainless 1.4571
Weight	approx. 20 g	approx. 30 g	approx. 66 g	approx. 34 g
Operating/Storage temperature	–40...+120 °C	–40...+120 °C	–40...+120 °C	–40...+120 °C
Displacement in water	approx. 35 mm	approx. 31 mm	approx. 41 mm	approx. 45 mm
Pressure resistance (static)	24 bar	20 bar	15 bar	40 bar
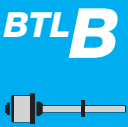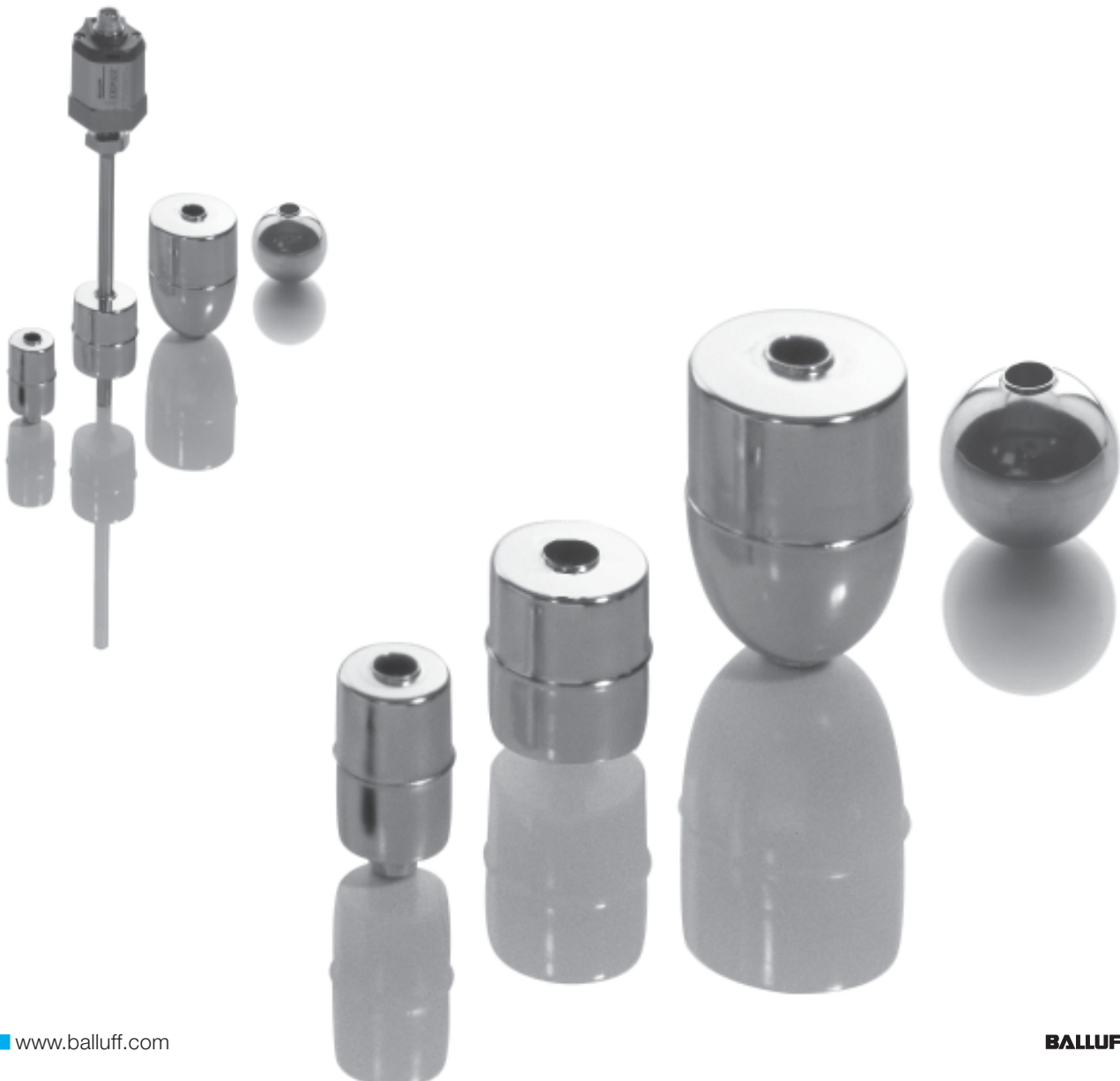
BTL B
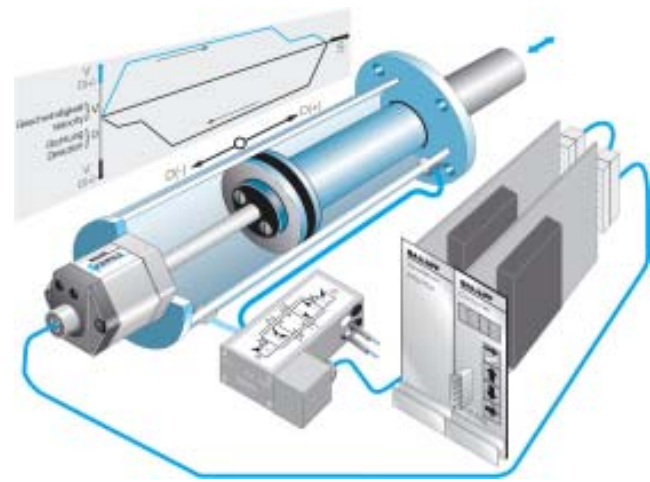

General data

Analog interface

Digital pulse interface

SSI-interface

CANopen interface

PROFIBUS-DP interface

Position recognition in the hydraulics

Magnets and floats

Installation notes

Special series

Application to a hydraulic
cylinder in a control loop

**SSI-SYNC –
Better control
characteristics and higher
dynamics**

The absolute positioning
information from the
Micropulse transducer is
transmitted synchronously to
the axis control card. This
synchronous data
acquisition permits a precise
calculation of the velocity
and acceleration.
The feedback of these
variables (velocity and
acceleration) allows the
damping and resonant
frequency of a hydraulic
system to be increased.
These measures permit a
higher control amplification,
and thus better control
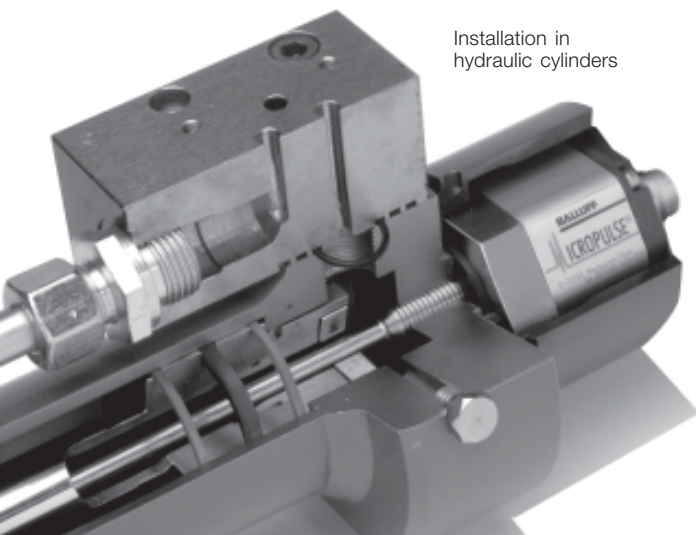characteristics and higher
dynamics

Micropulse Transducers
BTL5-S1_ _ -**S1**-...
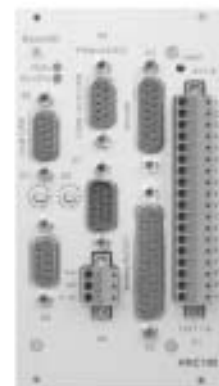
Control card with
SSI interface
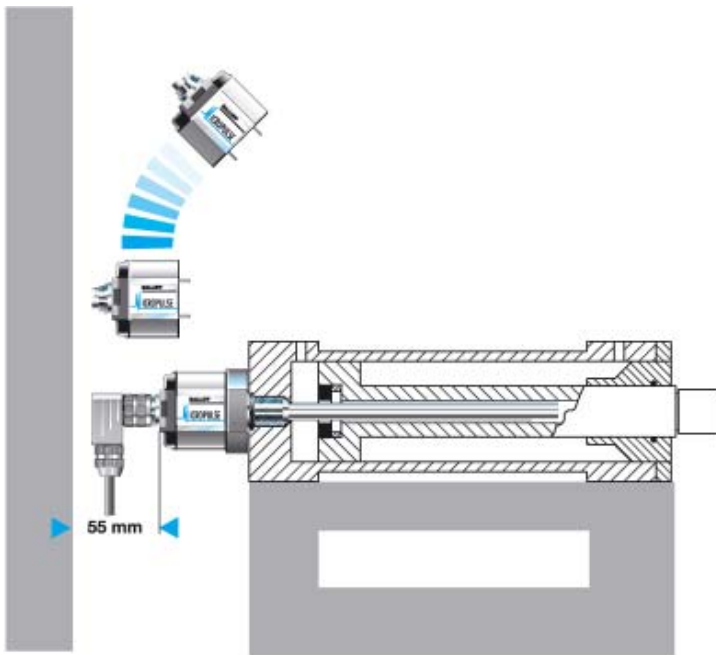for connection to
Micropulse Transducer
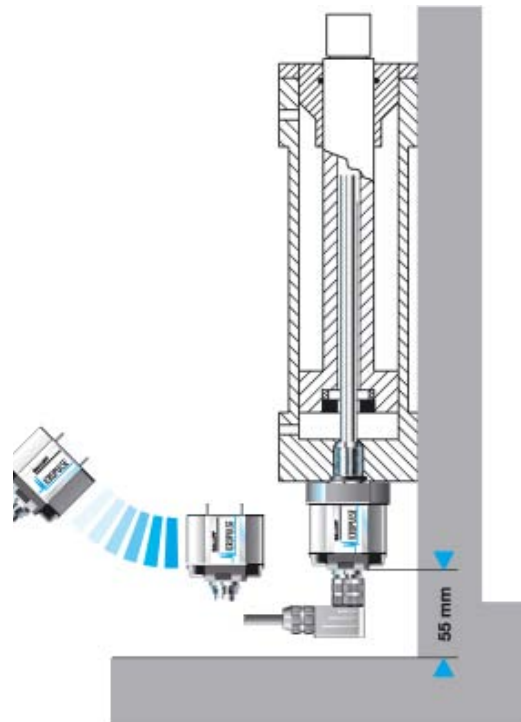
Installation in
hydraulic cylinders

Hassle-free service

Cylinder-mounted transducers are often located in difficult to access spots. If a transducer is damaged or fails, replacing the complete transducer with head and waveguide is often a difficult and expensive proposition. Should a problem occur in the electronics of the

Micropulse transducer, the electronics head can be easily and quickly exchanged for a new one. The fluid circuit also remains intact, with no draining necessary.
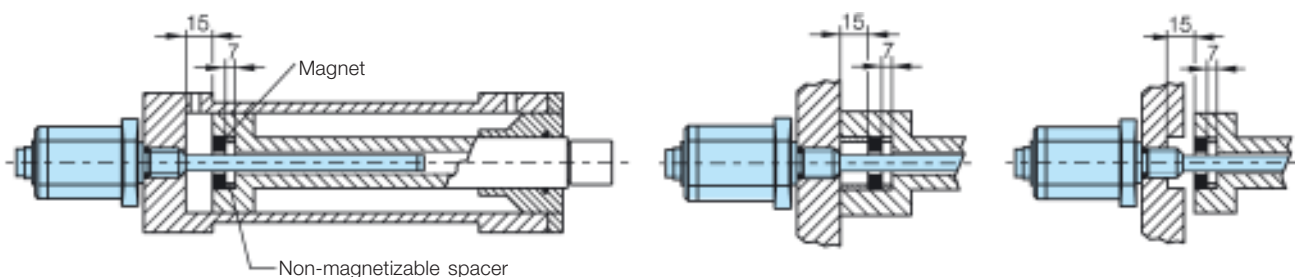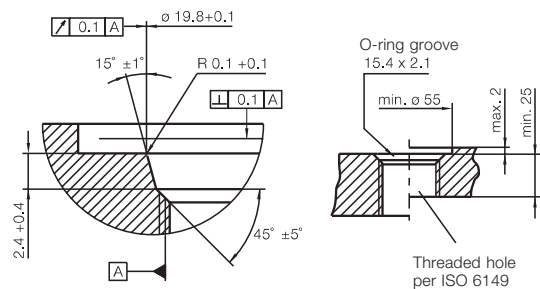
Servicing a vertical installation

Servicing a horizontal installation

Installation

The BTL Micropulse transducer is provided with an M18×1.5 mounting thread. We recommend mounting into non-magnetizable materials.

If magnetizable materials are used, the installation must be carried out as shown in the drawing below. Sealing is at the flange mounting surface, using the M18×1.5 thread and a supplied O-ring 15.4 × 2.1.

ø 19.8+0.1 · 15° ±1° · R 0.1 +0.1 · 2.4 +0.4 · 45° ±5°

O-ring groove 15.4 × 2.1 · min. ø 55 · max. 2 · min. 25 · Threaded hole per ISO 6149

Magnet

Non-magnetizable spacer

15 · 7

Micropulse Special series

Difficult applications often make special demands on the sensors. Balluff meets these requirements with transducers that have been specified and developed in conjunction with the systems integrator. Behind this is a large, highly motivated Micropulse development team as well as Balluff's own EMC Testing Laboratory and shock and vibration test centers.

The "3-in-1" transducer!

– 2- or 3-way redundant positioning system for heightened safety requirements
– One transducer consists of two or three completely separate positioning lines
– Start/Stop or analog interfaces
– Compact housing
– max. nominal stroke 1000 mm

Available outputs:

– analog 0...10 V, 4...20 mA, 0...20 mA, −10...10 V
– Pulse interface
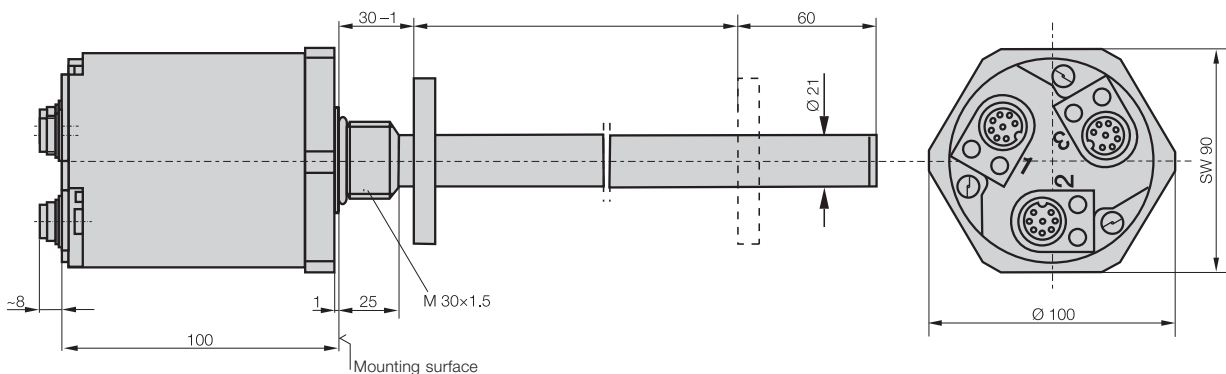
Tilt control on rail cars

Propeller pitch control

Ordering example:
BTL5-_ _ _-M_ _ _ _-T-_S 32

Interfaces	**Nominal strokes [mm]**	**Number of redundant systems**
Analog: voltage output	0025...1000	2 with two independent outputs
A10 0...10 V		3 with three independent outputs
G10 −10...10 V		
Output current		
C10 0...20 mA		
C17 20...0 mA		
E10 4...20 mA		
E17 20...4 mA		
Pulse:		
P11		

30 −1   60

Ø 21

SW 90

~8   1   25   M 30×1.5

100

Ø 100

Mounting surface

PL0044

Rudder control

BTL **B**

General
data

Analog
interface

Digital
pulse
interface

SSI-
interface

CANopen
interface

PROFIBUS-DP
interface

Position
recognition in
the hydraulics

Magnets
and
floats

Installation
notes

**Special
series**

0...10 V
4...20 mA
0...20 mA
–10...10 V