

BALLUFF

sensors worldwide

Micropulse AR

... Optimized for the Mobile Hydraulics of the Future



Position detection in mobile hydraulics

Sensors are being used increasingly to extend useful life and improve safety in mobile equipment. The new Micropulse AR Transducer from Balluff senses the piston position in mobile hydraulic cylinders. The sensor operates on the proven magnetostrictive principle. The compact size of the transducer makes it ideal for use in pivot bearing and spherical eye end cylinders or large bore cylinders. The processing electronics integrated in the transducer has been designed to meet the strict EMC Directives for industrial lift trucks, agricultural and forestry equipment and earthmoving machinery.

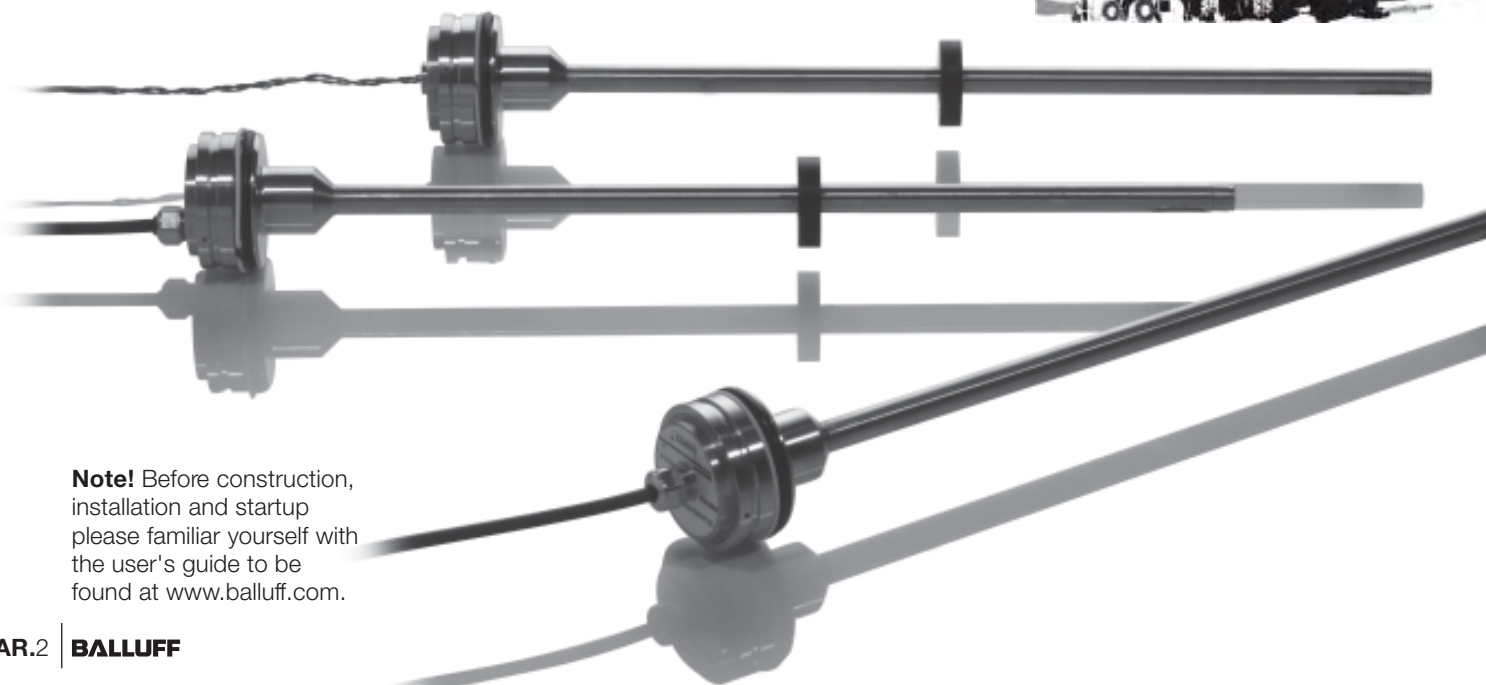
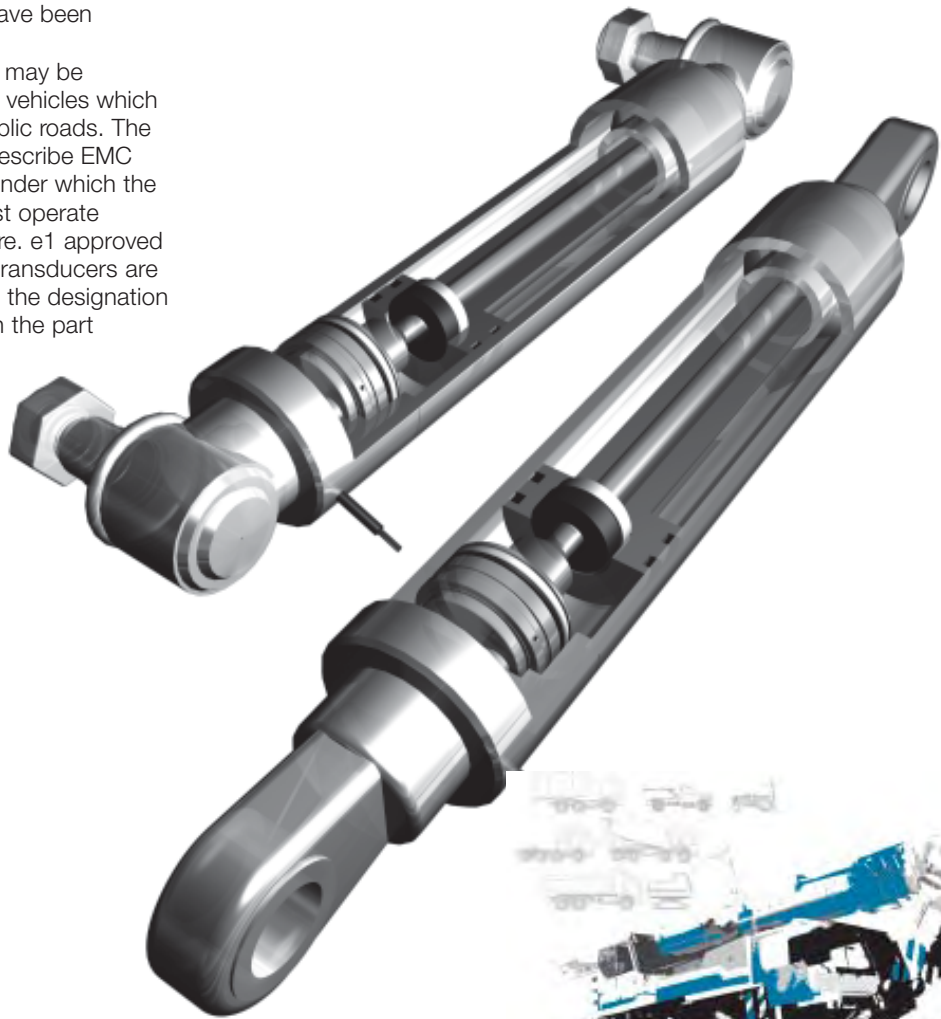
Compatibility testing according to EMC Directives

ISO 14982 Agricultural and Forestry Machinery
ISO 13766
Earthmoving Machinery
ISO 7637-1/2/3
Road Vehicles
EN 12895 Industrial Trucks
EN 50121-3-2
Railway Applications
ISO 11452-5
Electromagnetic HF field, 200 V/m

e1 Type-Approval

The e1-Type Approval is granted by the German Federal Motor Transport Authority KBA and confirms that special motor vehicle standards have been maintained.

The devices may be mounted on vehicles which travel on public roads. The standards describe EMC conditions under which the devices must operate without failure. e1 approved Micropulse transducers are indicated by the designation "-SA265-" in the part number.



Note! Before construction, installation and startup please familiar yourself with the user's guide to be found at www.balluff.com.

Series	BTL6 Rod AR
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Housing E2/E28, BTL6-...-E2/E28-...-KA

Cable out axial centric

	B	C
BTL6-A/B	25.2	13
BTL6-E/C	29.75	13
BTL6-P	25.2	16

	A (mm)	G (mm)
E2	10.2	Thread M4 x 4/6 deep
E28	8	No thread

PL0082a

Housing E2/E28, BTL6-...-E2/E28-...-LA

Cable out axial with pigtail

	B
BTL6-A/B	25.2
BTL6-E/C	29.75
BTL6-P	25.2

	A (mm)	G (mm)
E2	10.2	Thread M4 x 4/6 deep
E28	8	No thread

PL0083a

Housing E2/E28, BTL6-...-E2/E28-...-KE

Cable out axial eccentric

	B	C
BTL6-A/B	25.2	13
BTL6-E/C	29.75	13
BTL6-P	25.2	16

	A (mm)	G (mm)
E2	10.2	Thread M4 x 4/6 deep
E28	8	No thread

PL0084a

Order code	BTL6-...-M...-E2/E28-...
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Shock load	100 g/6 ms per IEC 60068-2-27
Continuous shock	50 g/2 ms
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Dielectric strength	500 V DC (GND to housing)
Protection per IEC 60529	IP 67
Housing material	Outer tube 1.4571 stainless, flange 1.4404 stainless
Pressure rating with 10.2 mm outer tube E2	350 bar when installed in hydraulic cylinder
Pressure rating with 8 mm outer tube E28	250 bar when installed in hydraulic cylinder
Connection type	Cable connection or pigtail
EMC tests:	
RF Emission	EN 55011 Group 1, Class A/B
Static Electricity (ESD)	IEC 61000-4-2 Severity Level 3
Electromagnetic Fields (RFI)	IEC 61000-4-3 Severity Level 3
Rapid Transients (BURST)	IEC 61000-4-4 Severity Level 3
Surge Voltage	IEC 61000-4-5 Severity Level 2
Line-induced Disturbances	IEC 61000-4-6 Severity Level 3
Magnetic Fields	IEC 61000-4-8 Severity Level 4
Standard nominal stroke lengths [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 or 1mm increments on request
with 8 mm outer rod (style E28) is the max. nom. stroke length 1016 mm	

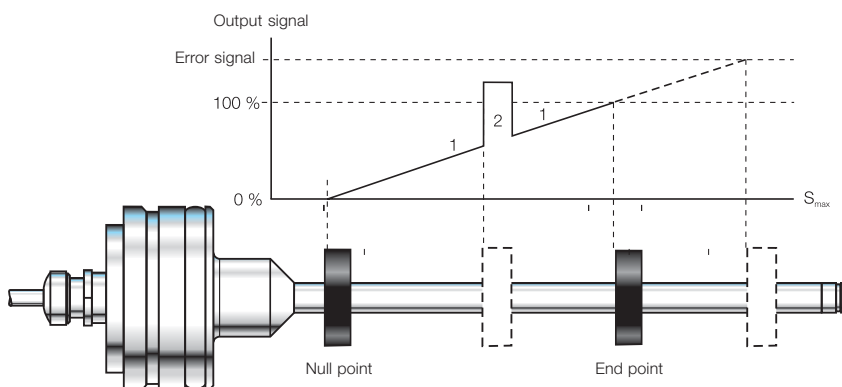


General Data

- Analog Interface
- Digital Pulse Interface
- Installation Notes
- Magnet
- Balluff Testing Laboratory

The propagation time of an ultrasonic wave, induced by magnetostriction, is used to determine the position of the magnet.

The position is output as an analog value which rises. This is done with high precision and repeatability within the measuring area designated as the nominal stroke length. If there is no magnet within the measuring area, an error signal is output. At the rod end is a damping zone. When a magnet is in this zone the output is spurious. The electrical connection between the transducer, the controller and the power supply is accomplished using a cable or pigtail.



Output signal rising

Magnet position

- 1 Within the measuring area
- 2 Magnet not present

Series	
Output signal	
Transducer interface	
Customer-side interface	



Order code

Output voltage	
Output current	
Load current	
Ripple max.	
Load resistance	
System resolution	

Hysteresis	
Repeat accuracy	
Sampling rate	
max. non-linearity	

Temperature coefficient	Voltage output
	Current output

Supply voltage	
Current draw	
Polarity reversal protected	
Overvoltage protected	
Dielectric strength	
Operating temperature	
Storage temperature	

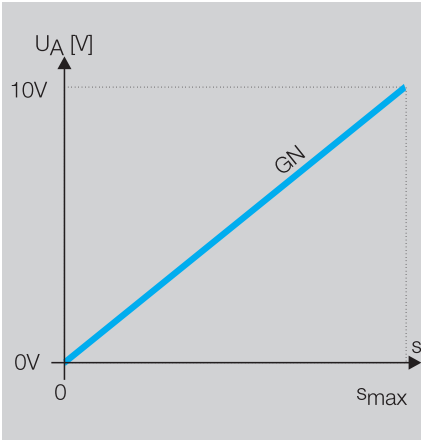
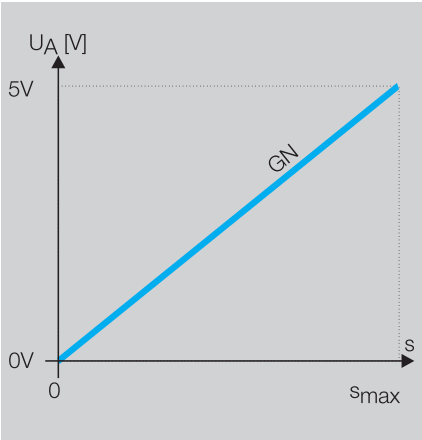
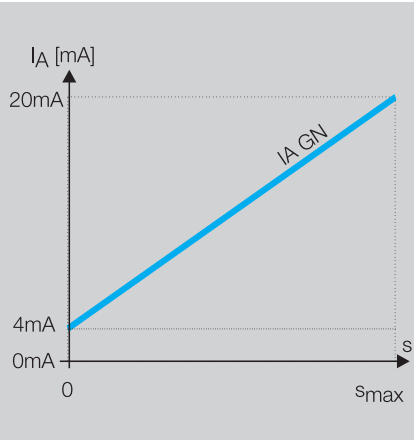
Pin assignments	Color
Output signals	GY
	GN
Operating voltage	BU
	BN

Shield connected to housing

► Please enter code for output signal, nominal stroke, housing style and connection type in the order code!

► Scope of delivery:
– Transducer
– Short guide

Dimensions and mechanical data **AR.3**
Please order separately:
Magnets see page **AR.9**

BTL6 Rod AR	BTL6 Rod AR	BTL6 Rod AR
analog	analog	analog
A	B	E
analog	analog	analog
		
BTL6- A 500-M	BTL6- B 500-M	BTL6- E 500-M
0...10 mm	0...5 mm	4...20 mm
max. 2 mA ≤ 5 mV	max. 2 mA ≤ 2 mV	≤ 500 Ohms ±7 µA
±1.5 mV	±1.5 mV	
	≤ 4 µm	
	System resolution/min. 2 µm	
	f _{STANDARD} = 1 kHz	
	±200 µm up to 500 mm nominal stroke	
	typ. ±0.02 % ≥ 500 nominal stroke	
	$[150 \mu\text{V}/^\circ\text{C} + (5 \text{ ppm}/^\circ\text{C} \times P \times U/L)] \times \Delta T$	
	$[0.6 \mu\text{A}/^\circ\text{C} + (10 \text{ ppm}/^\circ\text{C} \times P \times I/L)] \times \Delta T$	
	10...30 V DC	
	typ. ≤ 60 mA	
	yes	
	yes	
	500 V DC (GND to housing)	
	-40...+85 °C	
	-40...+100 °C	
BTL6- A 500...	BTL6- B 500...	BTL6- E 500...
0 V output	0 V output	0 V output
0...10 mm	0...5 mm	4...20 mm
GND	GND	GND
10...30 V DC	10...30 V DC	10...30 V DC

BTLAR



General Data
Analog Interface
Digital Pulse Interface
Installation Notes
Magnet
Balluff Testing Laboratory

Ordering example:

BTL6- 500-M

Output signal	Standard nominal stroke [mm]	Housing	Connection type
A 0...10 V	0025, 0050, 0075, 0100, 0125,	E2 outer tube	Axial out
B 0...5 V	0150, 0175, 0200, 0225, 0250,	Ø 10.2 mm	KA02 PUR cable 2 m
E 4...20 mA	0275, 0300, 0325, 0350, 0375,		
	0400, 0425, 0450, 0475, 0500,	E28 outer tube	Axial eccentric out
	0550, 0600, 0650, 0700, 0750,	Ø 8 mm,	KE02 PUR cable 2 m
	0800, 0850, 0900, 0950, 1000,	max. nominal	
	1100, 1200, 1300, 1400, 1500	stroke 1016 mm	Axial out
	or in 1mm increments on request		LA00,3 PUR pigtail 0.3 m

P510 interface

Compatible with Balluff BTA processors and controllers and modules from various manufacturers, including Siemens, B & R, Bosch, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO and others. Reliable signal transmission even over cable lengths of up to 500m between the BTA processor and the transducer is assured by the especially noise-immune RS485 differential drivers and receivers. Noise signals are effectively suppressed.

P510 universal for rising and falling edge evaluation

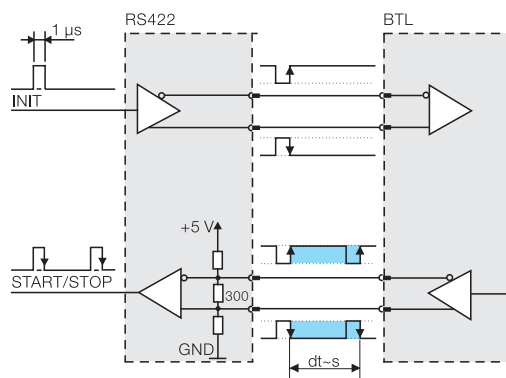
As a consequence of different control philosophies, digital pulse interfaces are available in two different types depending on the controller.

The difference is in which edge is used for processing. In the "P-interface" the falling edges are used for timing

and in the "M-interface" the rising edges.

To reduce the number of different models to a minimum, the "P510-interface" was created as a universal pulse interface which combines both functions.

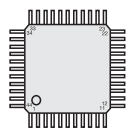
The reference point for the propagation time measurement is the "Start" pulse.



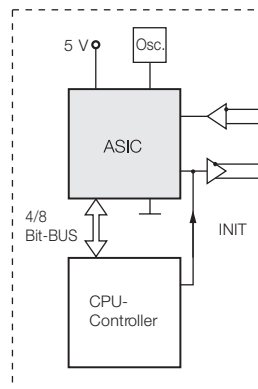
Block diagram of the P-interface

High-accuracy digitizing chip for P510 pulse interface

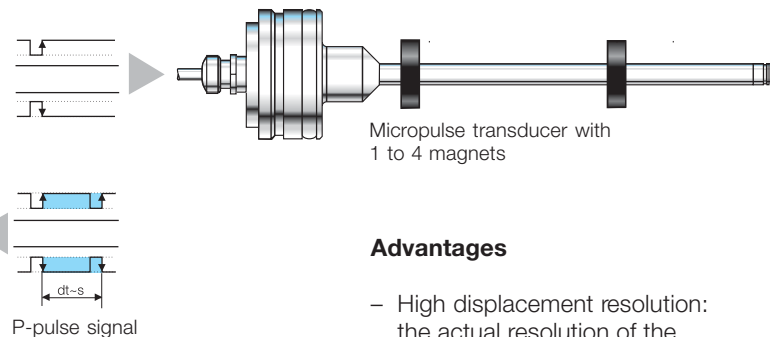
Companies who develop their own control and processing electronics can use the Balluff digitizing chip to implement a highly accurate P-type interface at low cost and without great effort. The digitizing chip was developed as a high-resolution, parameterizable ASIC for Micropulse transducers having a P-type pulse interface.



Digitizing chip 44QFP



Controller or processing electronics



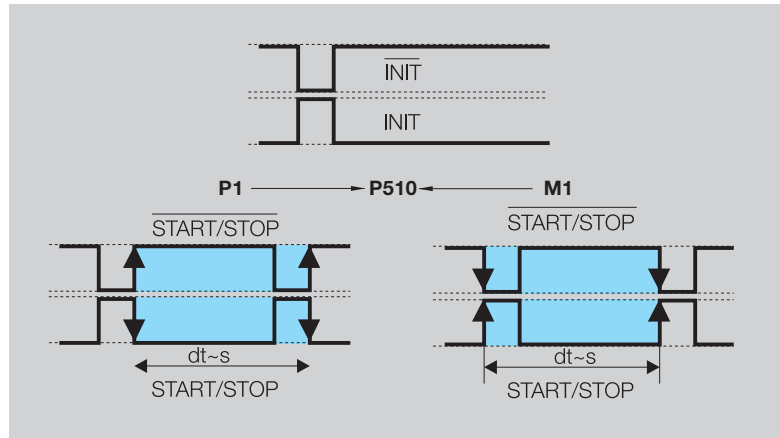
Micropulse transducer with 1 to 4 magnets

Advantages

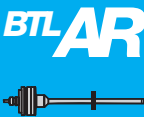
- High displacement resolution: the actual resolution of the BTL displacement measuring system of 1 µm is fully supported by the resolution of the 133 ps chip (at low clock frequency 2 or 20 MHz)
- Position data from 4 magnets can be processed simultaneously
- 4-/8-bit processor interface

ASIC INFO:
+49 7158 173-241

Series	BTL6 Rod AR
Transducer interface	Pulse P510
Customer-side interface	Pulse P510



Order code	BTL6-P510-M - - - - -	
System resolution	processor-dependent	
Repeat accuracy	≤ 10 μm	
Repeatability	≤ 20 μm	
Resolution	≤ 10 μm	
Non-linearity	±200 μm up to 500 mm nominal stroke typ. ±0.02 %, max. ±0.04 % 500...1500 mm nom. stroke length	
Supply voltage	10...30 V DC	
Current draw	≤ 60 mA (at 1kHz)	
Operating temperature	0...+70 °C	
Storage temperature	-40...+100 °C	
Pin assignments	Color	BTL6-P510-M ...
In-/output signals	Input	YE
	Output	GY
	Input	PK
	Output	GN
Operating voltage	BU	GND
	BN	+24 V DC
Shield connected to housing		



General Data
Analog Interface
Digital Pulse Interface
Installation Notes
Magnet
Balluff Testing Laboratory

► Please enter code for output signal, nominal stroke, housing style and connection type in the order code!

Ordering example:
BTL6-P510-M - - - - -

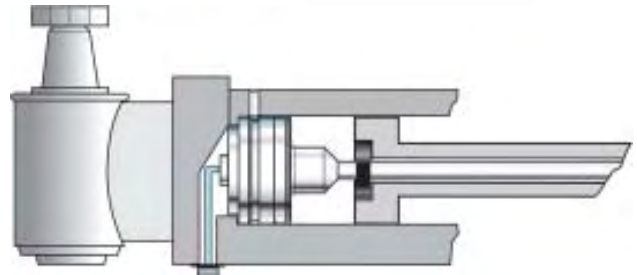
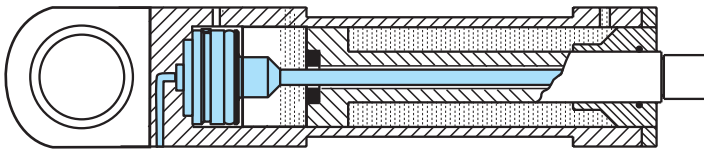
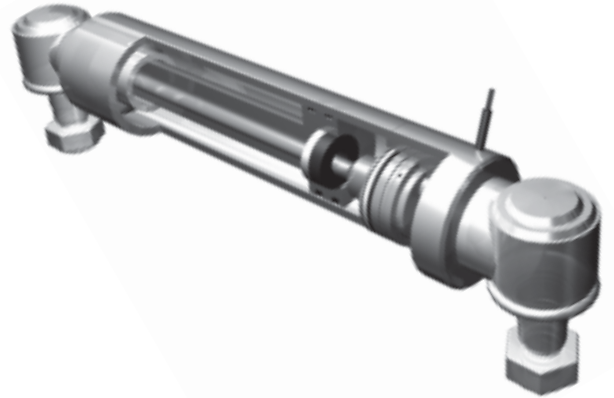
► Scope of delivery:
– Transducer
– Short guide

Dimensions and mechanical data **AR.3**
Please order separately:
Magnets see page **AR.9**

Standard nominal stroke [mm]	Housing	Connection type
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 or in 1mm increments on request	E2 outer tube Ø 10.2 mm E28 outer tube Ø 8 mm, max. nominal stroke 1016 mm	Axial out KA02 PUR cable 2 m Axial eccentric out KE02 PUR cable 2 m Axial out LA00,3 PUR pigtail 0.3 m

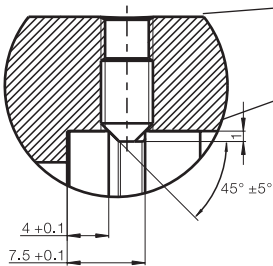
Series AR BTL Micropulse transducers are designed for integration in hydraulic cylinders. The transducer is mechanically supported at the housing. 3 M5 set screws spaced at 120 °C hold the transducer, which fits into a Ø 48 H8 hole.

Sealing is accomplished using the supplied O-ring and support ring. The magnet ring, which is integrated into the piston, marks the actual position of the piston as it moves without contact.

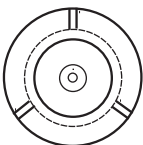


The metal surrounding of the cylinder replaces the needed cable shield when the BTL AR...**LA**, cable out pigtail version is installed in the cylinder. The pigtail version cannot be used without additional EMC protection (shield).

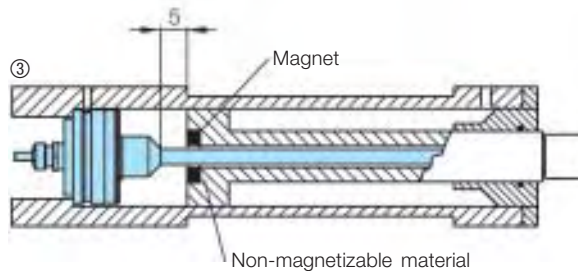
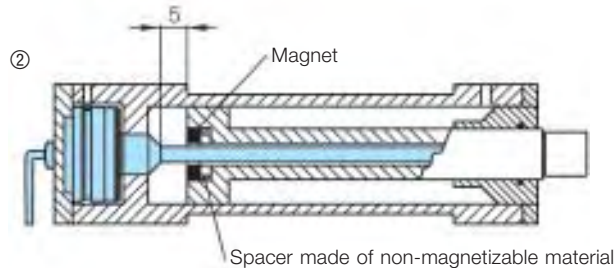
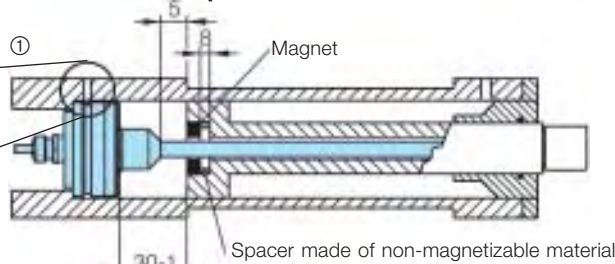
**Set screw
DIN 914 M5x8**



**Fixing the transducer
using 3 M5 set screws
spaced 120 °C**



Installation examples



- ① Installation on piston side
- ② Installation from rear
- ③ Installation on piston side, in magnetic piston material

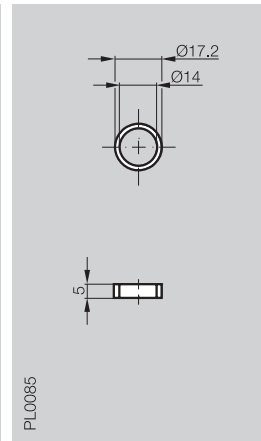
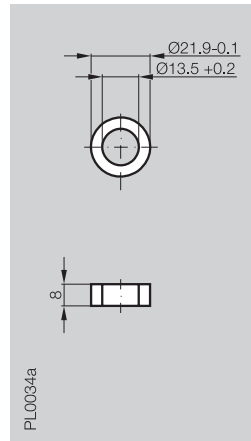
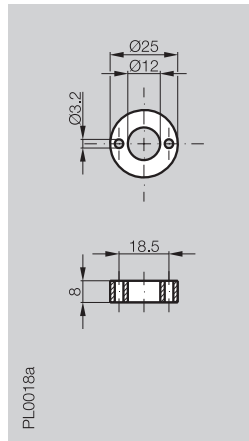
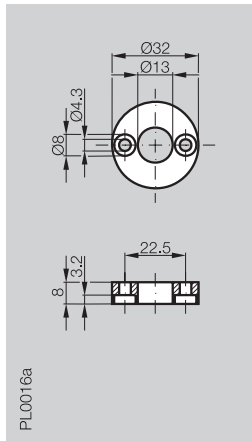


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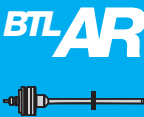
Micropulse AR Transducers

Magnet Rod Series AR

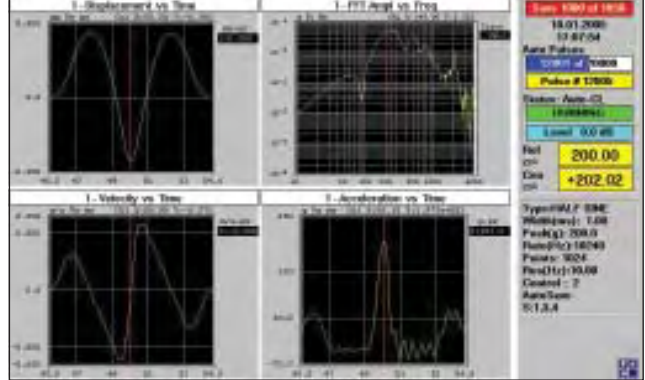
Description for series	Magnet BTL6 rod	Magnet BTL6 rod	Magnet BTL6 rod	Magnet BTL6 rod
------------------------	---------------------------	---------------------------	---------------------------	---------------------------



Order code	BTL-P-1013-4R	BTL-P-1012-4R	BTL-P-1014-2R	BTL-P-0814-GB-PAF
Material	Al	Al	Al	Ferrite PA 6
Weight	approx. 12 g	approx. 12 g	approx. 10 g	approx. 1.5 g
Magnet traverse speed	any	any	any	any
Operating temperature/storage temperature	-40...+100 °C	-40...+100 °C	-40...+100 °C	-40...+100 °C
Order code PA 60 fiberglass reinforced	BTL-P-1013-4R-PA	BTL-P-1012-4R-PA		
Material	PA 60 fiberglass reinforced	PA 60 fiberglass reinforced		
Weight	approx. 10 g	approx. 10 g		
Magnet traverse speed	any	any		
Operating temperature/storage temperature	-40...+100 °C	-40...+100 °C		



General Data
 Analog Interface
 Digital Pulse Interface
Installation Notes
Magnet
 Balluff Testing Laboratory



Reliability doesn't happen by chance

Tests and checks during the development process improve the product and give protection against "surprises" in service.

Objective: Simulate the mechanical loads on a product over its working life. Balluff products are often fitted in machines when mechanical vibrations and impacts occur. For reliable operation they must be designed to be immune to vibration and shock. In the Balluff test laboratory all products are therefore tested before series release for their mechanical stability.

The features of the vibration test equipment at Balluff are as follows:

Manufactured by	Unholtz-Dickie Corporation	
Model	SA 15-S092-BP	SAI60-H560B-24-LP
sinusoidal force vector	4.4 kN	35.6 kN
random force vector	4.4 kN	35.6 kN
shock force vector	8.8 kN	73 kN
max. sinusoidal acceleration	100 g	89 g
max. random acceleration	100 g	74 g
max. shock acceleration	200 g	210 g
max. sinusoidal velocity	2.0 m/s	1.9 m/s
max. shock velocity	5.1 m/s	3.5 m/s
max. amplitude	51 mmp-p	51 mmp-p
Frequency range up to	3.5 kHz	up to 2.7 kHz



The following tests can be performed on this equipment:

- Sinusoidal testing
- Noise testing
- Shocks

in addition one equipment if fitted with an FFT analyzer.

Tests can be performed to the following standards:

- MIL STD 202
- EN 60068-2-6
- EN 60068-2-27
- EN 60068-2-29
- EN 60068-2-64
- DIN EN 50155
- IEC / EN 61373
- GL 2001



Test equipment in the test laboratory

	Tests	Test equipment
1. Electro-magnetic compatibility (EMC)	Immunity from discharge of static electricity (EN 61000-4-2)	ESD generator ESD 30C, EM test with IEC finger and relay discharge module
	Immunity from electro-magnetic fields (EN 61000-4-3)	GTEM cell 1500, MEB Signal generator SML, Rohde & Schwarz HF amplifier model 100W1000M1, AR HF amplifier model CBA9429, SCHAFFNER HF circuit network RFSN, SCHAFFNER Wattmeter NRVS, Rohde & Schwarz Wattmeter head NRV-Z 51, Rohde & Schwarz Directional coupler RK 100, MEB Directional coupler C6187, VERLATONE Field strength measurement system HI-6005, Holaday Software MEB IMM, SCHAFFNER
	Immunity from rapid transient interference (bursts) (EN 61000-4-4)	Burst generator EFT 503, EM-Test Capacitive coupler HFK, EM-Test
	Immunity from abrupt voltage surges (EN 61000-4-5)	Hybrid generator CE-SURGE, Hilo-Test Coupling / decoupling network CDN 104 Coupling / decoupling network CDN 202
	Immunity from mains-borne high-frequency interference (EN 61000-4-6)	Signal generator SMH, Rohde & Schwarz HF amplifier model 150A100A, AR Coupling / decoupling network M2, MS3, S4, S9, AF2, AF4, RJ45/5 EM injection clamp F-203I-23mm, FCC Software MEB IMM, Schaffner MEB
	Immunity from magnetic fields with power transmission frequencies (EN 61000-4-8)	Self-built test equipment, Balluff GmbH
	Immunity from voltage dips, short breaks in power supply and voltage fluctuations (EN 61000-4-11)	Self-built test equipment, Balluff GmbH
	Radiated emissions (EN 55011)	GTEM cell 1500, MEB Measurement logger SM41, MEB Software, MEB
	Mains-borne emissions (EN 55011)	Measurement logger ESHS 30, Rohde & Schwarz Network simulator ESH3-Z5, Rohde & Schwarz Shield Cubicle
	Emissions, HF magnetic field (DIN EN 300 330-1)	Frame antenna HLA6120, SCHAFFNER Measurement logger ESHS 30, Rohde & Schwarz Shield Cubicle
2. Product-specific tests	Making capacity / breaking capacity (EN 60947-5-2)	Self-built test equipment, Balluff GmbH
	Testing cable anchoring of devices with integral connection cables (EN 60947-5-2)	Self-built test equipment, Balluff GmbH
	Short circuit testing (EN 60947-5-2)	Self-built test equipment, Balluff GmbH
3. Shock, sinusoidal and noise tests	Shock, sinusoidal and noise testing (EN 60068-2-6)	Shock and vibration equipment, model SA15-S092-PB and model SAIGO H560B-24LP, Unholtz-Dickie with software modules for: Sinusoidal vibrations Shocks Noise tests Signal analysis
	(EN 60068-2-27; EN 60068-2-29)	
	(EN 60068-2-64)	
4. Other	X-ray analysis	X-ray inspection equipment RTX 113, HEEB-INOTEC

BTLAR



General Data
Analog Interface
Digital Pulse Interface
Installation Notes
Magnet
Balluff Testing Laboratory



Closed-loop control and higher dynamics with SSI-SYNC

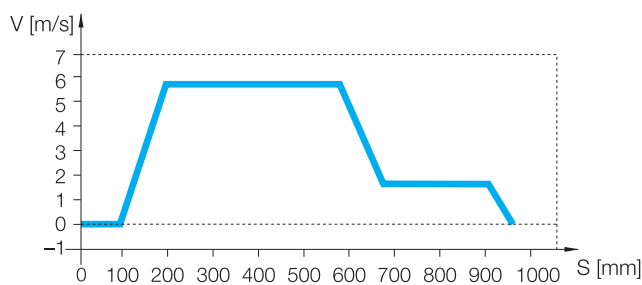
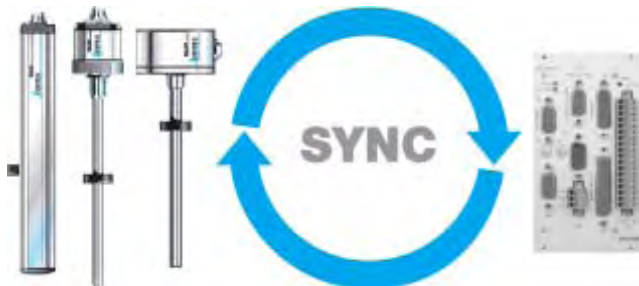
The absolute position information from the Micropulse Transducer is sent synchronously to the axis control card. This synchronous data acquisition enables exact calculation of the velocity and acceleration.

By feeding these state variables (velocity and acceleration) back, the damping and natural frequency of a hydraulic system are increased. These measures permit greater loop gain and with it better control behavior and higher dynamics.



The right feedback system for every application

- Non-contact, wear-free system
- Very reliable with high protection rating
- Pressure rated for integration in cylinders
- Wide variety of interface options
- Special form factors, e. g., for EX or redundant applications



	DeviceNet
	PROFIBUS-DP
	CAN open
	DeviceNet InterBus S MODBUS PROFIBUS-DP



For additional transducers, see the BTL main catalog, our CD-ROM, DVD-ROM or go online!



www.balluff.com

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