BALLUFF

sensors worldwide

Transducer Catalog

Linear Position Transducers

MICROPULSE®

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Search for Balluff products by part number

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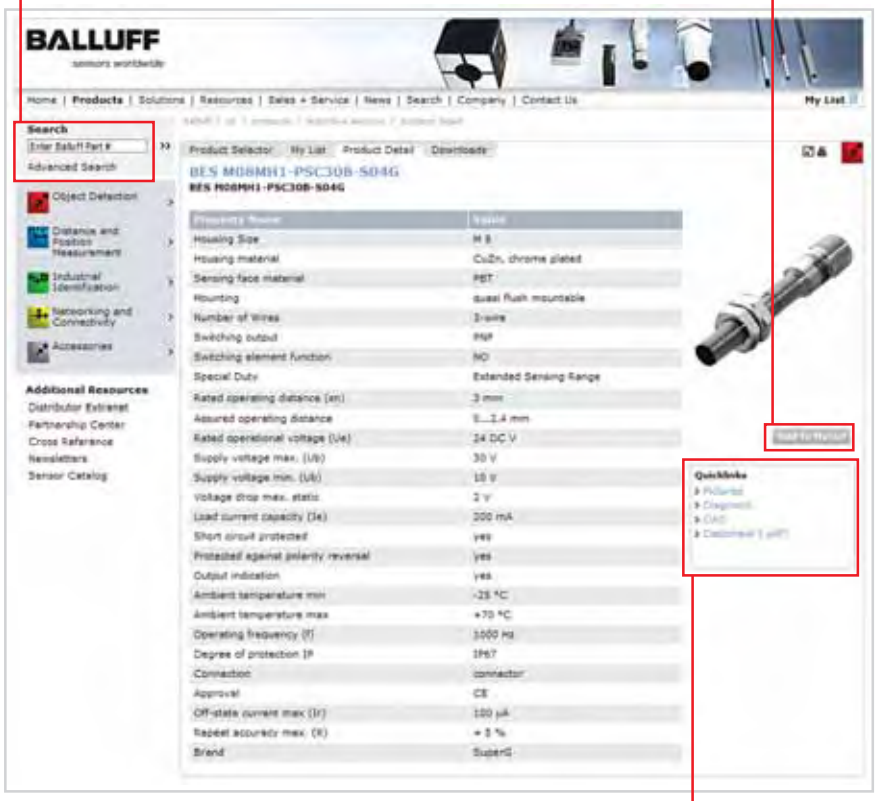

Download datasheets, manuals, and CAD drawings

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View previous issues and sign up for the Balluff monthly e-newsletter.

www.balluff.com/newsletter

Industry Center

Find products and solutions for your specific industry.

www.balluff.com/industry

Balluff North America

Florence, Kentucky USA
Enjoying one of the highest growth rates in the automation industry, Balluff's Florence, Kentucky United States headquarters is located just south of Cincinnati, Ohio. Our customers are in industries such as automotive, machine tool, robotics, injection molding, packaging, material handling, and more.

In addition to sales, marketing, and logistic functions, this facility manufactures regionally focused inductive proximity sensors and Micropulse® magnetostrictive linear position sensors.

The Balluff Global Network

Balluff spans the globe with representation in 49 countries.

Argentina
Australia
Austria
Belarus
Belgium
Brazil
Bulgaria
Canada
China
Columbia
Croatia
Czech Republic

Germany
World Headquarters
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Schurwaldstraβe 9
73765 Neuhausen a.d.f.
Phone: (+49 71 58) 1 73-0
Fax: (+49 71 58) 50 10

For a complete global listing visit www.balluff.com/global

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Iran
Israel
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Malaysia
Mexico
Netherlands
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Phillipines
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Romania
Russia

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Switzerland
Thailand
Taiwan
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USA
Venezuela

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Phone: (++52 442) 212-4882,
224-3583, 224-3171
Fax: (++52 442) 214-0536
E-Mail: balluff.mexico@balluff.com

Applications

Balluff control solutions are found wherever products are being produced, controlling key functions in virtually every type of production cycle. Balluff provides thousands of different sensors, but it also provides something else—a unique understanding of how best to apply them for maximum positive impact.

Balluff Application Expertise Can:

Prevent Unplanned Downtime
Reduce Planned Downtime
Decrease Life Cycle Costs

Increase Sensor Life
Increase Process Efficiency
Increase Product Quality
Increase Profitability

Service

- **24 hour on-call service.**
- **Same-day shipping—in by 2 PM, out the same day.**
- **Complete in-house technical support.**
- **Comprehensive product selection, cross reference, and application assistance.**
- **Fast, friendly experienced service – guaranteed!**

The best customer service team in the industry is ready to solve your automation challenges. We'll make finding the right sensor easier and faster.

1-800-543-8390
Give us a call.

Balluff's enthusiastic and knowledgeable staff help us stand out from the competition. When you call, you'll be instantly connected with experienced customer service, technical support, and application engineers. We know your industry, and we know how to make your job easier, and we'll go out of our way to make sure you are satisfied with our products and services.

Warranty

Balluff products are guaranteed to be free from defects in material and workmanship as follows:

Standard lifetime warranty for inductive sensors and magnetically operated sensors sold to the original user.

Standard 2-year warranty from the date of shipment for photoelectric, capacitive sensors, read-write ID systems, magnetostrictive transducers*, connectors and cables, electromechanical limit and rotary switches, and all products with electromechanical relays sold to the original user.

Balluff will repair or replace at our discretion, without charge, any unit which fails because of defective workmanship or material, during this guarantee period and which is returned to Balluff transportation prepaid. This guarantee will not apply if, in the judgement of Balluff, damage or failure has resulted from accident, alteration, misuse, abuse, or operation on an incorrect power supply. This guarantee expressly does not include any other costs such as the cost of removal of the defective part, installation, labor or consequential damages of any kind. Balluff assumes no responsibility for selection and installation of its products. The foregoing is in lieu of all other guarantees expressed, implied or statutory and Balluff neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with said products.

⚠ WARNING ⚠

These sensors are NOT approved for use in personnel safety applications. A sensor failure or malfunction can result in either an energized or de-energized output state. Never use these sensors for personnel safety. Doing so may result in serious bodily injury or death.

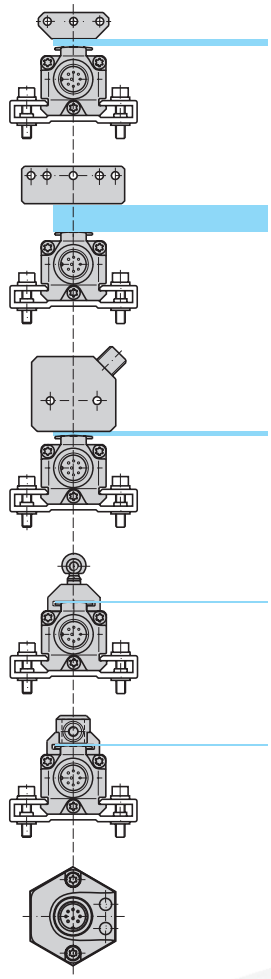
Only products specifically designated as safety products are designed to meet OSHA and ANSI standards for point-of-operation devices.

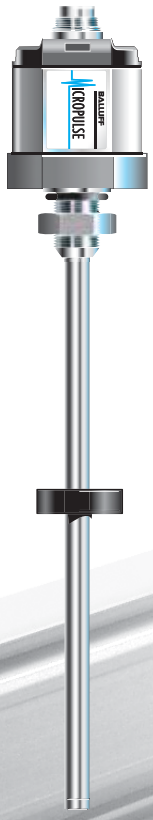
* Micropulse® AT 1-year warranty from date of shipment

MICROPULSE®

CE

non-contact





MICROPULSE®




Series	Rod Style Z	Rugged Style W&K	Rod Style AR	Explosion-Proof Rod Style EX
Analog				
Sin/Cos, 1Vpk-pk				
0...10 V and 10...0 V	■	■	■ (only 0-10)	■
-5...+5 V and +5...-5 V	■	■	■ (only 0-5)	■
-10...+10 V and +10...-10 V	■	■		■
4...20 mA or 20...4 mA	■	■	■ (only 4...20 mA)	■
0...20 mA or 20...0 mA	■	■		■
Digital				
Start/Stop, RS422	■	■	■	■
Start/Stop, RS422, DPI/IP				
Pulse-Width Modulated, RS422	■	■		■
PWM (w/recirculations), RS422	■	■		■
Specialized				
Synchronous Serial Interface (SSI)	■	■		■
CANopen	■			■
Profibus DP	■			■
Quadrature	■			■
Dual-Magnet Analog w/Programmable Stroke				
Resolution				
0.1 mV (analog)		■	± 1.5 mV	
0.2 µA (analog)		■	± 7 µA	
16 bit (analog)	■			■
Controller-dependent (Start/Stop & PWM)	■	■		■
1,2,3,5,10 µm selectable (Qudrature output)	■			■
5,10,20,40 µ selectable (SSI output)	■	■		■
5 µm increments selectable (CANopen & Profibus)	■			■
10 µm (analog)				
5 µm (analog)				
1...2000 µm				
Stroke Length				
Active measurement area*	1"-200"	1"-200"	1"-59"	1"-200"
Wiring Options				
Quick disconnect	■	■		
Cable-out	■	■	■	1/2" NPT
Operating Voltage				
24 Vdc (±20%)	■	■		■
±15 Vdc (±2%)	■	■		■
10...30 Vdc	■	■	■	■
5 Vdc				
Features	- 3/4"-16-UNF threads or M18 threads - Pressure-rated to 8700 psi for use in hydraulic cylinders - Optional Rapid Replacement Module - Analog signal adjustable in field - Industry standard configuration	- Rugged, all-stainless steel housing - Eliminates the need for protective covers - 3/4"-16-UNF threads (W) - Bolt-in design (K) - Pressure-rated to 8700 psi	- Rugged, compact housing - All stainless steel construction - For use in hydraulic cylinders - Embeddable design can be used in welded cylinders	- Factory Mutual, and ATEX approved - Explosion proof - Flame proof - Bolt-in design - Standard Rapid Replacement Module
* Depending on output type				
Page	**15-28**	**29-46**	**47-54**	**55-64**





	Profile Housing P	Low-Profile Housing R	Tube Profile Housing AT	Plunger Style BIW	Magnetic Linear Encoder
					■
	■	■	■	■	
	■	■			
	■	■		■	
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	2"-200"	2"-142"	2"-100"	75 mm-750 mm	up to 48 meters
	■	■	■	■	■
	■	■			■
	■	■	■		
	■				
	■ (Quad output only)			18...30 Vdc	■
					■
	- Designed for external mounting - Rugged aluminum extruded housing - Free-floating magnet or captive-sliding magnet	- Lowest-profile for space critical applications - Compatible with "rod-in-cylinder" type linear potentiometers	- Cost effective - Free-floating magnet - 0-10 V analog and start/stop interface - IP 67 - Dual magnet, dual analog programmable stroke version	- Linear pot form factor - All-new pulsed-inductive technology - Highly immune to EMI - Fast > 30 kHz update rate	- Non-contact linear measurement system - Flexible magnetic tape installs easily - Available in rotary versions - High speed (up to 20 m/s) - Highly accurate; resolution to 1 µm
	65-80	**81-90**	**91-102**	**103-106**	See www.balluff.com/BML

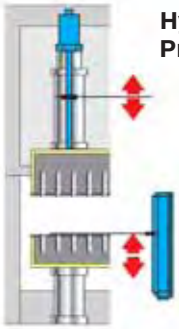
Micropulse Transducers at Work:

Balluff transducers are the rugged choice for use under extreme ambient conditions up to 85°C and over measuring distances between 25 mm (1") and 5080 mm (200").

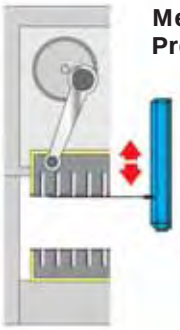
Hydraulic Cylinders & Presses

Hydraulic Cylinder with Transducer

RRM Rapid Replacement Module



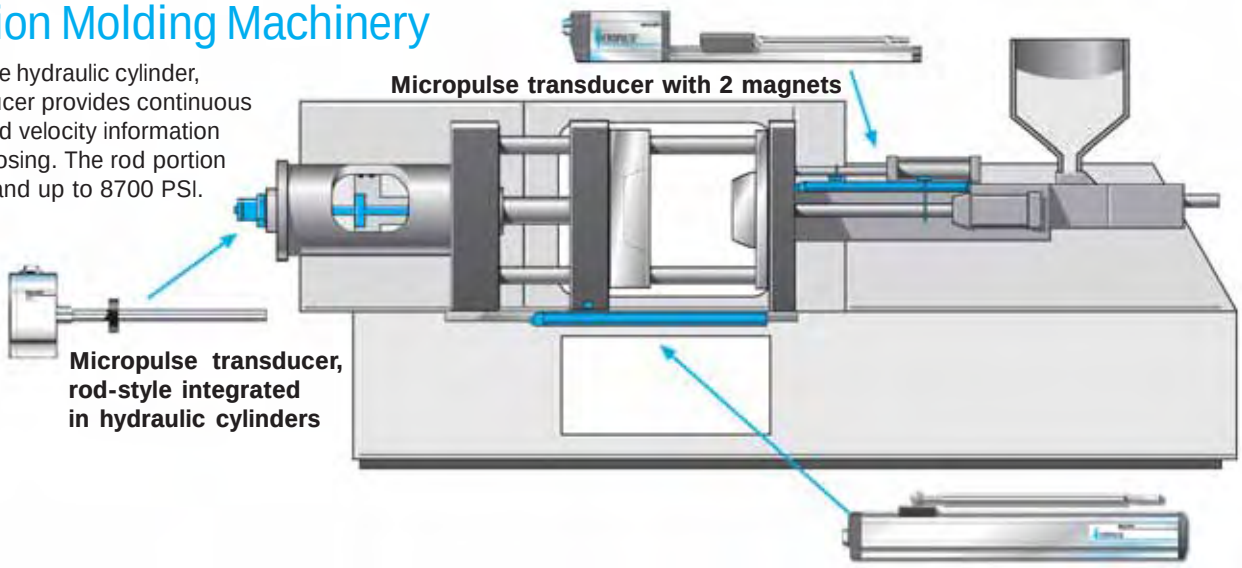
Hydraulic Press



Mechanical Press

Injection Molding Machinery

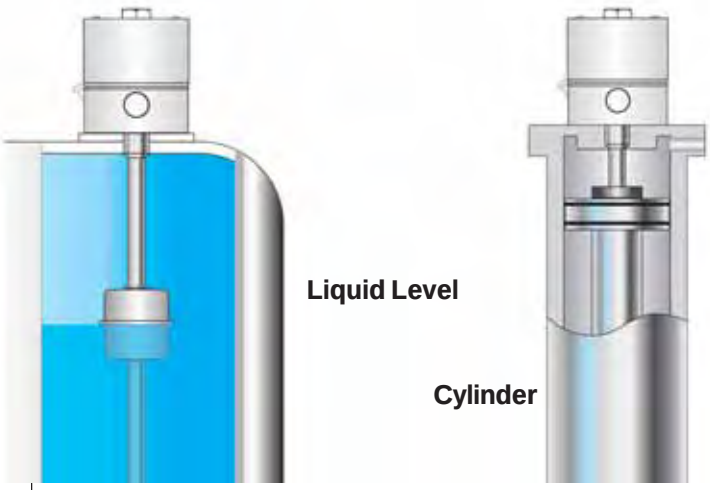
Built into the hydraulic cylinder, the transducer provides continuous position and velocity information for mold closing. The rod portion can withstand up to 8700 PSI.



Micropulse transducer with 2 magnets

Micropulse transducer, rod-style integrated in hydraulic cylinders

Hazardous Locations



Liquid Level

Cylinder

- Tooling & tool handling
- Presses
- Casting & rolling mills
- Foundries
- Injection molding
- Leveling machines
- Transport systems
- Lift controls
- Level monitoring
- Woodworking machinery
- Conveying
- Packaging machines
- Windmills
- Elevators

The rugged choice for extreme conditions

Enhanced Magnetostrictive Technology

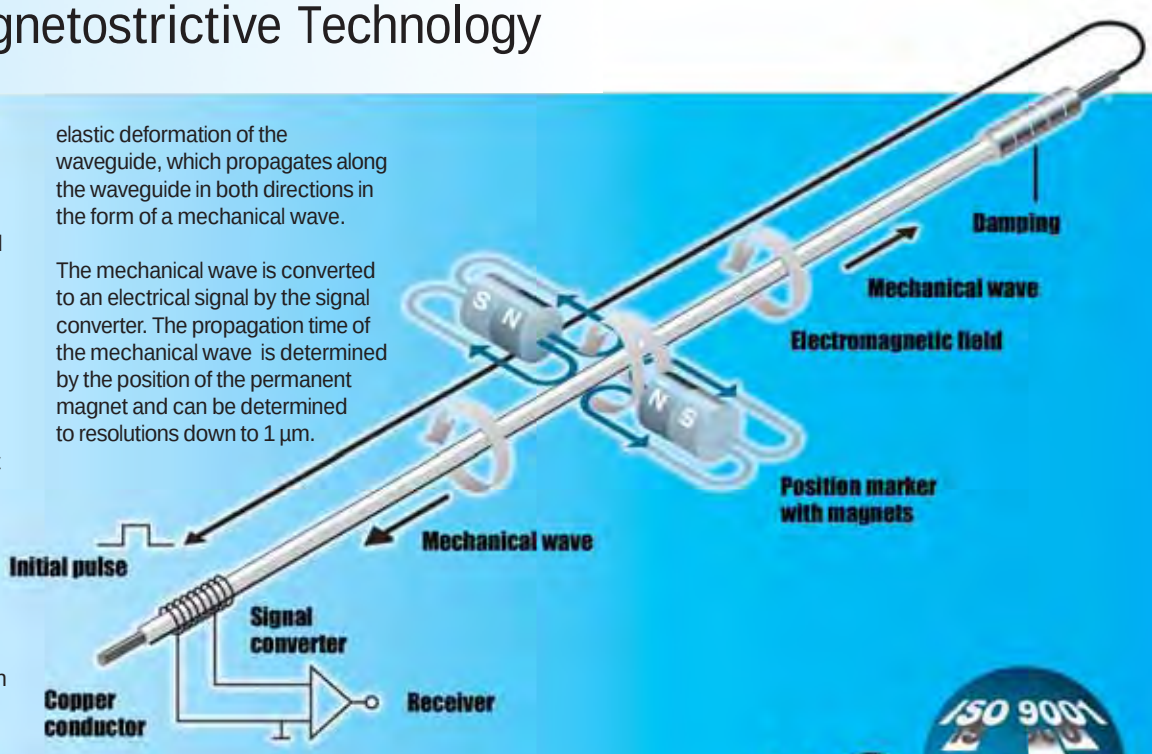
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

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 electrical 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.



MICROPULSE®

Accessories

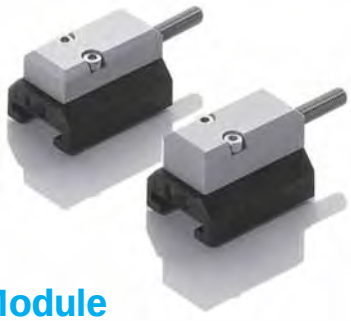
Setup is a snap with Balluff accessories!

Floats

Non-contact floats with integrated permanent magnet measure liquid level.

Magnets

Non - contact!



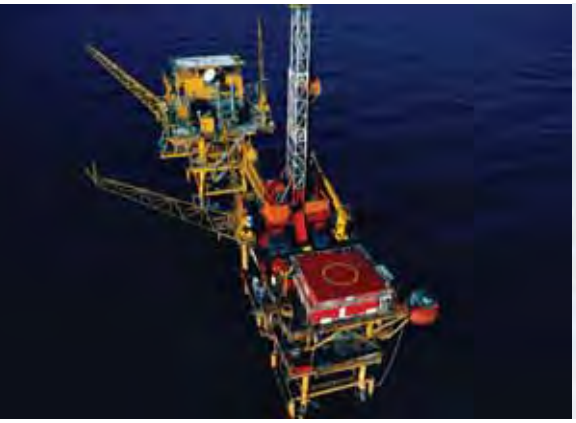
BTM Module

Provides up to 4 channels of analog position and/or velocity feedback!

Connectors

Connect with Balluff and decrease your setup and down time!

MICROPULSE® Withstands the rigors of



Oil & Gas Industry

- Globally certified by FM Approvals for use in US, Canada and ATEX applications
- Non-wearing, non-contact position feedback for long MTBF
- Rapid Replacement Module for quick and easy field replacement of electronics package
- Compact, rugged, stainless steel housing for harsh applications
- 100% scalable analog outputs for quick and easy setup: zero, span, and stroke length
- Wide range of outputs to match a variety of controller interfaces

Plastic Injection and Blow Molding Industry

- Captive (guided control rod) or floating magnet for versatile installation options (P & R profile styles)
- Low-profile housing provides mechanical upgrade path from linear potentiometers (R profile style)
- Wide range of outputs to match a variety of controller interfaces (P profile style)
- No-compromise non-contact performance in cost-sensitive applications (AT tubular style)
- 100% scalable analog outputs for quick and easy setup: zero, span, stroke length (AT tubular style)
- Dual-magnet, dual-analog outputs with differential mode (AT tubular style)

harsh, real-world applications!

Tire Manufacturing Industry

- 100% scalable analog outputs for quick and easy setup: zero, span, and stroke length (Z rod style)
- Rapid Replacement Module for quick change out without breaking cylinder seal (Z rod style)
- Legacy connectors and patented magnet Autotuning for trouble-free retrofits (Z rod style)
- ProSet4 with four programmable setpoint outputs eliminates discrete switches (Z rod style)
- Captive (guided control rod) or floating magnet for versatile installation options (P profile style)
- Wide range of standard outputs to match a variety of controller interfaces (P profile style)

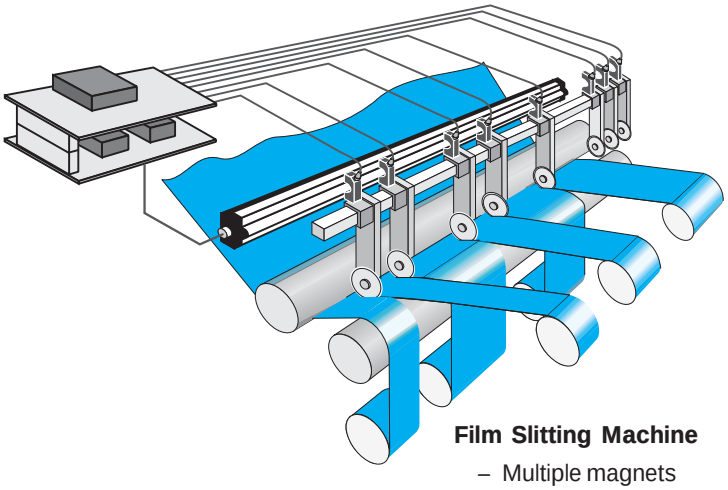
Lumber Industry

- High linearity to ±0.001" for precise cuts to increase yield (SSI interface)
- Synchronized position data for smoother high- and low-speed motion (SSI interface)
- Rapid Replacement Module for quick change out without breaking cylinder seal
- Legacy connectors and patented magnet Autotuning for trouble-free retrofits
- Simple DIP-switch setup of PWM recircs without special hardware or software

Applications:

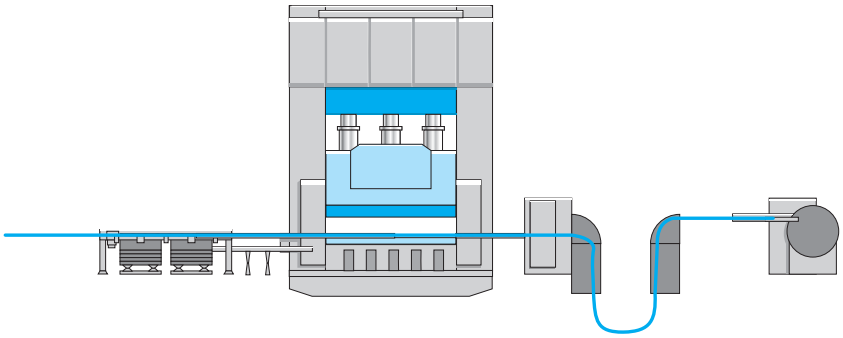
Balluff transducers offer features which assure reliable operation in many areas of automation and process technology under extreme conditions:

- Hydraulic cylinders
- Laminating presses
- Rolling mills
- Foundries
- Injection molding machines
- Liquid level monitoring
- Tunnel boring equipment
- Die casting machinery
- Woodworking machinery
- Flight simulators
- Cutting/slitting machinery
- Conveying
- Packaging machines
- Wire and cable
- Wind turbine pitch control
- Elevators
- Food processing
- Lumber
- Semiconductor
- Tire machinery
- Web processes
- Mobile equipment
- Dispensing equipment
- Dosing equipment
- Measurement



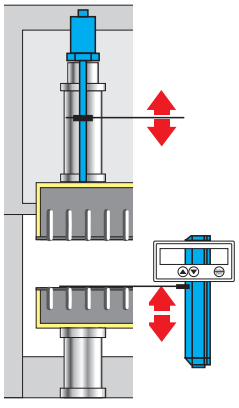
Film Slitting Machine

- Multiple magnets

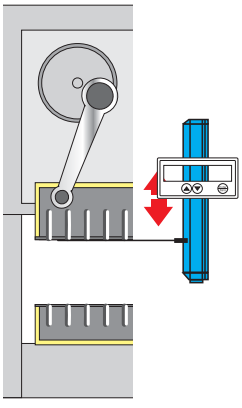


Hydraulic Press

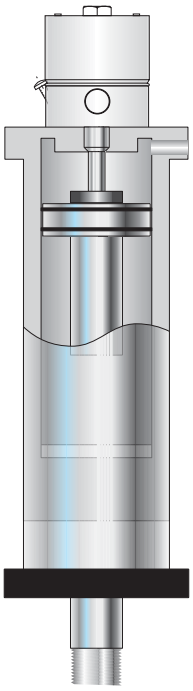
- Hydraulic cylinder
- Injection molding machine
- Tire press
- Veneer press or knife



Hydraulic Press



Mechanical Eccentric Press



Cylinder

Balluff transducers are the rugged choice for use under extreme ambient conditions and over measuring distances between 25 mm (1") and 5080 mm (200").

Various output signal formats are available for integration into your specific control system.

In addition, digital-to-analog processor modules are available with a variety of programming functions, for flexible interfacing to your control system.

Obtaining accurate position feedback is a critical part of many automation processes. Without accurate, reliable measurement feedback, quality and production suffer. The Micropulse® line of linear transducers has been providing a high level of linear measurement for years.

Micropulse® transducers incorporate some of the most advanced features found in any magnetostrictive linear transducer.

Features:

- Auto Tuning
- Non-contact
- Wear free
- IP 67 & IP 68
- Analog, Digital, SSI, Pulse, CANopen, Profibus, Quadrature, and DeviceNet

Advantages:

Compared with traditional position feedback systems, Balluff transducers offer the following advantages:

- Insensitive to shock, vibration, temperature swings, contamination, ambient moisture and electrical noise
- Wear and maintenance free, thanks to non-contact principle of operation
- Absolute output signal, even after voltage interruption; no re-homing of the machine necessary
- High resolution repeatability and linearity
- Simple installation, marker element (magnet) needs no power
- IP 67 per DIN 40 050
- Pressure-rated to 8700 PSI, for internal hydraulic cylinder installation

The CE-Marking confirms that our products meet the requirements of the EC Directive 89/336/EWG (EMC Directive) and the EMC Law. Testing done in our EMC Laboratory, which is accredited by the DATech for Electromagnetic Compatibility Testing, Balluff products have been shown to meet the EMC requirements of the Generic Standard EN 50 081-2 (Emission) and EN 50 082-2 (Noise Immunity). See the corresponding user's manual for detailed information.

MICROPULSE®

Z Standard Rod Style

The Z style product line is one of the most versatile lines in the Micropulse® family. With a variety of electrical options, interfacing to your control system will never be a problem.

Built into the hydraulic cylinder, or mounted externally, the transducer provides continuous, absolute position feedback.

The Z housing offers a variety of outputs, replaceable electronics and the ability to adjust the analog signal in the field.

Applications:
Balluff transducers offer features which assure reliable operation in many areas of automation and process technology, even under extreme ambient conditions:

- Hydraulic cylinders
- Laminating presses
- Rolling mills
- Foundries
- Injection molding
- Liquid level monitoring
- Tunnel boring equipment
- Die casting machinery
- Woodworking machinery
- Flight simulators
- Cutting/slitting machinery
- Conveying
- Packaging machines
- Wire and cable machines
- Wind turbine pitch control
- Elevators
- Tire machinery
- Extruders

Features:

- Absolute, non-contact position feedback
- Highly accurate, super reliable, maintenance-free
- Heavy duty stainless steel pressure tube
- Rated to 8700 psi
- Optional Rapid Replacement Module
  - Plug and play field repair
  - Fluid circuit remains intact
  - Reduced downtime
- Wide variety of available outputs
  - Analog voltage or current
  - Digital START/STOP
  - Digital Pulse-Width-Modulated (PWM)
  - Synchronous Serial Interface (SSI)
  - CANopen
  - Profibus-DP
  - Quadrature

Wide selection of standard, legacy, and military style connectors available!

Drop-In Replacement of Competitor's Legacy Transducers

- Micropulse® transducers are available with a wide variety of special connector options, allowing drop-in replacement of competitors' products.
- Balluff patented autotuning electronics allows use of new and legacy Balluff magnets as well as many competitive magnets.
- Available Rapid Replacement Module allows quick repair without removing pressure tube from cylinder – so no oil spillage and no need to bleed air from hydraulic system after replacement.
- User-adjustable stroke on analog models for quick calibration.
- Easy DIP-switch setup for recirculations on PWM models – no programming hardware or software required.

RRM Rapid Replacement Module

(See page 22)

- 100% scalable output signal (analog versions)
- User-scalable using supplied programming tool
- Programming tool is removable to guard against tampering
- Three programming modes to suit any application requirement:

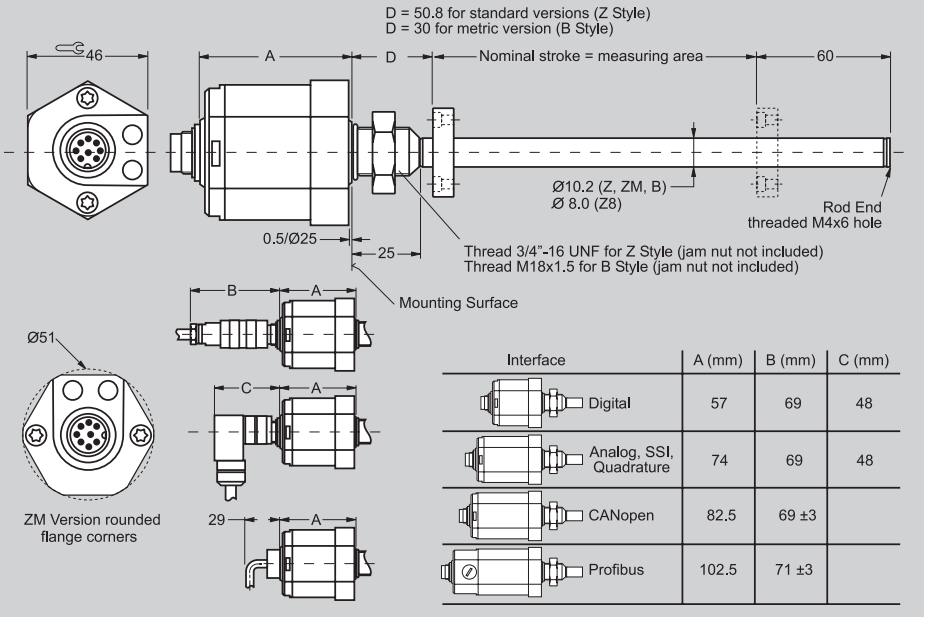
  Teach-In – Used to set the "zero" and "end" values anywhere within the nominal factory stroke range

  Adjust – Used to perform manual adjustment of output signal values

  Online Adjust – Used to perform real-time adjustment of output signal without disrupting the control-loop

BTL Z

Series	**Z Style**
Available Lengths	25 mm (1 in) to 5080 mm (200 in)
Output Signals	Analog, Digital Pulse, SSI, CANopen, Profibus, Quadrature



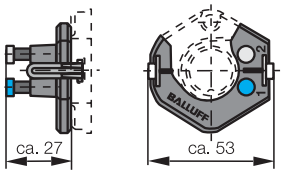
Ordering Code	**BTL5-_ _-M_ _ _-Z-_ _ _ _** (See ordering code on page 27)
Measurement Type	Linear displacement
Measurement Range	25 mm (1 in) to 5080 mm (200 in)
Shock Rating	100 g/6 ms (100 g/2 ms continuous) per IEC 68 2-27
Vibration Rating	12 g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	IP 67- with connector attached
Housing Material	Anodized aluminum body, stainless investment cast flange (DIN 1.3952), 316 stainless steel tube
Pressure Rating (rod)	600 bar (8700 PSI) max (10.2 mm Ø rod) 250 bar (3600 PSI) max (8 mm Ø rod)
Operating Temperature	-40 to + 185° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	connector or integral cable
Noise Immunity	ESD, RFI and BURST per IEC 1000-4-2/3/4/6, severity level 3
Approvals	CE

Warning:
These products are not rated for personnel safety applications.

Accessories:
Magnets and Floats ..... pg 23
Connectors ..... pg 24
Jam nuts ..... pg 24

For additional connectors, see pages 107-114

Calibration device BTL5 A-EH01



Supplied with analog versions

Autotuning Circuitry

Patented Autotuning circuitry in Balluff Micropulse® transducers automatically compensates for changes in the strength of the magnetostrictive return signal.

- Allows Micropulse rod-style transducers to be used in hydraulic cylinders that have both new and legacy Balluff magnets. Autotuning allows use of many legacy competitor's magnets as well.
- Automatically compensates for changes in temperature, providing a more stable signal over a wide temperature range.

Analog Stroke Adjustment

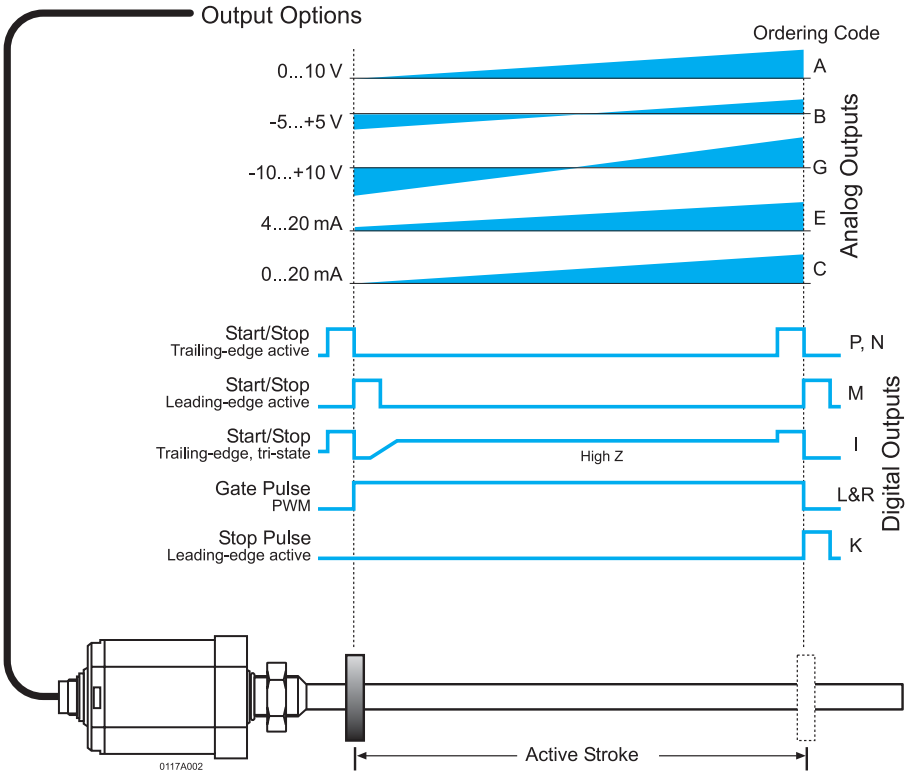
- Removeable magnetic push button tool
- No delicate trim pots
- Housing remains sealed

BTL Z

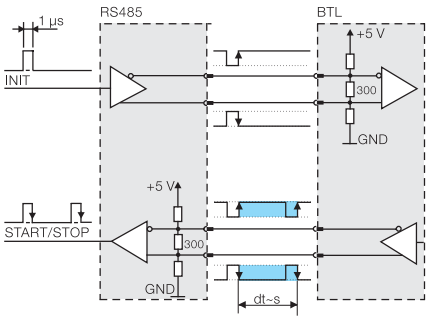
Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop PWM
Part No. Code (See pg. 27)	**A, B, G**	**E, C**	**P, M, N, I, L, R, K**
Output	0...+10 V, -5...+5 V, -10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2K Ω (5 mA max)	≤ 500 Ω	per spec
Resolution	≤ 0.33 mV	≤ 0.66 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	≤ 5 µm	≤ 5 µm	≤ 5 µm
Sampling Rate	2 kHz	2 kHz	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm
Temperature Coefficient*	[150 µV/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6 µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) / °C
Operating Voltage	24 Vdc ±20%, 10...30 Vdc or 15 Vdc ±2%	24 Vdc ±20%, 10...30 Vdc or 15 Vdc ±2%	24 Vdc ±20%, 10...30 Vdc or 15 Vdc ±2%
Operating Current	< 150 mA Nominal, @ 24 Vdc	< 150 mA Nominal, @ 24 Vdc	< 100 mA (at 1 kHz sampling rate)

Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**
V = output range in V
I = output range in [mA]
ΔT = temperature change
P = magnet position
NL = stroke length

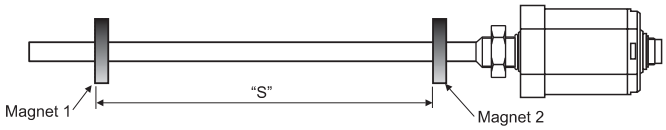


Analog and Digital Output Options for the Micropulse Z Style



RS-485 signal transmission with digital outputs

Two-Magnet Differential Mode
- Available on Analog and PWM
- Output proportional to distance "S"
- Add "-D" suffix to ordering code

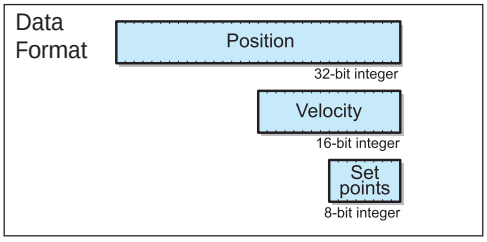


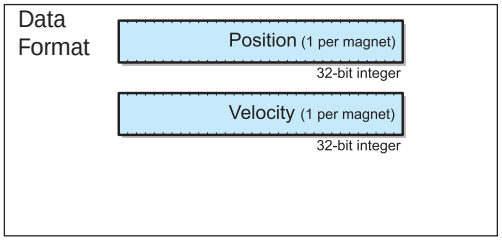
CANopen
This interface provides an efficient connection to machines using CANopen. Features include:
- Process data objects incorporating position, velocity and set-point information
- Emergency object for set-points
- Service data objects for configuring transducer modes
- Synchronization objects for network wide activities

Profibus
This interface provides an efficient connection to machines using Profibus. Features of this interface include:
- Single telegram message for fast updates even with 4 magnets
- Operates at 12 Mbps
- GSD file provided to configure telegram message
- Sync and Freeze functions available for coordination between other devices

Ordering Code	H	T
Resolution	Position 5 µm, Velocity 0.1 mm/s increments (selectable)	Position 5 µm (configurable) Velocity 0.1 mm/s increments (configurable)
Non-linearity	±30 µm at 5 µm resolution	±30 µm at 5 µm resolution
Repeatablity (resolution + hysteresis)	±1 digit	±1 digit
Hysteresis	≤ 1 digit	≤ 1 digit
Sampling Rate	1 kHz	1 kHz
Temperature Coefficient	(6 µm + 5 ppm x L)/°C	(6 µm + 5 ppm x L)/°C
Operating Voltage	24 Vdc ±20%	24 Vdc ±20%
Operating Current	≤ 100 mA	≤ 120 mA
Network Isolation	yes	yes
Network Speed	10, 20, 50, 100, 125, 250, 500, 800, 1000 kBaud	9.6, 19.2, 93.7, 187.5, 900, 1500, 12000 kBaud
Network Compatibility	CiA Standard DS301, DS406 (Encoder Profile)	EN 50170 (Encoder Profile)
Address Selection	Software/DIP switch	DIP switch
Communication Types	Producer/Consumer	Master/Slave
Configuration Software	none required	GSD file
Number of Magnets Supported	1, 2 or 4	1, 2 or 4

Notes:
For more technical information, see pages 123-128





BTL5-H1_ _-Mxxxx-Z-S94

Process Data
1 = 1 x position & 1 x velocity
2 = 2 x position & 2 x velocity
3 = 4 x position

Baud Rate
0 = 1 MBaud
1 = 800 kBaud
2 = 500 kBaud
3 = 250 kBaud
4 = 125 kBaud
5 = 100 kBaud
6 = 50 kBaud
7 = 20 kBaud
8 = 10 kBaud

Stroke Length
xxxx = length in mm (see chart on page 27)
Max = 156" (3962 mm)

Connection Type[1]
S92 = one 5-pin (optional)
S94 = two 5-pin M12 (standard)
Bus in: 5-pin male, M12
Mating connector: BKS-S92-00 (female)
Bus out: 5-pin female, M12
Mating connector: BKS-S94-00 (male)

BTL5-T1_0 -Mxxxx-Z-S103

No. of Magnets
1 = 1 magnet
2 = 2 magnets
3 = 4 magnets

Stroke Length
xxxx = length in mm
Max = 156" (3962 mm)
(see chart on page 27)

Connection Type[2]
S103 = 3 connectors (standard):
Power: 3-pin male, M8
Mating connector: BKS-S48-15-CP-xx (female)
Bus in: 5-pin male, M12
Mating connector: BKS-S103-00 (female)
Bus out: 5-pin female, M12
Mating connector: BKS-S105-00 (male)

[1]See pages 107-114 for mating cables/connectors.
[2]See pages 107-114 for mating cables/connectors.

SSI

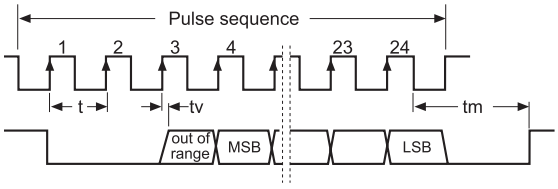
The SSI (synchronous serial interface) output interfaces with popular control systems from manufacturers such as Allen-Bradley, Delta Computer, Siemens, Parker, Bosch-Rexroth and many others. Cable spans can be up to 400 m with noise-free operation. Individual, EEPROM linearization of this interface makes it ideal for applications requiring the best accuracy available.

Ordering Code	S	S _ _ _ B*
Resolution	5, 10, 20 or 40 µm (see ordering code below)	5, 10, 20 or 40 µm (see ordering code below)
Non-linearity – Non-synchronized	±30 µm or ±2 LSBs, whichever is greater	±30 µm or ±2 LSBs, whichever is greater
Repeatablity (resolution + hysteresis)	±1 digit	±1 digit
Hysteresis	≤ 1 digit	≤ 1 digit
Sampling Rate	2 kHz	2 kHz
Temperature Coefficient	(6 µm + 5 ppm x L)/°C	(6 µm + 5 ppm xL)/°C
Communication Speeds	100, 200, 400, 500, 1000 kHz	100, 200, 400, 500, 1000 kHz
Output Modes	24 or 25 bits (binary or gray code)	24 or 25 bits (binary or gray code)
Operating Voltage	24 Vdc ±20% or 10...30 Vdc	24 Vdc ±20% or 10...30 Vdc
Operating Current	≤ 80 mA	≤ 80 mA
Output	Standard RS-485/422 levels	Standard RS-485/422 levels

Notes:

SSI Maximum cable lengths

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



***S_ _ _ _B Versions**

The internal interrogation of the S_ _ _ _B version is synchronized to the externally supplied clock pulses. This configuration results in a more uniform, predictable data update rate, and is better-suited for highly dynamic closed-loop servo applications. Like the standard version, the S_ _ _ _B version is EEPROM linearized at the factory.

BTL5-S_ _ _ _-Mxxxx-Z-_ _ _ _

Supply Voltage
1 = +24 V
5 = 10...30 V
Data Format
0 = Binary, increasing, 24 bit
1 = Gray code, increasing, 24 bit
2 = Binary, falling, 24 bit
3 = Gray code, falling, 24 bit
6 = Binary, increasing, 25 bit
7 = Gray code, increasing, 25 bit
8 = Binary, falling, 25 bit
9 = Gray code, falling, 25 bit
System Resolution
2 = 5 µm
3 = 10 µm
4 = 20 µm
5 = 40 µm
6 = 100 µm
8 = 50 µm
Synchronized Data
B = synchronized*
Blank = non-synchronized
Stroke Length
xxxx = length in mm
Max = 156" (3962 mm)
(see chart on page 27)
Connection Type
S 32 = 8-pin connector (standard)[1]
S140 = MS connector (optional)[2]
KA02 = 2 m PUR cable
KA05 = 5 m PUR cable
KA10 = 10 m PUR cable
KA15 = 15 m PUR cable

[1]See page 24 for mating cables/connectors.
[2]See pages 107-114 for mating cables/connectors.

Quadrature

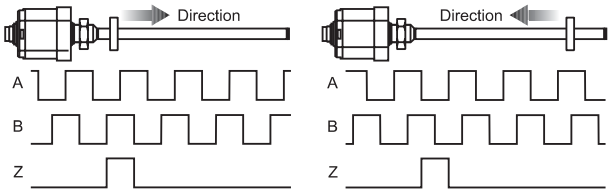
The quadrature output interfaces directly to standard encoder inputs (90° out of phase, A & B). This configuration gives you more interface options for connecting to motion based systems. In addition, the Micropulse quadrature output transducer has the ability to provide **absolute** position information through use of its innovative BURST function.

Ordering Code	Q
Resolution	1, 2, 5 10, 50 µm, 0.001", 0.0001", 0.0005" (switch selectable)
Non-linearity	±100 µm to 500 mm stroke, ±0.02% over 500 mm stroke
Repeatablity (resolution + hysteresis)	resolution + (±2 x resolution or 5 µm, whichever is greater)
Hysteresis	±2 x resolution or 5 µm, whichever is greater
Sampling Rate	Free-running: 1 ms, 2 ms, 4 ms; Synchronous: 500 µs to 10 ms
Temperature Coefficient	(6 µm + 5 ppm x L)/°C
Communication Speeds	10, 200, 400, 800 kHz
Output Modes	Free-running or Synchronous (switch selectable)
Operating Voltage	24 Vdc ±20%, ±15 Vdc ±2%, 10...30 Vdc
Operating Current	≤ 80 mA
Output	Standard A & B (RS-422 level)

Notes:

SSI Maximum cable lengths

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



BTL5-Q _ _ _ _-Mxxxx-Z-S140

Supply Voltage
1 = +24 V
2 = ±15 V
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"
7 = 0.001"
8 = 0.0005"

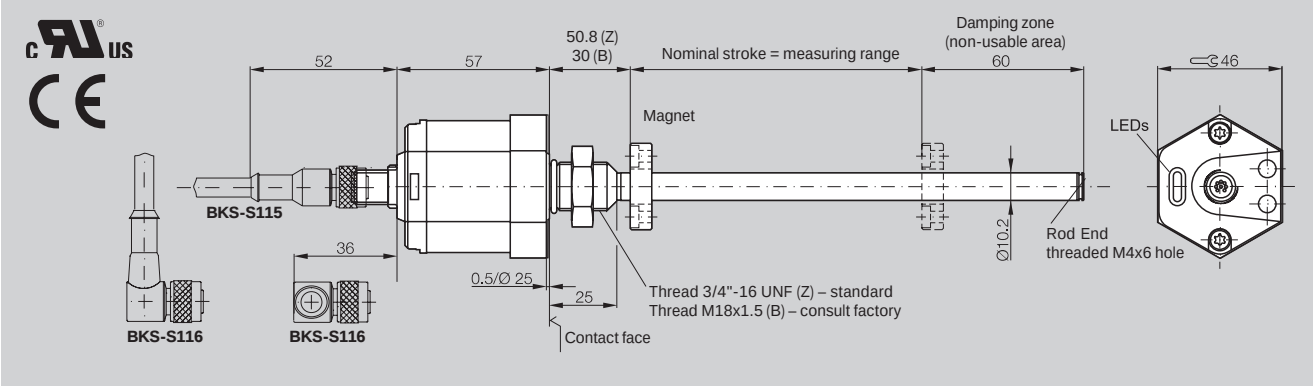
Mode/Update Rate
0 = Synchronous (initiated by controller— consult factory)
1 = free-running, 1 ms update — ≤ 1250 mm stroke only
2 = free-running, 2 ms update — 1251 mm to 2500 mm
4 = free-running, 4 ms update — ≥ 2501 mm

Stroke Length
xxxx = length in mm
(see chart on page 27)

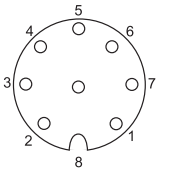
Connection Type
S140 = MS connector[1]
KA_ _ = Integral PVC cable (specify length in meters - 05 standard)

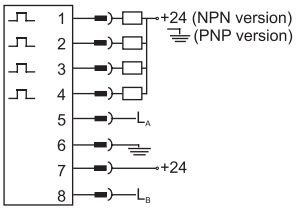
[1]See pages 107-114 for mating cables/connectors.

Series	**Z Style**
Transducer Interface Code	**F**
Input Interface	digital, programmable discrete setpoints



Ordering Code	**NPN**	**BTL5 F100-M_ _ _ _*-Z-S115**
	PNP	**BTL5 F110-M_ _ _ _*-Z-S115**
Output Signals		4 switching outputs
Max. Current Load Per Output		100 mA
Repeatability		±0.1 mm / ±0.004 inch
Internal Sampling Frequency		$f_{STANDARD}$ = 1 kHz = ≤ 1400 mm
Operating Voltage		24 Vdc ±20 %
No-load Current		≤ 100 mA
Operating Temperature		–40 to +185 °F
Storage Temperature		–40 to +212 °F
Pin Assignments		
	Pin 1	switching output (open collector)
	Pin 2	switching output (open collector)
	Pin 3	switching output (open collector)
	Pin 4	switching output (open collector)
	Pin 5	L_A; programming input (low-active)
	Pin 6	GND
	Pin 7	+24 Vdc (10...30 V not available)
	Pin 8	L_B; programming input (low-active)
Shock		100 g/6 ms per IEC 60068-2-27
Vibration		12 g, 10...2000 Hz per IEC 60068-2-6
Dielectric Strength		500 V (GND to housing)
Enclosure Rating per IEC 60529		IP 67 (with IP 67 BKS-S... connector attached)
Housing Material		Anodized Al/ 1.4571 (316) stainless steel rod, 1.3952 stainless investment cast flange
Mounting		Thread 3/4"-16 UNF (Z) or M18×1.5 (B)
Pressure Rating		600 bar (8700 psi) when installed in cylinder
Connection Type		S115 8-pole M12 DC Micro connector
Stroke Lengths		2" (51 mm)...200" (5080 mm)



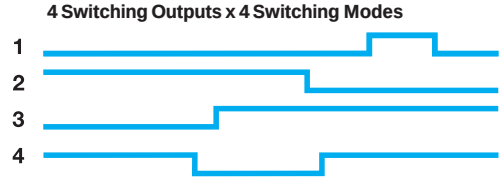


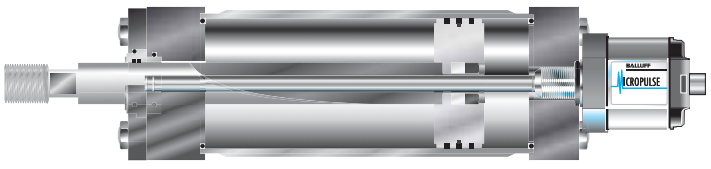
* See page 27 for standard lengths.

Advantages

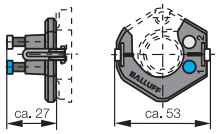
- Four setpoints detect cylinder end-of-stroke or anywhere in between
- Interfaces to discrete I/O instead of more costly analog inputs
- Upgrade from end-of-stroke sensors
- Eliminate multiple external proximity sensors, brackets, targets, cables, and connection blocks
- Eliminate motion controller: run speed/position ramping profiles with direct-input proportional valve
- Installs just like a traditional MDT in probe-ready steel-walled cylinders
- Auto-Tuning™ circuitry allows use of Balluff or competitors' magnets
- Two easy programming options: local, with handy programming tool; or remote, using teach-in connections

4 Switching Outputs x 4 Switching Modes





Programming Tool
BTL5-A-EH02
for teaching setpoints
(included)



RRM Rapid Replacement Module

Rapid Replacement Module Option

Balluff's new Rapid Replacement Module (RRM) option allows quick field replacement without removing the pressure tube from the cylinder, making change-outs easy and cutting equipment downtime.

Advantages of the RRM include:

- No hydraulic oil spillage and no need for environmental containment
- No danger from hot oil spilling onto repair personnel
- No need to bleed air from hydraulic system after replacement
- No danger of dirt entering open hydraulic port
- 100% exchange of sensor package eliminates guesswork
- Dimensionally identical to standard Balluff Z style for equivalent output type
- Backward-compatible with existing standard Balluff Z style pressure tubes*
- Available for all output types except Profibus, CANopen, and ProSet4

The RRM can be installed in your maintenance program in a variety of ways:

- For new installations, you can order optional ZM construction, which includes a Balluff pressure tube along with a RRM pre-installed. To change out this type, you simply remove two housing screws, replace the RRM, re-tighten the two housing screws – and you're done.
- For new installations, you can also order standard Z construction, which includes a complete standard transducer. You can still do field swaps on this type by removing the standard electronics head and internal waveguide element as two separate components, then replacing both with a single RRM unit.
- If you already have an installed base of standard Balluff Z transducers, you can also change them out quickly with the RRM as described above. The RRM easily retrofits into existing Balluff pressure tubes once the old electronics and waveguide element have been removed.*
- Keep spare RRM units on hand to maintain any Balluff ZM or Z construction transducer.

* Synchronized SSI RRM is not backward-compatible to standard pressure tubes used on non-synchronized SSI units. Synchronized SSI RRM only fits pressure tube supplied with complete synchronized SSI units.

Ordering Example – Complete Transducer Unit with RRM + Pressure Tube

BTL5-xxx-Mxxxx-ZM-xxx

Add "M" after "Z"

Ordering Example – Rapid Replacemnet Module Only

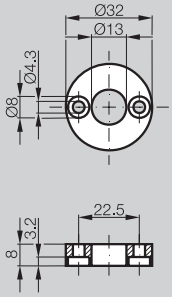
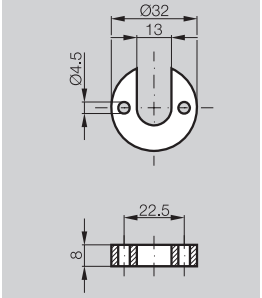
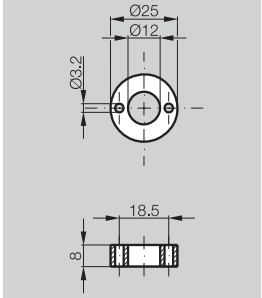
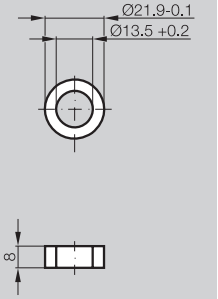
BTL5-xxx-Mxxxx-ZM-xxx/RU

Add "M" after "Z"

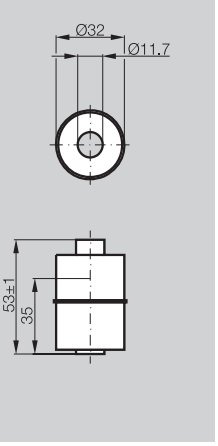
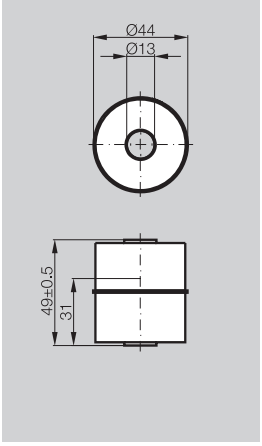
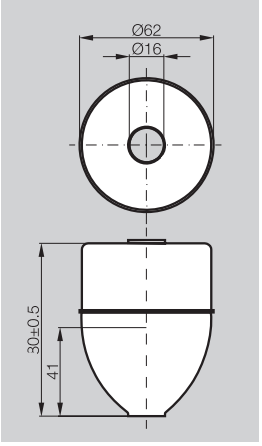
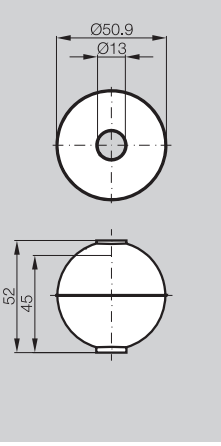
Add "/RU" at end of ordering code

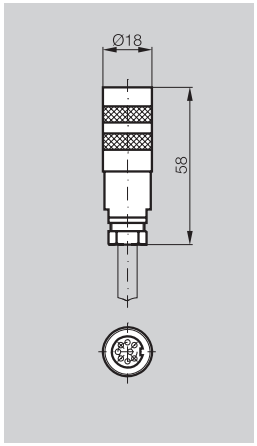
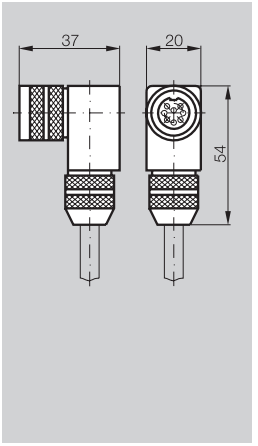
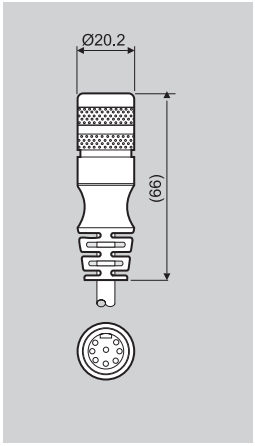
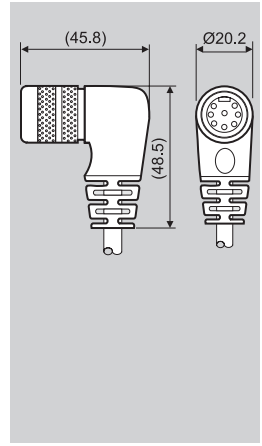
See page 27 for complete ordering code.

BTL Z

Product	Magnet, Spacer	Magnet, Spacer	Magnet, Spacer	Magnet
Type	Ø32 ring	Ø32 open ring	Ø25 ring	Ø22 ring
					
Ordering Code - Magnet	**BTL-P-1013-4R***	**BTL-P-1013-4S***	**BTL-P-1012-4R***	**BTL-P-1014-2R**
Ordering Code - Spacer	**BTL Z-P-1013-4R-SPACER**	**SPACER BTL-P-1013-DS**	**BTL Z-2-1012-4R-SPACER**	**N/A**
Material	AL	AL	AL	AL
Weight	12 g	12 g	12 g	10 g
Magnet Speed	any	any	any	any
Operating/Storage Temperature	-40…+100°C	-40…+100°C	-40…+100°C	-40…+100°C

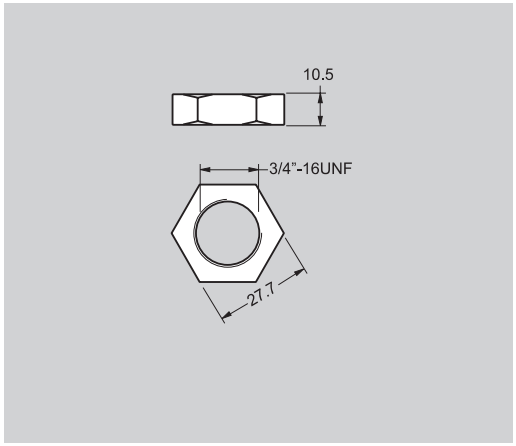
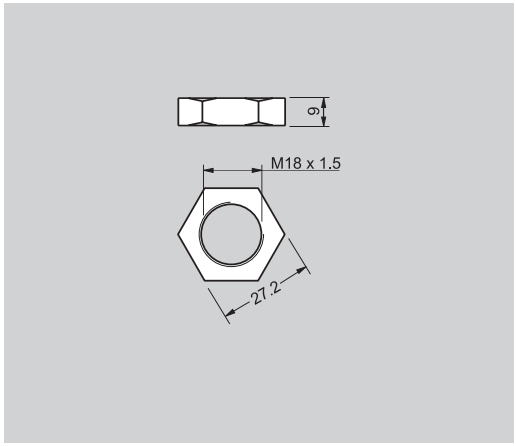
*Spacer is included with these magnets

Product	Magnet	Magnet	Magnet	Magnet
Type	Barrel float	Barrel float	Bullet float	Sphere float
					
Ordering Code	**BTL2-S-3212-4Z**	**BTL2-S-4414-4Z**	**BTL2-S-6216-8P**	**BTL2-S-5113-4K**
Material	Stainless 316	Stainless 316	Stainless 316	Stainless 316
Weight	20 g	35 g	66 g	34 g
Operating/Storage Temperature	-40…+120°C	-40…+120°C	-40…+120°C	-40…+120°C
Water Displacement	35 mm	30 mm	41 mm	26 mm
Pressure (static)	24 bar (348 psi)	20 bar (290 psi)	15 bar (217 psi)	40 bar (580 psi)

Product	Straight Connector	Right-angle Connector	Molded Straight Connector	Molded Right-angle Connector
Type	8-pin female	8-pin female	8-pin female	8-pin female
					
Ordering Code	**BKS-S 32M-_*_**	**BKS-S 33M-_*_**	**BKS-S 232-PU-_*_**	**BKS-S 233-PU-_*_**
Material	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated
Contact Surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Solder Connection	00 option only	00 option only	N/A	N/A
Cable	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24
Cable Diameter	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm
Allowable Cable Diameter	6…8 mm	6…8 mm	N/A	N/A
Cable Material	PUR	PUR	PUR	PUR
Environmental Rating	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)

For additional connectors, see pages 107-114

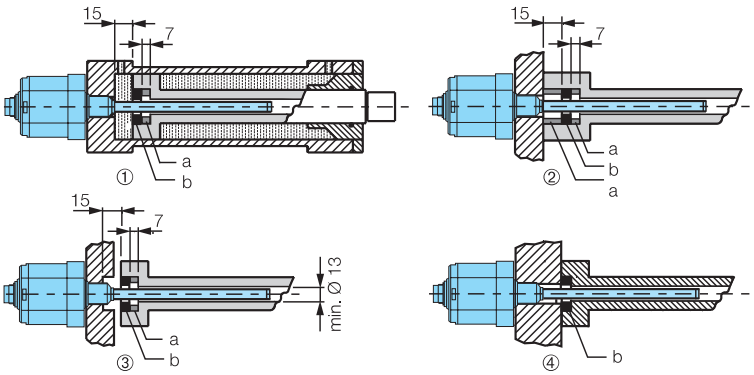
* Indicate cable length in ordering code in meters
(consult factory for longer lengths)
00 = connector only (only available for BKS-S 32M and BKS-S 33M)
02 = 2 meter cable
05 = 5 meter cable

Product	Jam nut	Jam nut
Type	3/4"-16 UNF	M18 x 1.5
		
Ordering Code	**BTL-5-JAM-NUT**	**BTL-A-FK01-E-M18x1.5**
Application	Z housing	B/H housing
Material	Stainless steel	Stainless steel

Note:
Jam nut not needed for in-cylinder applications

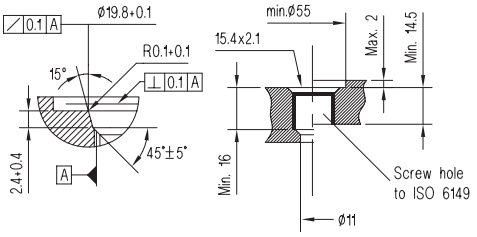
Installation

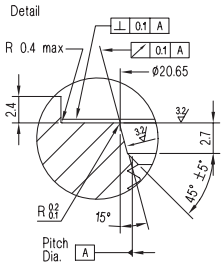
The BTL Micropulse transducer is provided with a ¾" x 16-UNF (optional M18 × 1.5) mounting thread. We recommend mounting into non-magnetizable materials. If magnetizable materials are used, the installation must be carried out as shown in the drawing below. Sealing is at the flange mounting surface, using the supplied O-ring.



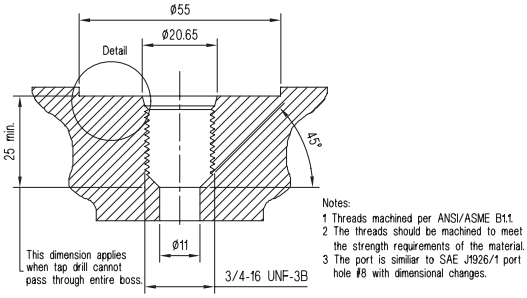
①②③ For magnetizable material
④ For non-magnetizable material
a Spacer made of non-magnetizable material
b Magnet

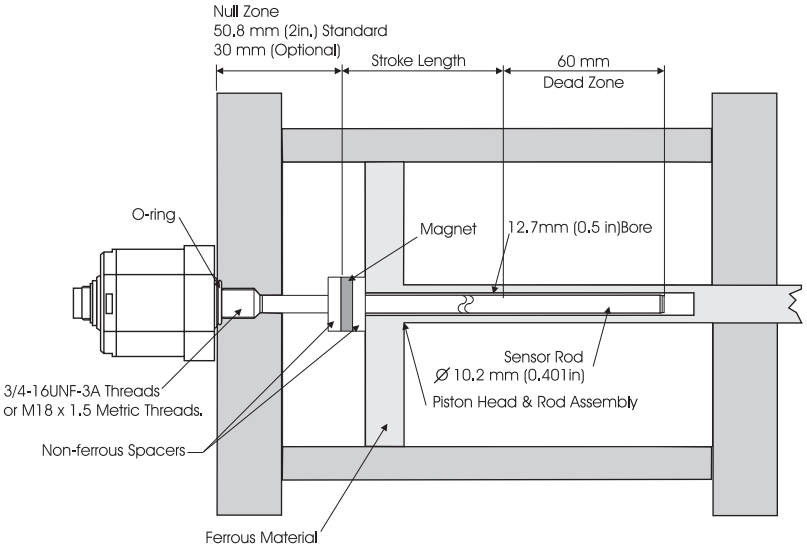
B Style Housing





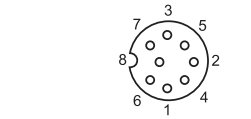
Z, Z8, ZM Style Housing



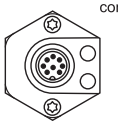


Typical Installation in Hydraulic Cylinder

Analog Wiring Diagrams



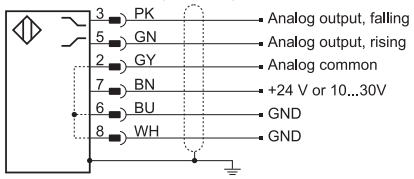
View of mating connector, wiring side



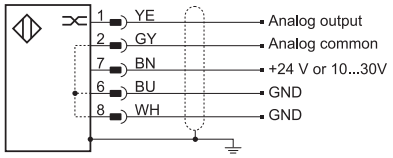
S32 Connector

Integral Cable

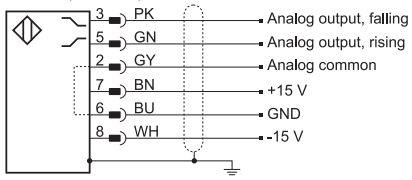
Analog Voltage
24 V or 10...30V (A, B, G)



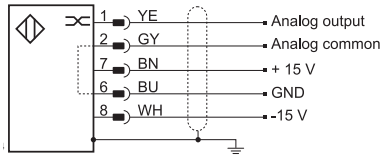
Analog Current
24 V or 10...30V (E, C)



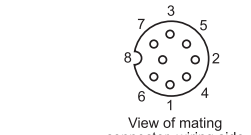
Analog Voltage
±15 V (A, B, G)



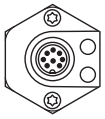
Analog Current
±15 V (E, C)



Digital Wiring Diagrams



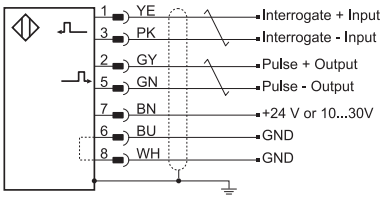
View of mating connector, wiring side



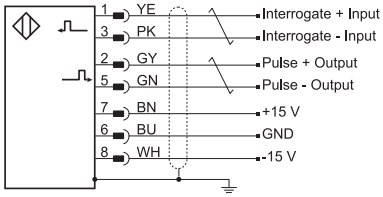
S32 Connector

Integral Cable

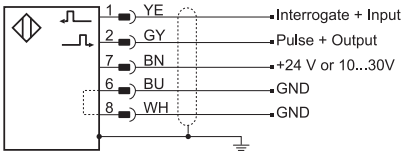
Digital, RS485 differential
24 V or 10...30V (P, M, I, K, L, R)



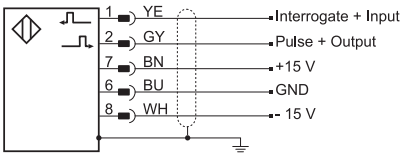
Digital, RS485 differential
±15 V (P, M, I, K, L, R)



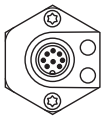
Digital, Single-ended
24 V or 10...30V (N)



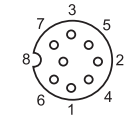
Digital, Single-ended
±15 V (N)



SSI Wiring Diagram

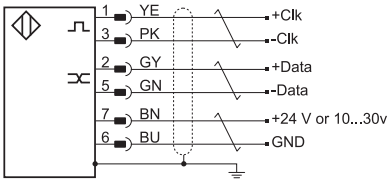


S32 Connector



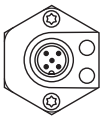
View of mating connector, wiring side

SSI (S)
24 V or 10...30V

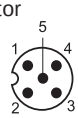


* Pin-8 (WH) must remain unconnected

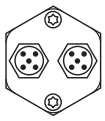
CANopen Wiring Diagram



S92 Connector

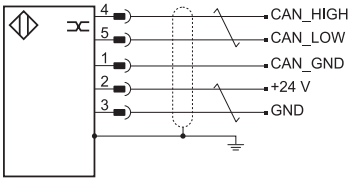


View of mating connector, wiring side



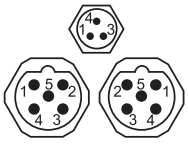
S94 Connector

CANopen (H)



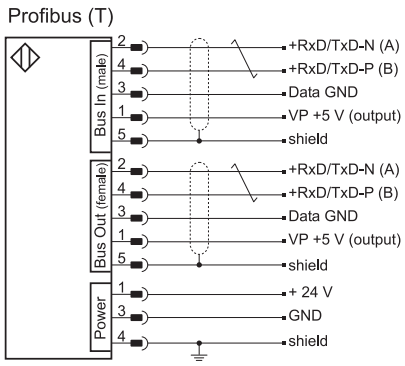
Profibus Wiring Diagram

S103 Connectors

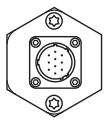


View of mating connector, wiring side

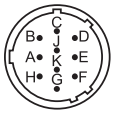
Profibus (T)



Quadrature Wiring Diagram

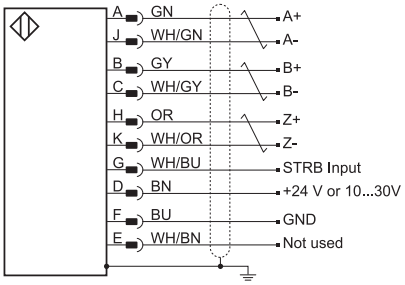


S140 Connector



View of mating connector, wiring side

Quadrature (Q)
24 V or 10...30V



Note: ⟍ = twisted-pair

B T L 5 - A 1 1 - M 0 3 0 5 - Z - S 3 2 - E 4 / U S
K A 0 5

Balluff
Linear Transducer

Generation 5

Output Type
A = 0 to 10 Vdc
B = -5 to +5 Vdc
C = 0 to 20 mA
E = 4 to 20 mA
F = Setpoint*
G = -10 to +10 Vdc
S = SSI*
T = Profibus*
H = CANopen*

Q = Quadrature*
I = Differential start/stop with tri-state
K = Differential stop - leading edge active
L = Differential pulse - width modulated
M = Differential start/stop - leading edge active
N = Single ended start/stop - leading edge (add/US)
P = Differential start/stop - trailing edge active
R = Differential pulse-width - recirculated

Supply Voltage
1 = 24 Vdc ±20%
2 = ±15 Vdc ±2% (Not available for S, T, H or F output types)
5 = 10...30 Vdc (Not available for T & H output types; not available for SSI "B")

Analog Output Operation
(blank for digital)
Voltage output (Output type A, B & G)
1 = User selectable rising or falling
Current output (Output type C & E)
0 = Minimum output at connector end (rising towards opposite end)
7 = Maximum output at connector end (falling towards opposite end)

Stroke Length
0 3 0 5 = active stroke length (in mm)

Housing Type
Z = Standard Rod Style (3/4"x16-UNF mounting threads and 50.8 mm null zone) 10.2 mm dia. pressure tube
Z8 = Z Rod 8.0 mm dia. pressure tube (1016 mm max. length, 3600 psi max. pressure)
ZM = Rapid Replacement Module version of standard Z rod style. Rounded flange corners for clearance in hydraulic cylinder protective caps.
B = Metric Rod Style (M18x1.5 mounting threads and 30 mm null zone) 10.2 mm dia. pressure tube
B8 = Metric B Rod Style 8.0 mm dia. pressure tube (1016 mm max. length, 3600 psi max. pressure)
BM = Rapid Replacement Module version of B metric rod style. Includes rounded flange corners.

Connection Type
S 3 2 = 8-pin quick disconnect metal (standard) connector (see page 24 for mating cable)
K A 0 5 = Cable out (5 m standard; specify length in meters)
S 1 4 0 = MS connector (optional) (see pages 107-114 for mating cable)
(For additional connector options, refer to pages 107-114 in the connector options section)

Interrogation (only valid if output type = R, otherwise leave blank)
I = Internal interrogation, E = External interrogation

Recirculation (only valid if output type = R, otherwise leave blank)
1=1 circulation, 2 = 2 circulations, 3 = 3 circulations, 4 = 4 circulations, 6 = 6 circulations, 8 = 8 circulations, 10 = 10 circulations,16 = 16 circulations

N output only

/US = TTL - single ended Start/Stop - leading edge (US Standard)

Blank = TTL - single ended Start only - leading edge (European Standard)

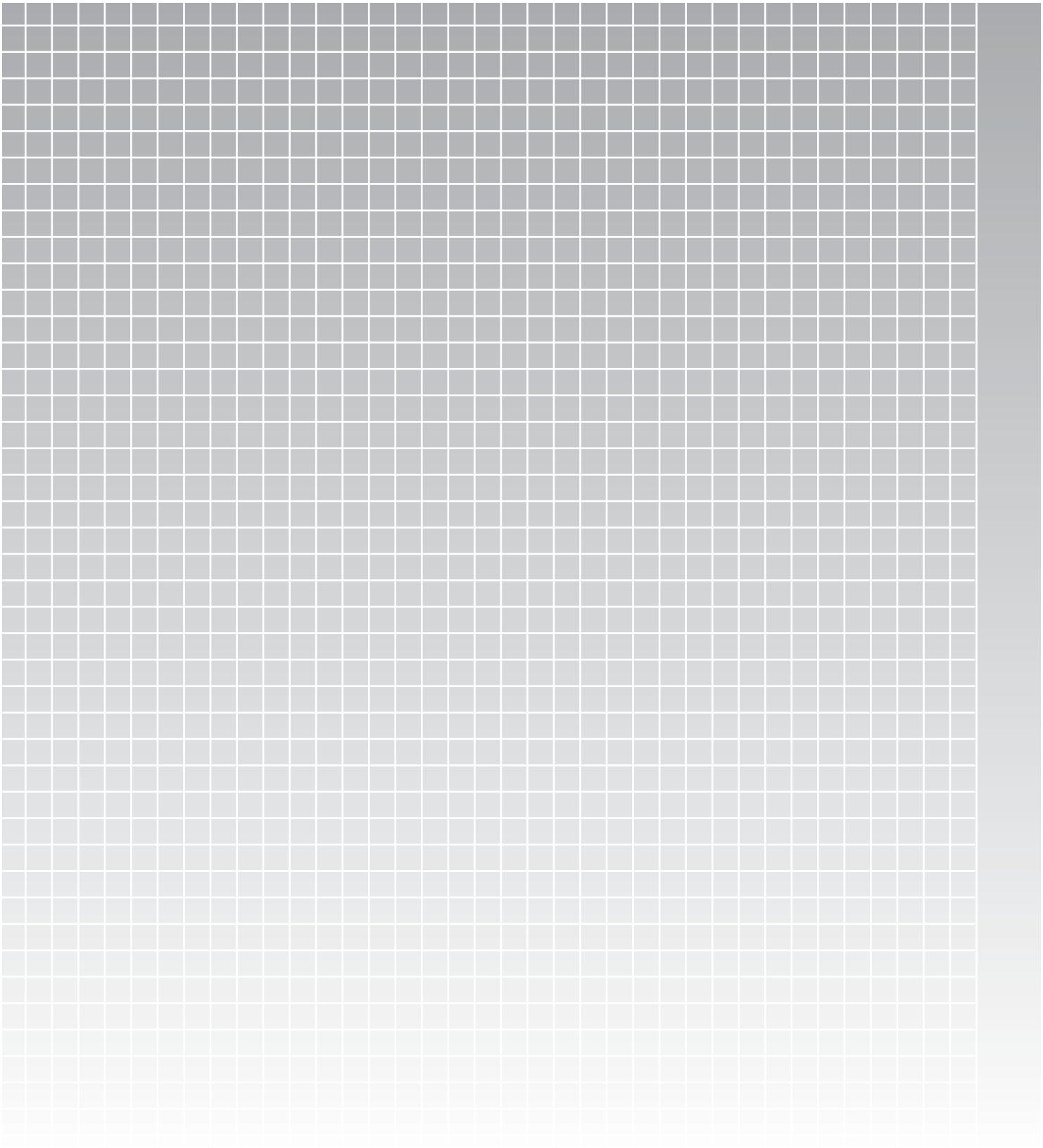
*See additional ordering information on pages 18-21.

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

1	(0025)	9	(0230)	22	(0560)	48	(1220)	89	(2261)	156[A]	(3962)	192	(4877)
2	(0051)	10	(0254)	24	(0610)	50	(1270)	98	(2490)	160	(4064)	196	(4978)
3	(0076)	11	(0280)	26	(0661)	54	(1372)	108	(2743)	164	(4166)	200	(5080)
3.5	(0090)	12	(0305)	28	(0711)	60	(1524)	118	(2997)	168	(4267)		
4	(0102)	13	(0330)	30	(0762)	66	(1676)	126	(3200)	172	(4369)		
5	(0127)	15	(0381)	32	(0813)	69	(1753)	140	(3556)	176	(4470)		
6	(0152)	16	(0407)	36	(0914)	72	(1829)	144	(3658)	180[B]	(4572)		
7	(0178)	18	(0457)	40	(1016)	78	(1981)	148	(3759)	184	(4674)		
8	(0203)	20	(0508)	42	(1067)	84	(2134)	152	(3861)	188	(4775)		

[A] Maximum length for SSI, Profibus, CANopen = 156 inches.

[B] Maximum length for analog outputs = 180 inches.



Compact Rugged Rod Style Thread-In

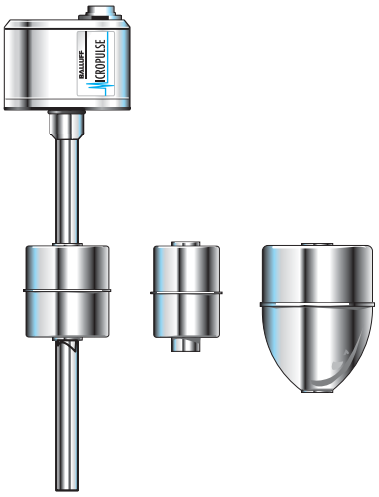
Compact, rugged, and built to last, the all stainless steel “W” housing can withstand the rigors of harsh, real-world applications. With its compact size and “built like a tank” ruggedness, the “W” housing is the logical choice for demanding applications.

Applications:

- Hydraulic cylinder
- Primary wood (lumber)
- Valve control
- Food processing
- Waste water plants
- Pulp and paper
- Gate position
- Hydro/Civil engineering

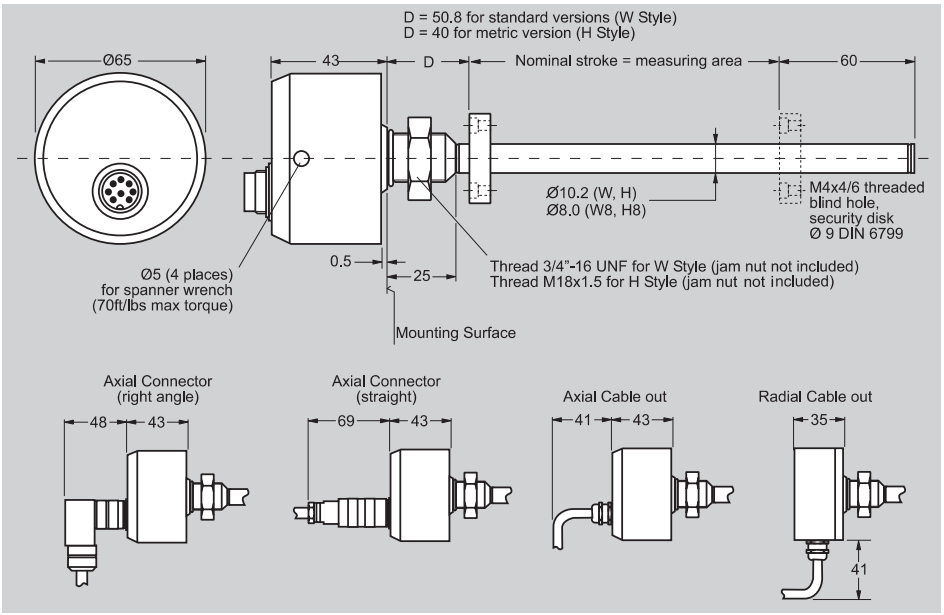
Features:

- Rugged all stainless steel housing
- Designed for demanding applications
- Eliminates need for protective covers
- Pressure rated 8700 psi
- 3/4"x16- UNF threads (W housing)
- Metric M18 thread version available (H housing)
- Outputs
  - Analog (voltage or current)
  - Digital start/stop
  - Pulse width Modulation (PWM)
  - PWM with recirculations
  - SSI
- Stroke length – 1" to 200"
- Quick disconnect or integral cable



W Compact, Threaded Rod Style

Series	**W Style**
Available Lengths	25 mm (1 in) to 5080 mm (200 in)
Output Signals	Analog, Digital Pulse, SSI



Ordering Code	**BTL 5-_ _ _-M_ _ _-W-_ _ _ _** (See ordering code on page 37)
Measurement Type	Linear displacement
Measurement Range	25 mm (1 in) to 5080 mm (200 in)
Shock Rating	100 g/6 ms (100 g/2 ms continuous) per IEC 68 2-27
Vibration Rating	12 g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	Connector versions: IP 67 Integral cable versions: IP 68
Housing Material	316 stainless steel
Rod & Flange Material	Tube: 316T stainless, flange: 316L
Pressure Rating (rod)	600 bar (8700 PSI) max (10.2 mm Ø Pressure Tube) 250 (3600 PSI) max (8 mm Ø Pressure Tube)
Operating Temperature	-40 to + 185° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	connector or integral cable
Noise Immunity	ESD, RFI and BURST per IEC 1000-4-2/3/4/6, severity level 3
Approvals	CE

Warning:
These products are not rated for personnel safety applications.

Accessories:
Magnets and Floats .... pg 33
Connectors ..... pg 34

For additional connectors, see pages 107-114

Autotuning Circuitry

Patented Autotuning circuitry in Balluff Micropulse® transducers automatically compensates for changes in the strength of the magnetostrictive return signal.

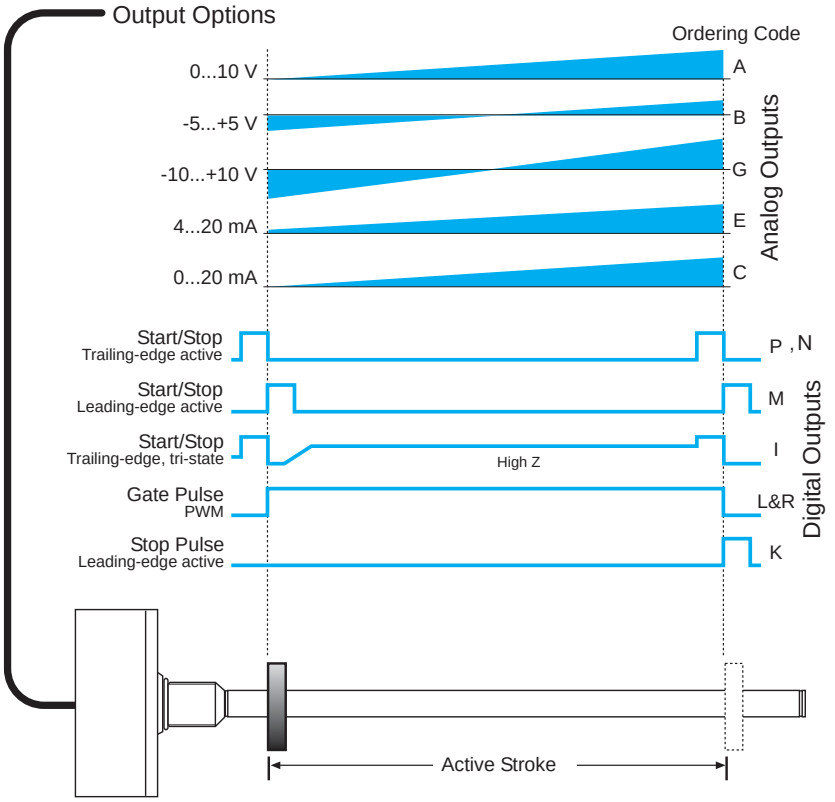
- Allows Micropulse rod-style transducers to be used in hydraulic cylinders that have both new and legacy Balluff magnets. Autotuning allows use of many legacy competitor's magnets as well.
- Automatically compensates for changes in temperature, providing a more stable signal over a wide temperature range.

Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop, PWM
Part No. Code (See Pg. 37)	**A, B, G**	**E, C**	**P, M, N, I, L, R, K**
Output	0...+10 V, -5...+5 V, -10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2K Ω (5 mA max)	≤500 Ω	per spec
Resolution	≤ 0.1 mV	≤0.2 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	4 µm	4 µm	4 µm
Sampling Rate	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm
Temperature Coefficient*	[150 µV/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6 µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) / °C
Operating Voltage	24 Vdc ±20% or 10...30 Vdc	24 Vdc ±20% or 10...30 Vdc	24 Vdc ±20% or 10...30 Vdc
Operating Current	< 150 mA Nominal, @ 24 Vdc	< 150 mA Nominal, @ 24 Vdc	< 150 mA Nominal, @ 24 Vdc

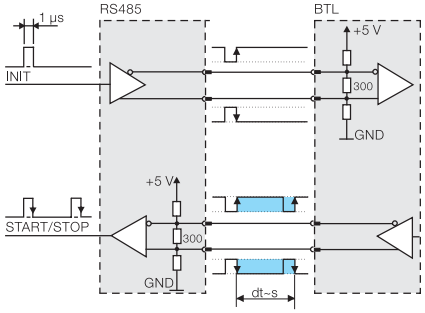
Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**

V	=	output range in V
I	=	output range in [mA]
ΔT	=	temperature change
P	=	magnet position
NL	=	stroke length



Analog and Digital Output Options for the Micropulse W Style



RS-485 signal transmission with digital outputs

SSI

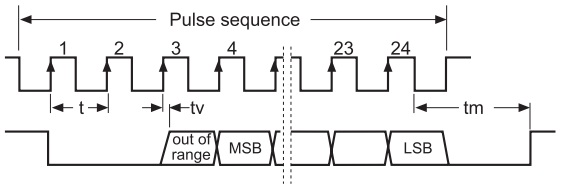
The SSI (synchronous serial interface) output interfaces with popular control systems from manufacturers such as Allen-Bradley, Siemens, Parker and many others. Cable spans can be up to 400 m with noise free operation. Individual EEPROM linearization of this interface makes it ideal for applications requiring the best accuracy available.

Ordering Code	S
Resolution	5, 10, 20 or 40 µm
Non-linearity	±30 µm or ±2LSBs, whichever is greater
Repeatablity (resolution + hysteresis)	±1 digit
Hysteresis	≤ 1 digit
Sampling Rate	500 µs
Temperature Coefficient	(6 µm + 5 ppm x L)/°C
Communication Speeds	100, 200, 400, 500, 1000 kHz
Output Modes	24 or 25 bits, binary or gray code
Operating Voltage	24 Vdc ±20%
Operating Current	≤ 80 mA
Output	Standard RS-485/422 levels

Notes:

SSI Maximum cable lengths

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



BTL5-S1_ _-Mxxxx-W-_ _ _ _

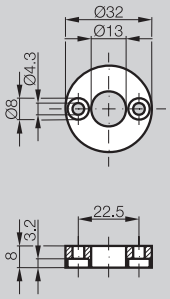
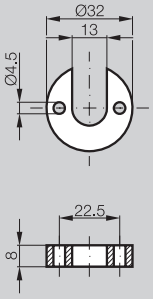
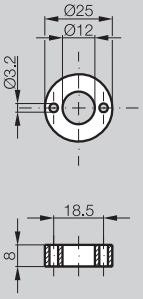
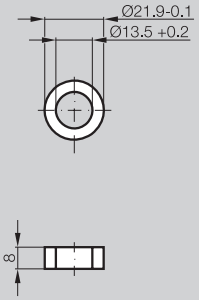
Data Format
0 = Binary, increasing, 24 bit
1 = Gray code, increasing, 24 bit
2 = Binary, falling, 24 bit
3 = Gray code, falling, 24 bit
6 = Binary, increasing, 25 bit
7 = Gray code, increasing, 25 bit
8 = Binary, falling, 25 bit
9 = Gray code, falling, 25 bit

System Resolution
2 = 5 µm
3 = 10 µm
4 = 20 µm
5 = 40 µm
6 = 100 µm
8 = 50 µm

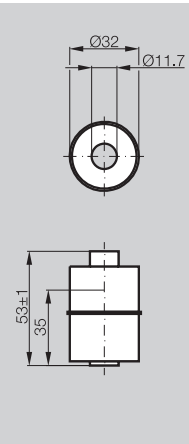
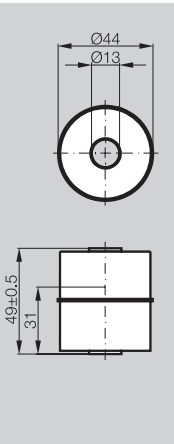
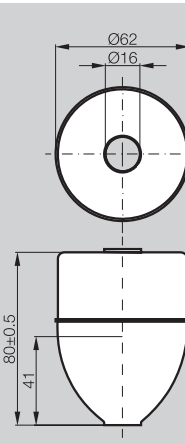
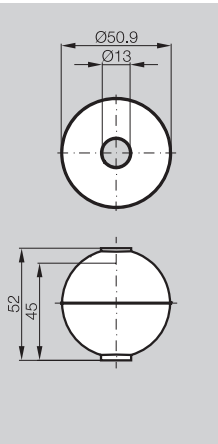
Stroke Length
xxxx = length in mm
(see chart on page 37)
Max = 156" (3962 mm)

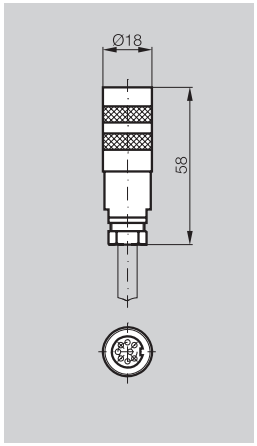
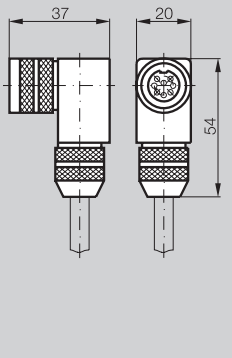
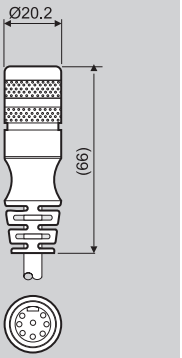
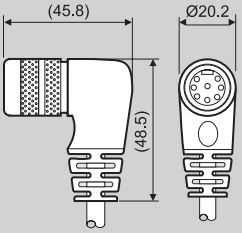
Connection Type
S 32 = 8-pin connector (standard)[1]
KA02 = 2m PUR cable
KA05 = 5m PUR cable
KA10 = 10m PUR cable
KA15 = 15m PUR cable

[1]See page 34 for mating cables/connectors.

Product Type	Magnet, Spacer Ø32 ring	Magnet, Spacer Ø32 open ring	Magnet, Spacer Ø25 ring	Magnet, Spacer Ø22 ring
				
Ordering Code - Magnet **Ordering Code - Spacer**	**BTL-P-1013-4R*** **BTL Z-P-1013-4R-SPACER**	**BTL-P-1013-4S*** **SPACER BTL-P-1013-DS**	**BTL-P-1012-4R*** **BTL Z-2-1012-4R-SPACER**	**BTL-P-1014-2R** **N/A**
Material	AL	AL	AL	AL
Weight	12 g	12 g	12 g	10 g
Magnet Speed	any	any	any	any
Operating/Storage Temperature	-40…+100°C	-40…+100°C	-40…+100°C	-40…+100°C

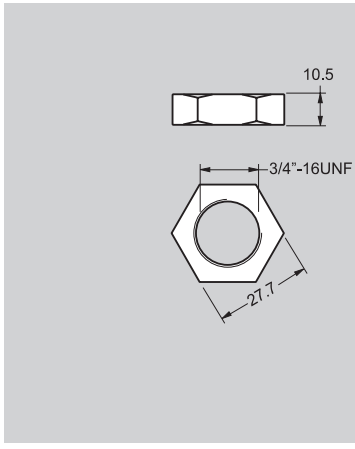
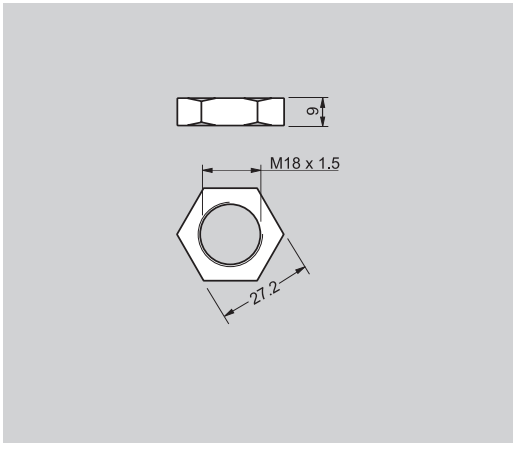
*Spacer is included with these magnets

Product Type	Magnet Barrel float	Magnet Barrel float	Magnet Bullet float	Magnet Sphere float
				
Ordering Code	**BTL2-S-3212-4Z**	**BTL2-S-4414-4Z**	**BTL2-S-6216-8P**	**BTL2-S-5113-4K**
Material	Stainless 316	Stainless 316	Stainless 316	Stainless 316
Weight	20 g	35 g	66 g	34 g
Operating/Storage Temperature	-40…+120°C	-40…+120°C	-40…+120°C	-40…+120°C
Water Displacement	35 mm	30 mm	41 mm	26 mm
Pressure (static)	24 bar (348 psi)	20 bar (290 psi)	15 bar (217 psi)	40 bar (580 psi)

Product	Straight Connector	Right-angle Connector	Molded Straight Connector	Molded Right-angle Connector
Type	8-pin female	8-pin female	8-pin female	8-pin female
					
Ordering Code	**BKS-S 32M-_*_**	**BKS-S 33M-_*_**	**BKS-S 232-PU-_*_**	**BKS-S 233-PU-_*_**
Material	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated
Contact Surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Solder Connection	00 option only	00 option only	N/A	N/A
Cable	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24
Cable Diameter	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm
Allowable Cable Diameter	6…8 mm	6…8 mm	N/A	N/A
Cable Material	PUR	PUR	PUR	PUR
Environmental Rating	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)

For additional connectors, see pages 107-114

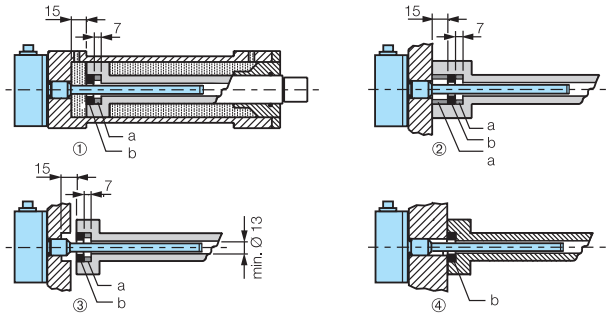
* Indicate cable length in ordering code in meters
(consult factory for longer lengths)
00 = connector only (only available for BKS-S 32M and BKS-S 33M)
02 = 2 meter cable
05 = 5 meter cable

Product	Jam nut	Jam nut
Type	3/4"-16 UNF	M18 x 1.5
		
Ordering Code	**BTL-5-JAM-NUT**	**BTL-A-FK01-E-M18x1.5**
Application	W housing	H housing
Material	Stainless steel	Stainless steel

Note:
Jam nut not needed for in-cylinder applications

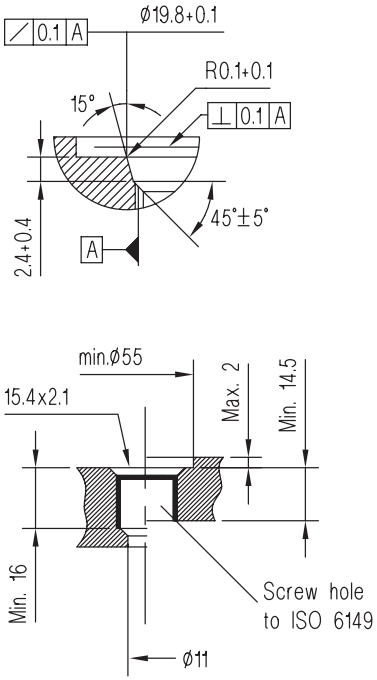
Installation

The BTL Micropulse transducer is provided with a ¾" x 16-UNF (optional 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 drawings at right. Sealing is at the flange mounting surface, using the supplied O-ring.

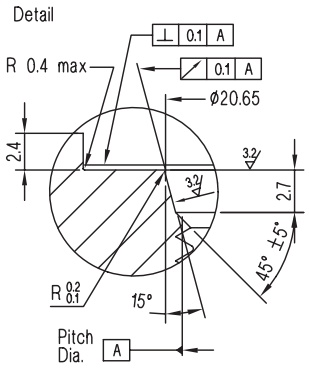


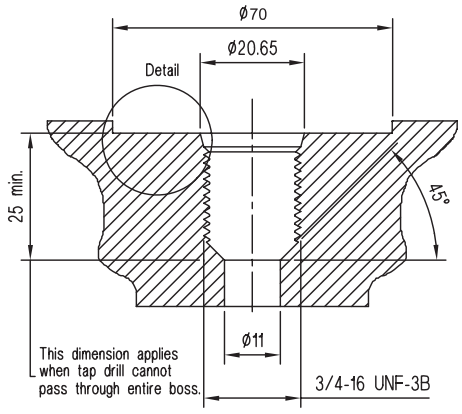
①②③ For magnetizable material
④ For non-magnetizable material
a Spacer made of non-magnetizable material
b Magnet

H Style Metric Thread Housing

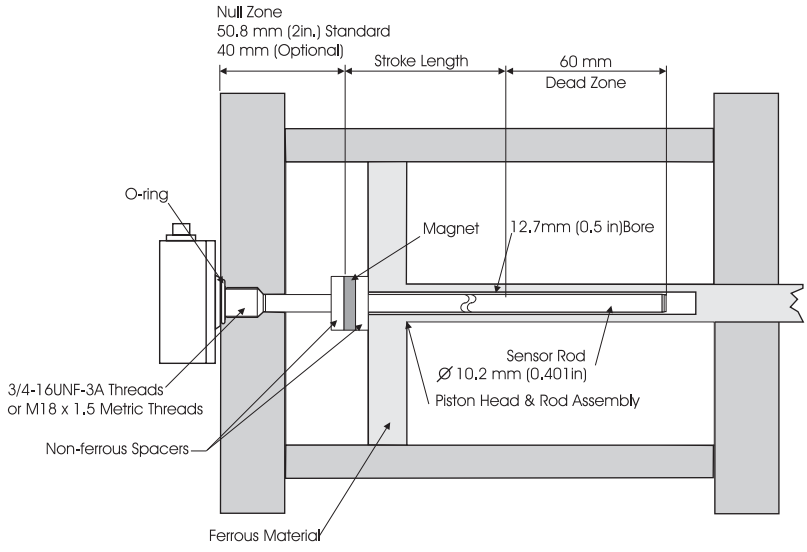


W Style Inch Thread Housing



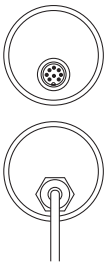


Notes:
1 Threads machined per ANSI/ASME B1.1.
2 The threads should be machined to meet the strength requirements of the material.
3 The port is similiar to SAE J1926/1 port hole #8 with dimensional changes.

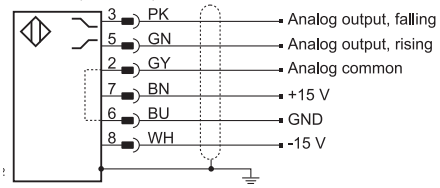


Typical Installation in Hydraulic Cylinder

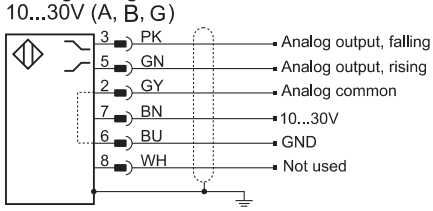
Analog Wiring Diagrams



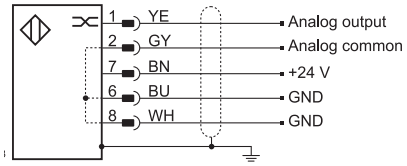
Analog Voltage ±15 V (A, B, G)



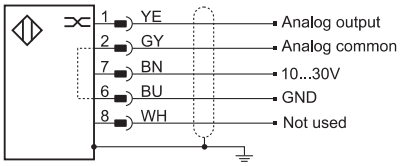
Analog Voltage 10...30V (A, B, G)



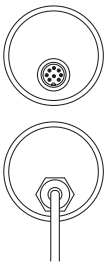
Analog Current 24 V (E, C)

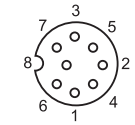


Analog Current 10...30V (E, C)



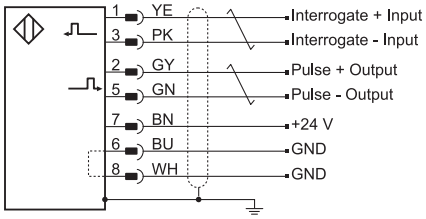
Digital Wiring Diagrams



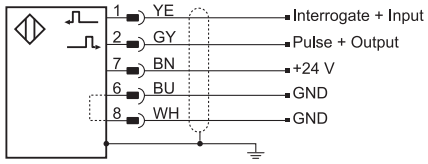


View of mating connector, wiring side

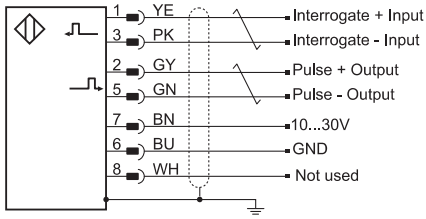
Digital, RS485 differential 24 V (P, M, I, K, L, R)



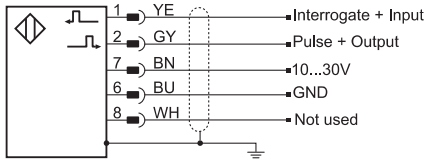
Digital, Single-ended 24 V (N)



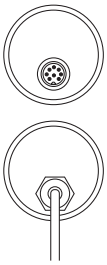
Digital, RS485 differential 10...30V (P, M, I, K, L, R)

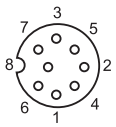


Digital, Single-ended 10...30V (N)



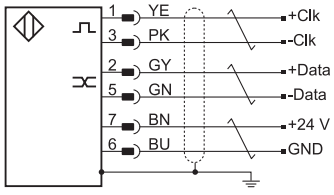
SSI Wiring Diagram





View of mating connector, wiring side

SSI (S)



* Pin-8 (WH) must remain unconnected

Note: = twisted-pair

B T L 5 - A 1 1 - M 0 3 0 5 - W - S 3 2 - E 4 / U S
K A 0 5

Balluff
Linear Transducer

Generation 5

Output Type
A = 0 to 10 Vdc
B = -5 to +5 Vdc
C = 0 to 20 mA
E = 4 to 20 mA
G = -10 to +10 Vdc
S = SSI*

I = Differential start/stop with tri-state
K = Differential stop - leading edge active
L = Differential pulse - width modulated
M = Differential start/stop - leading edge active
N = Single ended start/stop - leading edge (add/US)
P = Differential start/stop - trailing edge active
R = Differential pulse-width - recirculated

Supply Voltage
1 = 24 Vdc ±20%
5 = 10...30 Vdc

Analog Output Operation
(Leave Blank for Digital Versions)
Voltage output (Output type A, B & G)
1 = User selectable rising or falling
Current output (Output type C & E)
0 = Minimum output at connector end (rising towards opposite end)
7 = Maximum output at connector end (falling towards opposite end)

Stroke Length
0 3 0 5 = 305 mm active stroke length

Housing Type
W...10.2 mm...Compact, threaded rod style, 3/4"-16 UNF threads, 2 inch null point
W8 = 8.0 mm dia. pressure tube (1016 mm max length, 250 bar max pressure)
H...10.2 mm...Compact, threaded rod style, M18x1.5 threads, 40 mm null point
H8 = 8.0 mm dia. pressure tube (1016 mm max length, 250 bar max pressure)

Connection Type
S 3 2 = 8-pin quick disconnect metal connector (see page 34 for mating cable)
K A 0 5 = Axial cable out (5 m standard; specify length in meters)
K 0 5 = Radial cable out (5 m standard; specify length in meters)

Interrogation (only valid if output type = R, otherwise leave blank)
I = Internal interrogation, E = External interrogation

Recirculation (only valid if output type = R, otherwise leave blank)
1=1 circulation, 2 = 2 circulations, 3 = 3 circulations, 4 = 4 circulations, 6 = 6 circulations,
8 = 8 circulations, 10 = 10 circulations,16 = 16 circulations

N output only

/US = TTL - single ended Start/Stop - leading edge (US Standard)

Blank = TTL - single ended Start only - leading edge (European Standard)

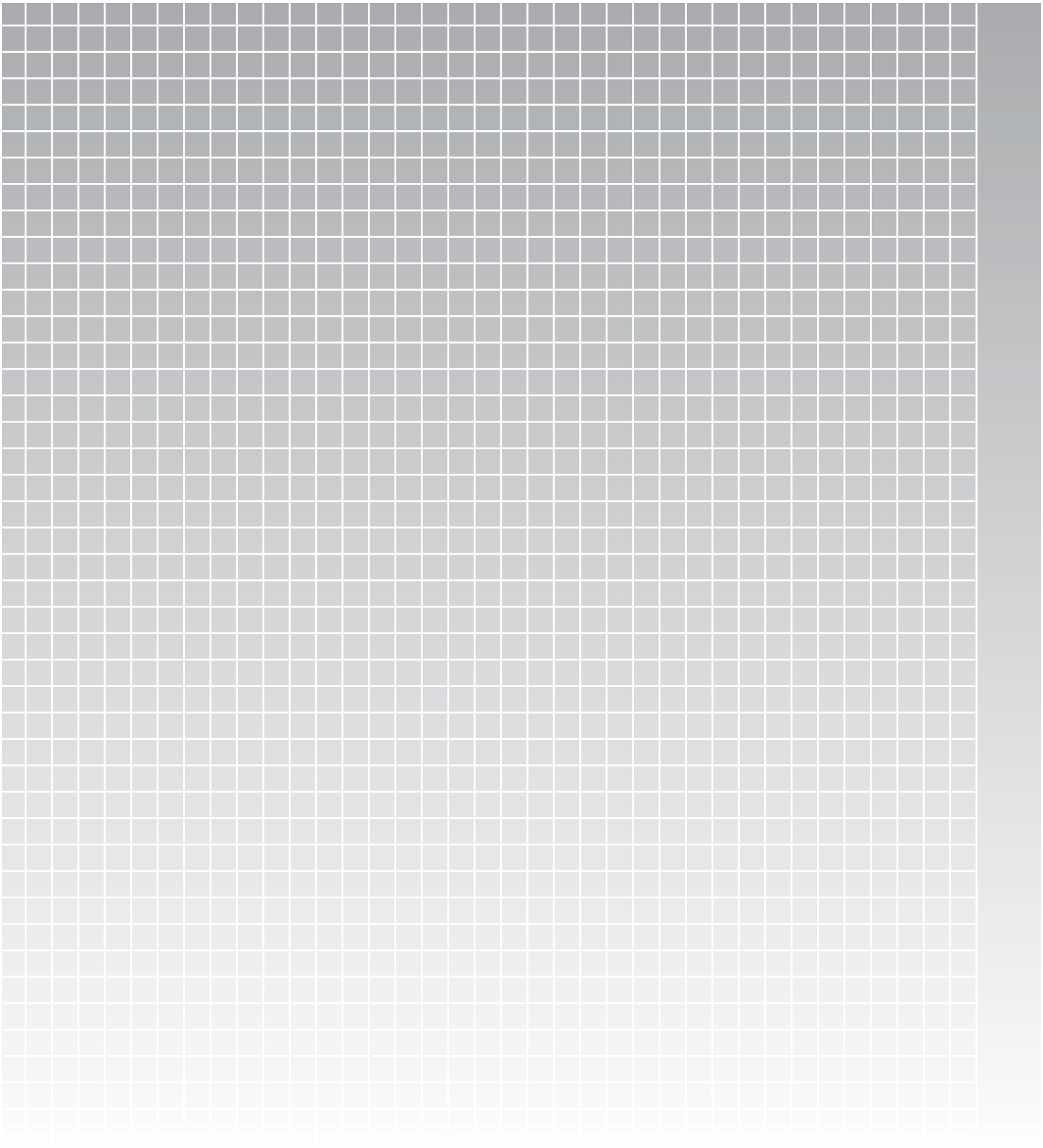
*See additional ordering information on page 32.

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

1	(0025)	9	(0230)	22	(0560)	48	(1220)	89	(2261)	156[A]	(3962)	192	(4877)		
2	(0051)	10	(0254)	24	(0610)	50	(1270)	98	(2490)	160	(4064)	196	(4978)		
3	(0076)	11	(0280)	26	(0661)	54	(1372)	108	(2743)	164	(4166)	200	(5080)		
3.5	(0090)	12	(0305)	28	(0711)	60	(1524)	118	(2997)	168	(4267)				
4	(0102)	13	(0330)	30	(0762)	66	(1676)	126	(3200)	172	(4369)				
5	(0127)	15	(0381)	32	(0813)	69	(1753)	140	(3556)	176	(4470)				
6	(0152)	16	(0407)	36	(0914)	72	(1829)	144	(3658)	180[B]	(4572)				
7	(0178)	18	(0457)	40	(1016)	78	(1981)	148	(3759)	184	(4674)				
8	(0203)	20	(0508)	42	(1067)	84	(2134)	152	(3861)	188	(4775)				

[A] Maximum length for SSI = 156 inches.

[B] Maximum length for analog outputs = 180 inches.



Compact Rugged Rod Style Bolt-In

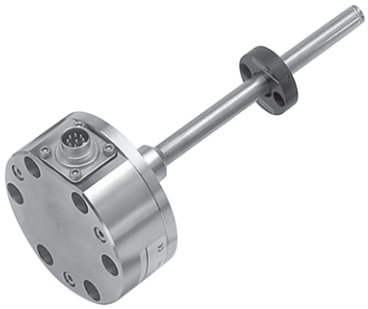
The rugged and tough stainless steel “K” housing, with its bolt-in mounting design feature, actually becomes an extension of the cylinder. Its compact size is ideal for space-restricted applications.

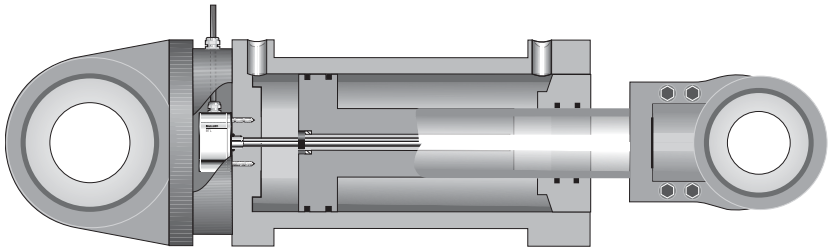
Applications:

- Hydraulic cylinder
- Primary wood (lumber)
- Valve control
- Food processing
- Waste water plants
- Pulp and paper
- Gate position
- Hydro/Civil engineering

Features:

- Bolt-in design
- Rugged all stainless steel housing
- Designed for demanding applications
- Eliminates need for protective covers
- Pressure rated 8700 psi
- Outputs
  - Analog (voltage or current)
  - Digital start/stop
  - Pulse with modulates (PWM)
  - PWM with recirculations
  - SSI
- Stroke length – 1" to 200"
- Quick disconnect and integral cable

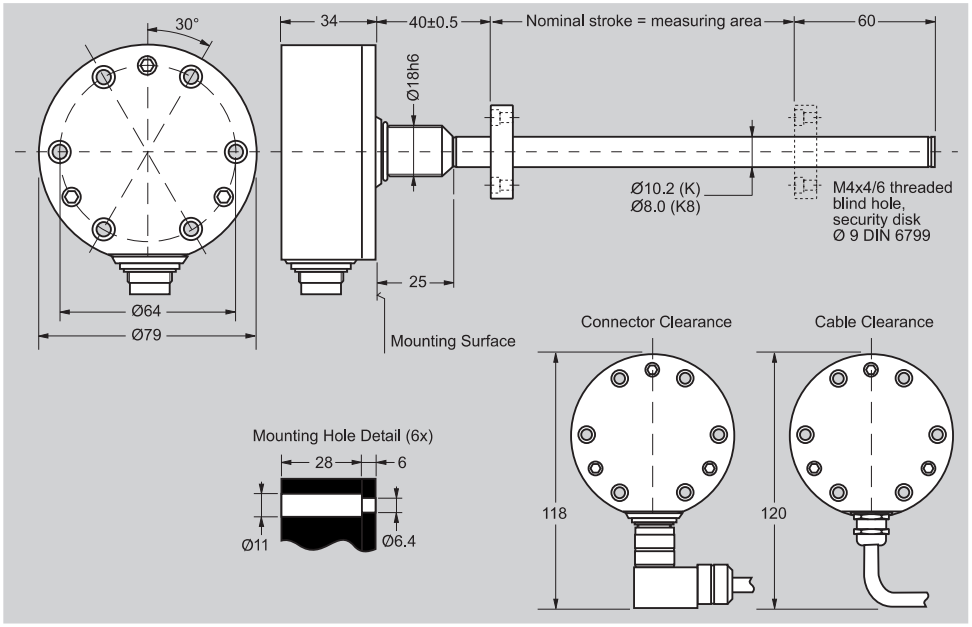




BTL K

K Compact, Bolt-in Rod Style

Series	**K Style**
Available Lengths	25 mm (1 in) to 3962 mm (156 in)
Output Signals	Analog, Digital Pulse, SSI



Ordering Code	**BTL-5-_ _-M_ _ _-K-_ _ _ _** (See ordering code on page 46)
Measurement Type	Linear displacement
Measurement Range	25 mm (1 in) to 3962 mm (156 in)
Shock Rating	100 g/6 ms (100 g/2 ms continuous) per IEC 68 2-27
Vibration Rating	12g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	Connector versions: IP 67 Integral cable versions: IP 68
Housing Material	316 stainless steel
Rod & Flange Material	Tube: 316T stainless, flange: 316L
Pressure Rating (rod)	600 bar (8700 PSI) max (10.2 mm Ø Pressure Tube 250 (3600 PSI) max (8 mm Ø Pressure Tube)
Operating Temperature	-40 to + 185° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	connector or integral cable
Noise Immunity	ESD, RFI and BURST per IEC 1000-4-2/3/4/6, severity level 3
Approvals	CE

Warning:
These products are not rated for personnel safety applications.

Accessories:
Magnets and Floats ..... pg 43
Connectors ..... pg 44

For additional connectors, see pages 107-114

Autotuning Circuitry

Patented Autotuning circuitry in Balluff Micropulse® transducers automatically compensates for changes in the strength of the magnetostrictive return signal.

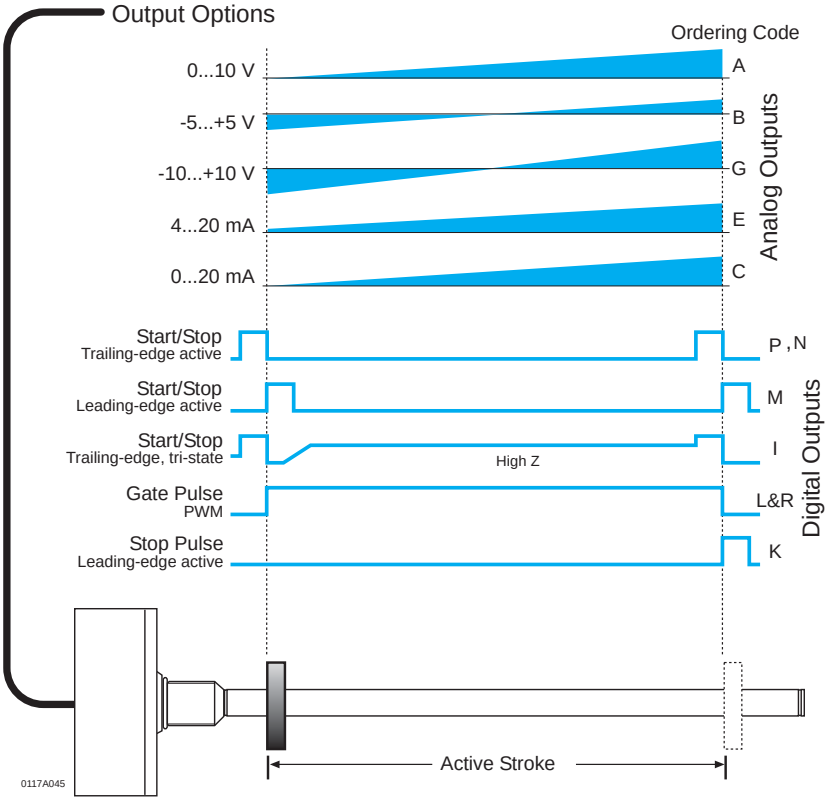
- Allows Micropulse rod-style transducers to be used in hydraulic cylinders that have both new and legacy Balluff magnets. Autotuning allows use of many legacy competitor's magnets as well.
- Automatically compensates for changes in temperature, providing a more stable signal over a wide temperature range.

Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop, PWM
Part No. Code (See pg. 46)	**A, B, G**	**E, C**	**P, M, N, I, L, R, K**
Output	0...+10 V, -5...+5 V, -10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2 KΩ (5 mA max)	≤ 500 Ω	per spec
Resolution	≤ 0.1 mV	≤ 0.2 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 50 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	4 µm	4 µm	4 µm
Sampling Rate	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm
Temperature Coefficient*	[150µ V/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) / °C
Operating Voltage	24 Vdc ±20% or 10...30 Vdc	24 Vdc ±20% or 10...30 Vdc	24 Vdc ±20% or 10...30 Vdc
Operating Current	< 150 mA Nominal, @ 24 Vdc	< 150 mA Nominal, @ 24 Vdc	<150 mA Nominal, @ 24 Vdc

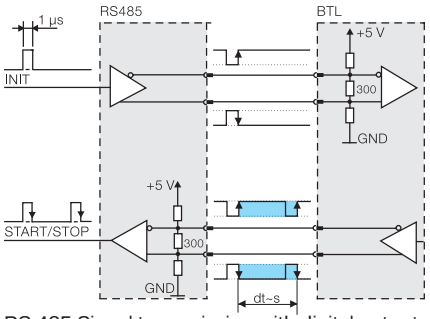
Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**

V = output range in V
I = output range in [mA]
ΔT = temperature change
P = magnet position
NL = stroke length



Analog and Digital Output Options for the Micropulse K Style



RS 485 Signal transmission with digital outputs

SSI

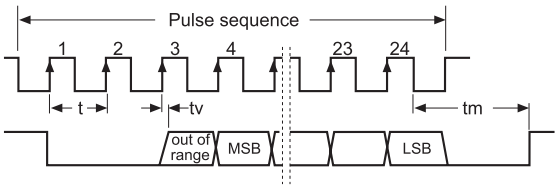
The SSI (synchronous serial interface) output interfaces with popular control systems from manufacturers such as Allen-Bradley, Delta Computer, Siemens, Parker and many others. Cable spans can be up to 400 m with noise free operation. Individual, EEPROM linearization of this interface makes it ideal for applications requiring the best accuracy available.

Ordering Code	S
Resolution	5, 10, 20 or 40 µm
Non-linearity	±30 µm or ±2LSBs, whichever is greater
Repeatablity (resolution + hysteresis)	±1 digit
Hysteresis	≤ 1 digit
Sampling Rate	500 µs
Temperature Coefficient	(6 µm + 5ppm x L)/°C
Communication Speeds	100, 200, 400, 500, 1000 kHz
Output Modes	24 or 25 bits
Operating Voltage	24 Vdc ±20%
Operating Current	≤ 80 mA
Output	Standard RS-485/422 levels

Notes:

SSI Maximum cable lengths

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



BTL5-S1_ _-Mxxxx-K-_ _ _ _

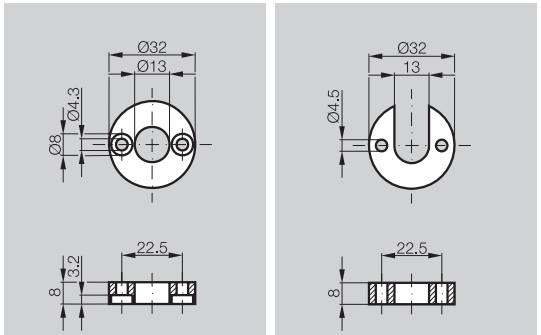
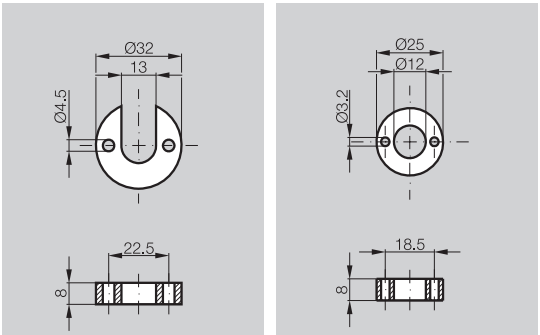
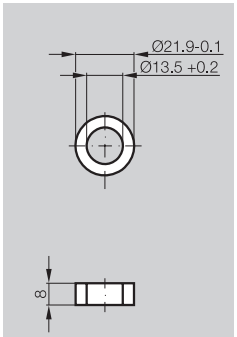
Data Format
0 = Binary, increasing, 24 bit
1 = Gray code, increasing, 24 bit
2 = Binary, falling, 24 bit
3 = Gray code, falling, 24 bit
6 = Binary, increasing, 25 bit
7 = Gray code, increasing, 25 bit
8 = Binary, falling, 25 bit
9 = Gray code, falling, 25 bit

System Resolution
2 = 5 µm
3 = 10 µm
4 = 20 µm
5 = 40 µm
6 = 100 µm
8 = 50 µm

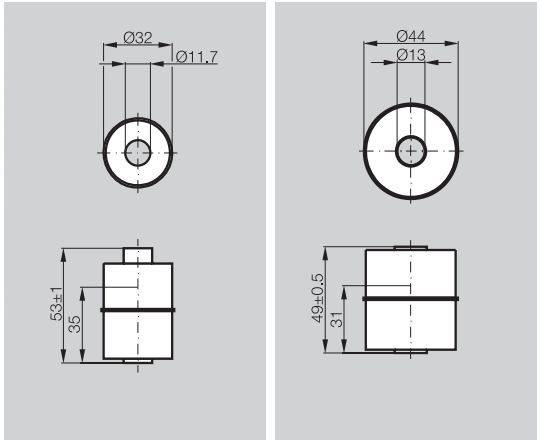
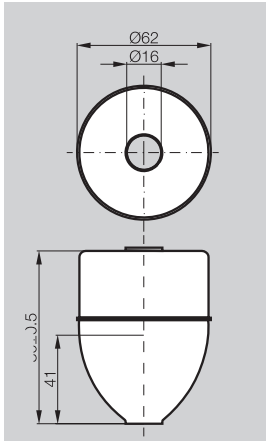
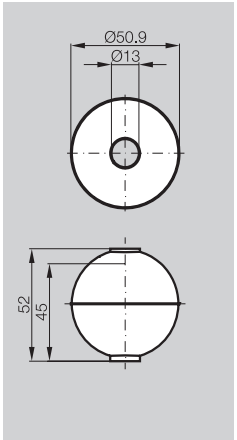
Stroke Length
xxxx = length in mm
(see chart on page 46)
Max = 156" (3962 mm)

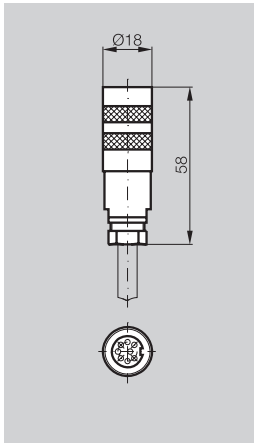
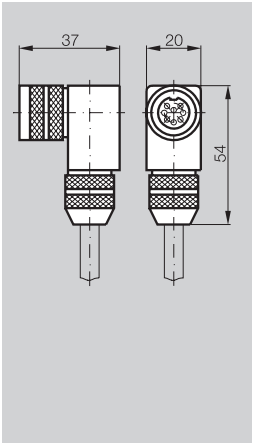
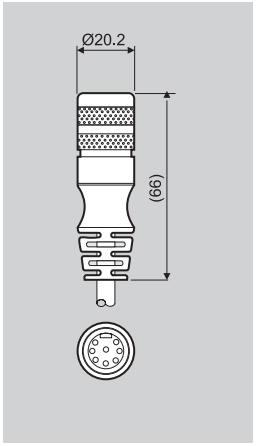
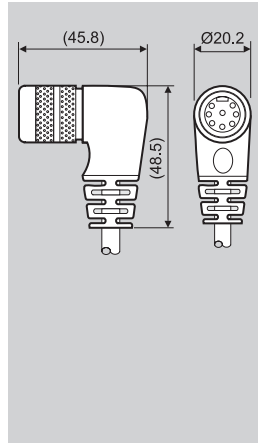
Connection Type
S 32 = 8-pin connector (standard)[1]
KA02 = 2 m PUR cable
KA05 = 5 m PUR cable
KA10 = 10 m PUR cable
KA15 = 15 m PUR cable

[1]See page 44 for mating cables/connectors.

Product Type	Magnet, Spacer Ø32 ring	Magnet, Spacer Ø32 open ring	Magnet, Spacer Ø25 ring	Magnet, Spacer Ø22 ring
					
Ordering Code - Magnet	**BTL-P-1013-4R***	**BTL-P-1013-4S***	**BTL-P-1012-4R***	**BTL-P-1014-2R**
Ordering Code - Spacer	**BTL Z-P-1013-4R-SPACER**	**SPACER BTL -P-1013-0S**	**BTL Z-2-1012-4R-SPACER**	**N/A**
Material	AL	AL	AL	AL
Weight	12 g	12 g	12 g	10 g
Magnet Speed	any	any	any	any
Operating/Storage Temperature	-40…+100°C	-40…+100°C	-40…+100°C	-40…+100°C

*Spacer is included with these magnets

Product Type	Magnet Barrel float	Magnet Barrel float	Magnet Bullet float	Magnet Sphere float
					
Ordering Code	**BTL2-S-3212-4Z**	**BTL2-S-4414-4Z**	**BTL2-S-6216-8P**	**BTL2-S-5113-4K**
Material	Stainless 316	Stainless 316	Stainless 316	Stainless 316
Weight	20 g	35 g	66 g	34 g
Operating/Storage Temperature	-40…+120°C	-40…+120°C	-40…+120°C	-40…+120°C
Water Displacement	35 mm	30 mm	41 mm	26 mm
Pressure (static)	24 bar (348 psi)	20 bar (290 psi)	15 bar (217 psi)	40 bar (580 psi)

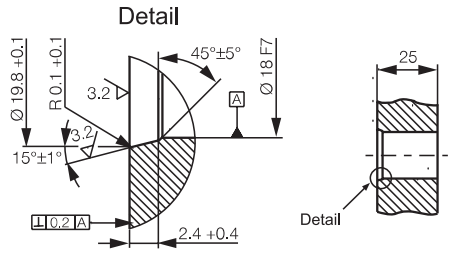
Product	Straight Connector	Right-angle Connector	Molded Straight Connector	Molded Right-angle Connector
Type	8-pin female	8-pin female	8-pin female	8-pin female
					
Ordering Code	**BKS-S 32M-_*_**	**BKS-S 33M-_*_**	**BKS-S 232-PU-_*_**	**BKS-S 233-PU-_*_**
Material	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated
Contact Surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Solder Connection	00 option only	00 option only	N/A	N/A
Cable	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24
Cable Diameter	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm
Allowable Cable Diameter	6…8 mm	6…8 mm	N/A	N/A
Cable Material	PUR	PUR	PUR	PUR
Environmental Rating	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)

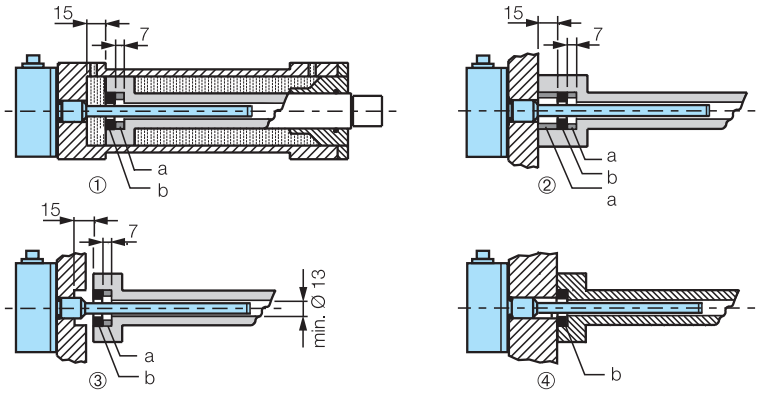
For additional connectors, see pages 107-114

* Indicate cable length in ordering code in meters
(consult factory for longer lengths)
00 = connector only (only available for BKS-S 32M and BKS-S 33M)
02 = 2 meter cable
05 = 5 meter cable

Installation

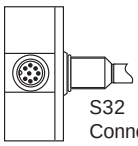
The Micropulse K transducer has 6 mounting holes for cylinder head screws (ISO 4762 M6×18 A2-70).
We recommend installing in non-magnetizable materials. If using magnetizable material, installation must be done as shown below. Sealing is at the flange mounting surface using a supplied 15.4 × 2.1 O-ring.

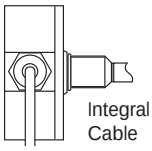


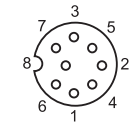


①②③ For magnetizable material
④ For non-magnetizable material
a Spacer made of non-magnetizable material
b Magnet

Analog Wiring Diagrams

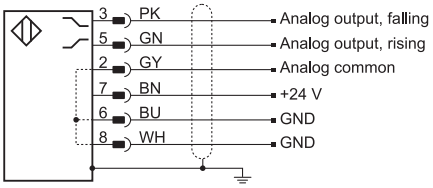




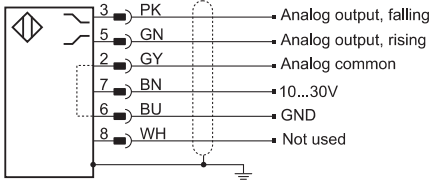


View of mating connector, wiring side

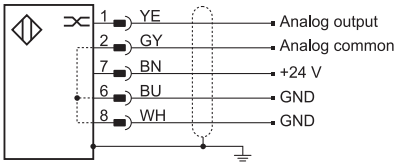
Analog Voltage 24 V (A, B, G)



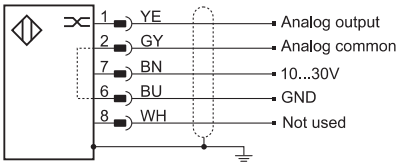
Analog Voltage 10...30V (A, B, G)



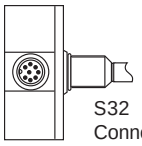
Analog Current 24 V (E, C)

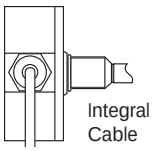


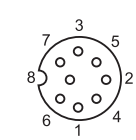
Analog Current 10...30V (E, C)



Digital Wiring Diagrams

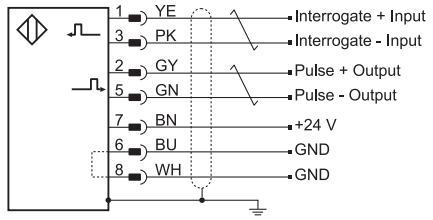




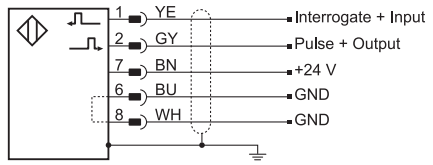


View of mating connector, wiring side

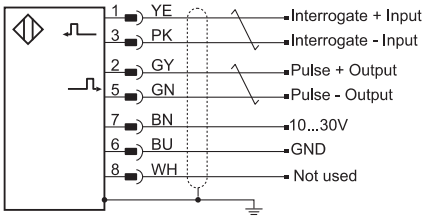
Digital, RS485 differential 24 V (P, M, I, K, L, R)



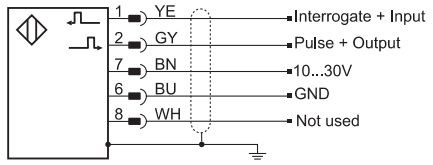
Digital, Single-ended 24 V (N)



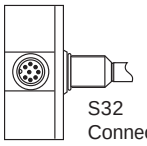
Digital, RS485 differential 10...30V (P, M, I, K, L, R)

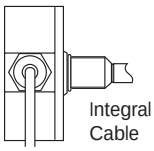


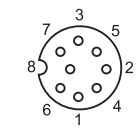
Digital, Single-ended 10...30V (N)



SSI Wiring Diagram

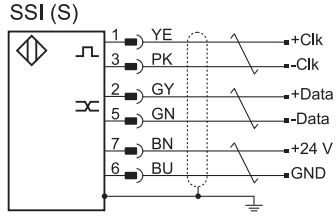






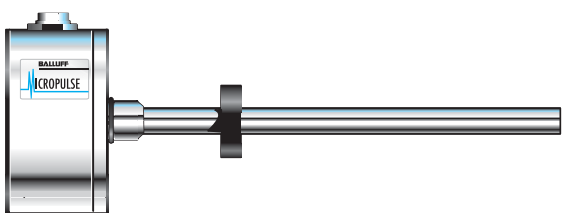
View of mating connector, wiring side

SSI (S)



* Pin-8 (WH) must remain unconnected

Note: = twisted-pair



Ordering Code

B T L 5 - A 1 1 - M 0 3 0 5 - K - S R 3 2 - E 4 / U S
K 0 5

Balluff
Linear Transducer

Generation 5

Output Type

A = 0 to 10 Vdc	I = Differential start/stop with tri-state
B = -5 to +5 Vdc	K = Differential stop - leading edge active
C = 0 to 20 mA	L = Differential pulse - width modulated
E = 4 to 20 mA	M = Differential start/stop - leading edge active
G = -10 to +10 Vdc	N = Single ended start/stop - leading edge (add/US)
S = SSI*	P = Differential start/stop - trailing edge active
	R = Differential pulse-width - recirculated

Supply Voltage
1 = 24 Vdc ±20%
5 = 10...30 Vdc (Not available for S output)

Analog Output Operation
(Leave Blank for Digital Versions)
Voltage output (Output type A, B & G)
1 = User selectable rising or falling
Current output (Output type C & E)
0 = Minimum output at connector end
(rising towards opposite end)
7 = Maximum output at connector end
(falling towards opposite end)

Stroke Length
0 3 0 5 = 305 mm active stroke length (in mA)

Housing Type
K = Compact, bolt-in rod style, 10.2 mm Pressure Tube (standard)
K8 = Compact, bolt-in rod style, 8 mm Pressure Tube
(1016 mm max length, 250 bar max pressure)

Connection Type
S R 3 2 = 8-pin quick disconnect metal connector (see page 44 for mating cable)
K 0 5 = Cable out (5 m standard; specify length in meters)

Interrogation (only valid if output type = R, otherwise leave blank)
I = Internal interrogation, E = External interrogation

Recirculation (only valid if output type = R, otherwise leave blank)
1=1 circulation, 2 = 2 circulations, 3 = 3 circulations, 4 = 4 circulations, 6 = 6 circulations,
8 = 8 circulations, 10 = 10 circulations,16 = 16 circulations

N output only

/US = TTL - single ended Start/Stop - leading edge (US Standard)

Blank = TTL - single ended Start only - leading edge (European Standard)

*See additional ordering information on page 42.

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

1	(0025)	9	(0230)	22	(0560)	48	(1220)	89	(2261)	156[A]	(3962)	192	(4877)
2	(0051)	10	(0254)	24	(0610)	50	(1270)	98	(2490)	160	(4064)	196	(4978)
3	(0076)	11	(0280)	26	(0661)	54	(1372)	108	(2743)	164	(4166)	200	(5080)
3.5	(0090)	12	(0305)	28	(0711)	60	(1524)	118	(2997)	168	(4267)		
4	(0102)	13	(0330)	30	(0762)	66	(1676)	126	(3200)	172	(4369)		
5	(0127)	15	(0381)	32	(0813)	69	(1753)	140	(3556)	176	(4470)		
6	(0152)	16	(0407)	36	(0914)	72	(1829)	144	(3658)	180[B]	(4572)		
7	(0178)	18	(0457)	40	(1016)	78	(1981)	148	(3759)	184	(4674)		
8	(0203)	20	(0508)	42	(1067)	84	(2134)	152	(3861)	188	(4775)		

[A] Maximum length for SSI = 156 inches.

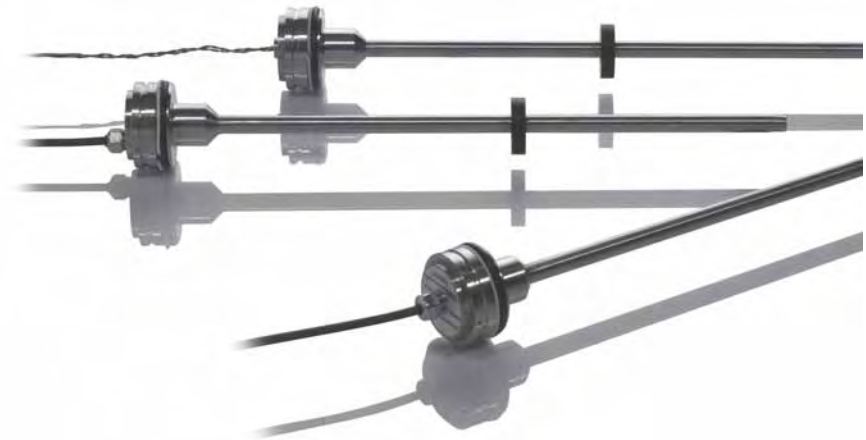
[B] Maximum length for analog outputs = 180 inches.

Micropulse AR
Embeddable Rod Style

Rugged and Reliable Compact Housing

The Micropulse AR is a rugged, compact rod-style linear position transducer designed and built to meet the needs of demanding mobile hydraulic applications.

The Micropulse AR's stainless steel housing and compact size allow it to be completely embedded into a hydraulic cylinder for maximum protection against harsh environments.



BTL AR

Features:

- Compact design for embedded cylinder applications
- Non-contact sensing technology
- No external electronics
- Analog outputs:
  - 0-10 Vdc
  - 0-5 Vdc
  - 4-20 mA
- Digital output:
  - RS422 Start/Stop

Applications:

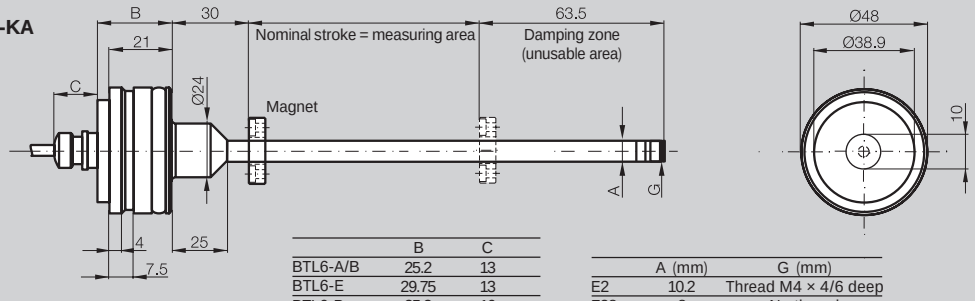
Micropulse AR transducers are designed and tested to withstand the rigors of demanding mobile hydraulic applications, such as:

- Agricultural machinery
- Forestry machinery
- Earth moving equipment
- Construction machinery

Series	AR Rod Style

Housing E2/E28, BTL6-...-E2/E28-_ _ _ _-KA

Cable out axial centric



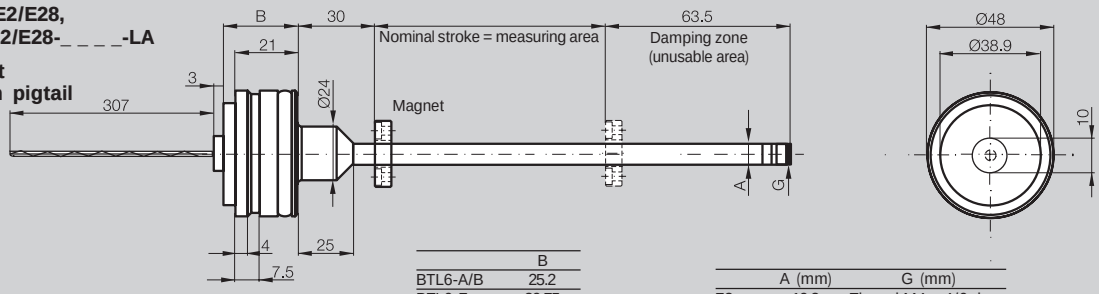
PL0082a

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

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

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

Cable out axial with pigtail



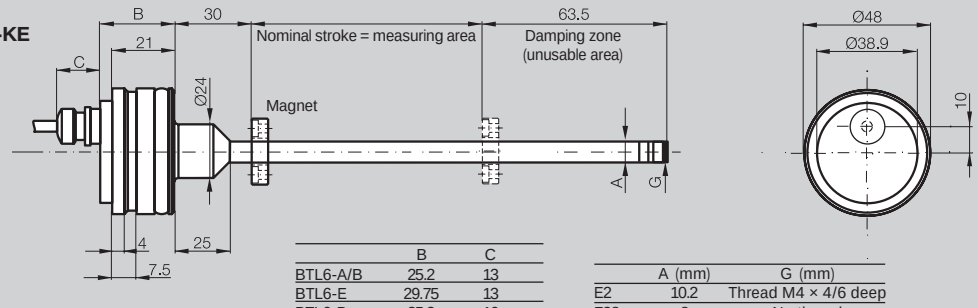
PL0083a

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

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

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

Cable out axial eccentric



PL0084a

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

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

Ordering Code	**BTL6-...-M_ _ _ _-E2/E28-_ _ _ _**
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 Vdc (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] Max. stroke length for 8 mm outer rod (Style E28) = 1016 mm	0025, 0051, 0076, 0090, 0102, 0127, 0152, 0178, 0203, 0230, 0254, 0280, 0305, 0330, 0381, 0407, 0457, 0508, 0560, 0610, 0661, 0711, 0762, 0813, 0914, 1016, 1067, 1220, 1270, 1372, 1524

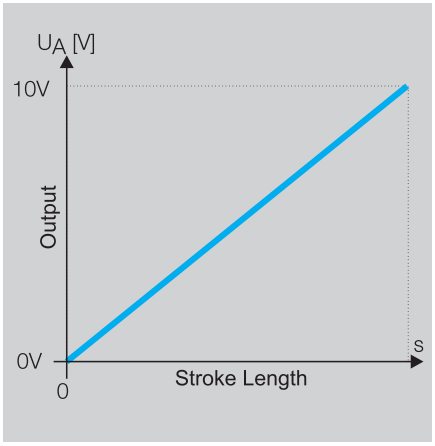
The propagation time of an ultrasonic wave, induced by magnetostriction, is used to determine the position of the magnet.

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.

Dimensions and mechanical data
page 48

Please order separately:
Magnets see page 53

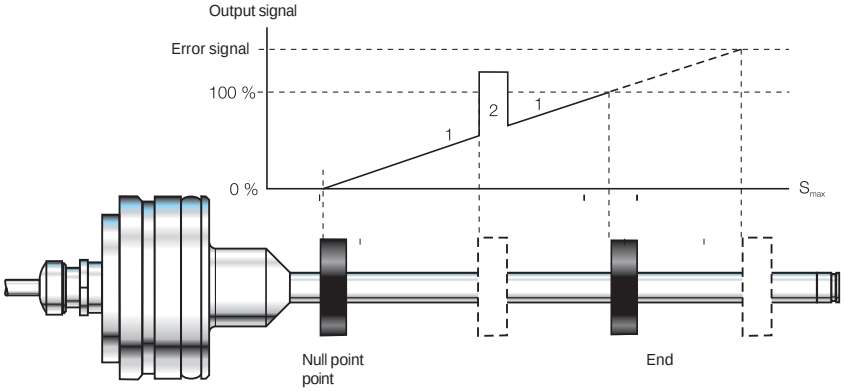
Series	**BTL6 Rod AR**
Output Signal	analog voltage
Part No. Code (see page 50)	**A**



Ordering Code		BTL6-**A**500-M_ _ _ _-_ _ _-_ _ _ _ _
Output Voltage		**0...10 Vdc**
Output Current		
Load Current		max. 2 mA
Ripple Max.		≤ 5 mV
Load Resistance		
System Resolution		±1.5 mV
Hysteresis		≤ 4 µm
Repeat Accuracy		System resolution/min. 2 µm
Sampling Rate		$f_{STANDARD}$ = 1 kHz
Max. Non-linearity		±200 µm up to 500 mm nominal stroke typ. ±0.02 % ≥ 500 nominal stroke
Temperature Coefficient	Voltage Output	[150 µV/°C + (5 ppm/°C × P × U/L)] × DT
	Current Output	[0.6 µA/°C + (10 ppm/°C × P × I/L)] × DT
Supply Voltage		10...30 Vdc
Current Draw		typ. ≤ 60 mA
Polarity Reversal Protected		yes
Overvoltage Protected		yes
Dielectric Strength		500 Vdc (GND to housing)
Operating Temperature		–40 to +185 °F
Storage Temperature		–40...+212 °F

Pin Assignments	Color	BTL6-**A**500...
Output Signals	GY	0 V output
	GN	0...10 Vdc
Operating Voltage	BU	GND
	BN	10...30 Vdc

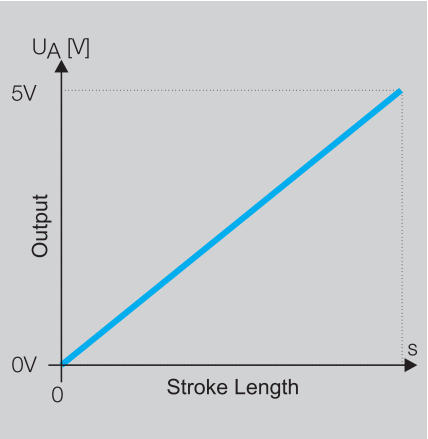
Shield connected to housing

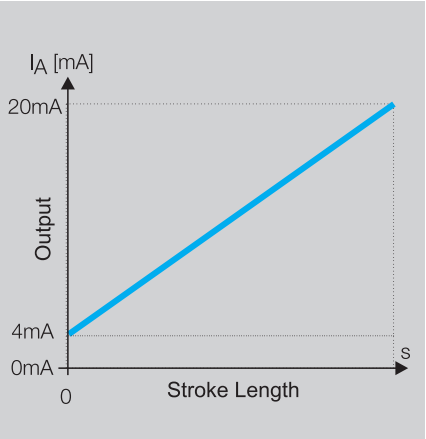


Output signal rising

Magnet position
1 Within the measuring area
2 Magnet not present

Series	**BTL6 Rod AR**	**BTL6 Rod AR**
Output Signal	analog voltage	analog current
Part No. Code (see below)	**B**	**E**





Ordering Code	BTL6-**B**500-M_ _ _ _-_ _ _-_ _ _ _ _	BTL6-**E**500_-M_ _ _ _-_ _ _-_ _ _ _ _
Output Voltage	**0...5 Vdc**	
Output Current		**4...20 mA**
Load Current	max. 2 mA	
Ripple Max.	≤ 2 mV	
Load Resistance		≤ 500 Ohms
System Resolution	±1.5 mV	±7 µA

Hysteresis		≤ 4 µm
Repeat Accuracy		System resolution/min. 2 µm
Sampling Rate		$f_{STANDARD}$ = 1 kHz
Max. Non-linearity		±200 µm up to 500 mm nominal stroke typ. ±0.02 % ≥ 500 nominal stroke
Temperature Coefficient	Voltage Output	[150 µV/°C + (5 ppm/°C × P × U/L)] × DT
	Current Output	[0.6 µA/°C + (10 ppm/°C × P × I/L)] × DT
Supply Voltage		10...30 Vdc
Current Draw		typ. ≤ 60 mA
Polarity Reversal Protected		yes
Overvoltage Protected		yes
Dielectric Strength		500 Vdc (GND to housing)
Operating Temperature		–40 to +185 °F
Storage Temperature		–40 to +212 °F

Pin Assignments	Color	BTL6-**B**500...	BTL6-**E**500...
Output Signals	GY	0 V output	0 V output
	GN	0...5 Vdc	4...20 mA
Operating Voltage	BU	GND	GND
	BN	10...30 Vdc	10...30 Vdc

Shield connected to housing

Ordering example:
BTL6-_500-M_ _ _ _-_ _ _-_ _ _ _ _

Output signal
A 0...10 V
B 0...5 V
E 4...20 mA

Standard nominal stroke [mm]
0025, 0051, 0076, 0090, 0102, 0127, 0152, 0178, 0203, 0230, 0254, 0280, 0305, 0330, 0381, 0407, 0457, 0508, 0560, 0610, 0661, 0711, 0762, 0813, 0914, 1016, 1067, 1220, 1270, 1372, 1524
Consult factory for special lengths

Housing
E2 outer tube Ø 10.2 mm
E28 outer tube Ø 8 mm, max. nominal stroke 1016 mm

Connection type
Axial out
KA02 PUR cable 2 m
Axial eccentric out
KE02 PUR cable 2 m
Axial out
LA00,3 PUR pigtail 0.3 m

P510 interface

Compatible with Balluff BTA processors, controllers, and modules from various manufacturers, including Siemens, B & R, Bosch, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO, AB 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.

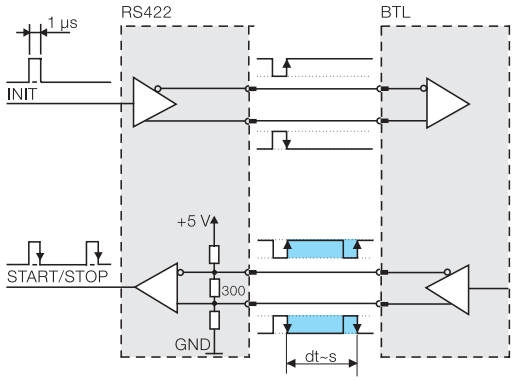
P510 universal for rising and falling edge evaluation

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.

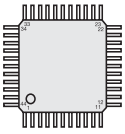
The reference point for the propagation time measurement is the “Start” pulse.



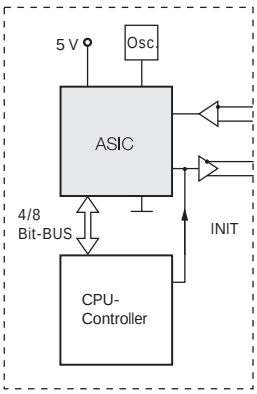
Block diagram of the P-interface

High-accuracy digitizing chip for P510 pulse interface

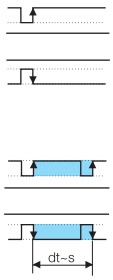
Companies who develop their own control and processing electronics can use the Balluff digitizing chip to implement a highly accurate P-type interface at low cost and without great effort. The digitizing chip was developed as a high-resolution, parameterizable ASIC for Micropulse transducers having a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



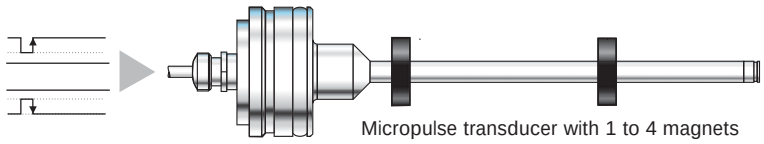
Digitizing chip 44QFP



Controller or processing electronics



P-pulse signal

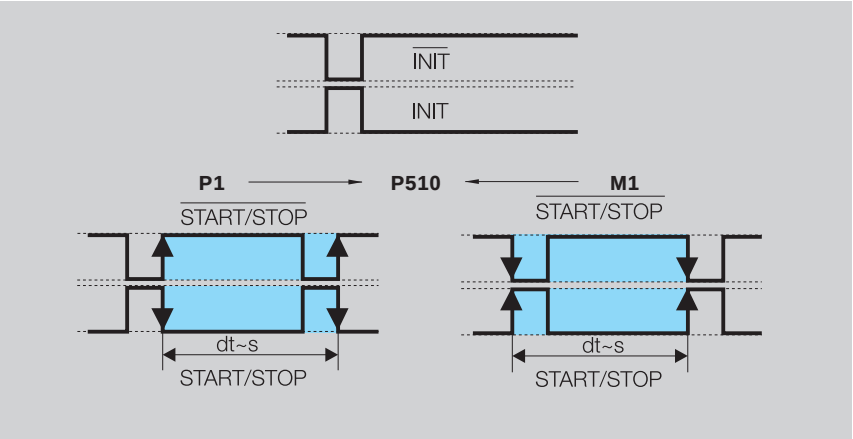


Micropulse transducer with 1 to 4 magnets

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

Series	**BTL6 Rod AR**
Part No. Code (see below)	**P**
Transducer Interface	Digital ST/SP Pulse



Ordering Code	BTL6-**P**510-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 Vdc
Current Draw	≤ 60 mA (at 1kHz)
Operating Temperature	-40 to +185 °F
Storage Temperature	-40 to +212 °F

Pin Assignments		Color	BTL6-**P**510-M...
In-/Output Signals	Input	YE	INIT
	Output	GY	START/STOP
	Input	PK	$\overline{\text{INIT}}$
	Output	GN	$\overline{\text{START/STOP}}$
Operating Voltage		BU	GND
		BN	+24 Vdc

Shield connected to housing

Dimensions and mechanical data
page 48

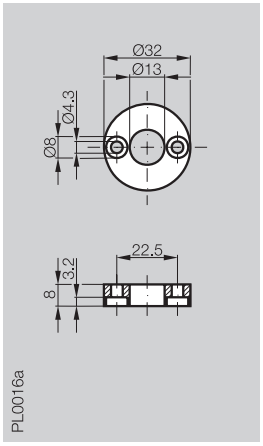
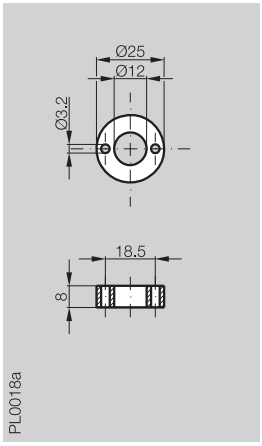
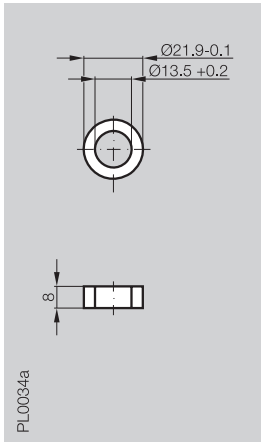
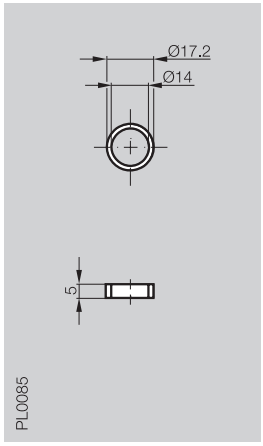
Please order separately:
Magnets see page 53

Ordering example:
BTL6-P510-M_ _ _ _-_ _ _-_ _ _ _ _ _

Standard nominal stroke [mm]
0025, 0051, 0076, 0090, 0102, 0127, 0152, 0178, 0203, 0230, 0254, 0280, 0305, 0330, 0381, 0407, 0457, 0508, 0560, 0610, 0661, 0711, 0762, 0813, 0914, 1016, 1067, 1220, 1270, 1372, 1524

Housing
E2 outer tube Ø 10.2 mm
E28 outer tube Ø 8 mm, max. nominal stroke 1016 mm

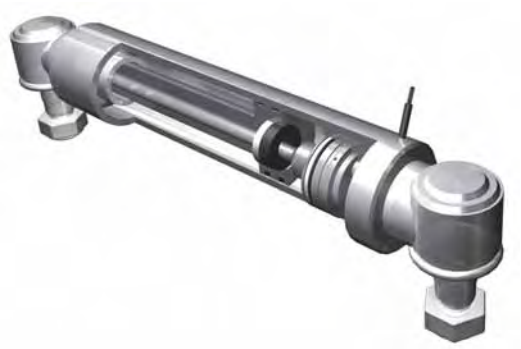
Connection type
Axial out
KA02 PUR cable 2 m
Axial eccentric out
KE02 PUR cable 2 m
Axial out
LA00,3 PUR pigtail 0.3 m

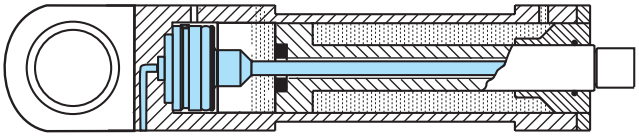
Description	**Magnet**	**Magnet**	**Magnet**	**Magnet**
for Series	BTL6 rod	BTL6 rod	BTL6 rod	BTL6 rod
				
Ordering Code - Magnet	**BTL-P-1013-4R***	**BTL-P-1012-4R***	**BTL-P-1014-2R**	**BTL-P-0814-GR-PAF**
Ordering Code - Spacer	**BTL Z-P-1013-4R-SPACER**	**BTL Z-2-1012-4R-SPACER**	**N/A**	**N/A**
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
Ordering Code PA 60 Fiberglass Reinforced	**BTL-P-1013-4R-PA***	**BTL-P-1012-4R-PA***		
Ordering Code - Spacer	**SPACER BTL-P-1013-DR**	**SPACER BTL-P-1012-DR**		
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		

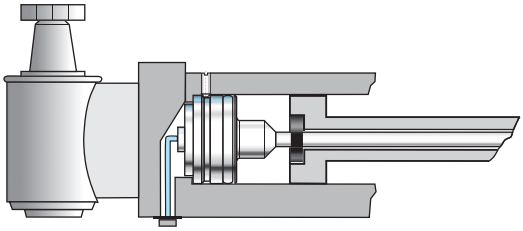
*Spacer is included with these magnets

Micropulse AR style transducers are designed for integration in hydraulic cylinders. The transducer is mechanically supported at the housing. Three M5 set screws spaced at 120 °C hold the transducer, which fits into a Ø48 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.

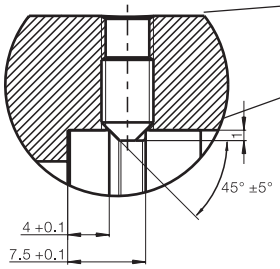




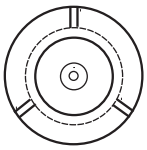


The metal surrounding of the cylinder replaces the needed cable shield when the BTL AR...**LA**, cable out pigtail version is installed in the cylinder. The pigtail version cannot be used without additional EMC protection (shield).

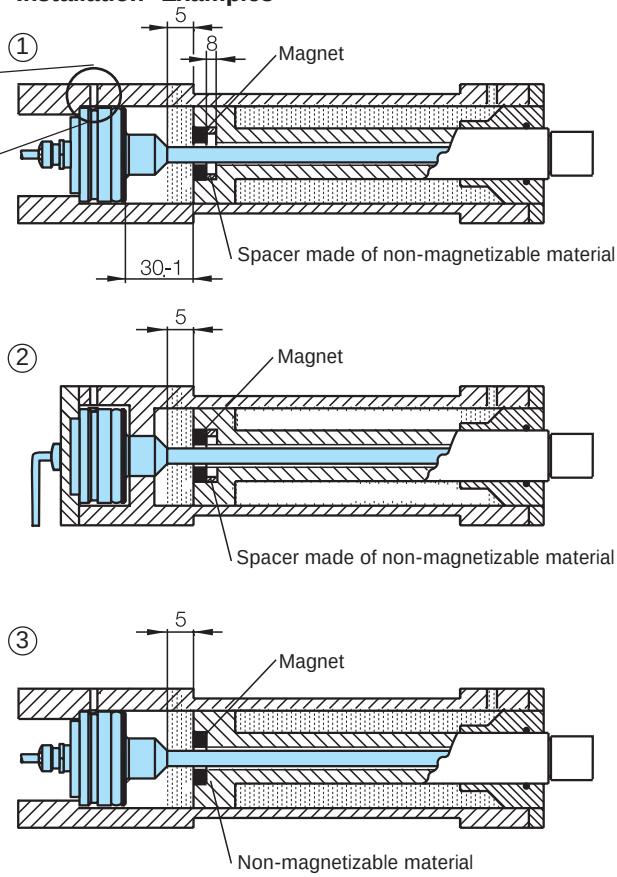
Set screw
DIN 914 M5×8



Fixing the transducer using three 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

Note: Before construction, installation, and startup please familiarize yourself with the user's guide found at www.balluff.com.

Explosion Proof Flame Proof

In the petrochemical and process industries, reliability and uptime are critical. Component failure must be a rare event, but when it does occur, replacements should be fast and easy. Micropulse non-contact magnetostrictive technology offers superior long-term reliability over competing contact sensors such as linear or rotary potentiometers.

Balluff's cutting-edge explosion proof housing design incorporates a Rapid Replacement Module to get you up and running quickly in the unlikely event replacement is ever necessary. There is no need to break the hydraulic seal to remove the entire unit, because the internal electronics and sensing element can be replaced as an assembly in just a matter of minutes. Held in by two retaining screws, the Rapid Replacement Module is simple to remove and re-install, giving you confidence and peace of mind.

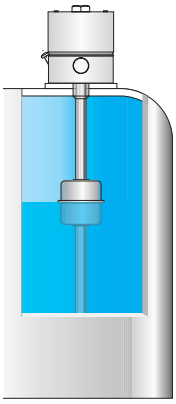
In today's global economy and world-wide scope of industrial operations, universal hazardous location approvals are indispensable for maintaining the flexibility to ship equipment throughout the world. The Balluff Micropulse® TA12 series offers the widest range of global application certifications for any magnetostrictive linear position feedback device on the market.

Features:

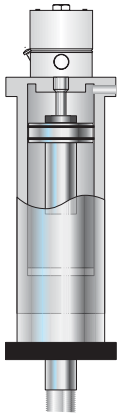
- Globally certified by FM Approvals for use in US, Canada and ATEX applications
- Rapid Replacement Module standard
- Eliminates the need for IS barriers
- Completely self-contained unit
- Solid stainless steel housing sealed to IP 68 standards
- Operates from 24 Vdc or 10...30 Vdc
- Wide range of output options to interface with virtually any control system
- Standard resolution to <2 µm and linearity of ±0.02%
- Provides consistent, stable accuracy over a temperature range of -40 to 176°F
- Enhanced wave guide construction provides a high level of resistance to shock and vibration.

Applications:

- Valve control
- Liquid level measurement
- Turbine applications
- Grain elevators
- Petroleum applications
- Paint manufacturing



Liquid Level



Cylinder

Enhanced Features

Balluff TA12 Ex-Proof transducers offer innovative features that enhance usability and increase performance.

Autotuning

- Patented Autotuning circuitry automatically compensates for changes in the strength of the magnetostrictive return signal.
- Autotuning compensates for changes in temperature, providing a more stable signal over a wide temperature range, and reducing maintenance and repair costs.
- Patented auto-tuning electronics help reduce maintenance and repair costs.

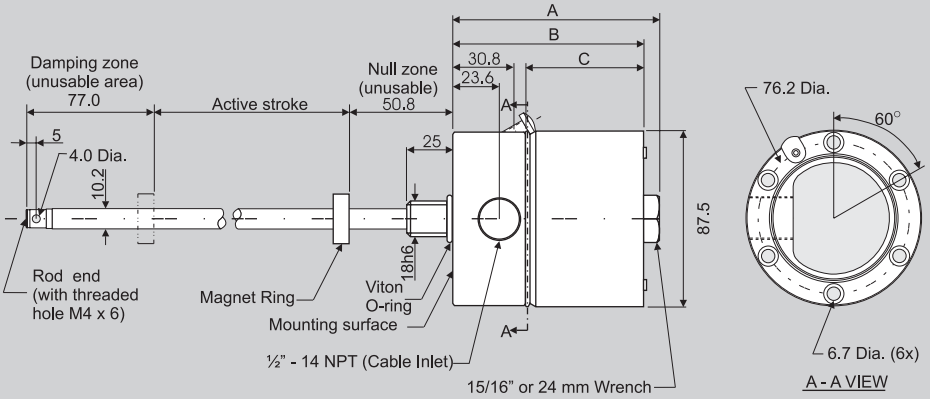
Rapid Replacement Module

- The Rapid Replacement Module allows quick replacement without having to remove the pressure tube from the cylinder – no need to de-pressurize the system.
- Decreases downtime – get up and running in minutes, not hours.

Configurable

- Analog-output versions offer 100% scalable stroke range.
- PWM versions feature easy DIP-switch configuration for recirculation count and interrogation method.

Series	**Explosion Proof, Flame Proof**
Approvals	FM Approvals, ATEX
Output Signals	Analog, Digital Pulse, SSI, CANopen, Profibus, Quadrature



- **Metric conduit adapter available. See page 61.**

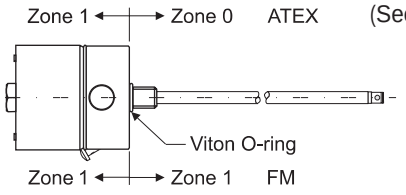
Mounting is accomplished using six M6x45 A2 (stainless) socket-head cap screws (supplied with transducer) or six 1/4"-20x1-3/4" socket-head cap screws (user-supplied)

Electrical Interface	Dim. A (mm)	Dim. B (mm)	Dim. C (mm)
Analog, Digital, SSI, Quadrature	104.12	96.12	59.5
Profibus, CANbus	135.62	127.62	91

Ordering Code	**BTL 5 _ _-_ _ _ _-J-DEXC-TA12** (See ordering code on page 63)
Measurement Type	Linear displacement
Measurement Range	25 mm (1 in) to 5080 mm (200 in)
Shock Rating	100 g/6 ms (100 g/2 ms continuous) per IEC 68 2-27
Vibration Rating	12 g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	IP 68
Housing Material	316 stainless steel; cover Nitronics 60 stainless steel
Pressure Rating (rod)	600 bar (8700 PSI) max
Operating Temperature	-40 to + 176° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	Terminal block via rigid conduit (see accessories for approved conduit adapter)
Compatible Magnets	See accessories
Approvals	Class I, Division I, Groups A, B, C, and D Class II/III, Division I, Groups E, F, and G T6 Ta=65°C, T5 Ta=80°C Type 4X/6P Class I Zone 1 AEx d IIC T6 Ta=65°C, T5 Ta=80°C FM08ATEX0037
	II 1/2 G Ex d IIC T6 Ta=65°C, T5 Ta=80°C IP68 II 1/2 D Ex tD A20 IP68 T85°C Ta=65°C, T100°C Ta=80°C CE 0518 Ex

Metric conduit adapter (if required) must be ordered separately. See page 61.

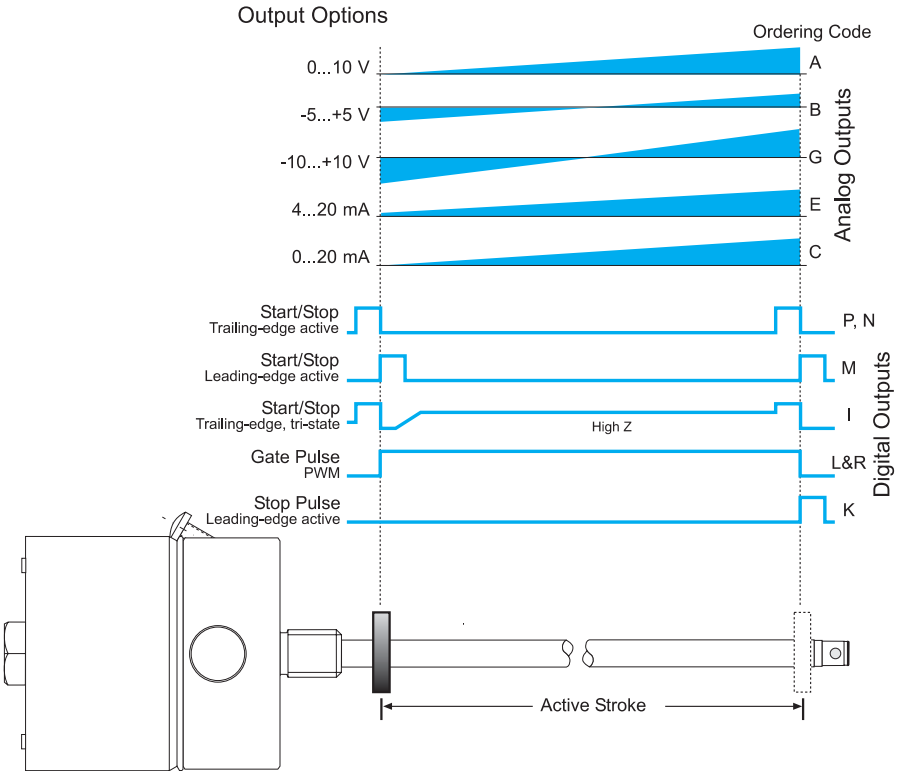
Warning:
Proper installation of the Micropulse Ex is essential. Follow all installation instructions and precautions are outlined in the Micropulse Ex manual, provided with every unit. These products are not rated for personnel safety applications.



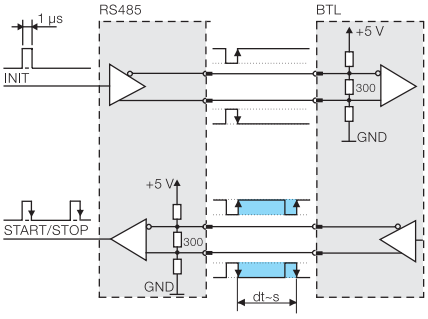
Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop PWM
Part No. Code (See pg. 63)	**A, B, G**	**E, C**	**P, M, N, I, L, R, K**
Output	0...+10 V, -5...+5 V, -10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2 KΩ (5 mA max)	≤ 500 Ω	per spec
Resolution	≤ 0.33 mV	≤ 0.66 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	≤ 5 µm	≤ 5 µm	≤ 5 µm
Sampling Rate	2 kHz	2 kHz	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm
Temperature Coefficient*	[150 µV/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6 µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) / °C
Operating Voltage	24 Vdc ±20%, 10...30 Vdc	24 Vdc ±20%, 10...30 Vdc	24 Vdc ±20%, 10...30 Vdc
Operating Current	<150 mA Nominal, @ 24 Vdc	<150 mA Nominal, @ 24 Vdc	<100 mA (at 1 kHz sampling rate)

Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**
V = output range in V
I = output range in [mA]
ΔT = temperature change
P = magnet position
NL = stroke length

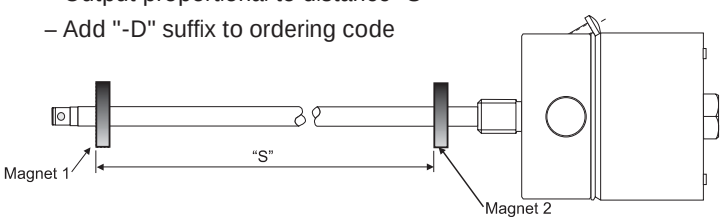


Analog and Digital Output Options for the Micropulse Ex Style



RS-485 signal transmission with digital outputs

Two-Magnet Differential Mode
– Available on Analog & PWM
– Output proportional to distance "S"
– Add "-D" suffix to ordering code



CANopen

This interface provides an efficient connection to machines using CANopen. Features include:

- Process data objects incorporating position, velocity and set-point information
- Emergency object for set-points
- Service data objects for configuring transducer modes
- Synchronization objects for network wide activities

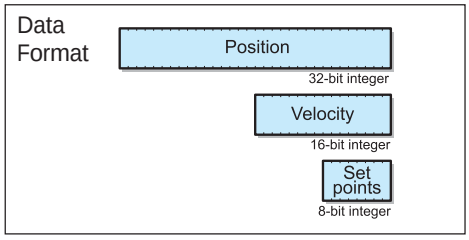
Profibus

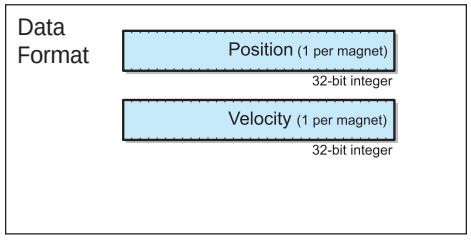
This interface provides an efficient connection to machines using Profibus. Features of this interface include:

- Single telegram message for fast updates even with 4 magnets
- Operates at 12 Mbps
- GSD file provided to configure telegram message
- Sync and Freeze functions available for coordination between other devices

Ordering Code	H	T
Resolution	Position 5 µm, Velocity 0.1 mm/s increments (selectable)	Position 5 µm (configurable) Velocity 0.1 mm/s increments (configurable)
Non-linearity	±30 µm at 5 µm resolution	±30 µm at 5 µm resolution
Repeatablity (resolution + hysteresis)	±1 digit	±1 digit
Hysteresis	≤ 1 digit	≤ 1 digit
Sampling Rate	1 kHz	1 kHz
Temperature Coefficient	(6 µm + 5 ppm x L)/°C	(6 µm + 5 ppm x L)/°C
Operating Voltage	24 Vdc ±20%	24 Vdc ±20%
Operating Current	≤ 100 mA	≤ 120 mA
Network Isolation	yes	yes
Network Speed	10, 20, 50, 100, 125, 250, 500, 800, 1000 kBaud	9.6, 19.2, 93.7, 187.5, 900, 1500, 12000 kBaud
Network Compatibility	CiA Standard DS301 DS406 (Encoder Profile)	EN 50170 (Encoder Profile)
Address Selection	Software	DIP switch
Communication Types	Producer/Consumer	Master/Slave
Configuration Software	none required	GSD file
Number of Magnets Supported	1, 2 or 4	1, 2 or 4

Notes:
For more technical information, see pages 123-128





BTL5-H1_ _-Mxxxx-J-DEXC-TA12

Process Data
1 = 1 x position & 1 x velocity
2 = 2 x position & 2 x velocity
3 = 4 x position

Baud Rate
0 = 1MBaud
1 = 800 kBaud
2 = 500 kBaud
3 = 250 kBaud
4 = 125 kBaud
5 = 100 kBaud
6 = 50 kBaud
7 = 20 kBaud
8 = 10 kBaud

Stroke Length
xxxx = length in mm (see chart on page 63)
Max=156" (3962 mm)

BTL5-T1_0 -Mxxxx-J-DEXC-TA12

No. of Magnets
1 = 1 magnet
2 = 2 magnets
3 = 4 magnets

Stroke Length
xxxx = length in mm (see chart on page 63)
Max=156" (3962 mm)

Specialized Interfaces

SSI

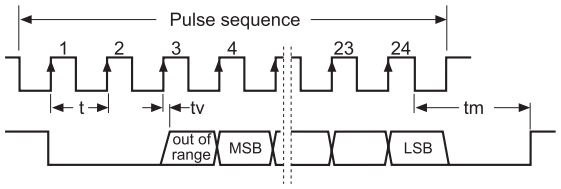
The SSI (synchronous serial interface) output interfaces with popular control systems from manufacturers such as Allen-Bradley, Delta Computer, Siemens, Parker, Bosch-Rexroth and many others. Cable spans can be up to 400 m with noise-free operation. Individual, EEPROM linearization of this interface makes it ideal for applications requiring the best accuracy available.

Ordering Code	S
Resolution	5, 10, 20 or 40 µm (see ordering code below)
Non-linearity–Non-synchronized	±30 µm or ±2LSBs, whichever is greater
"B" Synchronized	same as start/stop digital
Repeatablity (resolution + hysteresis)	±1 digit
Hysteresis	≤ 1 digit
Sampling Rate	2 kHz
Temperature Coefficient	(6 µm + 5 ppm x L)/°C
Communication Speeds	100, 200, 400, 500, 1000 kHz
Output Modes	24 or 25 bits (binary or gray code)
Operating Voltage	24 Vdc ±20%
Operating Current	≤ 80 mA
Output	Standard RS-485/422 levels

Notes:

SSI Maximum cable lengths

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



BTL5-S1 _ _ -Mxxxx-J-DEXC-TA12

Supply Voltage
1 = +24 V

Data Format
0 = Binary, increasing, 24 bit
1 = Gray code, increasing, 24 bit
2 = Binary, falling, 24 bit
3 = Gray code, falling, 24 bit
6 = Binary, increasing, 25 bit
7 = Gray code, increasing, 25 bit
8 = Binary, falling, 25 bit
9 = Gray code, falling, 25 bit

System Resolution
2 = 5 µm
3 = 10 µm
4 = 20 µm
5 = 40 µm
6 = 100 µm
8 = 50 µm

Stroke Length
xxxx = length in mm (see chart on page 63)
Max = 156" (3962 mm)

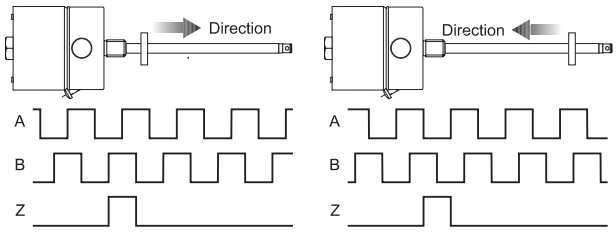
Quadrature
The quadrature output interfaces directly to standard encoder inputs (90° out of phase, A & B). This configuration gives you more interface options for connecting to motion based systems. In addition, the Micropulse quadrature output transducer has the ability to provide **absolute** position information through use of its innovative BURST function.

Ordering Code	Q
Resolution	1, 2, 5 10, 50 µm, 0.001", 0.0001", 0.0005" (switch selectable)
Non-linearity	±100 mm to 500 mm stroke, ±0.02% over 500 mm stroke
Repeatablity (resolution + hysteresis)	resolution + (±2 x resolution or 5 µm, whichever is greater)
Hysteresis	±2 x resolution or 5 µm, whichever is greater
Sampling Rate	Free-running: 1 ms, 2 ms, 4 ms; Synchronous: 500 µs to 10 ms
Temperature Coefficient	(6 µm + 5 ppm x L)/°C
Communication Speeds	10, 200, 400, 800 kHz
Output Modes	Free-running or Synchronous (switch selectable)
Operating Voltage	24 Vdc ±20%, 10...30 Vdc
Operating Current	≤ 80 mA
Output	Standard A & B (RS-422 level)

Notes:

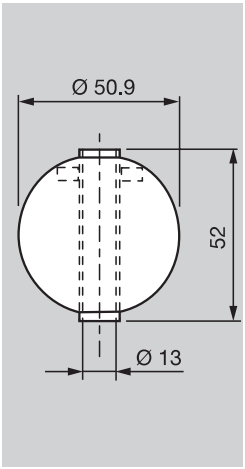
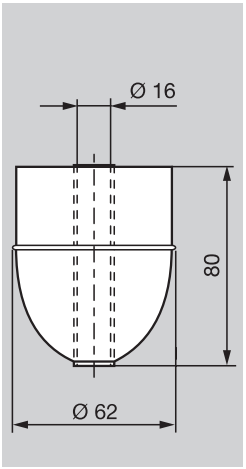
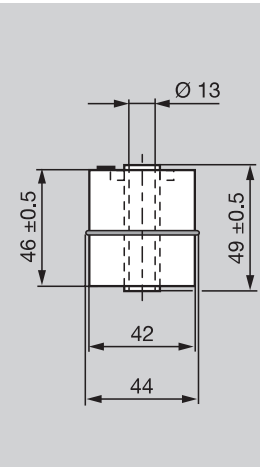
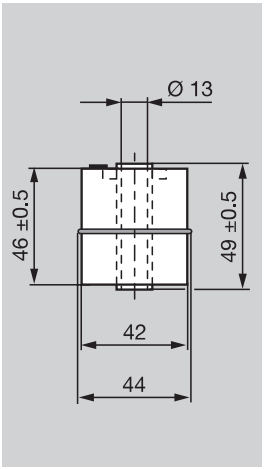
SSI Maximum cable lengths

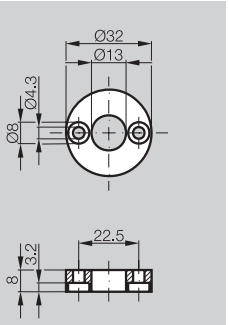
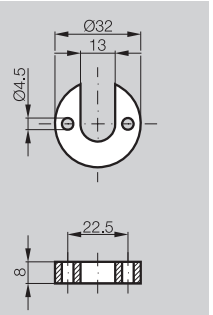
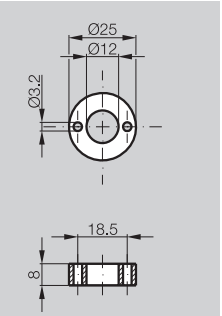
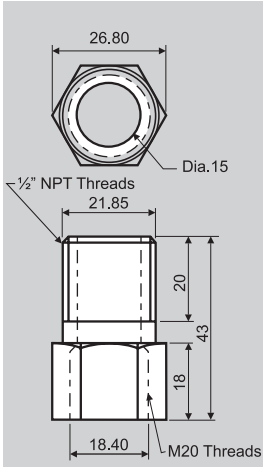
Cable length	Clock Freq.
< 25 m	< 1000 kHz
< 50 m	< 500 kHz
< 100 m	< 400 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz



BTL5-Q _ _ _ _-Mxxxx-J-DEXC-TA12

Supply Voltage
1 = +24 V
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"
7 = 0.001"
8 = 0.0005"
Mode/Update Rate
0 = Synchronous (initiated by controller)
1 = free-running, 1 ms update – ≤1250 mm stroke only
2 = free-running, 2 ms update – 1251 mm to 2500 mm
4 = free-running, 4 ms update – ≥ 2501 mm
Stroke Length
xxxx = length in mm (see chart on page 63)

Product Type	Ex Rated Float Magnet Sphere	Ex rated Float Magnet Bullet	Ex Rated Float Magnet Barrel	Ex Rated Float Magnet Barrel
				
Ordering Code	**BTL2-S-5113-4K-EX**	**BTL2-S-6216-8P-EX**	**BTL2-S-4414-4Z01-EX**	**BTL2-S-4414-4Z-EX**
Minimum Density	0.7 g/cm$_3$	0.6 g/cm$_3$	0.85 g/cm$_3$	0.7 g/cm$_3$
Immersion Depth in 1 g/cm$_3$ (H_20)	26	41	45	30
Immersion Depth in 0.7 g/cm$_3$	40	57	sinks	39
Material	Stainless 316	Stainless 316	Stainless 316	Stainless 316

Product Type	Magnet, Spacer Ø32 Ring	Magnet Ø32 Open Ring	Magnet Ø25 Ring	Adapter Rigid Conduit Adapter
				 **Approvals: See Below**
Ordering Code	**BTL-P-1013-4R***	**BTL-P-1013-4S***	**BTL-P-1012-4R***	**BTL-A-AD09-M-00EX**
Ordering Code - Spacer	**BTL Z-P-1013-4R-Spacer**	**Spacer BTL-P-1013-DS**	**BTL Z-2-1012-4R-Spacer**	
Material	Aluminum	Aluminum	Aluminum	Nickel Plated Brass

*Spacer is included with these magnets

Approvals for BTL-A-AD09-M-00EX:

ATEX
SIRA 00A TEX1094
EEx de I & IIC
I M2, II 2 GD

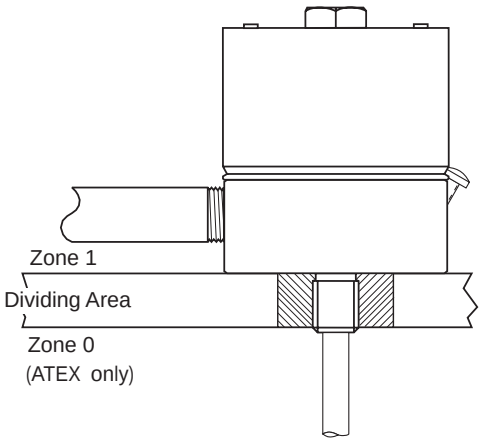
CSA/AEx
AEx de Class I, Zone I, Groups I & IIC
Class I, Division 1 & 2, Groups A, B, C, D
Class II & III, Groups E, F, G

Installing in Locations Classified as Zone 0 Under ATEX Guidelines

Only the rod section of the transducer may extend into Zone 0. To ensure safe isolation between Zone 0 and Zone 1, the relevant safety regulations for potentially explosive atmospheres must be strictly adhered to.

When using a float magnet, it is necessary that a static discharge between the transducer rod and the inner portion of the float be prevented. The floats on page 61 are designed so that, in normal operation, the float is tilted, thereby ensuring mechanical contact between the transducer rod and the float wall. Do not use other types of floats or attempt to disable this design feature.

Note: The transducer is not approved for locations classified as Zone 0 under FM Approval guidelines.



Output Type (Ordering Code) Fig. 1					
Pin	**Analog Voltage (A/B/G)**	**Analog Current (C/E)**	**Digital START/STOP (I/K/M/N/P)**	**DIGITAL PWM (L/R)**	**SSI (S)**
1	not used	Signal Out	Interrogate (+) (input)	Interrogate (+) (input)	CLK (+) (input)
2	signal GND	Signal GND	START/STOP (+) (output)	GATE (+) (output)	DATA (+) (output)
3	Signal Out (falling)	not used	Interrogate (-)[1] (input)	Interrogate (-) (input)	CLK (-) (input)
4	Pwr Supply GND	Pwr Supply GND	Pwr Supply GND	Pwr Supply GND	Pwr Supply GND
5	Pwr Supply (+10 to +30 Vdc)	Pwr Supply (+10 to +30 Vdc)	Pwr Supply (+10 to +30 Vdc)	Pwr Supply (+10 to +30 Vdc)	Pwr Supply (+10 to +30 Vdc)
6	Signal Out (rising)	not used	START/STOP (-)[1] (output)	GATE (-) (output)	DATA (-) (output)
7	not used	not used	not used	not used	not used

Note 1: Ordering code version "N" is a single-ended, TTL compatible START/STOP version. This version does not use **Interrogate (-)** or **START/STOP (-)**. Pins 3 and 6 should be left unconnected for "N"-type transducers.

Output Type (Ordering Code) Fig. 2	
Pin	**Profibus (T)**
1	RxD/TxD-N
2	RxD/TxD-P
3	Data GND
4	Pwr Supply GND
5	Pwr Supply (+)
6	VP (+5 V Output)
7	Not used
8	Not used

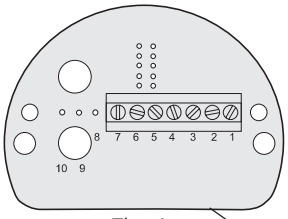


Fig. 1

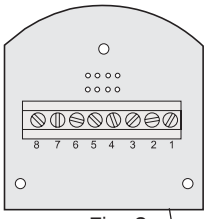


Fig. 2

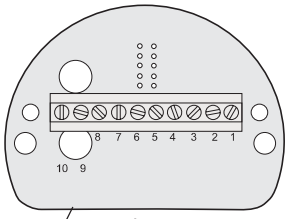
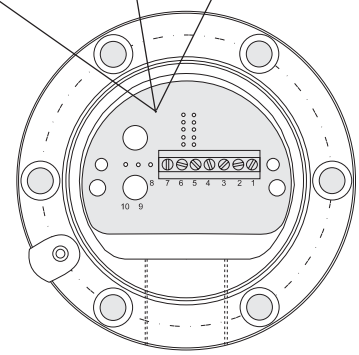


Fig. 3

Output Type (Ordering Code) Fig. 3		
Pin	**Quadrature (Q)**	**CANbus (H)**
1	Output Channel A (+)	CAN GND
2	Output Channel B (+)	CAN Low
3	Outpur Channel A (-)	CAN High
4	Pwr Supply GND	Pwr Supply GND
5	Pwr Supply (+10 to +30 Vdc)	Pwr Supply (+24V)
6	Output Channel B (-)	CAN GND
7	Output Channel Z (+)	CAN Low
8	Output Channel Z (-)	CAN High
9	Strobe Input	Not used
10	Not used	Not used



Typical housing with terminal block assembly.

Replacement Module Only **B T L 5 - A 1 1 - M 0 3 0 5 - J - M 0 1 - T A**

Complete Transducer **B T L 5 - A 1 1 - M 0 3 0 5 - J - D E X C - T A 1 2 - E 4 / U S**

Balluff Linear Transducer

Generation 5

Output Type

A = 0 to 10 Vdc	Q = Quadrature*
B = -5 to +5 Vdc	I = Differential start/stop with tri-state
C = 0 to 20 mA	K = Differential stop – leading edge active
E = 4 to 20 mA	L = Differential pulse – width modulated
G = -10 to +10 Vdc	M = Differential start/stop – leading edge active
S = SSI*	N = Single ended start/stop – leading edge (add /US)
T = Profibus*	P = Differential start/stop – trailing edge active
H = CANopen*	R = Differential pulse-width – recirculated

Supply Voltage
1 = 24 Vdc ±20%
5 = 10...30 Vdc (Not available for T & H output types; not available for SSI "B")

Analog Output Operation (blank for digital)
Voltage output (Output type A, B & G)
1 = User selectable rising or falling
Current output (Output type C & E)
0 = Minimum output at connector end (rising towards opposite end)
7 = Maximum output at connector end (falling towards opposite end)

Stroke Length
0 3 0 5 = active stroke length

Housing Style
J = Rod Style, Smooth Flange, O-ring seal
Supplied with (6) M6 x 45 stainless steel mounting screws

Rating Code
D E X = Explosion-Proof, **C** = Universal end plug

Electrical Connection Style
T A 1 2 = Terminal block connection, 1/2"-14 NPT conduit entry (see M20 adapter on page 61)

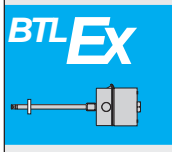
Interrogation (only valid if output type = R, otherwise leave blank
I = Internal interrogation, E = External interrogation

Recirculation (only valid if output type = R, otherwise leave blank)
1=1 circulation, 2 = 2 circulations, 3 = 3 circulations, 4 = 4 circulations, 6 = 6 circulations,
8 = 8 circulations, 10 = 10 circulations, 16 = 16 circulations

N output only

/US = single ended Start/Stop - leading edge (US Standard)

Blank = single ended Stop only - leading edge (European Standard)



*See additional ordering information on pages 58-60.

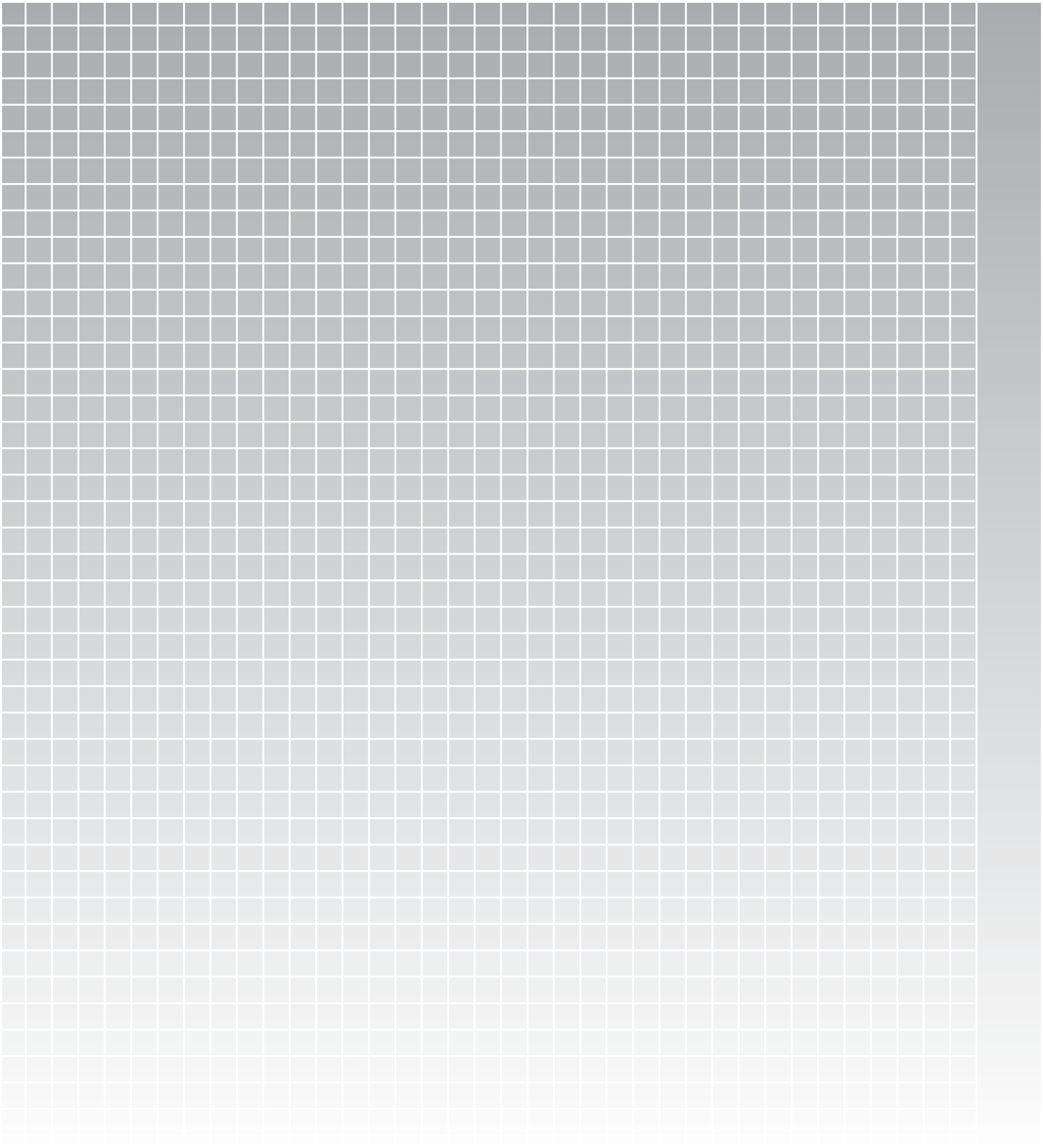
Notes:
– Conduit adapter 1/2" - 14 NPT to M20 metric **BTL-A-AD09-M-00EX**
– Replacement metric mounting screw kit: **BTL5-A-FK01-E-J-DEX**
– Analog Programming Tool: **BTL5-A-EH03**
– Replacement electronics and waveguide module: Substitute "J-M01-TA" for "J-DEXC-TA12" in part number of complete unit

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

1	(0025)	9	(0230)	22	(0560)	48	(1220)	89	(2261)	156[A]	(3962)	192	(4877)						
2	(0051)	10	(0254)	24	(0610)	50	(1270)	98	(2490)	160	(4064)	196	(4978)						
3	(0076)	11	(0280)	26	(0661)	54	(1372)	108	(2743)	164	(4166)	200	(5080)						
3.5	(0090)	12	(0305)	28	(0711)	60	(1524)	118	(2997)	168	(4267)								
4	(0102)	13	(0330)	30	(0762)	66	(1676)	126	(3200)	172	(4369)								
5	(0127)	15	(0381)	32	(0813)	69	(1753)	140	(3556)	176	(4470)								
6	(0152)	16	(0407)	36	(0914)	72	(1829)	144	(3658)	180[B]	(4572)								
7	(0178)	18	(0457)	40	(1016)	78	(1981)	148	(3759)	184	(4674)								
8	(0203)	20	(0508)	42	(1067)	84	(2134)	152	(3861)	188	(4775)								

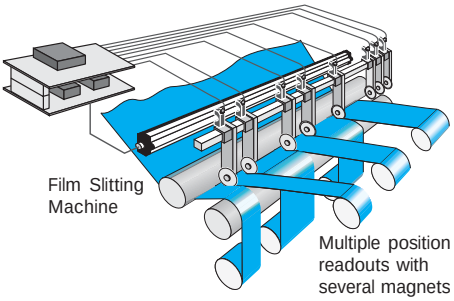
[A] Maximum length for SSI, Profibus, CANopen = 156 inches.

[B] Maximum length for analog outputs = 180 inches.



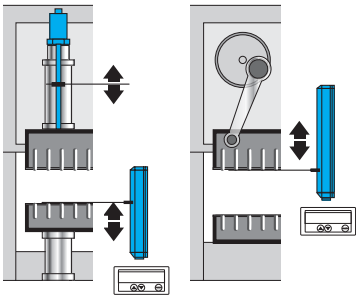
Profile Style

Balluff Micropulse® linear position transducers in the Profile-style housing are a rugged, wear-free alternative to other linear feedback devices such as wear-prone potentiometers, expensive and fragile glass scales, and limited-stroke LVDT's. Environmentally sealed to IP 67, and utilizing either a sliding captive magnet or a free-floating magnet, the Profile housing Micropulse transducer provides highly accurate linear position feedback in demanding, harsh industrial applications.



Film Slitting Machine

Multiple position readouts with several magnets on a single transducer



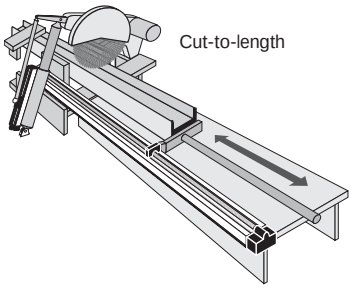
Hydraulic Press

Mechanical Eccentric Press

Speed up die changes with digital display of shut height and parallelism

Features/Advantages:

- Non-contact absolute position feedback
- IP 67, highly resistant to contamination
- Wear free
- High immunity to shock and vibration
- Direct replacement of lower grade linear feed back devices
- Captive or floating magnet



Cut-to-length

Outputs:

- Analog
- Digital Pulse
- SSI
- CANopen
- Profibus
- DeviceNet

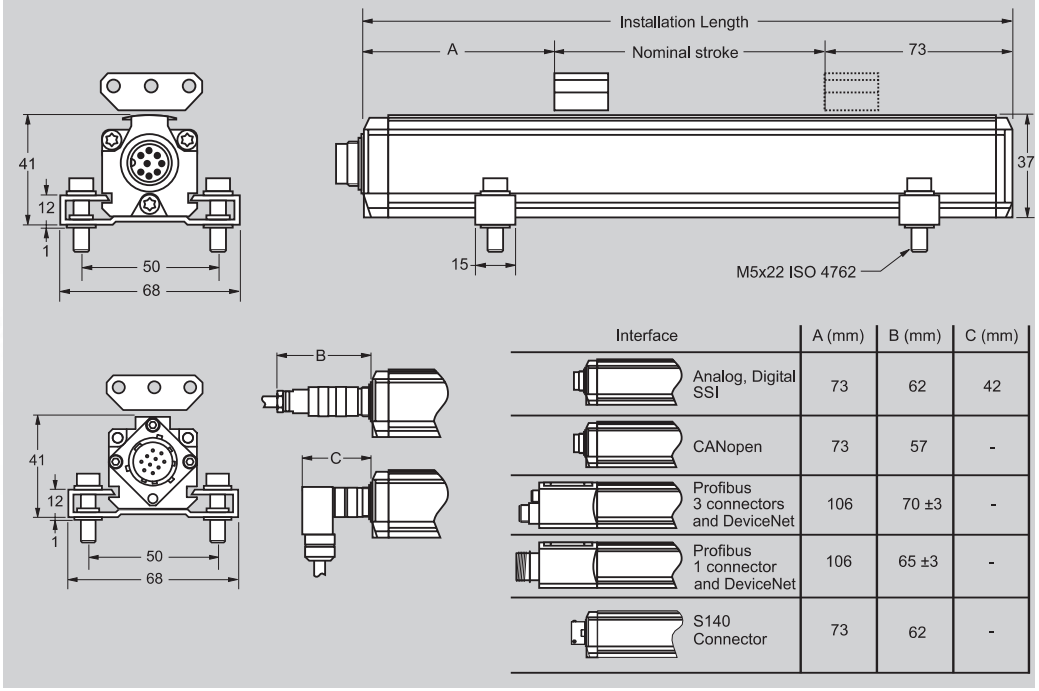
Applications:

Balluff transducers offer features which assure reliable operation in many areas of automation and process technology, even under extreme ambient conditions:

- Hydraulic cylinders
- Tooling and tool handling
- Presses
- Casting and rolling mills
- Foundries
- Injection molding
- Leveling machines
- Transport systems
- Lift controls
- Level monitoring
- Tunnel boring equipment
- Die casting machinery
- Portal robots
- Woodworking machinery
- Flight simulators
- Cutting/slitting machinery
- Conveying
- Packaging machines
- Windmills
- Elevators
- Forestry

BTL P

Series	**P Style**
Available Lengths	51 mm (2 in) to 5080 mm (200 in)
Output Signals	Analog, Digital Pulse, SSI, CANopen, Profibus, DeviceNet, Quadrature

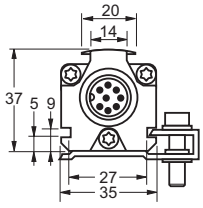


Interface	A (mm)	B (mm)	C (mm)
Analog, Digital SSI	73	62	42
CANopen	73	57	-
Profibus 3 connectors and DeviceNet	106	70 ±3	-
Profibus 1 connector and DeviceNet	106	65 ±3	-
S140 Connector	73	62	-

Ordering Code	**BTL5-_ _-M_ _ _-P-_ _ _ _** (See ordering code on page 76)
Measurement Type	Linear displacement
Measurement Range	51 mm (2 in) to 5080 mm (200 in)
Shock Rating	100 g/6 ms (100 g/2 ms continuous) per IEC 68 2-27
Vibration Rating	12 g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	IP 67 (when BKS-S32/33 is installed)
Housing Material	anodized aluminum
Operating Temperature	-40 to + 185° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	connector or integral cable
Noise Immunity	ESD, RFI and BURST per IEC 1000-4-2/3/4/6, severity level 3
Approvals	CE

Warning:
These products are not rated for personnel safety applications.

Accessories:
Magnets ..... pg 71-73
Connectors ..... pg 74



Additional mounting dimensions

Autotuning Circuitry

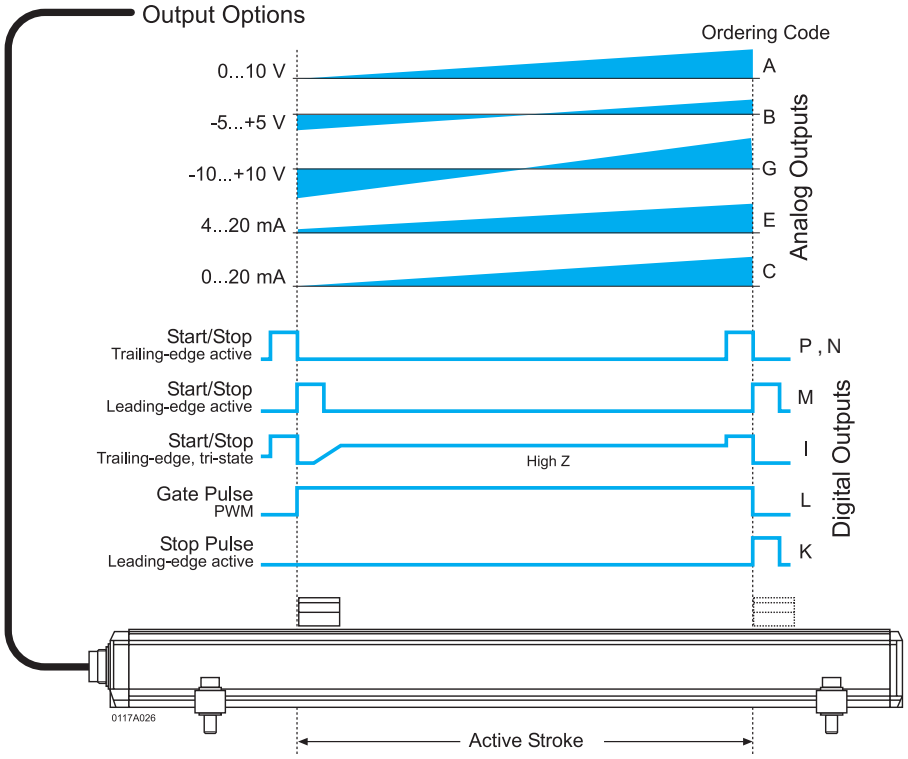
Patented Autotuning circuitry in Balluff Micropulse® transducers automatically compensates for changes in the strength of the magnetostrictive return signal.

- Automatically compensates for changes in temperature, providing a more stable signal over a wide temperature range.
- For Micropulse profile-style transducers using a floating magnet configuration, Autotuning ensures that the return signal remains stable, even if the distance from magnet to transducer varies.

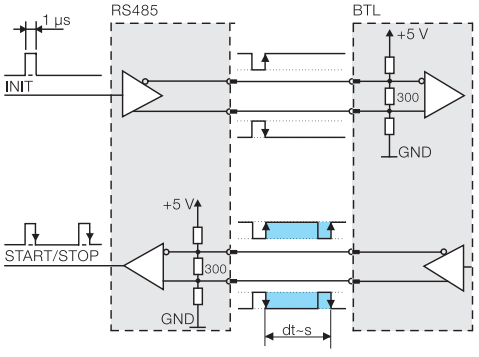
Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop & PWM
Part No. Code (See Pg. 76)	**A, B, G**	**E,C**	**P, M, N, I, L, K**
Output	0...+10 V, -5...+5 V, -10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2 KΩ (5 mA max)	≤ 500 Ω	per spec
Resolution	< 0.1 mV	< 0.2 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	4 µm	4 µm	4 µm
Sampling Rate	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm	500 Hz stroke > 2000 mm 1 kHz stroke < 2000 mm
Temperature Coefficient*	[150 µV/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6 µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) /°C
Operating Voltage	24 Vdc ±20% or 15 Vdc ±2%	24 Vdc ±20% or 15 Vdc ±2%	24 Vdc ±20% or 15 Vdc ±2%
Operating Current	< 150 mA (at 1 kHz sampling rate)	< 150 mA (at 1 kHz sampling rate)	< 150 mA (at 1 kHz sampling rate)

Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**
V = output range in V
I = output range in [mA]
ΔT = temperature change
P = magnet position
NL = stroke length



Analog and Digital Output Options for the Micropulse P Style



RS485 signal transmission with digital outputs

CANopen
This interface provides an efficient connection to machines using CANopen. Features include:
- Process data objects incorporating position, velocity and set-point information
- Emergency object for set-points
- Service data objects for configuring transducer modes
- Synchronization objects for network wide activities

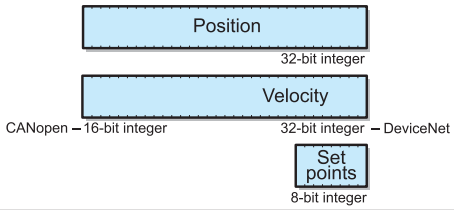
DeviceNet
This interface provides an efficient connection to machines using DeviceNet. Features include:
- Process data objects incorporating position, velocity and set-point information
- EDS file provided for configuration and set up
- Bi-color LED provides limited device and communication status
- High data security: output data is checked for validity and plausibility in the controller

Profibus
This interface provides an efficient connection to machines using Profibus. Features of this interface include:
- Single telegram message for fast updates even with 4 magnets
- Operates at 12 Mbps
- GSD file provided to configure telegram message
- Sync and Freeze functions available for coordination between other devices

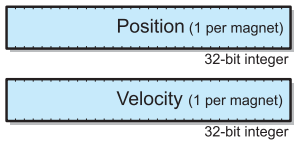
Ordering Code		H	D	T
Resolution	Position	5 µm	5 µm (configurable)	5 µm (configurable)
	Velocity	0.1 mm/s increments (selectable)	0.1 mm/s increments (configurable)	0.1mm/s increments (configurable)
Non-linearity		±30 µm at 5 µm resolution	±30 µm at 5 µm resolution	±30 µm at 5 µm resolution
Repeatablity (resolution + hysteresis)		±1 digit	±1 digit	±1 digit
Hysteresis		≤ 1 digit	≤ 1 digit	≤ 1 digit
Sampling Rate		1 kHz	1 kHz	1 kHz
Temperature Coefficient		(6 µm + 5 ppm x L)/°C	(6 µm + 5 ppm x L)/°C	(6 µm + 5 ppm x L)/°C
Operating Voltage		24 Vdc ±20%	20...28 Vdc	24 Vdc ±20%
Operating Current		≤ 100 mA	≤ 100 mA	≤120 mA
Network Isolation		yes	yes	yes
Network Speed		10, 20, 50, 100, 125, 250, 500, 800, 1000 kBaud	125, 250, 500 kBaud	9.6, 19.2, 93.7, 187.5, 900, 1500, 1200 kBaud
Network Compatibility		CiA Standard DS301, DS406 (Encoder Profile)	CIP 2.1 (Resolver Device)	EN 50170 (Encoder Profile)
Address Selection		Software	DIP switch or Software	DIP switch
Communication Types		Producer/Consumer	Producer/Consume	Master/Slave
Configuration Software		none required	EDS file	GSD file
Number of Magnets Supported		1, 2 or 4	1, 2 or 4	1, 2 or 4

Notes:
For more technical information, see pages 123-128

Data Format



Data Format



BTL5-H1_ _-Mxxxx-P-S94
BTL5-D1_ _-Mxxxx-P-S93

Process Data
1 = 1 x position & 1 x velocity
2 = 2 x position & 2 x velocity (CANopen only)
3 = 4 x position (CANopen only)

Baud Rate
0 = 1 MBaud (CANopen only)
1 = 800 kBaud (CANopen only)
2 = 500 kBaud
3 = 250 kBaud
4 = 125 kBaud
5 = 100 kBaud (CANopen only)
6 = 50 kBaud (CANopen only)
7 = 20 kBaud (CANopen only)
8 = 10 kBaud (CANopen only)

Stroke Length
xxxx = length in mm (see chart on page 76)

Connection Type[1]
S94 = two 5-pin M12 (standard–CANopen only)
Bus in: 5-pin male, M12
Mating connector: BKS-S92-00 (female)
Bus out: 5-pin female, M12
Mating connector: BKS-S94-00 (male)
S92 = one 5-pin (optional–CANopen only)
S93 = three connectors (standard–DeviceNet only)
Bus in: 5-pin male, M12
Mating connector: BKS-S92-00 (female)
Bus out: 5-pin female, M12
Mating connector: BKS-S94-00 (male)
Power: 3-pin male, M8
Mating connector: BKS-S48-15-CP-xx (female)

BTL5-T1_0 -Mxxxx-P-S103

No. of Magnets
1 = 1 magnet
2 = 2 magnets
3 = 4 magnets

Stroke Length
xxxx = length in mm
(see chart on page 76)

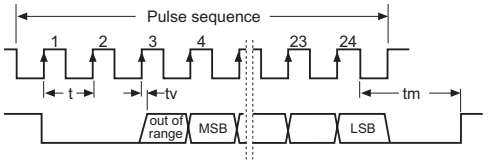
Connection Type
S103 = 3 connectors (standard):
Power: 3-pin male, M8
Mating connector: BKS-S48-15-CP-xx (female)
Bus in: 5-pin male, M12
Mating connector: BKS-S103-00 (female)
Bus out: 5-pin female, M12
Mating connector: BKS-S105-00 (male)

[1]See page 107-114 for mating cables/connectors.

Specialized Interface

SSI
The SSI (synchronous serial interface) output interfaces with popular control systems from manufacturers such as Allen-Bradley, Siemens, Parker and many others. Cable spans can be up to 400m with noise free operation. Individual EEPROM linearization of this interface makes it ideal for applications requiring the best accuracy available.

Ordering Code	S
Resolution	5, 10, 20 or 40 µm
Non-linearity	±30 µm or ±2LSBs, whichever is greater
Repeatablity (resolution + hysteresis)	±1 digit
Hysteresis	≤1 digit
Sampling Rate	500 µs
Temperature Coefficient	(6 µm + 5ppm x L)/°C
Communication Speeds	100, 200, 400, 500, 1000 kHz
Output Modes	24 or 25 bits
Operating Voltage	24 Vdc ±20%
Operating Current	≤ 80 mA
Output	Standard RS-485/422 levels
Output Load	> 2 KΩ (5 mA max)



Notes:

SSI Maximum cable lengths

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

BTL5-S1_ _-Mxxxx-P-_ _ _

Coding
0 = Binary, increasing, 24 bit
1 = Gray code, increasing, 24 bit
2 = Binary, falling, 24 bit
3 = Gray code, falling, 24 bit
6 = Binary, increasing, 25 bit
7 = Gray code, increasing, 25 bit
8 = Binary, falling, 25 bit
9 = Gray code, falling, 25 bit

System Resolution
2 = 5 µm
3 = 10 µm
4 = 20 µm
5 = 40 µm
6 = 100 µm
8 = 50 µm

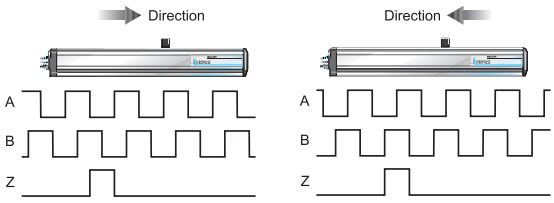
Stroke Length
xxxx = length in mm
(see chart on page 76)
Maximum stroke length = 156" (3962 mm)

Connection Type
S 32 = Connector (see page 74 for mating cables)
KA02 = 2 m PUR cable
KA05 = 5 m PUR cable
KA10 = 10 m PUR cable
KA15 = 15 m PUR cable

Quadrature
The quadrature output interfaces directly to standard encoder inputs (90° out of phase, A & B). This configuration gives you more interface options for connecting to motion based systems. Operating modes can be either free-running or synchronous (switch selectable) depending on the control system's requirements.

- Remotely triggered Burst Mode rapidly delivers accumulated pulse string for absolute information upon demand, eliminating the need to re-home after a power loss or other cycle interruption.
- Operates in either synchronous or free-running modes
- Selectable position resolution (1, 2, 5, 10, 50 µm or 0.001", 0.0005", 0.0001")
- Selectable pulse frequencies (10, 208, 416, 833 kHz)

Ordering Code	Q
Resolution	1, 2, 5, 10, 50 µm or 0.001", 0.0005", 0.0001" (switch selectable)
Non-linearity	±100 µm to 500 mm stroke, ±0.02% over 500 mm stroke
Repeatablity (resolution + hysteresis)	resolution + (±2 x resolution or 5 µm, whichever is greater)
Hysteresis	±2 x resolution or 5 µm, whichever is greater
Sampling Rate	Free-running: 1 ms, 2 ms, 4 ms Synchronous: 500 µs to 10 ms
Temperature Coefficient	(6 µm + 5 ppm x L)/°C
Pulse Frequency	10, 208, 416, 833 kHz
Output Modes	Free-running or Synchronous (switch selectable)
Operating Voltage	10...30 Vdc
Operating Current	≤ 75 mA @ 24 V, ≤ 100 mA @ 15 V, ≤ 150 mA @ 10 V
Output	Standard A & B (RS-422 level)



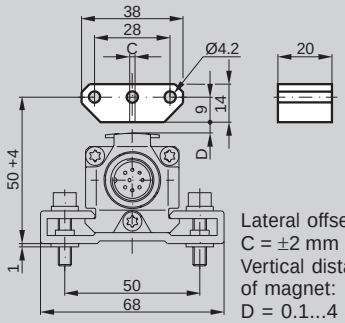
BTL5-Q5 _ _ _-Mxxxx-P-xxxx

Supply Voltage
5 = 10...30 Vdc
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 (initiated by controller — consult factory)
1 = free-running, 1 ms update — ≤ 1250 mm stroke only
2 = free-running, 2 ms update — 1251 mm to 2500 mm
4 = free-running, 4 ms update — ≥ 2501 mm
Stroke Length
xxxx = Length in mm (see chart page 76)
Connection Type
S140 = MS style connector (see page 107-114 for mating cables)
KA02 = 2 meter PVC cable
KA05 = 5 meter PVC cable
KA10 = 10 meter PVC cable
KA15 = 15 meter PVC cable

Balluff magnets are available in captive or floating styles. All BTL5 magnets shown here can be used on any Balluff Micropulse transducer.

The BTL5-P-3800-2 magnet can be used with a vertical offset from the upper surface of the transducer body of 0...4 mm, and the BTL5-P-5500-2 permits a distance of 5...15 mm. The BTL5-P-4500-1 is an electromagnet and requires a supply voltage of 24 V, which can be turned on and off for selective activation. This allows multiplex operation with multiple magnets on a single transducer, since only one magnet is active at a time.

Description	Magnet
for Series	BTL Profile
Type	Floating



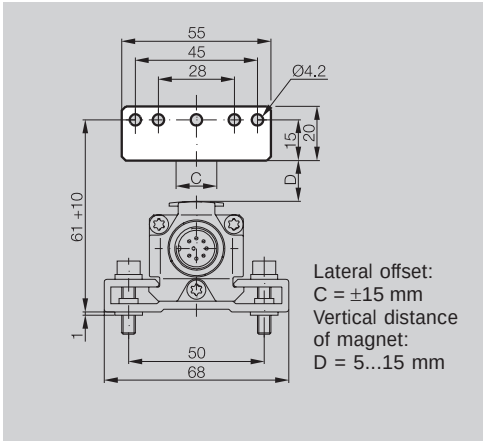
Ordering Code	**BTL5-P-3800-2**
Housing Material	Plastic
Weight	approx. 12 g
Magnet Traverse Speed	any
Supply Voltage	
Current Draw	
Operating Temperature/Storage Temperature	–40...+85 °C
Included	Magnet 2 mounting screws DIN 84 M4×35-A2 with washers and nuts

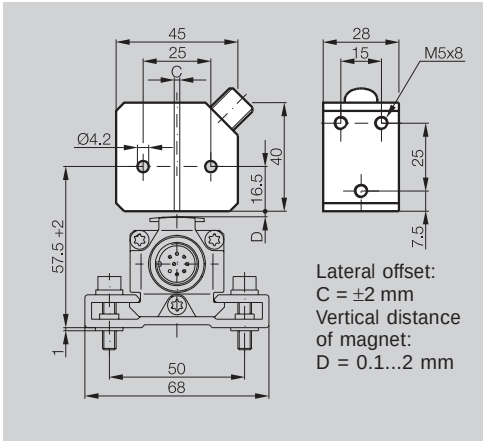
Each mounting foot includes 4 isolation washers and 2 mounting screws ordered separately.
Order part number:
BTL P-M5-VZ (sold in pairs)

Number of Mounting Feet (Recommended)

Transducer Stroke Length (mm)	Recommended Number of Feet
0051-0457	2
0508-0711	3
0762-0914	4
1016-1220	5
1270	6
1524	7
1778	8
2032	9
2286	10
2540	11
2794	12
3048	13
3302	14
3606	15
3962	16
4267	17
4572	18
4877	19
5080	20

Description	Magnet	Magnet
for Series	BTL Profile	BTL Profile
Type	Extended range, Floating	Electromagnet, Floating

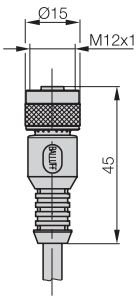




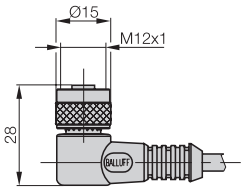
Ordering Code	**BTL5-P-5500-2**	**BTL5-P-4500-1**
Housing Material	Plastic	Plastic
Weight	approx. 40 g	approx. 90 g
Magnet Traverse Speed	any	any
Supply Voltage		24 Vdc
Current Draw		100 mA
Operating/Storage Temperature	–40...+85 °C	–40...+60 °C
Included	Magnet	Magnet
Accessories (please order separately)		Straight connector C04-AEC-00-VY-050M Right-angle connector C04-BEC-00-VY-050M

Non-contact! Vertical offset 0.1...4 mm or 5...15 mm

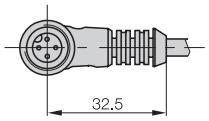
Please indicate cable length in ordering code:
03, 05, 10, 15
e.g. 050M = 5M



C04-AEC

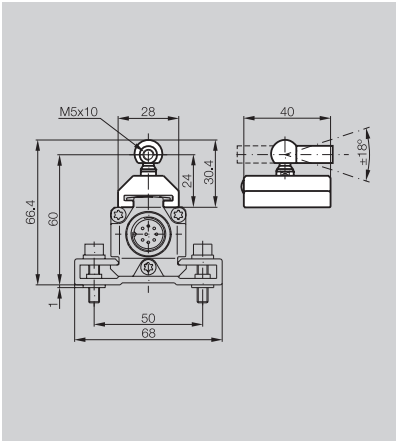


C04-BEC



Connector for Electromagnet

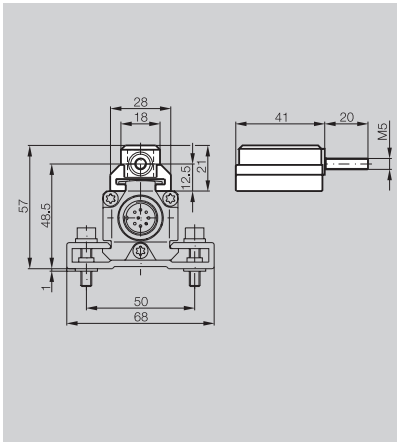
Description	Magnet
for Series	BTL Profile
Type	Standard Captive

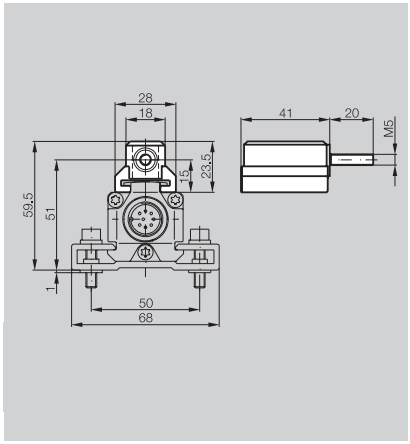


Ordering Code	**BTL5-F-2814-1S**
Material — Housing	Plastic
Material — Slide Surface	Plastic
Weight	approx. 28 g
Magnet Traverse Speed	any
Operating/Storage Temperature	–40...+85 °C

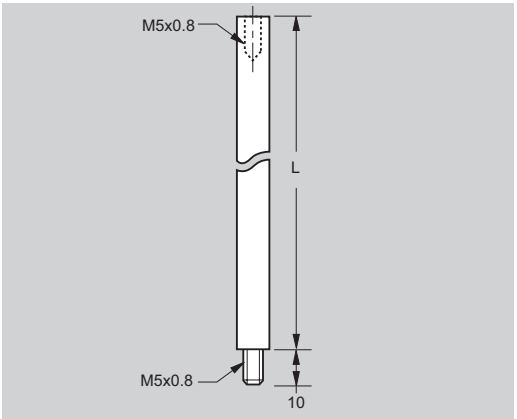
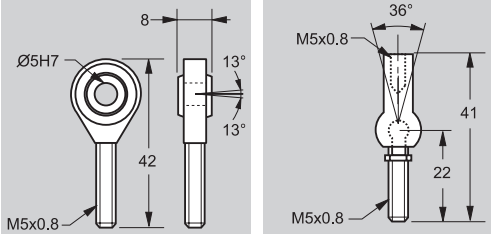
Each mounting foot includes 4 isolation washers and 2 mounting screws ordered separately.
Order part number:
BTL P-M5-VZ (sold in pairs)

Description	Magnet	Magnet
for Series	BTL Profile	BTL Profile
Type	Special Purpose Captive	Special Purpose Captive

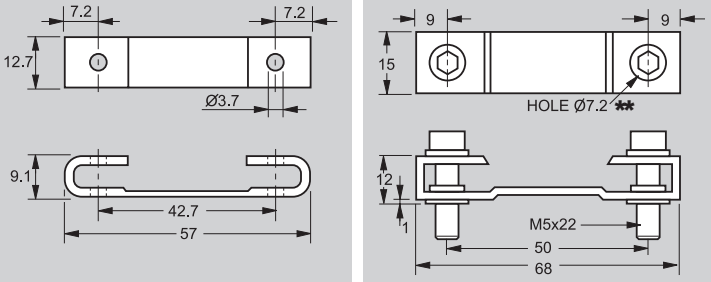


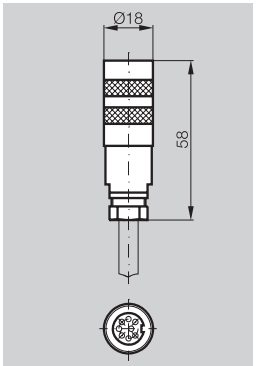
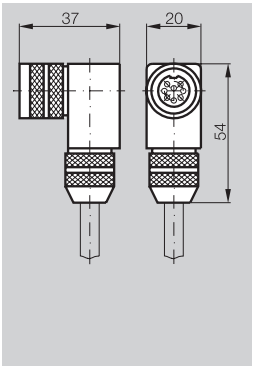
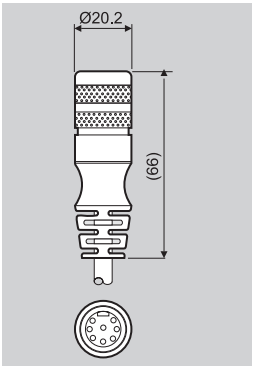
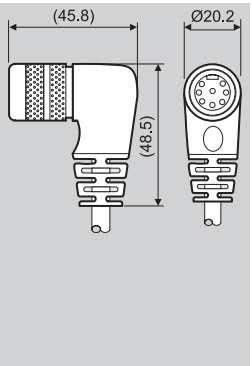


Ordering Code		**BTL5-M-2814-1S**	**BTL5-N-2814-1S**
Material	Housing	Anodized aluminum	Anodized aluminum
	Slide Surface	Plastic	Plastic
Weight		approx. 32 g	approx. 35 g
Magnet Traverse Speed		any	any
Operating/Storage Temperature		–40...+85 °C	–40...+85 °C

Product	Control Arm	Swivel Eye	Ball Joint
Compatibility	BTL5-F-2814-1S and BTL5-R-2814-1S	BTL5-GS08-	BTL5-GS08-
				
Ordering Code	**BTL Z-5-GS08-_ _*_ _-A**	**BTL5-SWIVEL-EYE**	**BTL5-A-BJ01**
Material	Aluminum	Aluminum/Steel	Aluminum/Steel
Weight	150 g/m	14 g	11 g

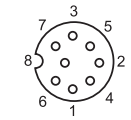
*Specify control arm length in mm e.g. BTL-5-GS08-0305-A

Product	Mounting feet	Mounting feet
Type	Narrow (optional)	Standard
			
		**Each BTL P-M5-VZ Mounting Foot is supplied with 4 plastic isolation washers with an inner diameter of 5.1 mm. If the cable shield is connected at the electrical panel, these washers should be used to isolate the transducer body from the machine frame, thereby avoiding potential ground loops.
Ordering Code	**BTL5-FEET-NR** (one foot)	**BTL P-M5-VZ** (sold in pairs)
Material	Aluminum	Black Anodized Aluminum
Weight	6 g	12 g

Product			Molded	Molded
	Straight Connector	Right-angle Connector	Straight Connector	Right-angle Connector
Type	8-pin female	8-pin female	8-pin female	8-pin female
				
For additional connectors, see page 107-114				
* Indicate cable length in ordering code (consult factory for longer lengths) 00 = connector only (only S32 and S33) 02 = 2 meter cable 05 = 5 meter cable				
Ordering Code	**BKS-S 32M-_*_**	**BKS-S 33M-_*_**	**BKS-S 232-PU-_*_**	**BKS-S 233-PU-_*_**
Material	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated
Contact Surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Solder Connection	00 option only	00 option only	N/A	N/A
Cable	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24
Cable Diameter	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm
Allowable Cable Diameter	6…8 mm	6…8 mm	N/A	N/A
Cable Material	PUR	PUR	PUR	PUR
Environmental Rating	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)

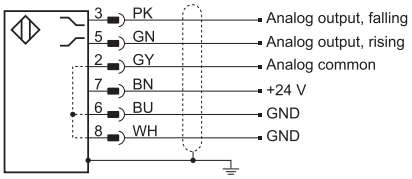
Analog Wiring Diagrams

S32 Connector

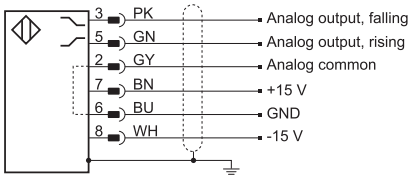


View of mating connector, wiring side

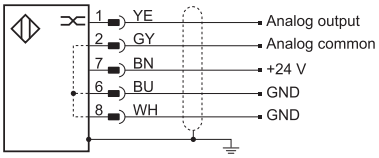
Analog Voltage 24 V (A, B, G)



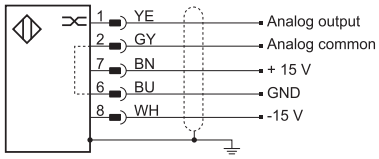
Analog Voltage ±15 V (A, B, G)



Analog Current 24 V (E, C)

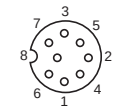


Analog Current ±15 V (E, C)



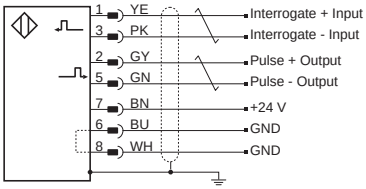
Digital Wiring Diagrams

S32 Connector

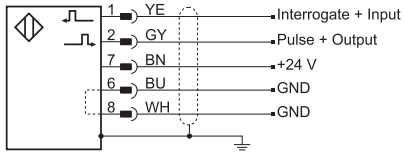


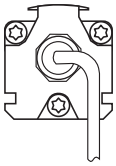
View of mating connector, wiring side

Digital, RS485 differential 24 V (P, M, I, K, L)

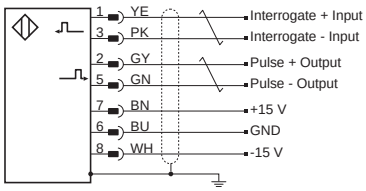


Digital, Single-ended 24 V (N)

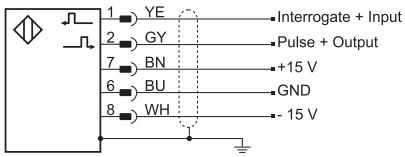




Digital, RS485 differential ±15 V (P, M, I, K, L)

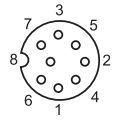


Digital, Single-ended ±15 V (N)



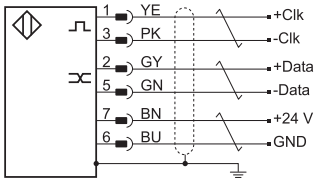
SSI Wiring Diagram

S32 Connector



View of mating connector, wiring side

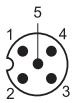
SSI (S)



* Pin-8 (WH) must remain unconnected

CANopen/DeviceNet Wiring Diagram

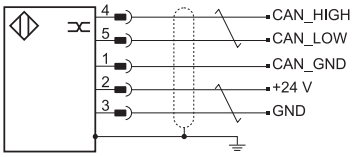
S92 Connector



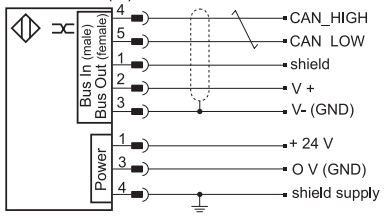
View of mating connector, wiring side

S94 Connector

CANopen (H)



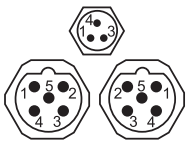
DeviceNet (D)



S93 Connector

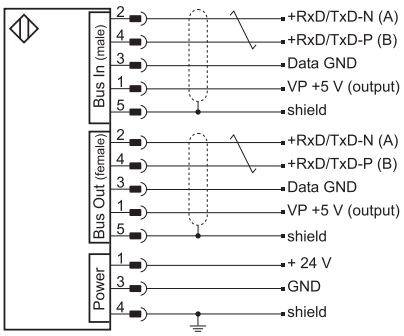
Profibus Wiring Diagram

S103 Connector



View of mating connector, wiring side

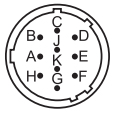
Profibus (T)



Note: \ = twisted-pair

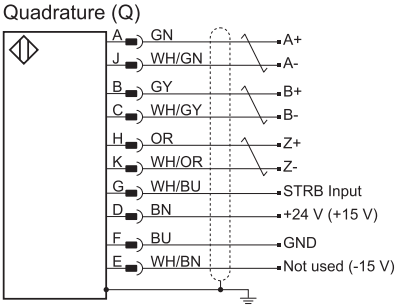
Quadrature Wiring Diagram

S140 Connector



View of mating connector, wiring side

Quadrature (Q)



Ordering Code

B T L 5 - A 1 1 - M 0 3 0 5 - P - S 3 2 / U S
K A 0 5

Balluff - Linear Transducer

Generation 5

Output Type

A = 0 to 10 Vdc (add /US)
B = -5 to +5Vdc (add /US)
C = 0 to 20 mA (add /US)
E = 4 to 20 mA (add /US)
G = -10 to +10 Vdc (add /US)
Q = Quadrature*
S = SSI*
T = Profibus*
H = CANopen*
D = DeviceNet*

I = Differential start/stop with tri-state
K = Differential stop – leading edge active
L = Differential pulse – width modulated
M = Differential start/stop – leading edge active
N = Single ended start/stop – leading edge active (add /US)
P = Differential start/stop – trailing edge active

Supply Voltage

1 = 24 Vdc ±20%
2 = ±15 Vdc ±2% (Not available for Q, S, T, H, or D outputs)
5 = 10...30 Vdc (Q output only)

Analog Output Operation (blank for digital)

Voltage output (Output type A, B & G)
1 = User selectable rising or falling

Current output (Output type C & E)
0 = Minimum output at connector end (rising towards opposite end)
7 = Maximum output at connector end (falling towards opposite end)

Normal Stroke Length

0 3 0 5 = 305 mm active stroke

Housing Type

P = Standard Profile Housing

Connection Type

S 3 2 = 8-pin quick disconnect metal connector (standard) (see page 74 for mating cables)

K A 0 5 = Cable out (5 m standard; specify length in meters)

S 1 4 0 = M5 - style quick disconnect for Quadrature output (see page 107-114 for mating cables)

Analog and N output only

Analog/US =
Non-potential-free

Analog blank =
Potential free

N output/US =
TTL single-ended start/stop

N output blank =
TTL single-ended stop only

* See additional ordering information on pages 68-70.

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

1	(0025)	9	(0230)	22	(0560)	48	(1220)	89	(2261)	156[A]	(3962)	192	(4877)
2	(0051)	10	(0254)	24	(0610)	50	(1270)	98	(2490)	160	(4064)	196	(4978)
3	(0076)	11	(0280)	26	(0661)	54	(1372)	108	(2743)	164	(4166)	200	(5080)
3.5	(0090)	12	(0305)	28	(0711)	60	(1524)	118	(2997)	168	(4267)		
4	(0102)	13	(0330)	30	(0762)	66	(1676)	126	(3200)	172	(4369)		
5	(0127)	15	(0381)	32	(0813)	69	(1753)	140	(3556)	176	(4470)		
6	(0152)	16	(0407)	36	(0914)	72	(1829)	144	(3658)	180[B]	(4572)		
7	(0178)	18	(0457)	40	(1016)	78	(1981)	148	(3759)	184	(4674)		
8	(0203)	20	(0508)	42	(1067)	84	(2134)	152	(3861)	188	(4775)		

[A] Maximum length for SSI, Profibus, CANopen = 156 inches.

[B] Maximum length for analog outputs = 180 inches.

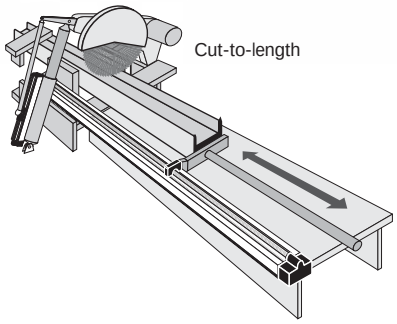
SLT Economical Profile Style

Accurate, Rugged, Reliable
Unmatched Value

The Micropulse® SLT offers a lower-cost alternative to traditional profile-style linear position transducers.

The Micropulse SLT use the same field-proven magnetostrictive technology that has made Balluff a world leader in linear position sensing.

The economical SLT is made possible by utilizing streamlined manufacturing techniques and standardized configurations. The result is a high-performance linear position sensor offering unmatched value.



Cut-to-length

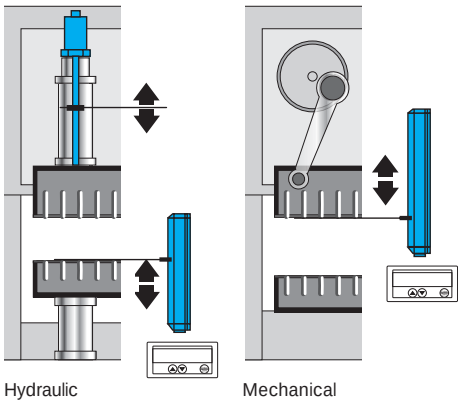
Features:

- 0-10 V or 4-20 mA Output
- Floating or Captive Magnet
- Measuring Lengths from 2" to 110"

Applications:

Balluff transducers offer features which assure reliable operation in many areas of automation and process technology, even under extreme ambient conditions:

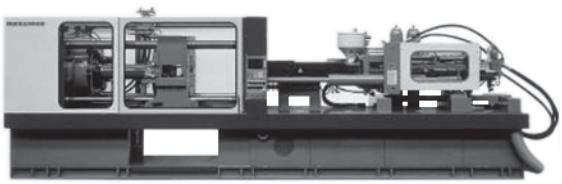
- Plastic injection molding machinery
- Tire manufacturing machinery
- Presses
- Die casting machinery
- Casting and rolling mills
- Level monitoring
- Cutoff saws
- Packaging and conveying machinery
- Tooling and handling
- Woodworking machinery
- Cutting/slitting machinery



Hydraulic Press

Mechanical Eccentric Press

Speed up die changes with digital display of shut height and parallelism



SLT
The SLT “A110” voltage output model offers both rising (0-10 Vdc) and falling (10-0 Vdc) outputs. Current output models must be ordered as rising (E100, 4-20 mA) or falling (E170, 20-4 mA). Mounting feet are included with the “SLT”. The PK3 and PK4 packages offer a magnet and mounting feet included with the transducer. See page 80 for ordering instructions of magnet packages.

Ordering Code (See page 80)	**BTL6-A110-M____-P-S115** **BTL6-E1_0-M____-P-S115**
Output	0-10 Vdc and 10-0 Vdc **(A110)** or 4-20 mA **(E100)** / 20-4 mA **(E170)**
Resolution	≤ 10 µm
Repeat Accuracy	≤ 10 µm
Non-linearity	Stroke length ≤ 500 mm ± 100 µm Stroke length > 500 mm ± 0.02% of full scale
Update Rate	1 ms
Operating Voltage	+ 24 Vdc ± 20%
Current Draw	≤ 150 mA
Reverse Polarity Protected	Yes
Overvoltage Protected	Yes
Operating Temperature	-40 to +176 °F
Storage Temperature	-40 to +212 °F
Protection Class	IP 67
Vibration Rating	12 g. 10 to 2000 Hz per IEC 68-2-6
Shock Rating	100 g, 6 ms per IEC 68-2-27
Housing Material	Anodized aluminum
Approvals	CE

Analog Output Options

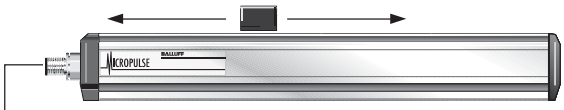
The following versions are available:

0-10 V and 10-0 V (BTL6-A110-...)

4-20 mA (BTL6-E100-...)

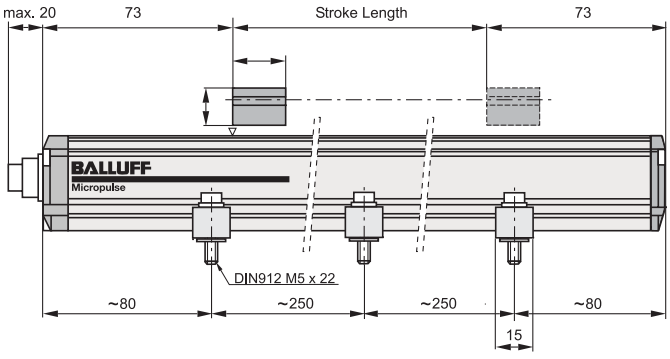
20-4 mA (BTL6-E170-...)

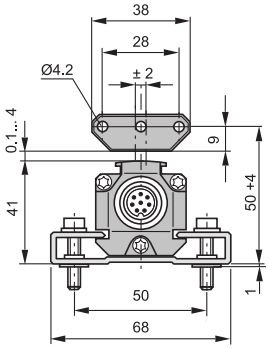
Position magnet attached to moving part of machine

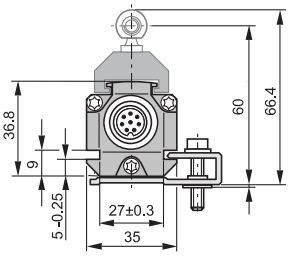


0-10 Vdc / 10-0 Vdc or 4-20 mA

Installation







Mounting Instructions

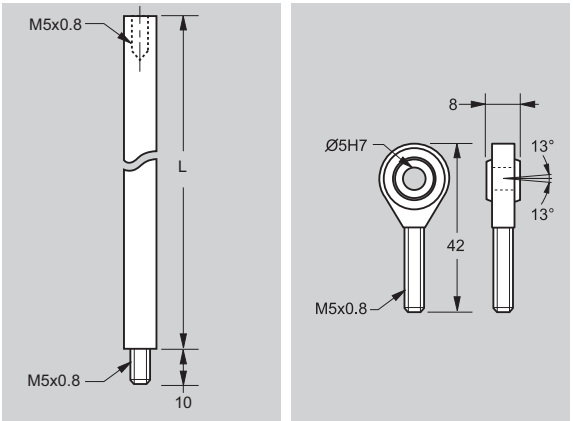
Mounting feet, along with M5 x 22 socket-head screws and plastic isolation washers are supplied with transducer.

Additional mounting feet must be purchased separately.

Stroke Length (in.)	Number of Mounting Feet Supplied
2-18	2
20-36	4
40-60	6
70-110	8

Product	Control Arm	Swivel Eye	Ball Joint
Compatibility	BTL5-F-2814-1S BTL5-R-2814-1S	BTL5-GS08-	BTL5-GS08-

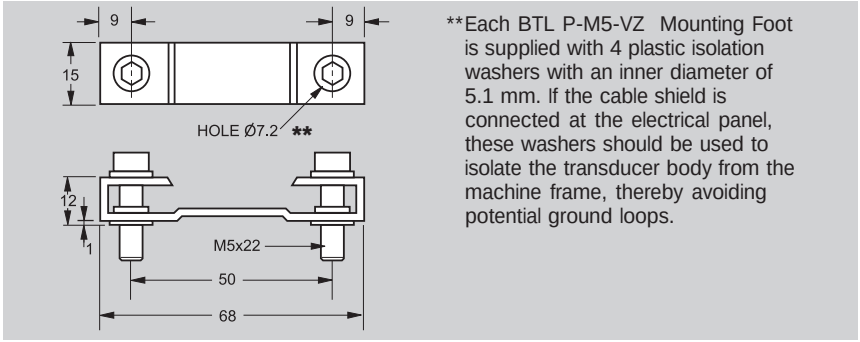
Note: Mounting feet and magnet are included. Other accessories must be ordered separately.



Ordering Code	BTL Z-5-GS08-_ _ * _ -A	BTL5-SWIVEL-EYE	BTL5-A-BJ01
Material	Aluminum	Aluminum/Steel	Aluminum/Steel
Weight	150 g/m	14 g	11 g

*Specify control arm length in mm e.g. BTL-5-GS08-0305-A

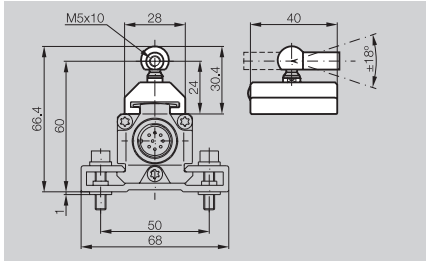
Product	Mounting feet (included with package)
Type	Standard

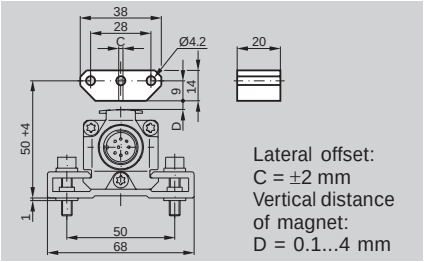


**Each BTL P-M5-VZ Mounting Foot is supplied with 4 plastic isolation washers with an inner diameter of 5.1 mm. If the cable shield is connected at the electrical panel, these washers should be used to isolate the transducer body from the machine frame, thereby avoiding potential ground loops.

Ordering Code	BTL P-M5-VZ (sold in pairs)
Material	Black Anodized Aluminum
Weight	12 g

Description	Magnet	Magnet
For Series	BTL Profile	BTL Profile
Type	Standard Captive	Floating



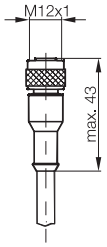


Lateral offset:
C = ±2 mm
Vertical distance of magnet:
D = 0.1...4 mm

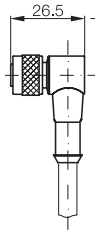
Ordering Code	BTL5-F-2814-1S	BTL5-P-3800-2
Housing Material/Slide Surface	Plastic/Plastic	Plastic/--
Weight	approx. 28 g	approx. 12 g
Magnet Traverse Speed	any	any
Operating/Storage Temperature	–40...+85 °C	–40...+85 °C

Included: Magnet, 2 mounting screws DIN 84 M4×35-A2 with washers and nuts

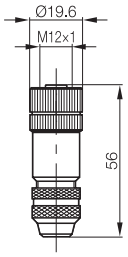
Wiring Instructions/Connector Drawing/ Wiring Diagram



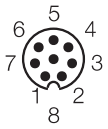
BKS-S115-PU-__*



BKS-S116-PU-__*



BKS-S115-PU-00



Pin numbering for connector, male pin view

* Specify cable length in meters: 02, 05, 10, 15, 20, 25

Pin	Analog Voltage Output **BTL6-A1__-**	Analog Current Output **BTL6-E1__-**	Wire Color
1	Signal Common (GND)	Signal Common (GND)	Yellow
2	Signal Common (GND)	Signal Common (GND)	Grey
3	Output Signal 10…0 V	Not used	Pink
4	Not used	Not used	Red
5	Output Signal 0…10 V	Signal Output 4...20 mA (BTL6-E100-...) Signal Output 20...4 mA (BTL6-E170-...)	Green
6	Supply GND	Supply GND	Blue
7	Supply Voltage +24 Vdc	Supply Voltage +24 Vdc	Brown
8	Not used	Not used	White

How to Order

BTL6-xxxx-Mxxxx-P-S115/PKx

Output Type/Operating Voltage

A110 = 0-10 V and 10-0 V output, +24 V ±20% Supply Voltage
E100 = 4-20 mA output, +24 V ±20% Supply Voltage
E170 = 20-4 mA output, +24 V ±20% Supply Voltage

Stroke Length, inches (mm)

2 (0051)	11 (0280)	26 (0661)	60 (1524)
3 (0077)	12 (0305)	28 (0711)	70 (1778)
4 (0102)	13 (0330)	30 (0762)	80 (2032)
5 (0127)	15 (0381)	32 (0813)	90 (2286)
6 (0152)	16 (0407)	36 (0914)	100 (2540)
7 (0178)	18 (0457)	40 (1016)	110 (2794)
8 (0203)	20 (0508)	42 (1067)	
9 (0230)	22 (0560)	48 (1220)	
10 (0254)	24 (0610)	50 (1270)	

Connector

S115 = 8-pin M12 Micro Connector (BKS-S115-PU-xx)

Magnet Type

PK3 = **BTL5-F-2814-1S** Captive Sliding Magnet included, **BTL-P-M5-VZ** Mounting Feet included
PK4 = **BTL5-P-3800-2** Floating Magnet included, **BTL-P-M5-VZ** Mounting Feet included

R Low-Profile Style

Ultra-low Profile

The low-profile “R” housing is designed to be mechanically compatible with legacy linear potentiometers. The centerline at the control rod is the same vertical location as the rod on many popular “pots.” However, the R style provides long-life, non-contact magnetostrictive technology that will outlast any wear-prone linear potentiometer.

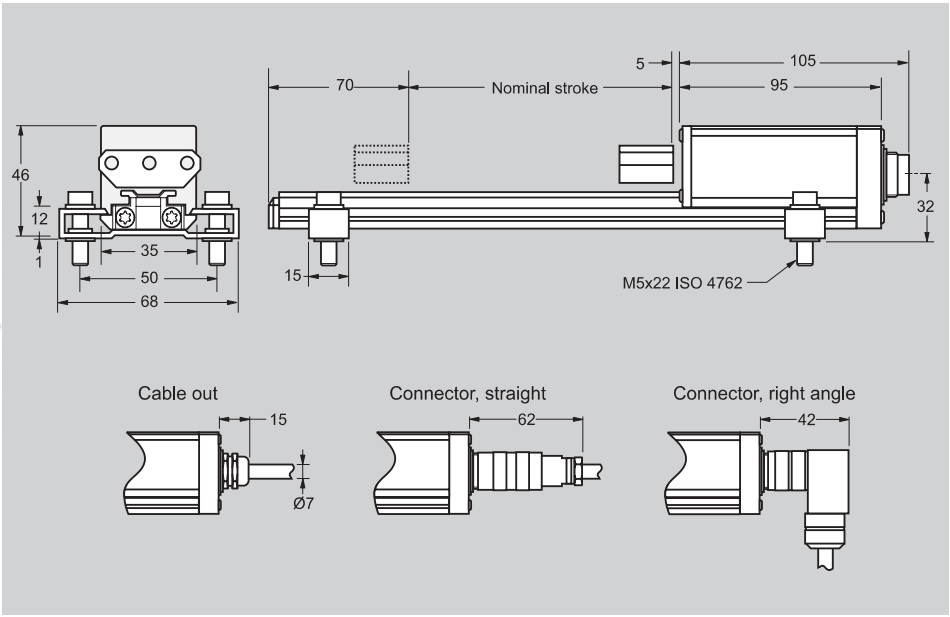
Features:

- Low profile for space critical applications
- Compatible with plunger type linear potentiometers
- Cable out or quick disconnect
- Stroke Length 2” – 142”
- Floating or captive magnet
- Outputs – Digital start/stop, Pulse Width Modulated PWM, Analog Voltage or Current
- IP 67
- Can sense floating magnet on top or bottom side

Applications:

- Pneumatic slides
- Plastic injection molding
- Stamping presses
- Transport systems
- Die casting
- Entertainment motion platforms
- Flight simulators
- Tool handling
- Packaging
- Conveying
- Measurement
- Semiconductor fabrication
- Test cells

Series	**R Style**
Available Lengths	51 mm (2 in) to 3734 mm (147 in)
Output Signals	Analog & Digital Pulse



Ordering Code	**BTL-5-_ _-M_ _ _-R-_ _ _ _** (See ordering code on page 90)
Measurement Type	Linear displacement
Measurement Range	51 mm (2 in) to 3734 mm (147 in)
Shock Rating	100 g/6 ms (100 g /2m s continuous) per IEC 68 2-27
Vibration Rating	12 g, 10 to 2000 Hz per IEC 68-2-6
Environmental Protection	IP 67 (with connector attached)
Housing Material	anodized aluminum
Operating Temperature	-40 to + 185° F
Storage Temperature	-40 to + 212° F
Humidity	< 90% non-condensing
Connection Type	connector or integral cable
Noise Immunity	ESD, RFI and BURST per IEC 1000-4-2/3/4/6, severity level 3 (4 for BURST)
Approvals	CE

Warning:
These products are not rated for personnel safety applications.

Accessories:
Magnets ..... pg 84-87
Connectors ..... pg 88

Autotuning Circuitry

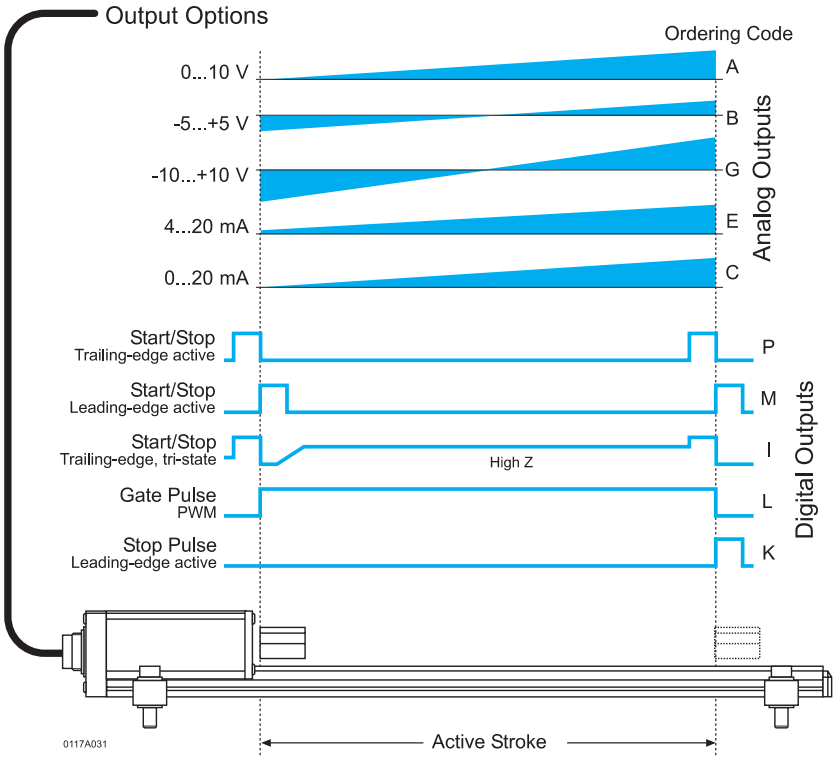
Patented Autotuning circuitry in Balluff Micropulse® transducers automatically compensates for changes in the strength of the magnetostrictive return signal.

- Automatically compensates for changes in temperature, providing a more stable signal over a wide temperature range.
- For Micropulse profile-style transducers using a floating magnet configuration, Autotuning ensures that the return signal remains stable, even if the distance from magnet to transducer varies.

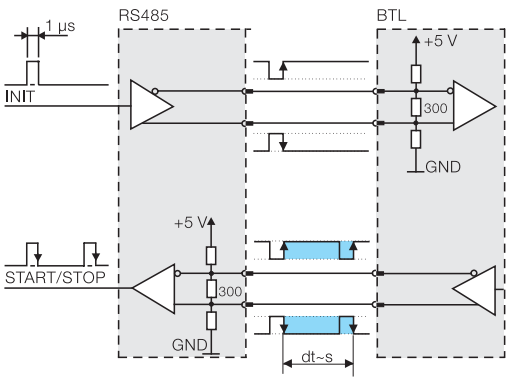
Electrical Interface	Analog	Analog	Digital
Electrical Type	Voltage	Current	Start/Stop & PWM
Part No. Code (See pg. 90)	**A, B, G**	**E,C**	**P, M, I, L, K**
Output	0...+10 V ,-5...+5 V ,-10...+10 V	4...20 mA, 0...20 mA	Start/Stop or Pulse-width-modulated (RS422/RS485)
Output Load	> 2 KΩ (5 mA max)	≤ 500 Ω	per spec
Resolution	≤ 0.1 mV	≤0.2 µA	Controller dependent
Non-linearity	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke	±100 µm to 500 mm stroke, ±0.02 % over 500 mm stroke
Repeatability	Resolution/ min 2 µm	Resolution/ min 2 µm	Resolution/ min 2 µm
Hysteresis	5 µm	5 µm	5 µm
Sampling Rate	1 kHz	1 kHz	1 kHz
Temperature Coefficient*	[150 µ V/° C + (5 ppm/°C*P*V/NL)] * ΔT	[0.6 µA/°C + (10 ppm/°C*P*V/NL)] * ΔT	(6 µm + 5 ppm*NL) / °C
Operating Voltage	24 Vdc ±20%	24 Vdc ±20%	24 Vdc ±20%
Operating Current	≤ 150 mA	≤ 150 mA	≤ 150 mA

Notes:
Analog voltage output versions incorporate both rising and falling outputs. Analog current version must be ordered as rising or falling ouputs.

***Temperature coefficient variables:**
V = output range in V
I = output range in [mA]
ΔT = temperature change
P = magnet position
NL = stroke length



Analog and Digital Output Options for the Micropulse R Style

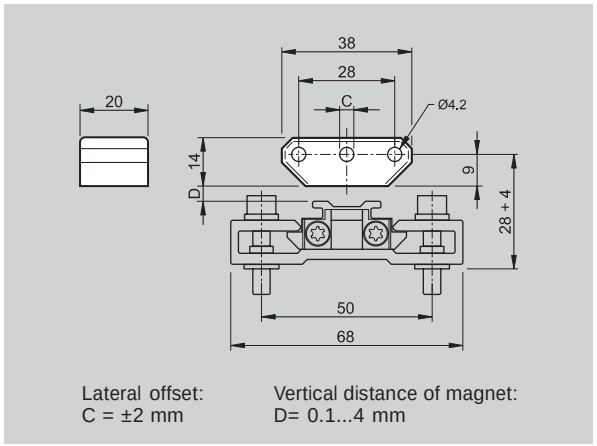


RS485 Transmission of digital signals

Balluff magnets are available in captive or floating styles. All BTL5 magnets shown here can be used on any Balluff Micropulse transducer. Maximum resolution and repeatability are achieved using BTL5-F/M/N-2814-1S captive magnets on page 86-87.

The BTL5-P-3800-2 magnet can be used with a vertical offset from the upper surface of the transducer body of 0...4 mm, and the BTL5-P-5500-2 permits a distance of 5...15 mm. The BTL5-P-4500-1 is an electromagnet and requires a supply voltage of 24 V, which can be turned on and off for selective activation. This allows multiplex operation with multiple magnets on a single transducer, since only one magnet is active at a time.

Description	Magnet
for Series	BTL Profile
Type	Standard, floating



Lateral offset: C = ±2 mm

Vertical distance of magnet: D= 0.1...4 mm

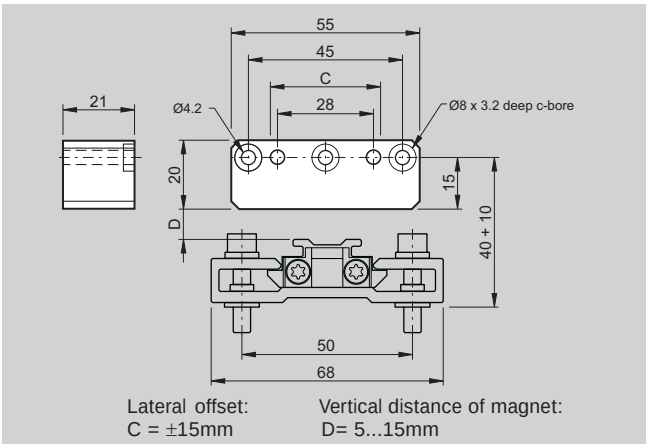
Ordering Code	**BTL5-P-3800-2**
Housing Material	Plastic
Weight	approx. 12 g
Magnet Traverse Speed	any
Supply Voltage	
Current Draw	
Operating Temperature/Storage Temperature	–40...+85 °C
Included	Magnet 2 mounting screws DIN 84 M4×35-A2 with washers and nuts
Accessories (please order separately)	

Each mounting foot includes 4 isolation washers and 2 mounting screws ordered separately.
Order part number:
BTL P-M5-VZ (sold in pairs)

Number of Mounting Feet (Recommended)

Transducer Stroke Length (mm)	Recomended Number of Feet
0051-0457	2
0508-0711	3
0762-0914	4
1016-1220	5
1270	6
1524	7
1778	8
2032	9
2286	10
2540	11
2794	12
3048	13
3302	14
3606	15
3734	16

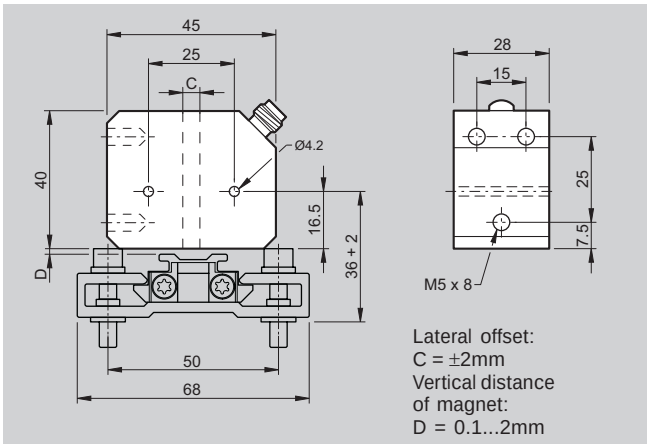
Magnet
BTL Profile
Extended range, floating



BTL5-P-5500-2

Plastic
approx. 40 g
any
–40...+85 °C
Magnet

Magnet
BTL Profile
Electro-magnet, floating

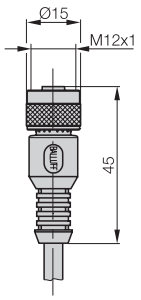


BTL5-P-4500-1

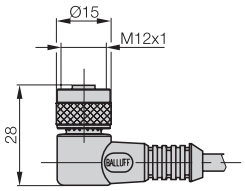
Plastic
approx. 90 g
any
24 Vdc
100 mA
–40...+60 °C
Magnet
Straight connector C04-AEC-00-VY-050M Right-angle connector C04-BEC-00-VY-050M

Non-contact! Vertical offset 0.1...4 mm or 5...15 mm

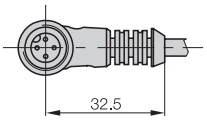
Please indicate cable length in ordering code:
03, 05, 10, 15 e.g. 050M = 5M



C04-AEC

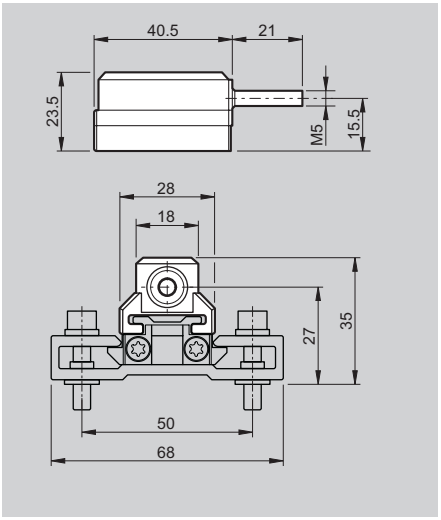


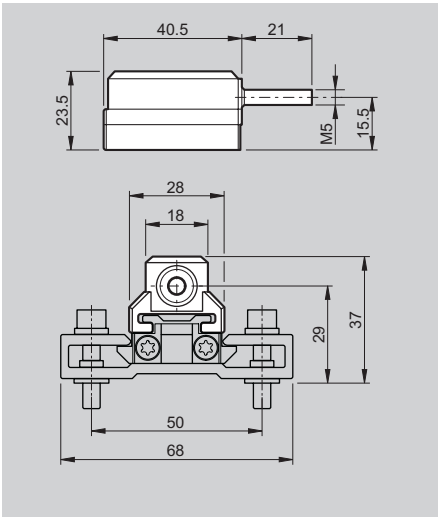
C04-BEC



Mating connector for electromagnet

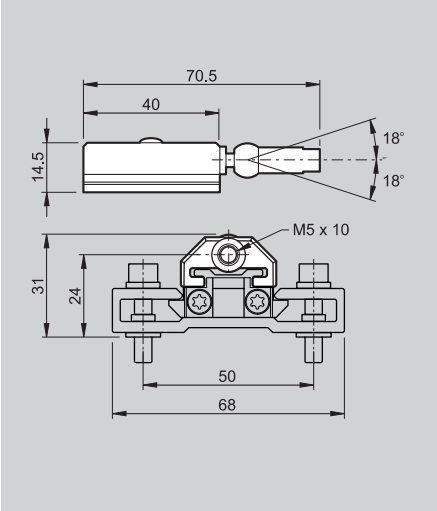
Description	Magnet	Magnet
for Series	BTL Profile	BTL Profile
Type	Captive	Captive

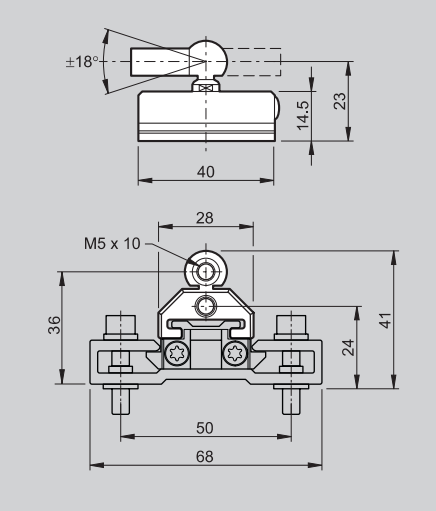




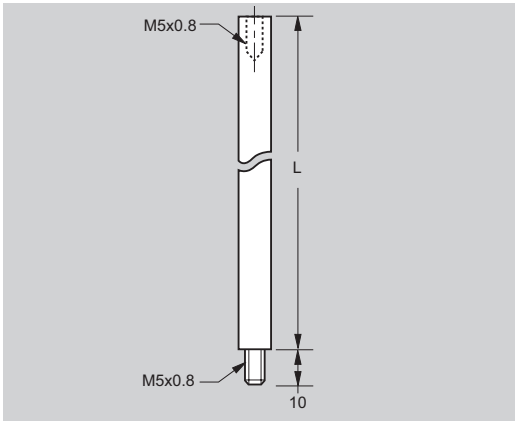
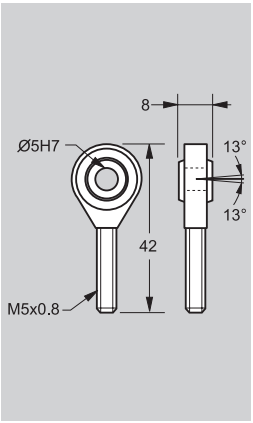
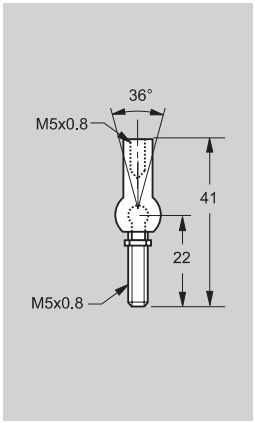
Ordering Code		**BTL5-M-2814-1S**	**BTL5-N-2814-1S**
Material	Housing	Anodized aluminum	Anodized aluminum
	Slide Surface	Plastic	Plastic
Weight		approx. 32 g	approx. 35 g
Magnet Traverse Speed		any	any
Operating Temperature/Storage Temperature		–40...+85 °C	–40...+85 °C

Description	Magnet	Magnet
for Series	R-style only	BTL Profile
Type	Captive	Captive

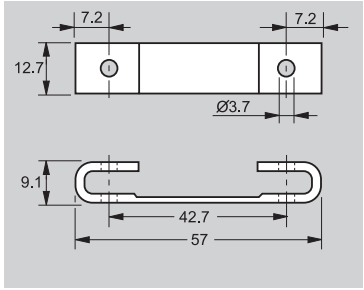
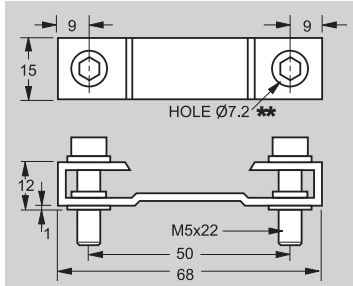




Ordering Code		**BTL5-R-2814-1S**	**BTL5-F-2814-1S**
Material	Housing	Plastic	Plastic
	Slide Surface	Plastic	Plastic
Weight		approx. 28 g/m	approx. 28 g
Magnet Traverse Speed		any	any
Operating Temperature/Storage Temperature		–40...+85 °C	–40...+85 °C

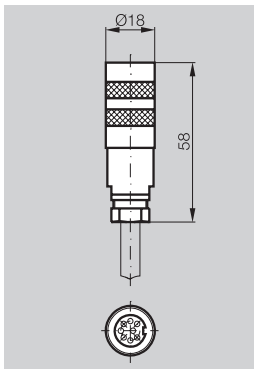
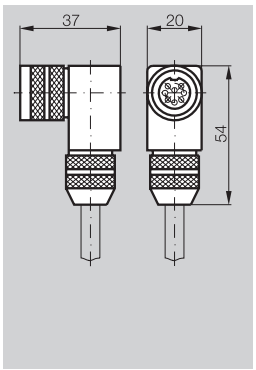
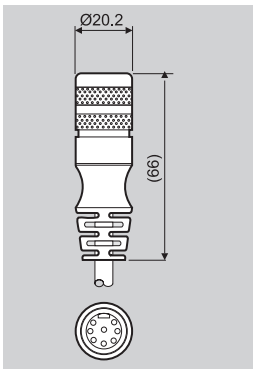
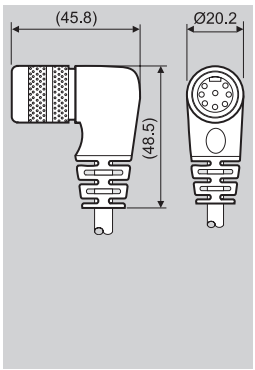
Product	Control Arm	Swivel Eye	Ball Joint
Compatibility	BTL5-F-2814-1S and BTL5-R-2814-1S	BTL5-GS08-	BTL5-GS08-
				
Ordering Code	**BTL Z-5-GS08-_ _*_ _-A**	**BTL5-SWIVEL-EYE**	**BTL5-A-BJ01**
Material	Aluminum	Aluminum/steel	Aluminum/steel
Weight	150 g/m	14 g	11 g

*Specify control arm length in mm e.g. BTL-5-GS08-0305-A

Product	Mounting feet	Mounting feet
Type	Narrow (optional)	Standard
			

**Each BTL P-M5-VZ Mounting Foot is supplied with 4 plastic isolation washers with an inner diameter of 5.1 mm. If the cable shield is connected at the electrical panel, these washers should be used to isolate the transducer body from the machine frame, thereby avoiding potential ground loops.

Ordering Code	**BTL5-FEET-NR** (one foot)	**BTL P-M5-VZ** (sold in pairs)
Material	Aluminum	Black Anodized Aluminum
Weight	6 g	12 g

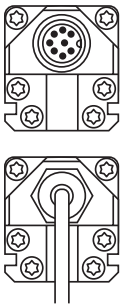
Product			Molded	Molded
Type	Straight Connector 8-pin female	Right-angle Connector 8-pin female	Straight Connector 8-pin female	Right-angle Connector 8-pin female
					
Ordering Code	**BKS-S 32M-_*_**	**BKS-S 33M-_*_**	**BKS-S 232-PU-_*_**	**BKS-S 233-PU-_*_**
Material	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated	CuZn, nickel plated
Contact Surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Solder Connection	00 option only	00 option only	N/A	N/A
Cable	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24	7 x 0.25 mm²/AWG 24
Cable Diameter	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm	6.35 mm ± 0.35 mm
Allowable Cable Diameter	6…8 mm	6…8 mm	N/A	N/A
Cable Material	PUR	PUR	PUR	PUR
Environmental Rating	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)	IP 67 (when installed)

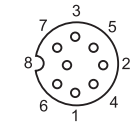
For additional connectors, see page 107-114

*Indicate cable length in ordering code (consult factory for longer lengths)
00 = connector only (only S32 and S33)
02 = 2 meter cable
05 = 5 meter cable

Analog Wiring Diagrams

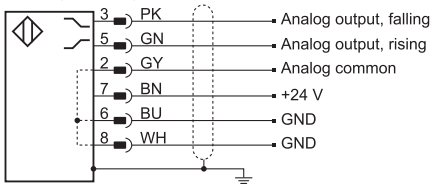
S32 Connector



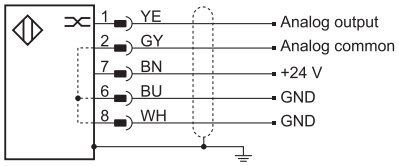


View of mating connector, wiring side

Analog Voltage
24 V (A, B, G)

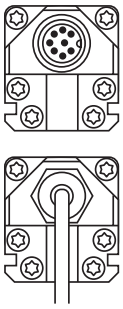


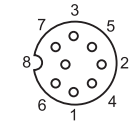
Analog Current
24 V (E, C)



Digital Wiring Diagram

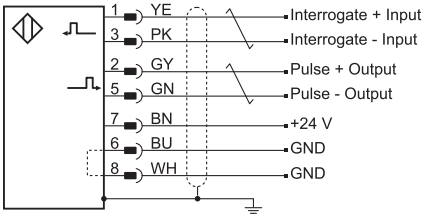
S32 Connector





View of mating connector, wiring side

Digital, RS485 differential
24 V (P, M, I, K, L, R)



Note: = twisted-pair

Ordering Code

B T L 5 - A 1 1 - M 0 3 0 5 - R - S 3 2
K A 0 5

Balluff - Linear Transducer

Generation 5

Output Type

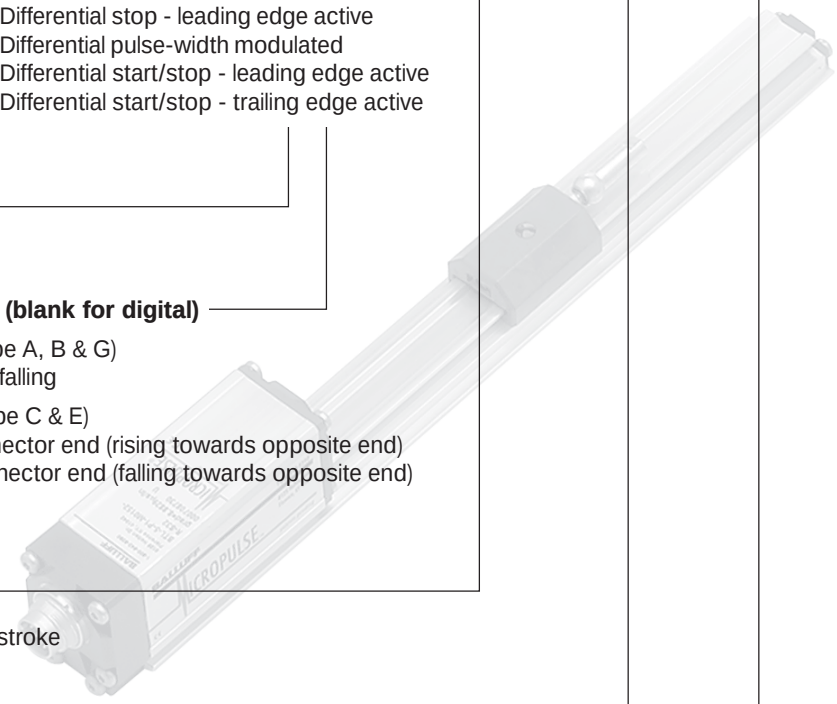
A = 0 to 10 Vdc	I = Differential start/stop with tri-state
B = -5 to +5 Vdc	K = Differential stop - leading edge active
C = 0 to 20 mA	L = Differential pulse-width modulated
E = 4 to 20 mA	M = Differential start/stop - leading edge active
G = 10 to +10 Vdc	P = Differential start/stop - trailing edge active

Supply Voltage
1 = 24 Vdc ±20%

Analog Output Operation (blank for digital)

Voltage output (Output type A, B & G)
1 = User selectable rising or falling

Current output (Output type C & E)
0 = Minimum output at connector end (rising towards opposite end)
7 = Maximum output at connector end (falling towards opposite end)



Nominal Stroke Length

0 3 0 5 = 305 mm active stroke

Housing Type
R = Low Profile Housing

Connection Type

S 3 2 = 8-pin quick disconnect metal connector (see page 88 for mating cables)
K A 0 5 = Cable out (5 m standard; specify length in meters)

Standard Stroke Lengths, Inches (mm) (consult factory for additional lengths)

2	(0051)	12	(0305)	30	(0762)	90	(2286)
3	(0077)	13	(0330)	32	(0813)	100	(2540)
4	(0102)	15	(0381)	36	(0914)	110	(2794)
5	(0127)	16	(0407)	40	(1016)	120	(3048)
6	(0152)	18	(0457)	42	(1067)	130	(3302)
7	(0178)	20	(0508)	48	(1220)	142	(3606)
8	(0203)	22	(0560)	50	(1270)	147	(3734)
9	(0230)	24	(0610)	60	(1524)		
10	(0254)	26	(0661)	70	(1778)		
11	(0280)	28	(0711)	80	(2032)		

Micropulse AT

Magnetostrictive Technology at a Potentiometer Price

Wear-Free

Inexpensive

Easy to Order

Easy to Hook Up

Accurate Linear Position Measurement

The Micropulse® AT is a superior alternative to traditional low-cost linear feedback devices such as linear potentiometers (pots). Balluff designed the Micropulse AT in a modular fashion to simplify manufacturing and reduce component costs to be competitive with these devices.

The main advantage of the Micropulse AT is the non-contact, wear-free magnetostrictive sensing principle. Linear potentiometers, by contrast, are electro-mechanical devices that utilize a moving wiper contact riding along a resistive element. Both the wiper contact and the resistive element are subject to wear from repeated operation and continuous machine vibration. Abrasive contaminants are able to enter the potentiometer housing through the mechanical seals, further accelerating wear – leading to erratic position signals.

With no moving parts, the Micropulse AT is impervious to environmental contamination such as dust and grit. It is also shock and vibration rated for use in demanding industrial applications. The convenient M12 connector assures easy installation and quick replacement without the need to remove and reinstall hardwired cabling.

The round housing of the Micropulse AT allows the unit to be rotated to sense the position magnet in multiple directions, enhancing installation flexibility. The position magnet is a floating design, meaning no mechanical linkage is required, saving cost and reducing installation complexity. Linkage is eliminated as a source of backlash error. No mechanical linkage also eliminates over-stroking as a potential source of sensor breakage and production downtime.

Advantages

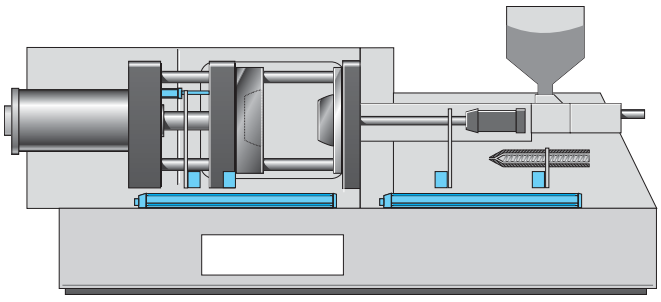
- Non-contact, wear-free, unlimited cycles
- No mechanical linkage required; saves space
- Correct position reading on power-up without re-homing
- Precise position indication
- Universal controller compatibility
- High noise immunity

Features

- Magnetostrictive sensing principle
- Floating target magnet
- Absolute position output
- Resolution 10 microns
- 0-10 V analog output
- Start/stop digital output

ATvantage

Micropulse ATvantage offers two-magnet operation with two analog outputs that are user-programmable for stroke length and rising 0-10 V or falling 10-0 V signals. The second output can also be user-configured for differential mode to output a 0-10 V signal that is proportional to the difference in position between Magnet A and Magnet B.



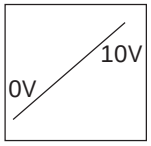
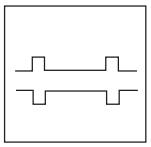
Micropulse AT – ideal for use in injection molding machines

Micropulse AT Ordering Code - Quick Reference

BTL6-_ _ _ _-M_ _ _ _-A1-S115

Output Code — **Stroke Length in Millimeters**

Micropulse AT Output Types - Refer to following pages for detailed specifications

Diagram	Output	Signal	Features	Resolution	Stroke*	Output Code
	Analog	0...10 V, 10...0 V	- Rising & falling signals included	< 10 µm	51...1524 mm (2...60")	**A110**
	Adjustable Analog ATvantage	0...10 V, 10...0 V	- Adjustable stroke - Two independent outputs - Use with one or two magnets - Rising & falling signals included - 2nd magnet differential mode - Setup LED	< 10 µm	50...1500 mm	**A301**
	Digital	Start/Stop Pulse	- Leading & trailing edge active	< 10 µm	51...2540 mm (2...100")	**P110**
	Smart Digital DPI/IP	Start/Stop Pulse	- DPI/IP Data Exchange protocol (allows "plug and play")† - Leading & trailing edge active	< 10 µm	51...2540 mm (2...100")	**P111**

* see following pages for standard stroke lengths
† with compatible controller, e.g. Sigmatek

Position Magnets

BTL6-A-3801-2 Standard magnet
BTL6-A-3800-2 Optional magnet for legacy applications

Pg. 100

Mounting Feet

BTL6-A-MF03-K-50 Standard plastic mounting foot
BTL6-A-MF01-A-50 Aluminum mounting foot, 50 mm bolt spacing
BTL6-A-MF01-A-43 Aluminum mounting foot, 43 mm bolt spacing

Pg. 100

Connector Cables

BKS-S115-PU-02 Standard connector cable, 2-meter, straight
BKS-S116-PU-02 Standard connector cable, 2-meter, right angle
BKS-S115-PU-___ Connector cable, straight, available lengths 05, 10, 20, 25 meters
BKS-S116-PU-___ Connector cable, right angle, available lengths 05, 10, 15, 20, 25 meters

Pg. 101

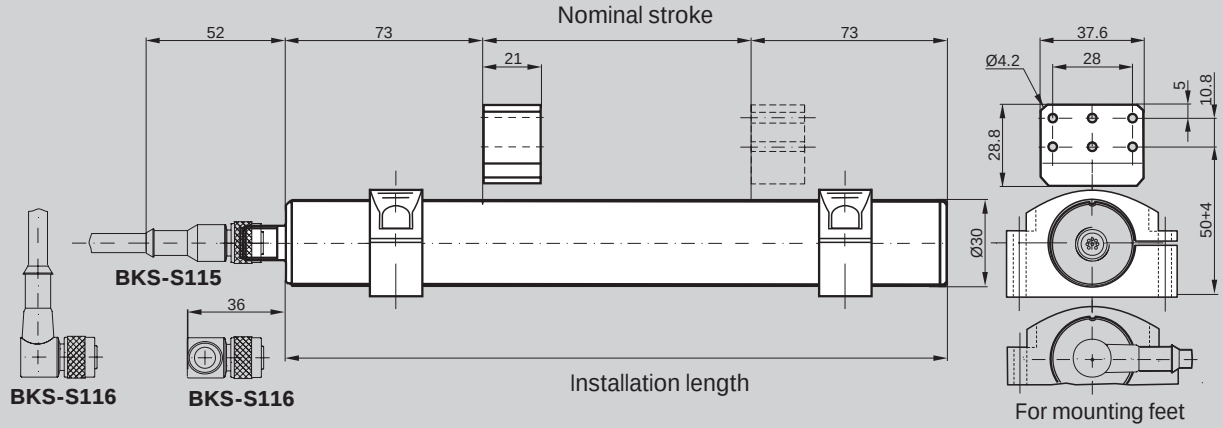
Economical Digital Displays

BDD UM-3023 Analog voltage input
BDD 100 Digital start/stop pulse input
BDD 640 Analog voltage/current input

Pg. 118-119

Series	**BTL6 Profile A1**

Transducer with floating magnet, S115 connection with BKS-S115/BKS-S116 connector for transducers with analog interface and digital pulse interface



For mounting feet dimensions, see pg. 100

Ordering Code	**BTL6-_ _ _ _-M_ _ _ _-A1-S115**
Shock Load	50 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	yes
Enclosure Rating per IEC 60529	IP 67 (with BKS-S... IP 67 connector attached)
Housing Material	Anodized aluminum
Housing Attachment	Mounting clamps
Connection Type	Connector M12, 8-pin standard
EMC Testing:	
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
Fast Transients (BURST)	IEC 61000-4-4 Severity Level 3
Line-carried Noise,	IEC 61000-4-6 Severity Level 3
Induced by High-frequency Fields	IEC 61000-4-8 Severity Level 4

Included:
– Transducer
– User's guide

Please order separately:
Magnets ..... pg 100
Mounting clamps/cuff ... pg 100
Connectors ..... pg 101

P110-Interface

Compatible with various OEM controls, e.g., Siemens, Schleicher, B & R, Bosch, Mitsubishi, Schiele, Parker, Esitron, WAGO, etc.

Reliable signal transmission, even over cable lengths up to 500 m between BTL and controller, is assured by the especially noise-immune RS422 differential drivers and receivers. Noise signals are effectively suppressed.

P110 Rising/Falling in a Single Interface

Based on differing philosophies, two controller-specific interfaces have been established for the digital pulse versions. The difference lies in how the edges are processed.

In the "P" interface the falling edges and in the "M" interface the rising edges are processed.

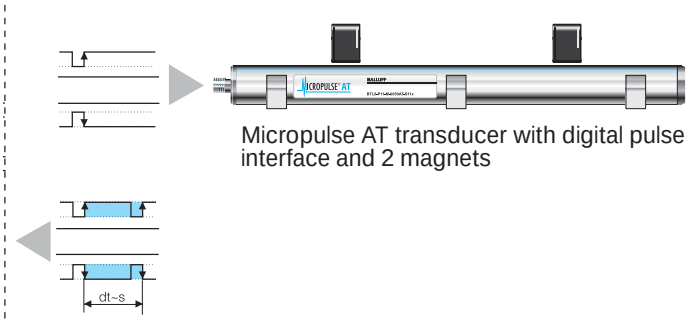
To reduce the amount of part numbers, the "P110 interface" has been developed which combines both functions.

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

P111 Interface
Cost savings using DPI/IP for start-up and installation

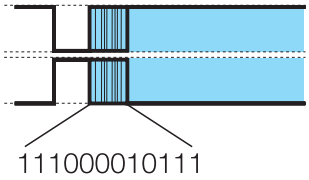
DPI/IP is a protocol for direct data interchange between a controller and transducer. The signal lines are used to send additional information such as manufacturer, stroke length and waveguide gradient. This allows start-up or replacement of a transducer without having to make manual changes in the controller parameters.

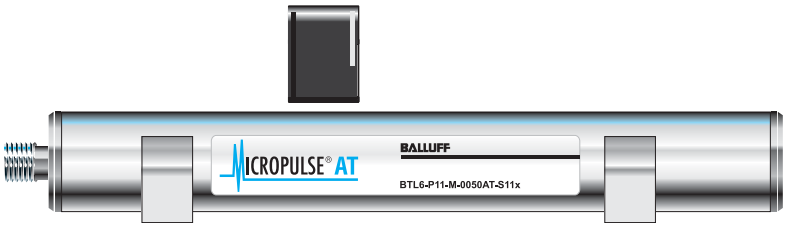
With the P110 start/stop digital output, both the rising and the falling edges of the signal are precisely controlled, allowing the flexibility to match the controller interface requirements with a single part number.



Micropulse AT transducer with digital pulse interface and 2 magnets

P pulse signal





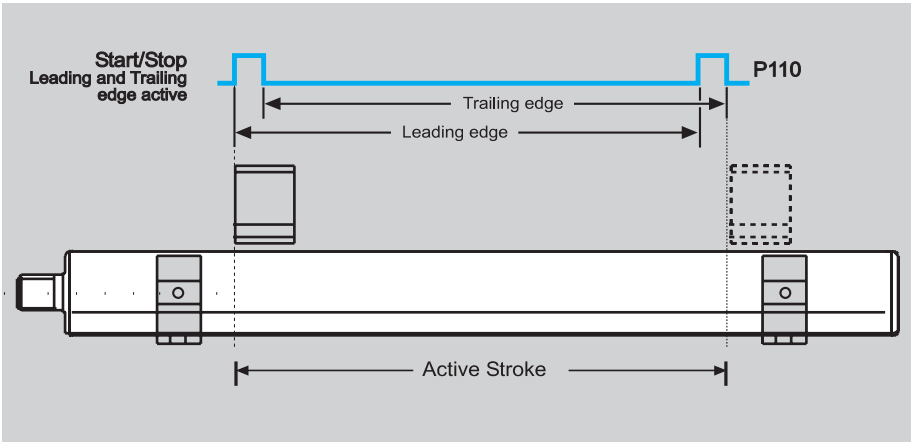
Features

- Bi-directional communication
- Transducer controlled using INIT and START/STOP signals
- Integrated diagnostic functions
- Plug and Play
- Automatic parameterizing reduces downtimes
- Sending of sensor model, stroke length, specific parameters

Benefits

- High resolution
- Position data from 2 magnets can be processed simultaneously
- 4/8-bit processor interface

Series	**BTL6 Profile A1**
Part No. Code (see below)	**P**
Transducer Interface	Digital ST/SP Pulse



Ordering Code	**BTL6-P110-M_ _ _ _-A1-S115**
System Resolution	processing-dependent
Repeatability	≤ 10 µm
Repeat Accuracy	≤ 20 µm
Resolution	≤ 10 µm
Non-linearity	≤ ±200 µm up to 500 mm nominal stroke
	typ. ±0.02 %, max. ±0.04 % 508...2540 mm nominal stroke
Supply Voltage	20...28 Vdc
Current Draw	≤ 60 mA (at 1 kHz)
Operating Temperature	0 to +158 °F
Storage Temperature	–40 to +212 °F

Pin Assignments		Pin	Color	BTL6-P11_-M...
In-/Output Signals	Input	1	YE	INIT
	Output	2	GY	START/STOP
	Input	3	PK	INIT
		4	RD	Not used—No connection
	Output	5	GN	START/STOP
Supply Voltage		6	BU	GND
		7	BN	+24 Vdc
		8	WH	Not used—No connection

Connect shield to housing,
pins 4 and 8 must remain unconnected.

Please enter length for nominal stroke in ordering code.

Included:
– Transducer
– User's guide

Please order separately:
Magnets ..... pg 100
Mounting clamps/cuff ..... pg 100
Connectors ..... pg 101

Ordering example:

BTL6-P11_-M_ _ _ _-A1-S115

Data Protocol

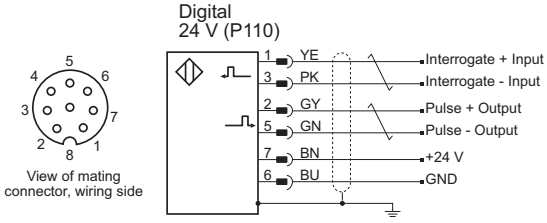
0 without DPI/IP (Standard)

1 with DPI/IP

Metric to Inch Conversion: inches = mm/25.4

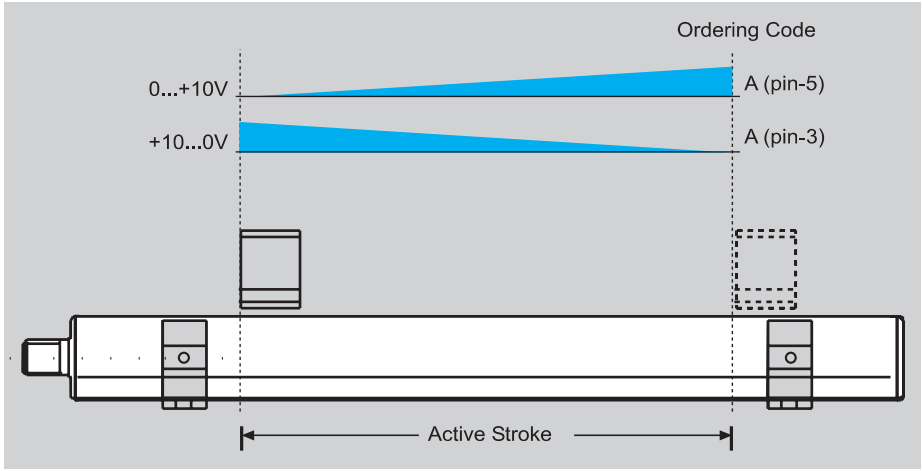
Standard nominal strokes [mm]

0051, 0077, 0102, 0127, 0152, 0178, 0203, 0230, 0254, 0280, 0305, 0330, 0381, 0407, 0457, 0508, 0533, 0560, 0610, 0661, 0711, 0762, 0813, 0914, 1016, 1067, 1220, 1270, 1372, 1524, 1778, 2032, 2286, 2540



Pins 4 and 8 must remain unconnected

Series	**BTL6 Profile A1**
Output Signal	Analog Voltage
Transducer Interface	**A**



Ordering Code	**BTL6-A110-M_ _ _ _-A1-S115**
Output Voltage	0...10 V and 10...0 V
Load Current	max. 5 mA
max. Ripple	≤ 5 mV
System Resolution	≤ 10 µm
Repeatability	≤ 10 µm
Repeat Accuracy	≤ 20 µm
Sampling Rate	STANDARD = 1 kHz
Non-linearity	≤ ±200 µm to 500 mm nominal stroke typ. ±0.02 %, max. ±0.04 % 508...1524 mm nominal stroke
Supply Voltage	20...28 Vdc
Current Draw	≤ 70 mA
Polarity Reversal Protected	yes
Operating Temperature	0 to +158 °F
Storage Temperature	–40 to +212 °F

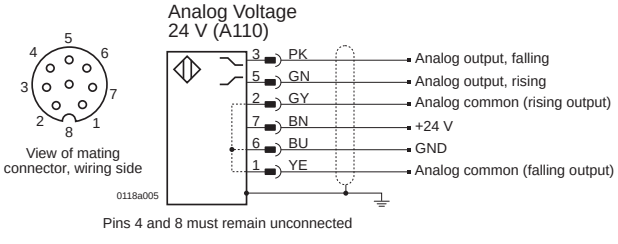
Pin Assignments	Pin	Color	BTL6-A110...
Output Signals	1	YE	Analog common (falling)
	2	GY	Analog common (rising)
	3	PK	10...0 V output
	4	RD	Not used—No connection
	5	GN	0...10 V output
Supply Voltage	6	BU	GND
	7	BN	+24 Vdc
	8	WH	Not used—No connection

Connect shield to housing,
pins 4 and 8 must remain unconnected.

Please enter length for nominal stroke in ordering code.

Included:
– Transducer
– User's guide

Please order separately:
Magnets ..... pg 100
Mounting clamps/cuff ..... pg 100
Connectors ..... pg 101



Pins 4 and 8 must remain unconnected

Ordering example:
BTL6-A110-M_ _ _ _-A1-S115

Standard nominal strokes [mm]

Metric to Inch Conversion: inches = mm/25.4

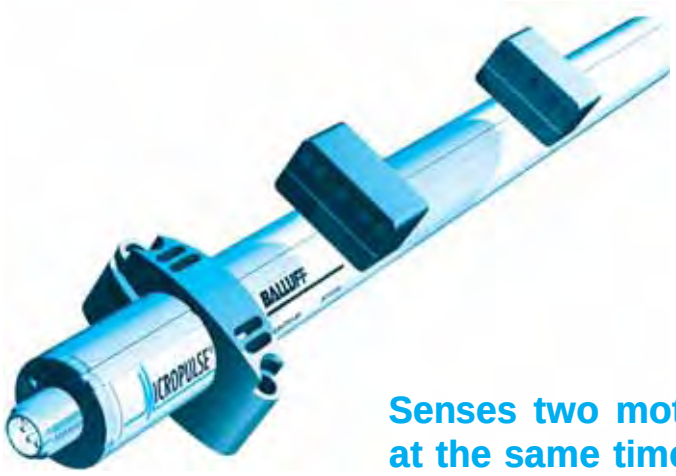
0102, 0127, 0152, 0178, 0203, 0230, 0254, 0280, 0305, 0330, 0381, 0407, 0457, 0508, 0533, 0560, 0610, 0661, 0711, 0762, 0813, 0914, 1016, 1067, 1220, 1270, 1372, 1524

ATvantage

Advanced, multi-function tracking capability in one transducer

The Balluff Micropulse® ATvantage starts with all the advantages of the Micropulse AT, and adds two-magnet operation to detect two independent machine motions or speeds at the same time in the same installation. The added ability to track single stroke/dual motion machine functions (such as clamp/eject on a plastic injection molding machine) allows a single transducer to perform the same function as two separate transducers.

- 100% adjustable analog signal
- LED indicator for programming assistance
- Separate teach-in for all zero and span points
- Selectable dual position or single position plus differential measurement modes



Senses two motions at the same time!

100% Field-Scalable

Track two motions with one system

- The ATvantage senses two motions at the same time
- Two magnets provide two user programmable analog outputs for stroke length and rising 0-10 V or falling 10-0 V signals – set your zero and span points anywhere between
- Significant cost reduction with one transducer taking the place of two

Higher performance, longer life, lower cost

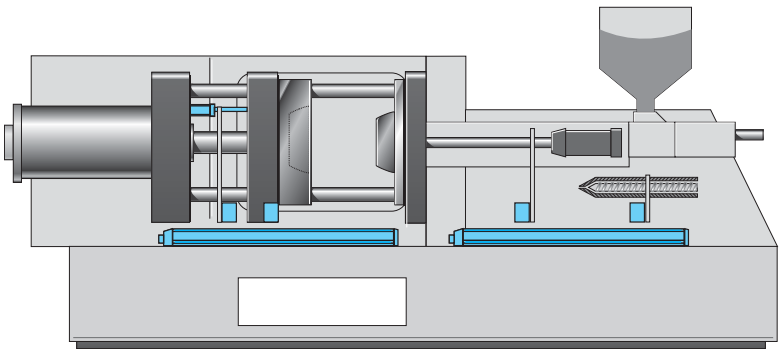
- With no moving parts, the Micropulse AT's non-contact magnetostrictive sensing technology is far superior to wear prone electro-mechanical contact designs such as potentiometers
- Impervious to dust, grit, shock, and vibration and rated for use in a wide variety of industrial applications

From optional to standard: an industry example

Micropulse transducers have long been standard in the plastics machinery industry on high-precision machines and offered on standard machines as a non-contact option to potentiometric systems.

The Micropulse AT and ATvantage have been designed in cooperation with development engineers from the plastics machinery industry. The AT family is competitively priced and meets all the technical demands of the industry.

With the introduction of Micropulse AT transducers, downtimes can be reduced to a minimum – not just on high-end specialty machines, but on standard production models as well.



Micropulse AT and ATvantage – ideal for use in injection molding machines

Using the ATvantage

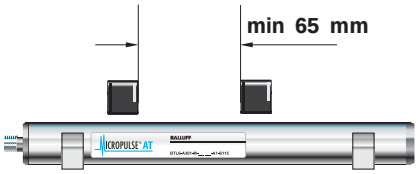
Two moving members on a machine often travel in the same direction. Each axis normally requires a separate feedback sensor.

With the Micropulse AT you can now sense both movements at the same time with just one transducer having two analog outputs.

The position of the respective null and end points can be set individually using two programmable inputs.

The two ranges may be adjacent, may overlap, and can be programmed for a rising or falling output signal. The transducer can be operated using one or two magnets.

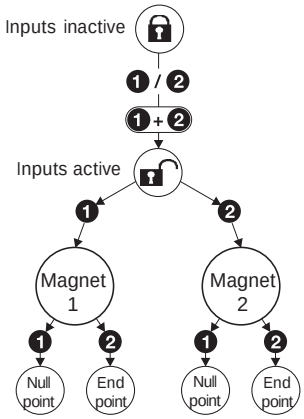
If one magnet leaves the programmed range or if only one is present, the position is indicated on Output 1. Output 2 then indicates an error value.



The separation between two magnets should not be less than 65 mm.

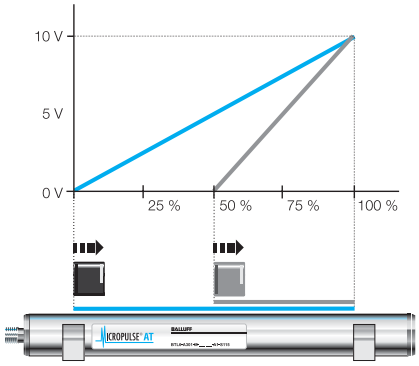
Teach-in

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.

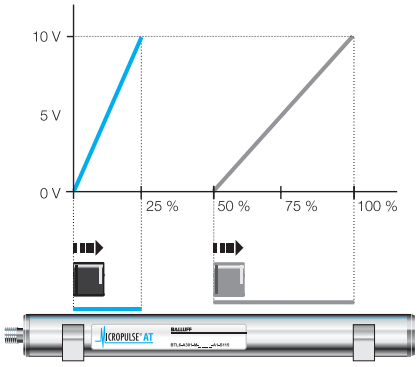


Example: Programming steps for setting the measurement range

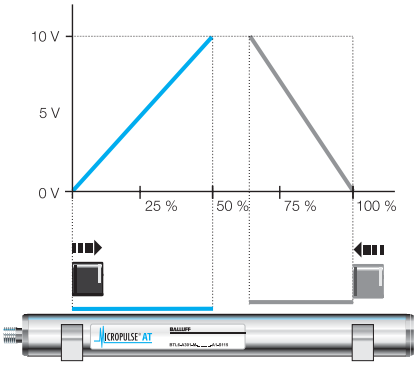
Mode for individual feedback from 2 positions



Basic default setting

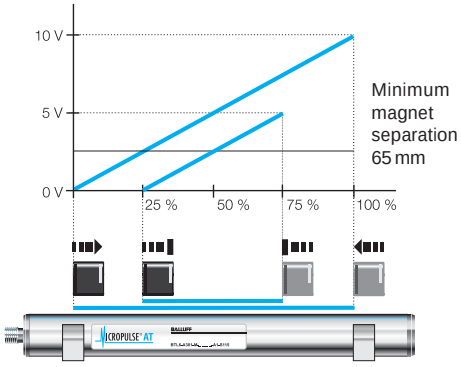


Programming example:
Output 1: 25 % nominal stroke, signal rising
Output 2: 50 % nominal stroke, signal rising

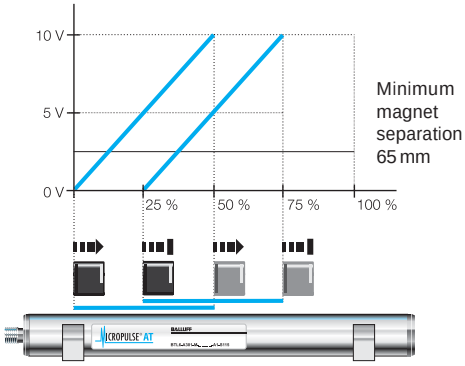


Programming example:
Output 1: 50 % nominal stroke, signal rising
Output 2: 37.5 % nominal stroke, signal falling

Mode for differential measurement between 2 magnets



Default setting: Differential measurement
Output 1: Standard travel signal (not shown)
Output 2: differential signal 100 % nominal stroke = 10 V
Programming example:
Differential travel 50 % nominal stroke = 5 V differential signal



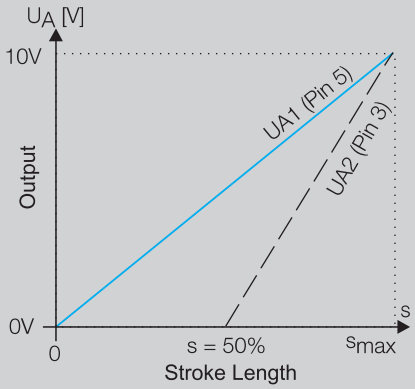
Programming example:
Differential travel 50 % nominal stroke = 10 V differential signal

Mode selection

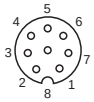
The standard function is separate measurement of two positions.

The programming inputs are used to switch over to differential mode.

Series	**BTL6 Profile A1**
Output Signal	Analog Voltage, Programmable
Transducer Interface	**A**



Ordering Code	**BTL6-A301-M____-A1-S115**
Output Voltage (U_A)	**0...10 V programmable**
Load Current	max. 5 mA
Max. Ripple	≤ 5 mV
System Resolution	≤ 10 µm
Repeatability	≤ 10 µm
Repeat Accuracy	≤ 20 µm
Sampling Rate	fSTANDARD = 1 kHz (< 850 mm)
Non-linearity	≤ ±200 µm to 500 mm nominal stroke typ. ±0.02 %, max. ±0.04 % 500...1500 mm nominal stroke
Supply Voltage	18...30 Vdc
Current Draw	≤ 100 mA
Polarity Reversal Protected	yes
Operating Temperature	0 to +158 °F
Storage Temperature	–40 to +212 °F

Pin Assignments	Pin	Color*	BTL6-**A301**...
Output Signals	1	YE	Programming input (a)
	2	GY	Analog common
	3	PK	Output 2, 0-10 V programmable
	4	RD	Programming input (b)
	5	GN	Output 1, 0-10 V programmable
Supply Voltage	6	BU	Supply GND
	7	BN	+24 Vdc supply
	8	WH	Not used — Do not connect

Connect shield to housing,
Pin 8 (WH) must remain unconnected.
*Connector BKS-S115/BKS-S116

Please enter code for nominal stroke in ordering code

Included:
– Transducer
– User's guide

Please order separately:
Magnets ..... pg 100
Mounting clamps/cuff ..... pg 100
Connectors ..... pg 101

Ordering example:

BTL6-A301-M_ _ _ _-A1-S115

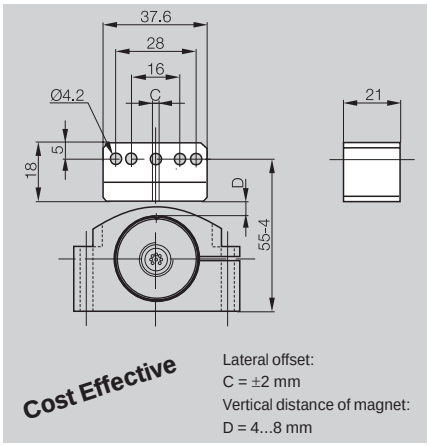
Output signal

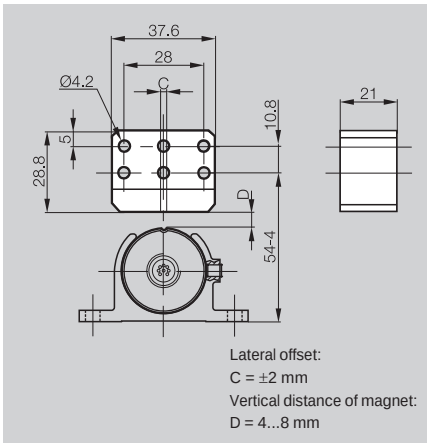
2 analog outputs
Single or differential-measurement, rising, falling, zero and end point programmable

Standard nominal strokes [mm]

0050, 0100, 0130, 0150, 0175, 0200, 0225, 0250, 0300, 0350, 0360, 0400, 0450, 0500, 0550, 0600, 0650, 0700, 0750, 0800, 0900, 0950, 1000, 1100, 1200, 1250, 1300, 1400, 1500, on request in 25 mm increments for high quantities only

Description	**Magnet**	**Magnet**
Series	BTL6 Profile A1	BTL6 Profile A1





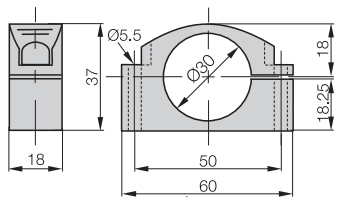
Ordering Code	**BTL6-A-3801-2**	**BTL6-A-3800-2**
Housing Material	Plastic	Plastic
Weight	ca. 25 g	ca. 30 g
Magnet Traverse Speed	any	any
Operating Temperature/Storage Temperature	–40...+85 °C	–40...+85 °C
Included	Magnet	Magnet

The BTL6-A-3800-2 magnet can be operated at a distance of 4...8 mm from the top surface of the profile housing.

Together with mounting clamps BTL6-A-MF01-A-50 or mounting cuff BTL6-A-MF03-K-50 the mechanical installation is compatible to series BTL5-...-P-S 32 with magnets BTL5-P-3800-2 or BTL5-P-5500-2 on page 71-72.

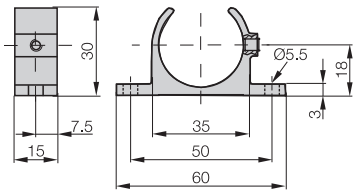
This means that both families of transducers can be interchanged without making any mechanical modifications.

Mounting clamps/cuff

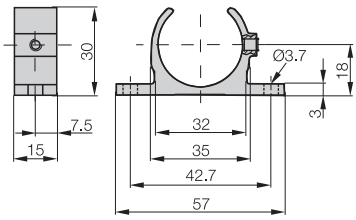


Cost Effective

Mounting cuff
Ordering code: **BTL6-A-MF03-K-50**
Includes: 1 cuff



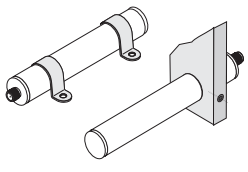
Mounting clamp
Ordering code: **BTL6-A-MF01-A-50**
Includes: 1 clamp



Mounting clamp
Ordering code: **BTL6-A-MF01-A-43**
Includes: 1 clamp

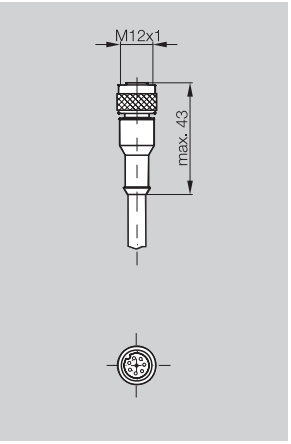
When extreme shock and vibration are present, we recommend spacing mounting clamps every 250 mm.

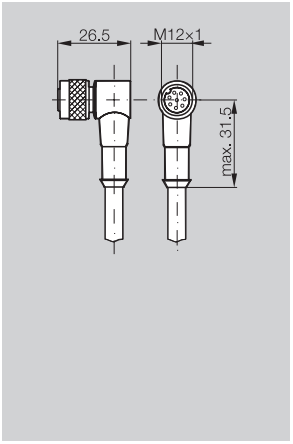
Length (stroke length)	No. of mounting clamps/cuffs
up to 250 mm	2
251 to 500 mm	3
501 to 750 mm	4
751 to 1000 mm	5
1001 to 1250 mm	6
1251 to 1500 mm	7

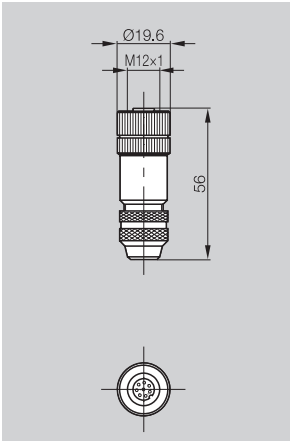


Custom mounting options

Connectors	**BKS-S115-PU-_ _**	**BKS-S116-PU-_ _**	**BKS-S115-00**
for Series	BTL6-_ _ _-S115	BTL6-_ _ _-S115	BTL6-_ _ _-S115
Type	8-pin, Straight, female	8-pin, Right angle, female	8-pin, female

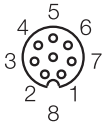


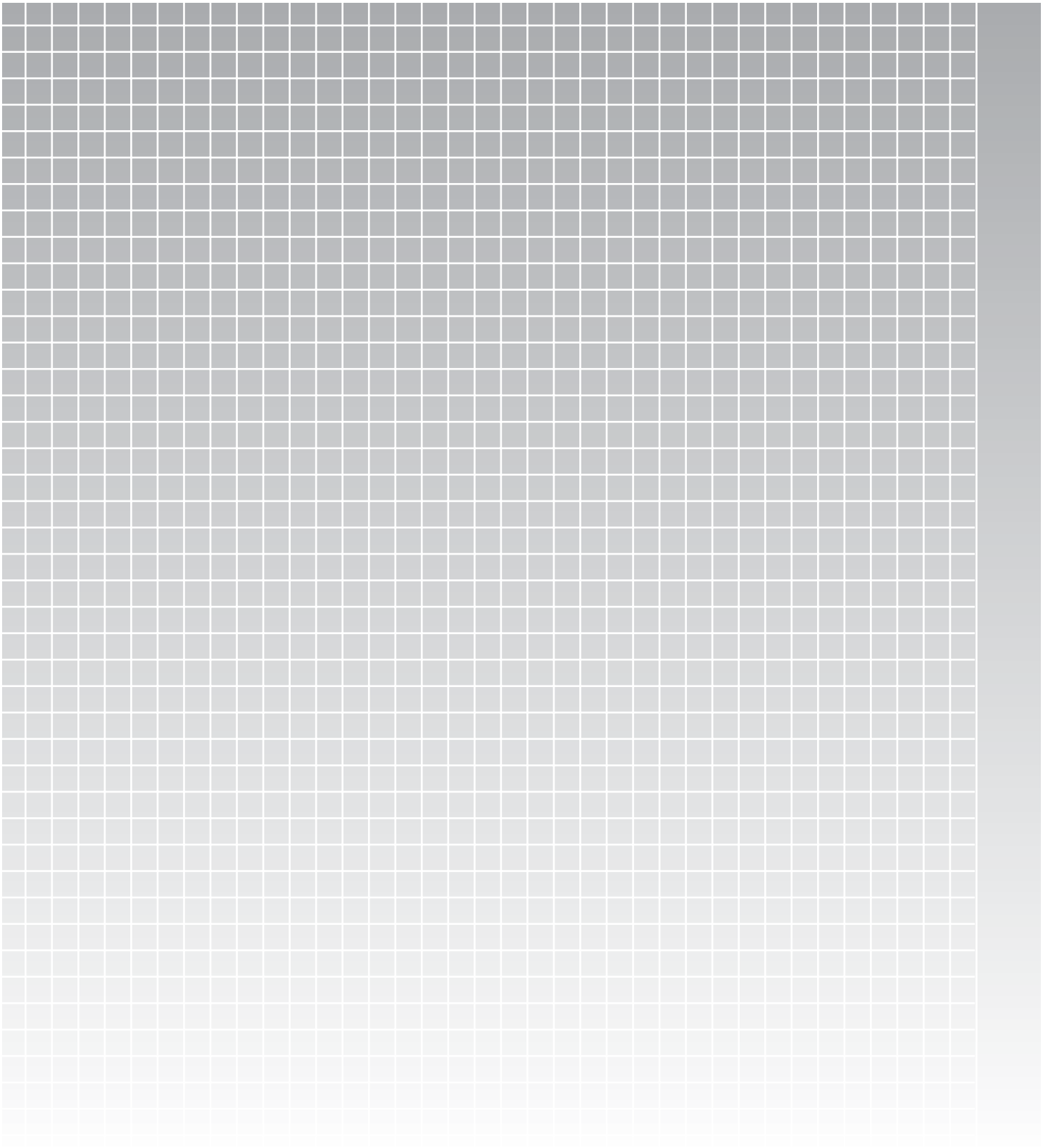




Ordering Code	**BKS-S115-PU-__**	**BKS-S116-PU-__**	**BKS-S115-00**
Screw Terminal			max. 0.75 mm²
Housing Material	PUR	PUR	CuZn nickel plated
Contacts	CuZn	CuZn	CuZn
Contact Finish	0.8 µm Au	0.8 µm Au	
Cable Strain Relief			PG 9
Accepts Cable Diameter			6...8 mm
Enclosure Rating per IEC 60529	IP 67	IP 67	IP 67 (when attached)
Knurled Coupling Ring	CuZn	CuZn	
Finish	2.5 µm Ni	2.5 µm Ni	
O-ring	Viton	Viton	Viton
Cable	Molded-on PUR		
No. of Wires × Conductor Cross Section	8 × 0.25 mm² + braided shield		
Type	LIYY-CF11Y		
Conductor Configuration	14 × 0,15 mm		
Outer Diameter	6,6 ±0,2 mm		
Min. Bending Radius	dynamic 4 × D, static 3 × D		

Please indicate cable length
in ordering code
02 = Length 2 m; 05 = Length 5 m;
10 = Length10 m; 15 = Length 15 m;
20 = Length 20 m; 25 = Length 25 m

Pin assignments	Pin	Color
	1	YE
	2	GY
	3	PK
	4	RD
	5	GN
	6	BU
View of	7	BN
female	8	WH



Micropulse BIW

Non-Contact Performance, Standard Form Factor, Linear Potentiometer Price

The Micropulse BIW uses patented pulsed-inductive measurement technology to provide 0-10 Vdc or 4-20 mA position feedback in a form factor identical to many wear-prone resistive linear potentiometers. Unlike linear potentiometers, the BIW's non-contact technology assures years of trouble free operation.

Features:

- Plunger-style form factor provides for drop-in replacement of linear potentiometers
- Non-Contact Sensing Technology
- No External Electronics
- Analog Outputs:
  - 0-10 Vdc / 10-0 Vdc
  - 4-20mA / 20-4 mA

Applications:

The Micropulse BIW is ideal for applications such as:

- Plastic injection molding machinery
- Packaging machinery
- Hydraulic and pneumatic motion bases / flight simulators

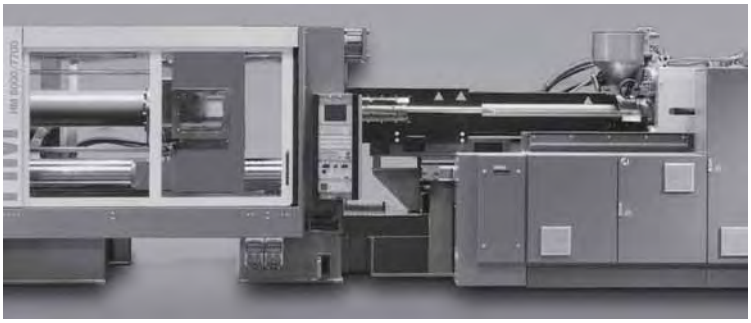
Principle of Operation

The BIW inductive linear position transducer is based on a new, patented principle of operation which detects the measured position without contact.

The BIW transducer contains a sender/ receiver element and an oscillator protected by an extruded aluminum housing.

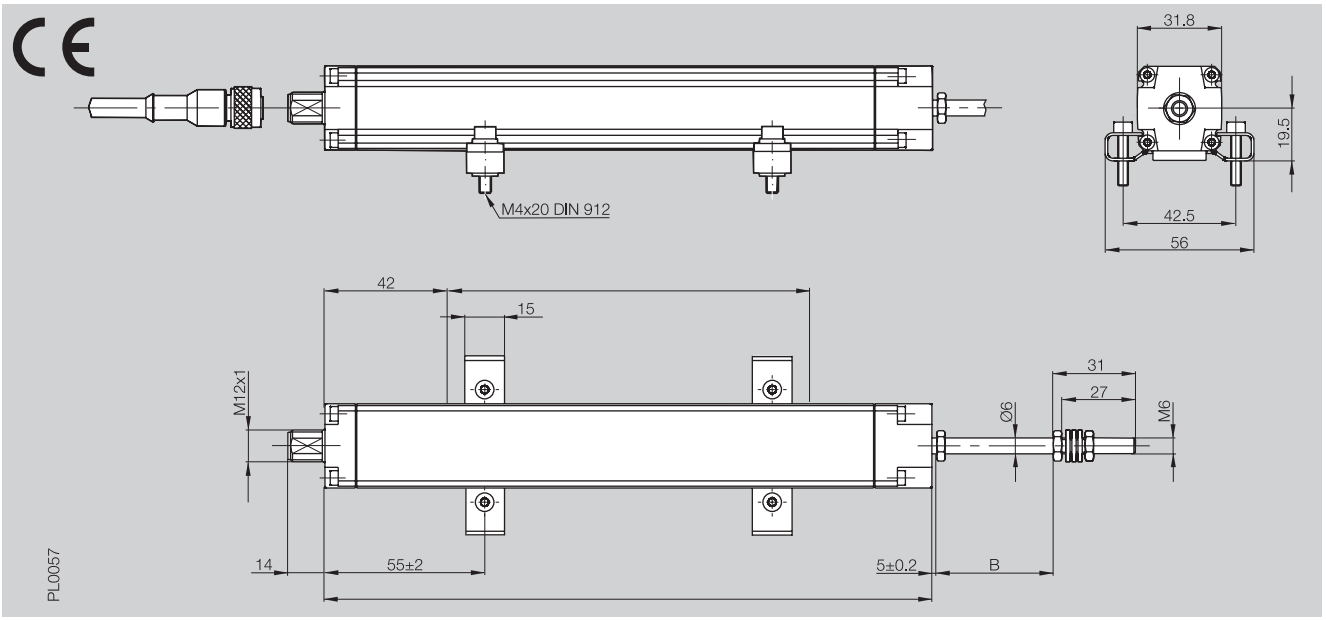
The oscillator is attached to a sliding rod which is in turn attached to the moving member of the machine or equipment. The oscillator is excited by the sender component at a sampling rate of 32 kHz and couples the current position signal into the receiver element. The position is immediately available on the output as an absolute analog value.

The direction of the output signal – rising or falling – can be determined by how the output slope connections are made.



General Specifications .. pg 104
Accessories ..... pg 105

Series	**BIW**	**BIW**
Output Signal	Analog Voltage	Analog Current
Transducer Interface	**A/G**	**C/E**



Ordering Code	**BIW1-A/G310-M_ _ _ _-P1-S115**	**BIW1-C/E310-M_ _ _ _-P1-S115**
Output	0...+10 V (order code A) -10...+10 V (order code G)	0...20 mA (order code C) 4...20 mA (order code E)
Output Load	6 mA	≤ 500 Ω
System Resolution	5 µm	
Repeatability	10 µm	
Non-linearity	≤ ±200 µm up to 500 mm nominal stroke typ. ±0.02 %, max. ±0.04 % 508...2540 mm nominal stroke	
Sampling Rate	typ. 32 kHz	
Supply Voltage	18...30 Vdc	
No-load Current	≤ 60 mA	
Operating Temperature	–4 to +185 °F	
Storage Temperature	–40 to +212 °F	

Pin Assignments	Pin	Color	
	1	YE	Slope selector
	2	GY	0 V (signal common)
	3	PK	not used
	4	RD	Slope selector
	5	GN	Output signal
	6	BU	GND
	7	BN	+24 Vdc
	8	WH	not used

Shock Load	100 g/2 ms
Vibration	12 g, 10...2000 Hz
Dielectric Strength	500 V (GND to housing)
Enclosure Rating per IEC 60529	IP 54
Housing Material	Anodized aluminum
Mounting	Mounting clamps
Connection Type	Connector M12, 8-pin standard
Housing Length A	Nominal stroke + 100 mm
Mechanical Stroke B	Nominal stroke + 10 mm

Included:
– Transducer
– User's guide
– 2 Mounting clamps

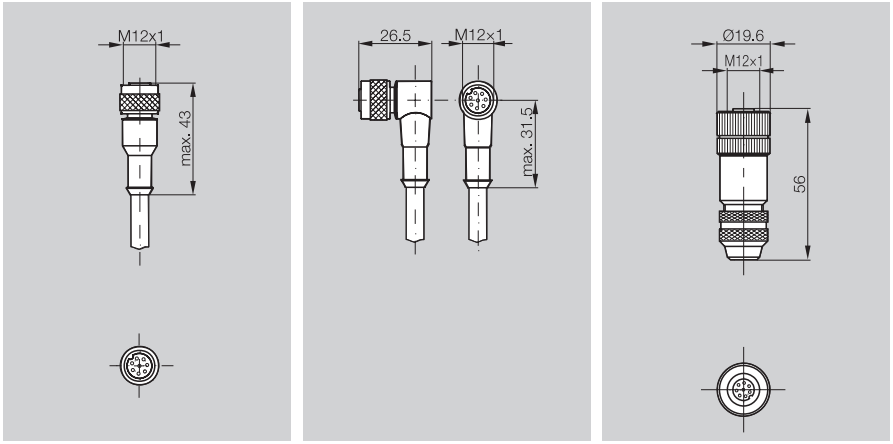
Ordering example:
BIW1_310-M_ _ _ _-P1-S115

Data Protocol
A 0...+10 V
G -10...+10 V
C 0...20 mA
E 4...20 mA

Standard nominal strokes [mm]
0075, 0100, 0130, 0150, 0175, 0225, 0300, 0360, 0375, 0400, 0450, 0500, 0600, 0650, 0750

Metric to Inch Conversion: inches = mm/25.4

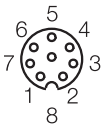
Connectors/Accessories	BKS-S115-PU-__	BKS-S116-PU-__	BKS-S115-00
for Series	BIW-___-S115	BIW-___-S115	BIW-___-S115
Type	8-pin, Straight, female	8-pin, Right angle, female	8-pin, female



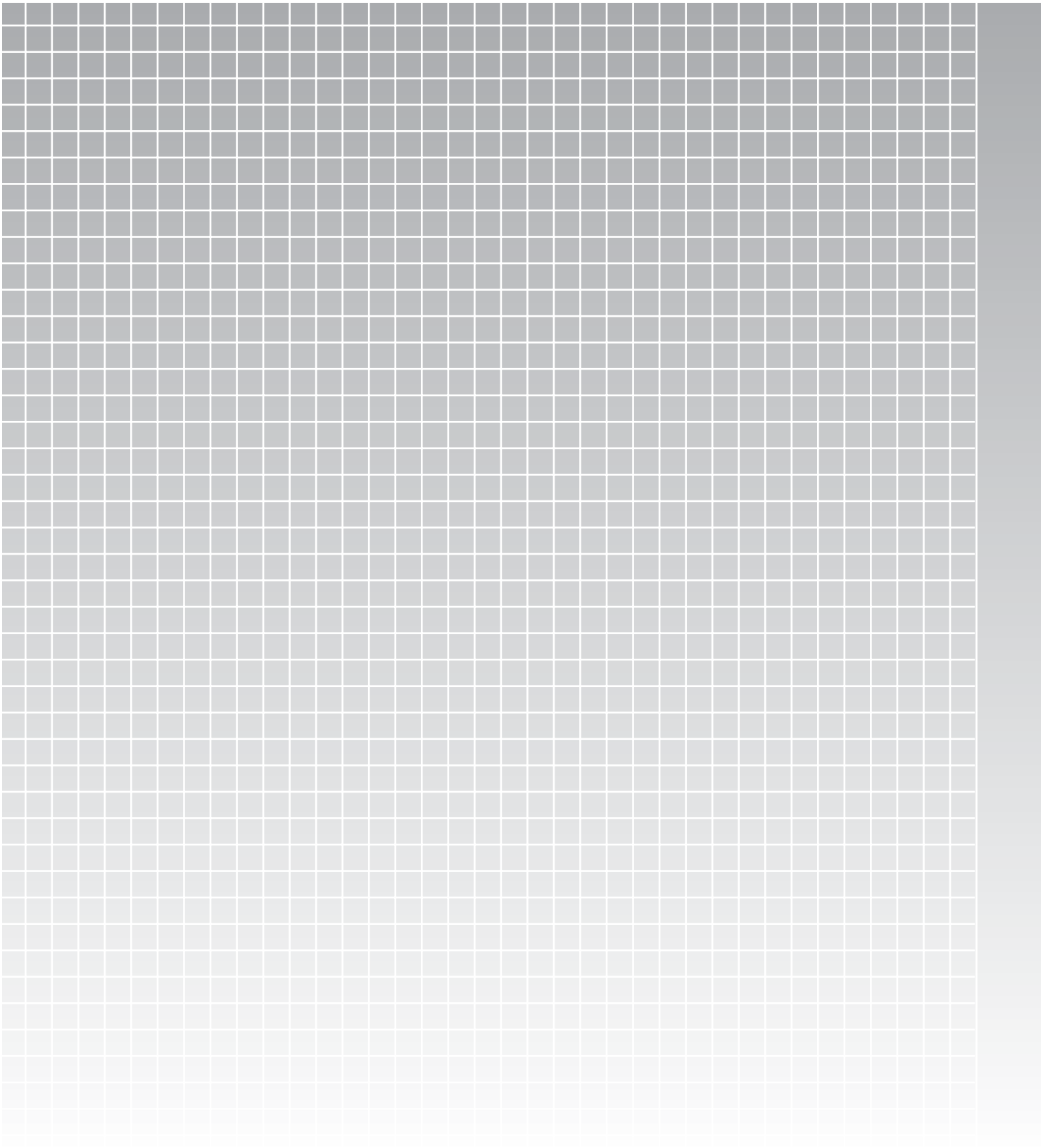
Ordering Code	BKS-S115-PU-__	BKS-S116-PU-__	BKS-S115-00
Screw Terminal			max. 0.75 mm²
Housing Material	PUR	PUR	CuZn nickel plated
Contacts	CuZn	CuZn	CuZn
Contact Finish	0.8 µm Au	0.8 µm Au	
Cable Strain Relief			PG 9
Cable Diameter			6...8 mm
Enclosure Rating per IEC 60529	IP 67	IP 67	IP 67 (when attached)
Knurled Coupling Ring	CuZn	CuZn	
Finish	2.5 µm Ni	2.5 µm Ni	
O-ring	Viton	Viton	Viton
Cable	Molded-on PUR		
No. of Wires × Conductor Cross Section	8 × 0.25 mm²		
Type	LIYY-CF11Y		
Conductor Configuration	14 × 0,15 mm		
Outer Diameter	6,6 ±0,2 mm		
Min. Bending Radius	dynamic 4 × D, static 3 × D		

Please indicate cable length
in ordering code
02 = Length 2 m; 05 = Length 5 m;
10 = Length10 m; 15 = Length 15 m;
20 = Length 20 m; 25 = Length 25 m

Pin assignments	Pin	Color
	1	YE
	2	GY
	3	PK
	4	RD
	5	GN
	6	BU
View of female	8	WH



Adapter BKS-S15 to BKS-S32
Ordering code: BKS-S115/GS32-PU-00.2



Connectors and Accessories

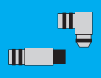
In addition to the standard connector options, Micropulse® transducers offer many additional connector configurations to suit various application requirements.

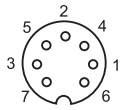
Compatibility – Micropulse transducers are available with connectors designed to offer plug-and-play replacement of competitive products.

Rugged Connectors – For demanding applications in harsh environments, rugged MS-style connectors offer rugged construction and a quick, positive-locking bayonet-style connection mechanism.

Fieldbus Connectors – Special connectors for CANbus and Profibus allow Micropulse transducers to be quickly and easily connected to fieldbus systems. A choice of molded cable assemblies or field-installable connectors provides maximum versatility.

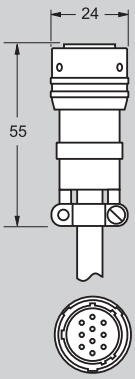
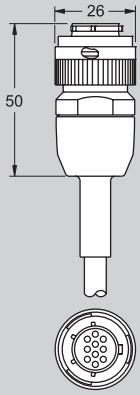
BKS



Connector Type	Housing Styles	Transducer Ordering Code	Mating Connector(s)	Catalog Page
7-pin DIN Style 	Z Rod P Profile 	BTL5-...**S147**	BKS-**S147**-xx (straight)	110
10-pin MS Connector 	Z Rod P Profile 	BTL5-...-**S140**	BKS-**S140**-xx (straight) BKS-**S140**-23-xx (straight shielded)	109
6-pin DIN Style (D6) 	Z Rod P Profile R Low-Profile 	BTL5-...-**S135**	BKS-**S135**-xx (straight) BKS-**S136**-xx (right angle)	110
CANopen/DeviceNet Connectors 	Z Rod P Profile 	BTL5-...-**S92** BTL5-...-**S94** BTL5-...-**S93**	BKS-**S92**-00 (straight female) BKS-**S94**-00 (straight male) BKS-**S93**-00 (right angle female) BKS-**S95**-00 (right angle male) BKS-**S48**-15-CP-xx (power for S93)	111-112
Profibus Connectors 	Z Rod P Profile 	BTL5-....-**S103**	BKS-**S103**-00 (field-installable female) BKS-**S105**-00 (field-installable male) BKS-**S103**-CP-xx (molded cordset female) BKS-**S105**-CP-xx (molded cordset male) BKS-**S48**-15-CP-xx (power for S103)	113-114

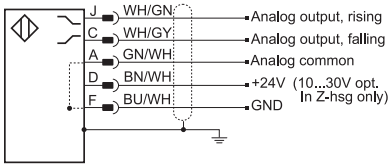
Connector Options

The table above summarizes the special connector options available for Micropulse® transducers.
For detailed information, refer to the pages referenced in the table.
For configurations not listed, please consult factory.

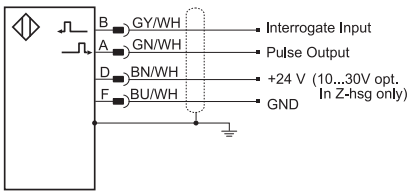
Connector Series	**S140**	**S140**
Connector Description	10-pin MS, Bayonet connector	10-pin MS, Bayonet connector - shielded
For Transducer Series	Rod Style Z, Profile Style P	Rod Style Z, Profile Style P
Transducer Ordering Code	BTL5-...-**S140**	BTL5-...-**S140**
			
Ordering Code	**BKS-S140-00** (field-installable, straight) **BKS-S140-xx** (cable assembly, straight, specify cable length "xx" in meters)	**BKS-S140-23-00** (shielded) **BKS-S140-23-xx** (shielded, specify cable length "xx" in meters)
Connector Specifications:		
Housing Material	Anodized aluminum	Anodized aluminum
No. of Contacts/Material	10/Gold-plated nickel	10/Gold-plated nickel
Cable Diameter Range (field-installable)	6...9 mm	6...9 mm
Cable Assembly Specifications:		
Wire Gauge	24 AWG	24 AWG
Number of Conductors	10 + braided shield	10 + braided shield
Overall Diameter	8 mm	8 mm
Jacket Material	PVC	PVC
Environmental Rating	IP 65 (when connected)	IP 65 (when connected)

Wiring Diagrams

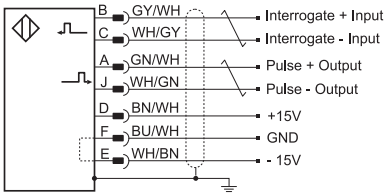
Analog Voltage
24V (10...30V opt. In Z-hsg only)



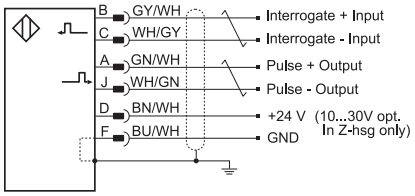
Digital, Single-ended
+ 24 V (10...30V opt. In Z-hsg only)



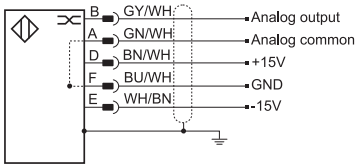
Digital, RS485 differential
+/- 15V



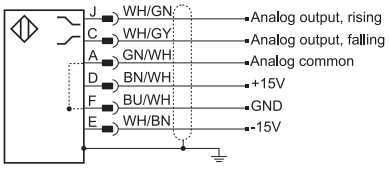
Digital, RS485 differential
24V (10...30V opt. In Z-hsg only)



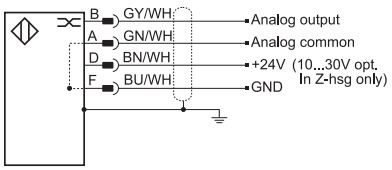
Analog Current
+/- 15V



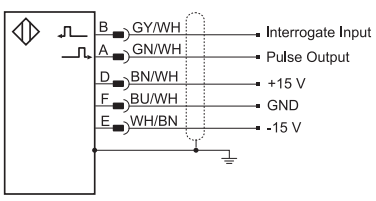
Analog Voltage
+/- 15V



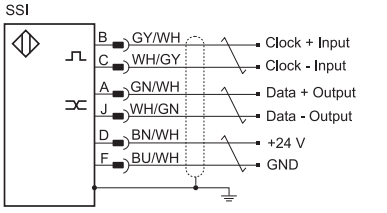
Analog Current
24V (10...30V opt. In Z-hsg only)



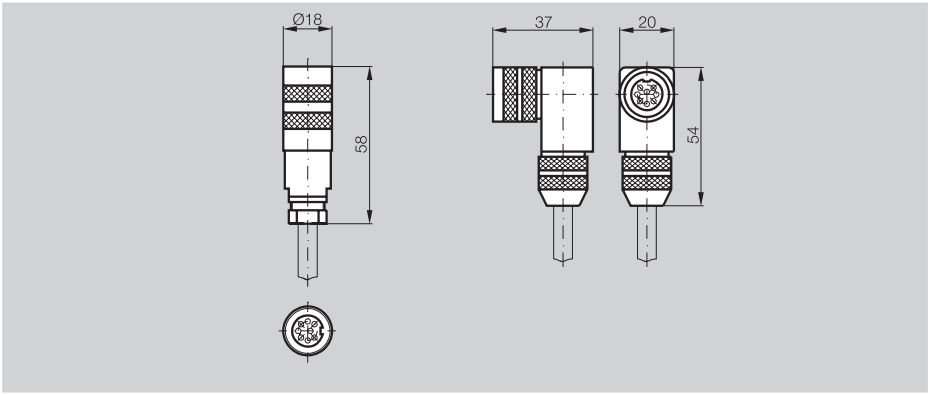
Digital, Single-ended
+/- 15 V



SSI



Connector Series	**S135**	**S147**
Connector Description	6-pin DIN	7-pin DIN
For Transducer Series	Rod Style Z, Profile Style P, Low-profile Style R	Rod Style Z, Profile Style P
Transducer Ordering Code	BTL5-...-**S135**	BTL5-...-**S147**

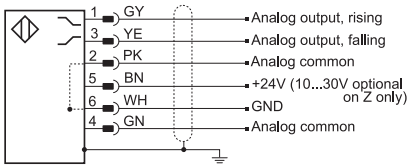


Ordering Code	**BKS-S135-00** (Field-installable, straight) **BKS-S136-00** (Field-installable, right angle) **BKS-S135-xx** (cable assembly, straight, specify cable length "xx" in meters) **BKS-S136-xx** (cable assembly, right angle, specify cable length "xx" in meters)	**BKS-S147M-00** (Field-installable, straight) **BKS-S147M-xx** (cable assembly, straight, specify cable length "xx" in meters)

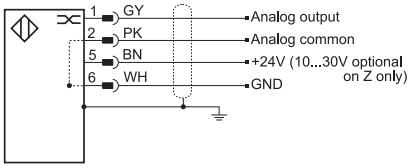
Connector Specifications:		
Housing Material	Nickel-plated Brass	Nickel-plated Brass
No. of Contacts/Material	6/Gold-plated nickel	7/Gold-plated nickel
Cable Diameter Range (field-installable)	6...8 mm	6...8 mm
Cable Assembly Specifications:		
Wire Gauge	24 AWG	24 AWG
Number of Conductors	6 + braided shield	7 + braided shield
Overall Diameter	6 mm	6 mm
Jacket Material	PUR	PUR
Environmental Rating	IP 67 (when connected)	IP 67 (when connected)

Wiring Diagrams

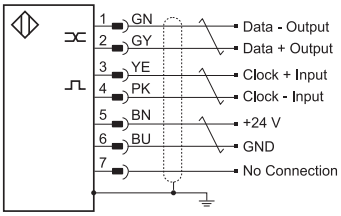
Analog Voltage
A, B, G



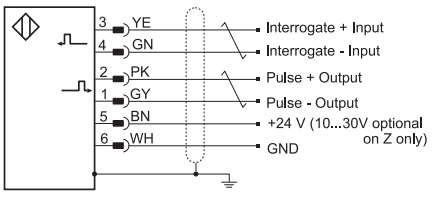
Analog Current
E, C



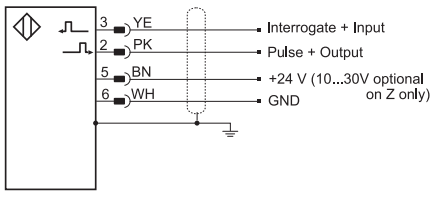
S147 Only
SSI

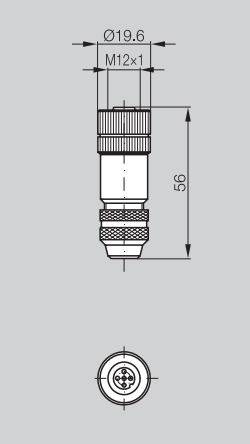
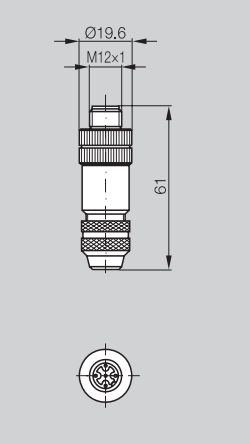
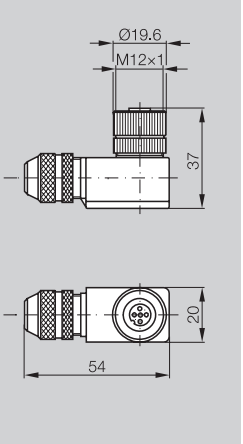
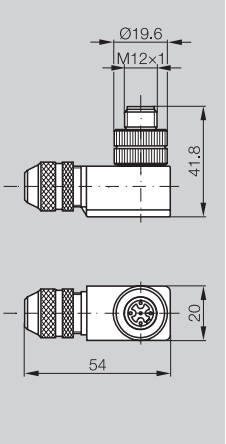


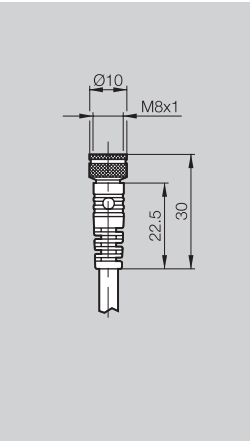
Digital, RS485 differential
P, M, I, K, L, R



Digital, Single-ended
(N)



Connectors/Accessories	BKS-S 92-00	BKS-S 94-00	BKS-S 93-00	BKS-S 95-00
for Series	CANopen/DeviceNet	CANopen/DeviceNet	CANopen/DeviceNet	CANopen/DeviceNet
Type	Straight, female	Straight, male	Right angle, female	Right angle, male
				
Ordering Code	**BKS-S 92-00**	**BKS-S 94-00**	**BKS-S 93-00**	**BKS-S 95-00**
Screw Terminal	max. 0.75 mm²/AWG 18	max. 0.75 mm²/AWG 18	max. 0.75 mm²	max. 0.75 mm²
Housing Material	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
Contacts	Brass	Brass	Brass	Brass
Contact Finish	0.8 µm gold plated	0.8 µm gold plated	0.8 µm gold plated	0.8 µm gold plated
Cable Strain Relief	PG 9	PG 9	PG 9	PG 9
Cable Diameter	6...8 mm	6...8 mm	6...8 mm	6...8 mm
Enclosure Rating Per IEC 60529	IP 67 (when attached)	IP 67 (when attached)	IP 67 (when attached)	IP 67 (when attached)

Connectors/Accessories	BKS-S 48-15-CP-
for Series	BTL5-D1...-S93 Supply voltage
Type	3-pin, female
	
Ordering Code	**BKS-S 48-15-CP-_*_**
Housing Material	PUR
Contacts	Brass
Contact Finish	
No. of Wires × Conductor Cross Section	2 × 0.25 mm²/AWG 24
Enclosure Rating Per IEC 60529	IP 67 (when attached)

CANopen Wiring

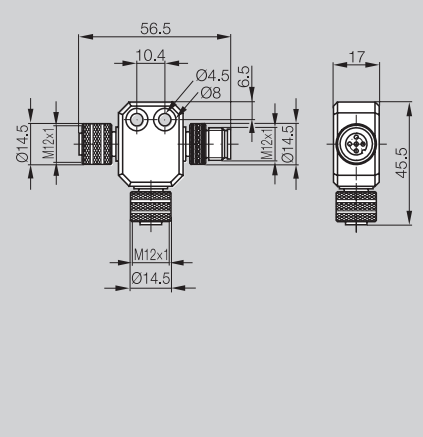
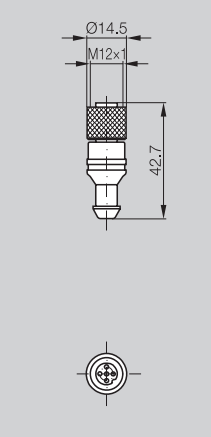
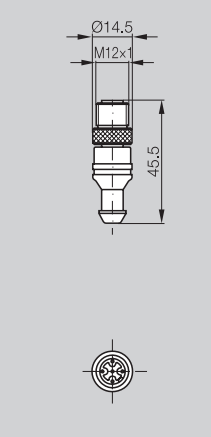
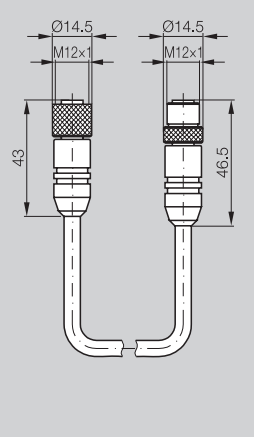
Pin Assignments	BKS-S 92-00/-S 93-00/ -S 94-00/-S 95-00		BKS-S 92-R01/-S 94-R01	
 View of female coupling side	Pin	Signal	Pin	Signal
	1	CAN_GND	1	-
	2	+24 V	2	-
	3	GND (0 V)	3	-
	4	CAN_HIGH	4	121 Ohms
	5	CAN_LOW	5	

DeviceNet Wiring

Pin Assignments	BKS-S 92-00/-S 93-00/ -S 94-00/-S 95-00	
 View of female coupling side	Pin	Signal
	1	Shield
	2	V +
	3	V- (GND)
	4	CAN_HIGH
	5	CAN_LOW
External supply voltage and shield	**S 48 3-pin**	
	1	+24 V
	3	0 V (GND)
	4	Shield Supply

* Indicate cable length in meters.
02 = Length 2 m
05 = Length 5 m
10 = Length 10 m

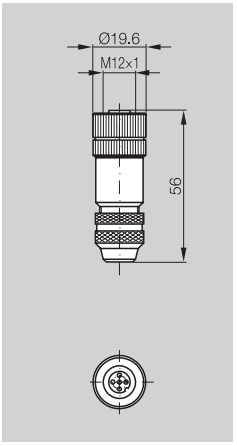
BKS

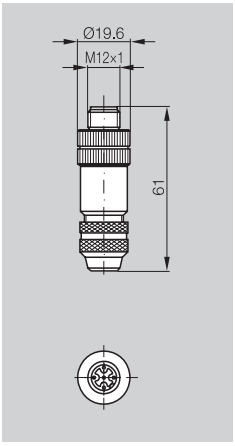
Connectors/Accessories	BKS-S 92-TA1	BKS-S 92-R01	BKS-S 94-R01	BKS-S 92-16/GS92-_ _
for Series	CANopen/DeviceNet	CANopen/DeviceNet	CANopen/DeviceNet	CANopen/DeviceNet
Type	T-splitter, 2 x F, 1 x M	Termination resistor, female	Termination resistor, male	Male/female extension
				
Ordering Code	**BKS-S 92-TA1**	**BKS-S 92-R01**	**BKS-S 94-R01**	**BKS-S 92-16/GS92-_*_**
Housing Material	PA	TPU	TPU	PUR
Contacts	Brass	Brass	Brass	Brass
Contact Finish	Ni	0.8 µm gold plated	0.8 µm gold plated	0.8 µm gold plated
No. of Wires × Conductor Cross Section				5 × 0.34 mm²/AWG 22
Enclosure Rating Per IEC 60529	IP 67	IP 68	IP 68	IP 67
Knurled Coupling Ring	Brass	Brass	Brass	Brass
Finish	2.5 µm Ni	2.5 µm Ni	2.5 µm Ni	2.5 µm Ni
O-ring	HBR	Viton	Viton	Viton
Resistor		121 Ohms	121 Ohms	

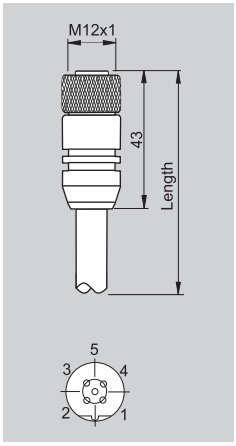
* Indicate cable length in meters.
02 = Length 2 m
05 = Length 5 m
10 = Length 10 m

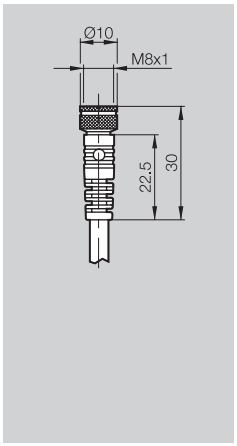
Connectors/Accessories	**BKS-S 103-00**	**BKS-S 105-00**	**BKS-S103-CP-xx**	**BKS-S 48-15-CP-**
for Series	BTL5-T1...-S103	BTL5-T1...-S103	BTL5-T1...-S103	BTL5-T1...-S103
				Supply voltage
Type	5-pin, female	5-pin, male	5-pin, female, molded cordset	3-pin, female

CE









Ordering Code	**BKS-S 103-00**	**BKS-S 105-00**	**BKS-S103-CP-_***	**BKS-S 48-15-CP-_***
Screw Connection	max. 0.75 mm²/ AWG 18	max. 0.75 mm²/ AWG 18		
Housing Material	Nickel plated brass	Nickel plated brass	PUR	PUR
Contacts	Brass	Brass	Brass	Brass
Cable Strain Relief	PG 9	PG 9		
Cable Diameter	6...8 mm	6...8mm		
No. of Wires × Conductor Cross Section			2 x 0.64 mm²/ AWG 18	2 × 0.25 mm²/ AWG 24
Enclosure Rating Per IEC 60529	IP 67 (when attached)	IP 67 (when attached)	IP 67 (when attached)	IP 67 (when attached)
Knurled Coupling Ring			Nickel plated brass	
O-ring			Viton	

* Indicate cable length in meters.
003= Length 0.3 m
02 = Length 2 m
05 = Length 5 m
10 = Length 10 m

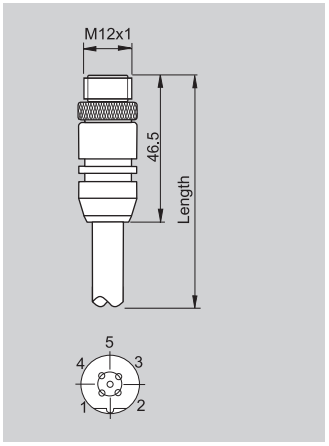
Pin Assignments		**S 103/S 105 5-pin**	**S 48 3-pin**
Control and data signals	Data GND	3	
	RxD/TxD-N (A)	2	
	RxD/TxD-P (B)	4	
	VP +5 V	1	
Supply voltage and shield	+24 V		1
	0 V (GND)		3
	Ground PROFIBUS-DP	5	
	Shield Supply		4

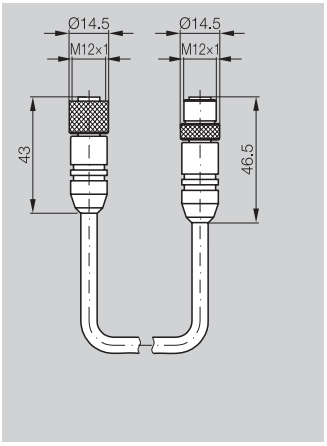

Profibus Profile Style

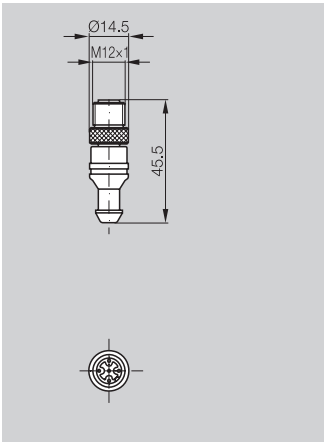

Profibus Rod Style

BKS

Connectors/Accessories for Series	**BKS-S105-CP-xx** BTL5-T1...-S103	**BKS-S103/GS103-CP-** BTL5-T1...-S103	**BKS-S 105-R01** BTL5-T1...-S103
Type	5-pin, male, molded cordset	Male/female extension	Termination resistor, male







Ordering Code	**BKS-S105-CP-_*_**	**BKS-S103/GS103-CP-_*_**	**BKS-S 105-R01**
Screw Connection			
Housing Material	PUR	PUR	PUR
Contacts	Brass	Brass	Brass
Cable Strain Relief			
Cable Diameter			
No. of Wires × Conductor Cross Section	2 x 0.64 mm²/ AWG 18	2 × 0.64 mm²/ AWG 18	
Enclosure Rating Per IEC 60529	IP 67 (when attached)	IP 67 (when attached)	IP 67 (when attached)
Knurled Coupling Ring	Nickel plated brass	Nickel plated brass	Nickel plated brass
O-ring	Viton	Viton	Viton

* Indicate cable length in meters.
02 = Length 2 m
05 = Length 5 m
10 = Length 10 m

Analog Interface Modules and Digital Displays

This section contains digital displays and analog interface modules to be used with Micropulse transducers.

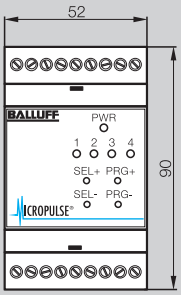
Analog Interface Module
The versatile BTM module converts a START/STOP digital pulse signal from a Micropulse transducer into user-scalable analog position and/or velocity information. In addition, the BTM module can be used to provide a position signal from up to 4 magnets on a single Micropulse transducer. Since the conversion from digital signal into analog signal takes place in the close proximity to the analog input device, a high degree of signal noise immunity can be achieved.

Digital Interface Module
The BTM-H1 module converts a START/STOP digital pulse signal from a Micropulse transducer into parallel digital outputs (up to 23-bits, depending on transducer length). The output data format is user-selectable binary, BCD, or Gray code. The BTM-H module also provides a 24-bit Synchronous Serial Interface (SSI) signal. User-selectable resolutions, and a super-fast update rate make the BTM-H1 a high-performance interface solution.

Digital Displays
Ranging from simple, low cost displays to allow visual position monitoring up to full-featured displays with programmable setpoints and serial communication capabilities, Balluff offers a display product to meet any application requirement.

BDD
BTM

Type	**BTM-A1/E1**
	Analog Output Processor



Ordering Code	**See below**
Input	Balluff BTL5 or BTL6 P1... START/STOP linear transducer
Outputs	Analog position and/or analog velocity
Operating Voltage	+24 Vdc ±20%
Current Draw	125 mA max (excluding transducer)
Operating Temperature	0 to 70° C
Number of Outputs	1 to 4 (see ordering code)
Position Output	0 to 10 Vdc, -10 to +10 Vdc , -5 to +5 Vdc, user programmable
Velocity Output	-10 to +10 Vdc
Velocity Range	2 to 400 inches/sec.
Output Resolution	16-bit
Update Rate	0.5ms / 2 ms for velocity

Description:
Used in conjunction with the Balluff P1... START/STOP linear transducer, the Balluff BTM module is used to provide up to 4 channels of analog position and/or velocity feedback. In multi-magnet mode, the BTM can be used to provide independent position information on up to 4 magnets on the Balluff transducer.

Features:
- User-scalable outputs: -10 to +10, -5 to + 5, 0 to 5, 0 to 10 Vdc, 4-20 mA
- Standard DIN-rail mounting
- Fast 0.5 ms update rate
- Noise-immune RS-422 interface allows for cable lengths of up to 1,600 feet between transducer and BTM-A
- Outputs short-circuit and reverse-polarity protected

B T M - A 1 - 1 0 2 - V U X X X X

Balluff-Transducer-Module

Analog Interface
A = Voltage output, E = current output

Supply Voltage
1= +24 Vdc (±20%)

Version
101 = 1 analog output (position or velocity)
102 = 2 analog outputs [(1 position, 1 velocity) or (2 position or 2 velocity)]
103 = 3 analog outputs (position only)
104 = 4 analog outputs (position only)

Velocity Option (leave blank if velocity feedback is not required
Indicates pre-programmed velocity scaling

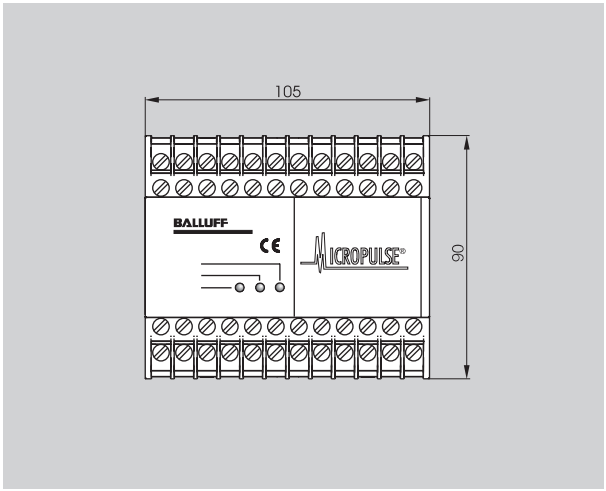
If “M” in position 13 specify velocity in millimeters/second
If “U” in position 13, specify velocity in inches and tenths of inches/second

e.g.
VU0300 = velocity scaling of 30.0 in/second
VM0762 = velocity scaling of 762 mm/second

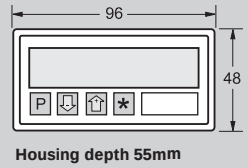
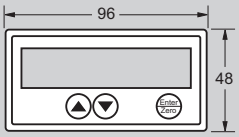
Description:
Used in conjunction with the Balluff BTL5 or BTL6 P1… START/STOP linear transducer, the BTM-H1 Module provides 23-bits of parallel data in binary, BCD or Gray Code. The BTM-H1 also provides a 24-bit SSI output in Gray Code. The BTM-H1 can be used to interface to discrete inputs on PLC's and other controllers.

Features:
- User selectable resolution (10, 25, 100, or 1000 um)
- Fast 0.5 ms position update
- DATA READY, SIGN, and ERROR, UP-DOWN and Parity outputs
- DATA HOLD and ENABLE inputs
- Available with short-circuit protected 10-30 V Source Driver I/O (BTM-H1-240) or TTL-level I/O (BTM-H1-340)
- Standard DIN-rail mounting

Type	**BTM-H1-240/340**
	Digital Parallel Interface Processor



Ordering Code	**BTM-H1-240** (10-30 V Source Driver Outputs) **BTM-H1-340** (TTL Level Outputs)
Input	Balluff BTL5 or BTL6 P1.... START/STOP linear transducer
Outputs	Parallel: 23-bit binary, BCD or Gray Code (user selectable) SSI: 24-bit Gray Code
Parallel Output Loading	20 mA max
Resolution	10, 25, 100, 1000 um, user selectable
Repeatability	1 digit
Update Rate	0.5 ms
Operating Voltage	24 Vdc +/- 10%
Current Draw	max 500 mA (module + transducer)
Operating Temperature	0 to 60° C
Humidity	≤ 90%, non-condensing

Name	BDD-UM 3023	BDD-100
Series	Analog - input digital display	Digital display for Micropulse transducers with ST/SP (P) interface
	 Housing depth 55mm **Analog Input**	 Housing depth 70mm **START/STOP Input**
Ordering Code	**BDD-UM 3023**	**BDD-100**
Features	– 4-digit (14 mm, red LED) – Analog Input (0-10 V or 4-20 mA) – 10-bit resolution – 5 measurements/sec – Scalable – Programmable Decimal Point – 24 Vdc input power	– 6-digit, 0.57" high, seven-segment LED display – 0.002" resolution – Fixed 5 ms update rate – Programmable decimal point, Units, and Gradient – Remote Zero – RS-232 serial interface for programming and data transfer – Removable Phoenix-type connectors – Front panel lock-out – 24 Vdc input power

BDD-UM 3023

BDD-100

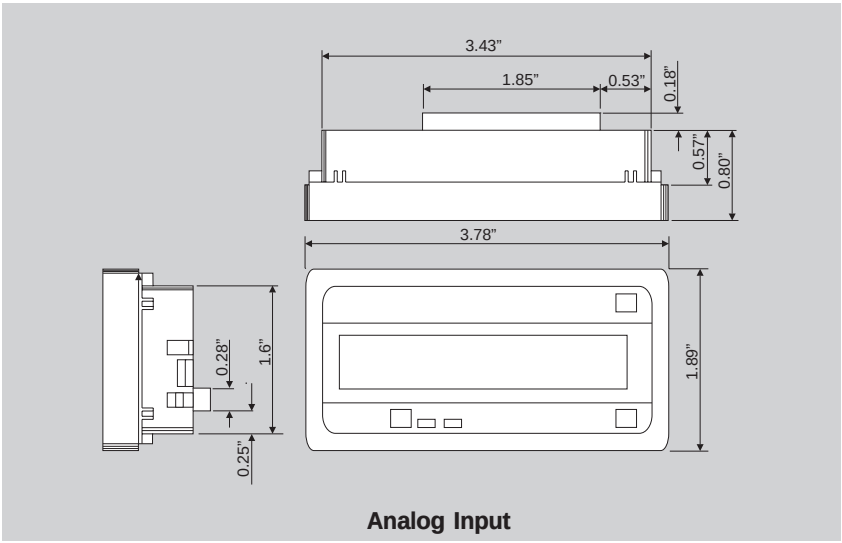
BDD 640

The BDD 640 series panel meters offer high performance and advanced functionality in a compact package. The BDD 640 series is a high resolution display designed for use with continuous output analog position sensors. The universal 16-bit analog input allows the BDD 640 series to be used with either 0-10 Vdc or 4-20 mA analog inputs. Available options include a scaleable 16-bit output and up to 4 programmable PNP set-points.

Features:

- Ultra thin design consumes minimal panel space
- 100% adjustable zero and span
- 16-bit input resolution for superior accuracy
- Fast update rate provides superior display readout response
- Available with up to 4 programmable setpoint outputs
- Scaleable 16-bit analog output available

Name	**BDD 640**
Series	Analog - input digital display



Analog Input

Versions	
BDD 640-R3A-0-00-E-00	16-bit analog input, display only
BDD 644-R3A-0-54-E-00	16-bit analog input, four programmable PNP outputs
BDD 645-R3A-5-53-E-00	16-bit analog input, two programmable PNP outputs, 16-bit 0-10 Vdc or 4-20 mA analog output, 100% adjustable

Technical Specifications	
Input Signal	0-10 Vdc or 4-20 mA
Display	6-digit (5-digit usable for analog models), 0.56" digits, 6 ms refresh rate
Supply Voltage	24 Vdc ± 20%
Temperature Range	0 to 70ºC
Update Rate	67 ms
Resolution	16-bit A/D
Digital Outputs	PNP, 100 mA per output
Analog Output	16-bit analog, 0-10 Vdc or 4-20 mA, 100% adjustable
Housing Information	Plastic, 1/8 DIN housing, panel mountable

Accessories (optional)	
BDD Z-001	Clear Nema 4X IP65 display cover

BDD
BTM

BDD 652

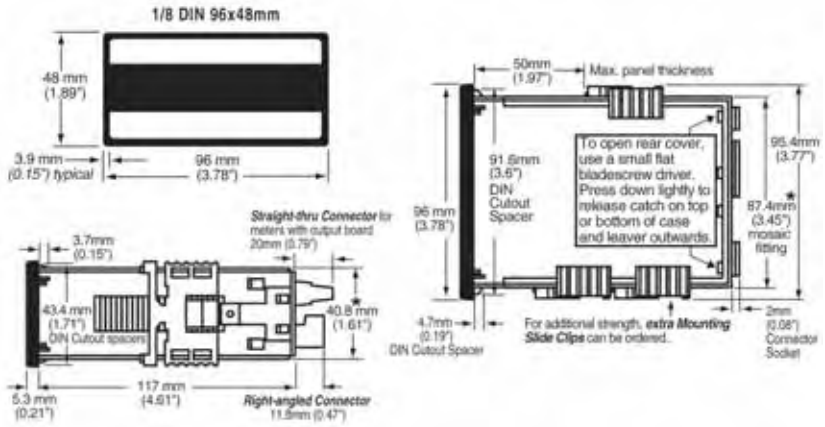
Magnetostrictive Start/ Stop Display and Controller

The BDD 652 is a full-featured digital display that is compatible with Micropulse® magnetostrictive linear position transducers with a START/ STOP interface. The BDD 652 features a 6-digit alphanumeric display with scrolling menu prompts for easy programming and setup. The modular construction of the BDD 652 allows for a variety of relay, analog and serial output options using factory installed plug-in output cards.

Features:

- High resolution – down to 0.0001"
- Multiple position magnets: up to 4 magnets can be used on a single Transducer
- Display position or velocity
- Easy programming with scrolling alphanumeric display
- Front panel zero button including “reset-to-preset” capability
- 120 Vac operation with built-in +24 Vdc supply
- Up to 4 programmable setpoints with 5-amp form A relays
- Optional 16-bit auxiliary analog output
- Optional RS232 serial interface

Name	**Magnetostrictive START/STOP Display and Controller**
Series	BDD 652



Ordering Code	**BDD 652-R_[1]P-_[2]-_ _ [3]-E-_ _[4]** (See ordering options below)
Transducer Interface	Micropulse Start/Stop transducer, leading edge (“M1”) or trailing edge (“P1”)
Display	6-digit, alphanumeric, 0.56" digits
Resolution	Inches: 0.01", 0.001", or 0.0001" Millimeters: 0.1, 0.01, 0.001 mm
Display Range	0.00001 to 99999.9
Displayed Value	Position or velocity for 1 to 4 position magnets
Update Rate	10 samples/sec.
Max. Sensor Length	165" (4000 mm)
Programmable Setpoints	Up to 4 programmable setpoints utilizing 5-amp form A relays
Analog Output	Optional 16-bit analog output (0 to 10 Vdc, 4 to 20 mA, or 0 to 20 mA)
Serial Communications	Optional RS232 ASCII interface
Operating Voltage	85-265 Vac / 95-370 Vdc or 15-48 Vac / 10-72 Vdc
Power Supply	Built-in +24 Vdc, 150 mA power supply
Operating Temperature	0 to 50° C (32 to 122° F)
Storage Temperature	-20 to +70° C (-4 to +158° F)
Case Dimensions	1/8 DIN, 96 x 48 mm (3.78" x 1.89")
Case Material	94 V-0 UL rated self-extinguishing polycarbonate (metal case optional)
Approvals	CE approval per EN-61000-3/4/6 and EN-61010-1

Ordering Options:

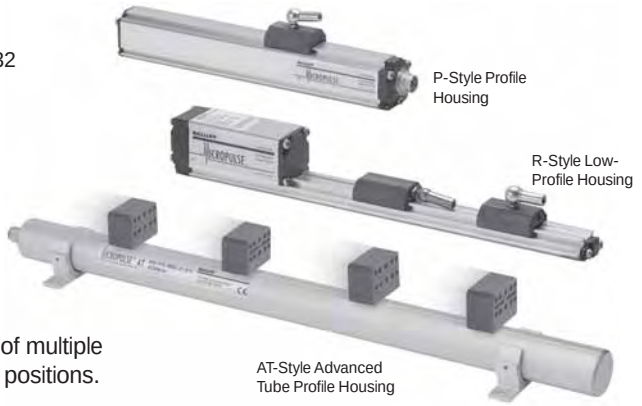
[1] = Power Supply
- 1 = High Range 85-265 Vac/90-370 Vdc
- 2 = Low Range 15-48 Vac/10-72 Vdc

[2] = Analog Output
- 0 = None
- 1 = Isolated 16-bit voltage output, 0-10 Vdc
- 4 = Isolated 16-bit current output, 0-20 or 4-20 mA

[3] = Relay Outputs
- 00 = None
- 34 = Four 5A form A relays, isolated

[4] = Options
- 00 = None
- S2 = Isolated ASCII code RS232 serial interface

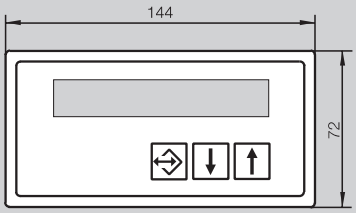
The BDD 652 is compatible with Micropulse® transducers with a START/STOP interface.



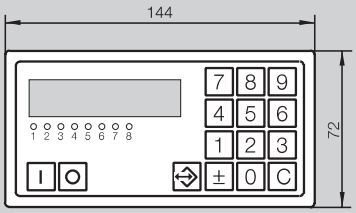
The BDD 652 supports the use of multiple magnets for monitoring multiple positions.

Name	BDD-AM 10-1-P	BDD-AM 10-1-SSD	BDD-CC 08-1-P	BDD-CC 08-1-SSD
Series	Digital display for Micropulse transducers with ST/SP (P) interface	Digital display for Micropulse transducers with SSI interface	Cam controller for Micropulse transducers with ST/SP (P) interface	Cam controller for Micropulse transducers with SSI interface

CE



Housing depth 110 mm



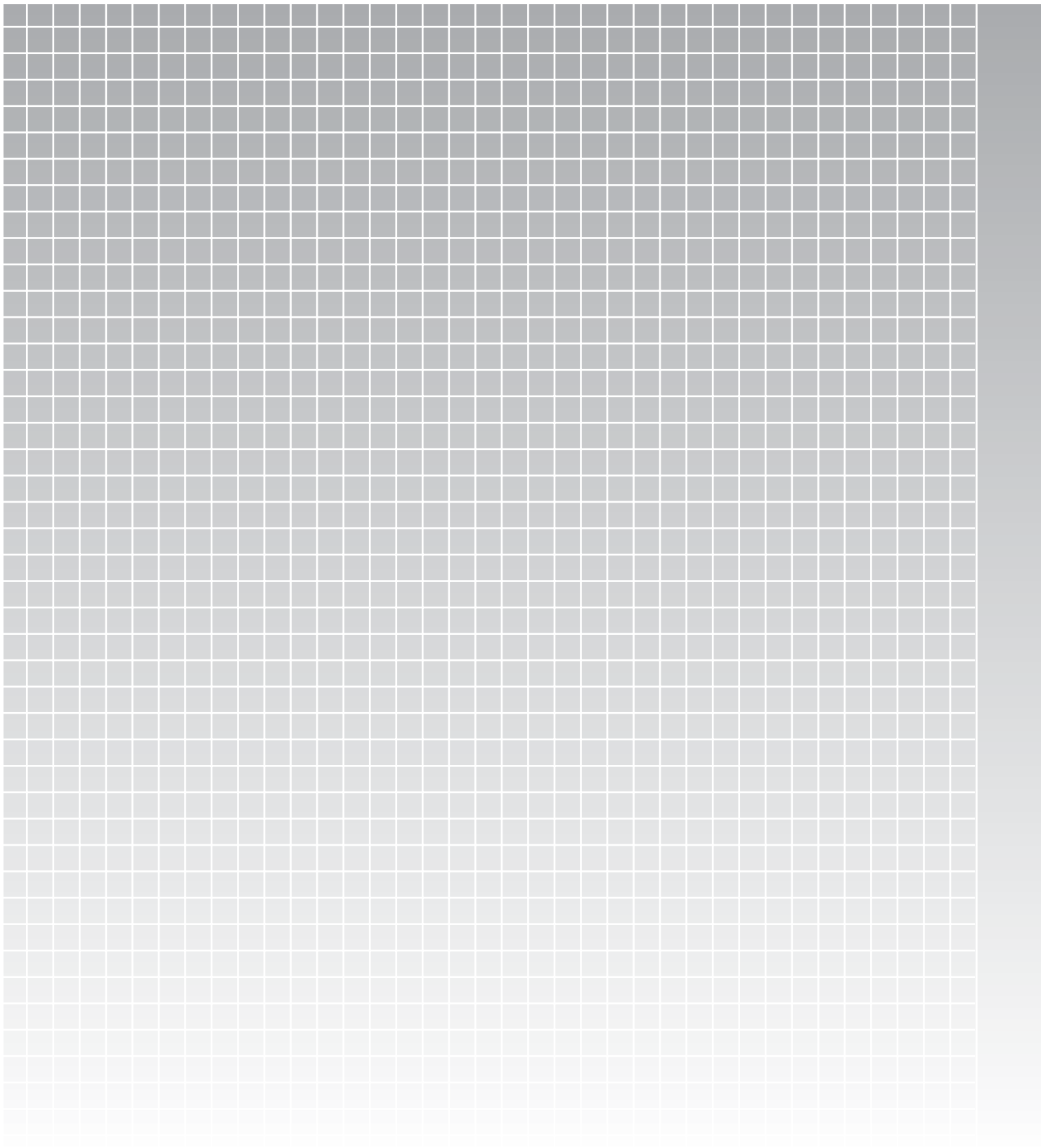
Housing depth 110 mm

Ordering Code	BDD-AM 10-1-P	BDD-AM 10-1-SSD	BDD-CC 08-1-P	BDD-CC 08 1-SSD

Features

- 7 1/2-digit display with sign
- LED display 14 mm high red 7-segment
- 0.002" resolution (BDD-AM 10-1-P)
- 0.0002" resolution (BDD-AM10-1-SSD)
- scalable units
- variable decimal point setting
- adjustable null point
- operating voltage 10...32 V
- 2 programmable relay outputs, defined as
  - limit switch/comparator
  - dwell
  - 2-position (on if below, off if above set value)
- 2 configurable inputs
  - external null set
  - latch display value
- isolated DIN housing for panel mount (mounting hardware included)
- 24 Vdc input power

- 8 programmable outputs
- 8 directional switchpoints possible
- LED display, 14 mm high red 7-segment, 6-position
- 0.002" reolution (BDD-CC08-1-P)
- 0.0002" resolution (BDD-AM10-1-SSD)
- LED switchpoint status on front panel
- 300 switchpoints can be distributed over up to 15 programs
- adjustable nullpoint shift
- static and dynamic setpoints with deadtime compensation
- multiple BDD-CC 08 can be wired in parallel
- built-in transducer supply voltage 300 mA, 24 V
- isolated DIN housing for panel mount (mounting hardware included)
- 18...32 Vdc input power



Terminology and Testing

Resolution

The smallest increment of position change that can be detected by the transducer. The resolution of Micropulse transducers depends on the output type chosen.

Digital Pulse Output (all housings)
For digital pulse-output systems (i.e. Start/Stop or PWM) resolution is determined by the clock frequency of the customer interface which measures the time interval between the Start pulse and the Stop pulse (or the rising and falling edges of the PWM signal). Resolution can be determined as follows:

Resolution (in inches) =
1 ÷ (Gradient x Clock Frequency)

The gradient value is printed on the label of each transducer and is expressed in microseconds per inch (µsec/inch).

The Clock Frequency is the frequency of the counter in the customer supplied interface and is usually expressed in megahertz (MHz).

Example - assuming a gradient value of 9.000 µs/inch and a clock frequency of 56 MHz

Resolution (in inches)
= 1 ÷ (9 x 56)
= 1 ÷ 504
= 0.00198”

Digital Serial Systems (SSI, Canbus, etc.)
Resolution is a defined value, stated in inches.

Digitally-Derived Analog (Z housing, rod-style only)
Output resolution is expressed as 16-bits. The digital position information is converted into an analog signal internally through a digital-to-analog converter.

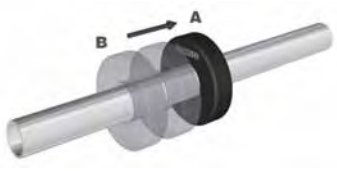
True Analog (all other housing styles)
The analog output is derived without using a digital-to-analog converter. Resolution for this type of system is virtually infinite. Attainable resolution is determined primarily by electrical noise inherent to the application, and input resolution of the control system.

Temperature Coefficient
Expressed as ppm/°C or °F, TC is the degree to which the output signal (and therefore the indicated position) is affected by ambient temperature changes.

Non-Linearity
The degree to which the output value from the Micropulse transducer system is not perfectly proportional to travel distance. Standard transducers show a non-linearity of max. ±0.02% full scale. Example: a 24-inch stroke BTL5 with analog output may output a position value which is 0.0048" greater or less than the true, absolute position. This value is repeatable, however, to within 0.0002" (see “resolution” and “repeatability”). For higher accuracy requirements, Micropulse transducers with Synchronous Serial Interface (SSI) can be used.

Hysteresis
The difference in indicated position when the same point is reached from two different directions. Repeatability refers to travel from one direction only, hysteresis from two directions.

Repeatability
The degree to which the indicated position point B as represented by the output value is reproduced when moving in one direction from point A and back to point B. In the case of a BTL5 system, position repeat accuracy is always the same as the stated resolution + hysteresis.



Dead Zone
The end of the Micropulse transducer rod, from end of stroke to the end of the rod. This is usually the last 2.3 inches of the rod. If the magnet enters the dead zone the output will be unpredictable.

Null Space
The distance from the head of the transducer to the start of the electrical stroke.

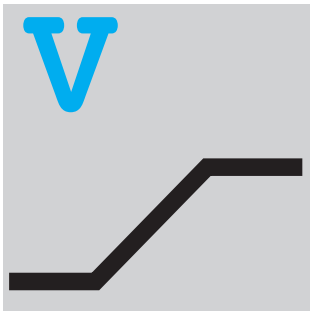
Null Position
The position of the magnet on the transducer rod which reads a zero or minimum output.

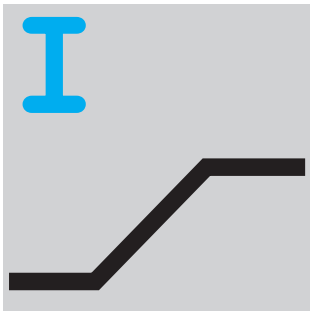
Stroke
The active electrical portion or the sensing portion of the Micropulse transducer.

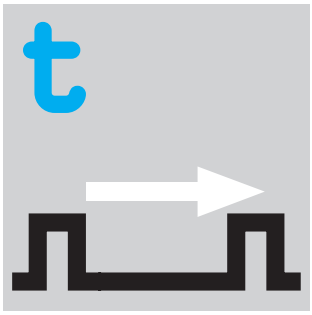
Analog
The output of the transducer is an analog voltage (0 to 10 Vdc, -10 to +10 Vdc, or -5 to 5 Vdc) or an analog current (0 to 20 mA, 4-20 mA) and is proportional to the position of the magnet.

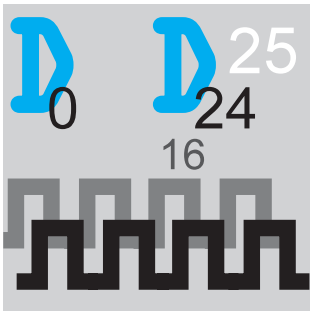
Digital Pulse Output
The output of the transducer is a digital Start/Stop pulse or a Pulse Width Modulated (PWM) signal. Magnet position is directly proportional to the time interval between the Start pulse and the Stop pulse (or the rising and falling edges of the PWM signal). An external counter is required to measure this time interval.
A wide variety of processor cards, PLC plug-in cards, and stand-alone controllers designed around this interface are available.

Digital Serial Output
The output of the transducer is in the form of a serial data word or string in SSI (binary or Gray code) or CANbus format.









Analog voltage output

The output voltage is directly proportional to the position of the magnet along the waveguide.

The most important parameter for analog outputs is the refresh rate and the ripple of the output signal. Many transducers on the market attain the specified values for output ripple only by means of low-pass filtering. This always carries with it an undesirable time delay of the output signal.

Micropulse transducers attain the specified signal quality without extensive low-pass filters, instead using improved circuit design. This means fast update times with low levels of ripple and noise on the output signal. Micropulse transducers with voltage output have 2 outputs, one increasing and one decreasing.

Available versions include:

0...10 V (10...0 V)

-10...10 V (10...-10 V) and

-5...5 V (5 V...-5 V)

Analog current output

The output signal is directly proportional to the magnet position along the waveguide. Analog current interfaces of 0...20 mA and 4...20 mA are standard in numerous applications and in many industries. Current interfaces are significantly less sensitive to induced noise than are analog voltage interfaces. A 500 Ohm resistor can be used to easily convert the 0..20 mA signal into a voltage of 0...10 V. The 4...20 mA signal provides a simple form of cable break monitoring, since even at the nullpoint of the stroke a current of 4 mA must flow. Micropulse transducers with current output are available with increasing or decreasing signals.

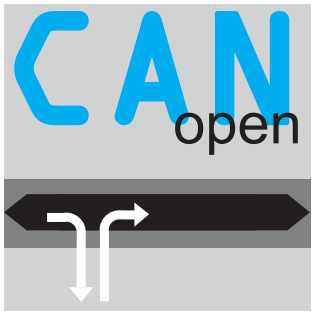
Pulse interface

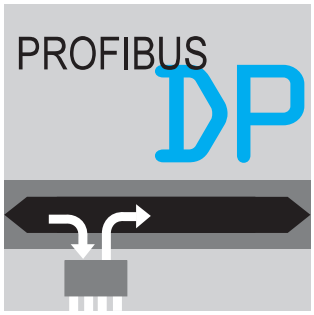
The time between an interrogation and the reply signal is directly proportional to the position of the magnet along the waveguide. These pulses are transmitted using RS485/422 differential line drivers, guaranteeing noise-free signal transmission over distances of up to 500 m (1640 ft.). The great advantage of these interfaces is the noise-immune signal transmission with a simple and economical interface. Interfaces with tristate outputs allow multiplexing of several Micropulse transducers. Appropriate control cards are available.

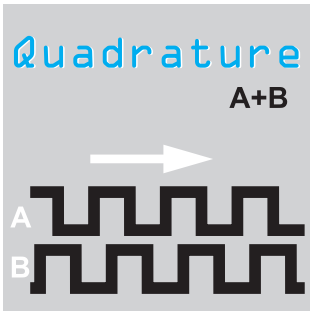
SSI synchronous serial interface

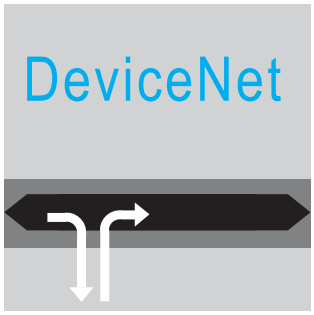
The position of the magnet along the waveguide is sent to the control serially in the form of a data word.

Micropulse transducers with SSI interface can be connected directly to controls or closed-loop control cards with SSI interfaces designed for absolute encoders. The data transmission from the sensor to the control is synchronized by means of a clock pulse from the control. Depending on the required resolution, transducers with 24 or 25-bit data words are available. The maximum non-linearity of the SSI Micropulse transducer of ±30 µm over the entire stroke, the update frequency of 2 kHz and a resolution of 5 µm make the SSI Micropulse transducers an ideal feedback sensor, even in the most demanding applications.









CAN*open*

The position of the magnet along the waveguide is sent over the CAN-Bus to the control in so-called Process Data Objects, PDOs. Micropulse transducers work with standard CAN*open* protocols per CiA DS 301 and with the standard device profile per DS 406. CAN*open* offers greater flexibility because of the large number of configuration options for the transducer. For example, the resolution is programmable for 5, 10, 20 or 100 µm, depending on your application. Or you can select whether only position or also velocity information shall be sent to your control; cyclically, or on-demand. And there's more: Up to 4 so-called software cams can be defined in the active stroke range. Each time the status of one of these cams changes, high-priority Emergency messages are sent to the control (check factory for availability).

– Consult factory for technical data

PROFIBUS

This interface provides an efficient connection to machines using Profibus. Features of this interface include:

– Single telegram message for fast updates even with 4 magnets
– Operates at 12 Mbps
– GSD file provided to configure telegram message
– Sync and Freeze functions available for coordination between other devices

Quadrature

The quadrature output interfaces directly to standard encoder inputs (90° out of phase, A & B). This configuration gives you more interface options for connecting to motion based systems. Operating modes can be either free-running or synchronous (switch selectable) depending on the control system's requirements.

DeviceNet™

DeviceNet is a manufacturer-independent, open standard fieldbus used to interconnect control devices and sensors for data exchange. It uses **Controller Area Network** (CAN) as the backbone technology.

The Micropulse® linear position transducer with DeviceNet interface is compatible with the CIP Common Specification Object Library “Position Sensor Object”.

Micropulse DeviceNet transducers feature:

– Selectable position resolution to 5 µm
– Selectable velocity resolution to 0.1 mm/s
– MAC-ID and baud rate can be preset using DIP switches, and can also be changed via software
– On-board status LED shows network/device status

HALT – High Accelerated Lifetime Test – Highest function security over years

The result is linear displacement systems and sensors of the highest quality and reliability which will continue to perform with the same safety and precision for years to come. Their use increases equipment up time, prevents service and repair costs and achieves significantly greater efficiency.

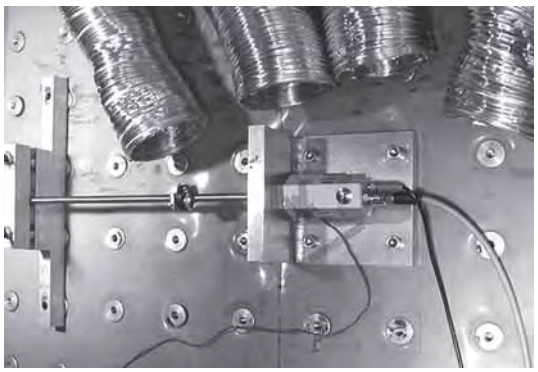
Rapid temperature cycles from –100 °C to +200 °C and vibration loads between 10 and 50 g can simulate aging of a sensor. Using this procedure the products are tested for their specifications to determine the reliability, load capacity and life expectancy of the sensor.

The sample is intentionally destroyed so that we can immediately improve the first component to fail. In the HALT system both sensors and transducers can be tested.

Technical Data

HALT System	
Manufacturer	Thermotron Industries USA
Frequency Spectrum	2...10000 Hz
Acceleration	up to 50 g
Excitation	9 pneumatic cylinders, noise spectrum, 3-axis, 3 linear and 3 rotary degrees of freedom
Temperature Range	–100 °C...+200 °C
Temperature Gradient	70 K/min
Electrical Power	96 kW
Procedure	Electric heater, liquid nitrogen for cooling

Nitrogen tank for the cooling system

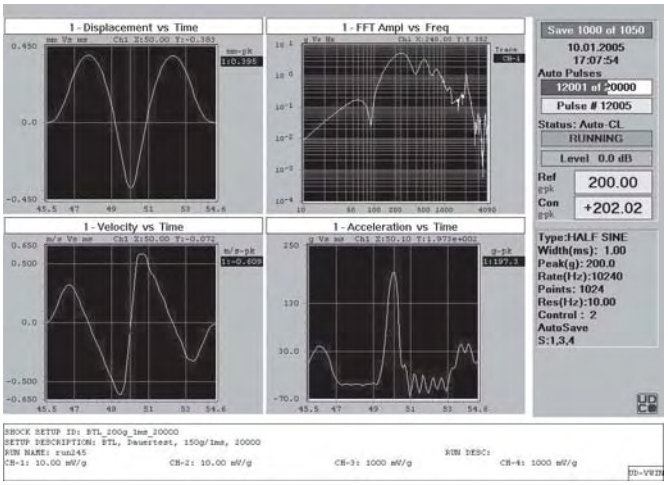

"Stress on the sample"

Multifunctional climate chamber

Reliability doesn't happen by chance

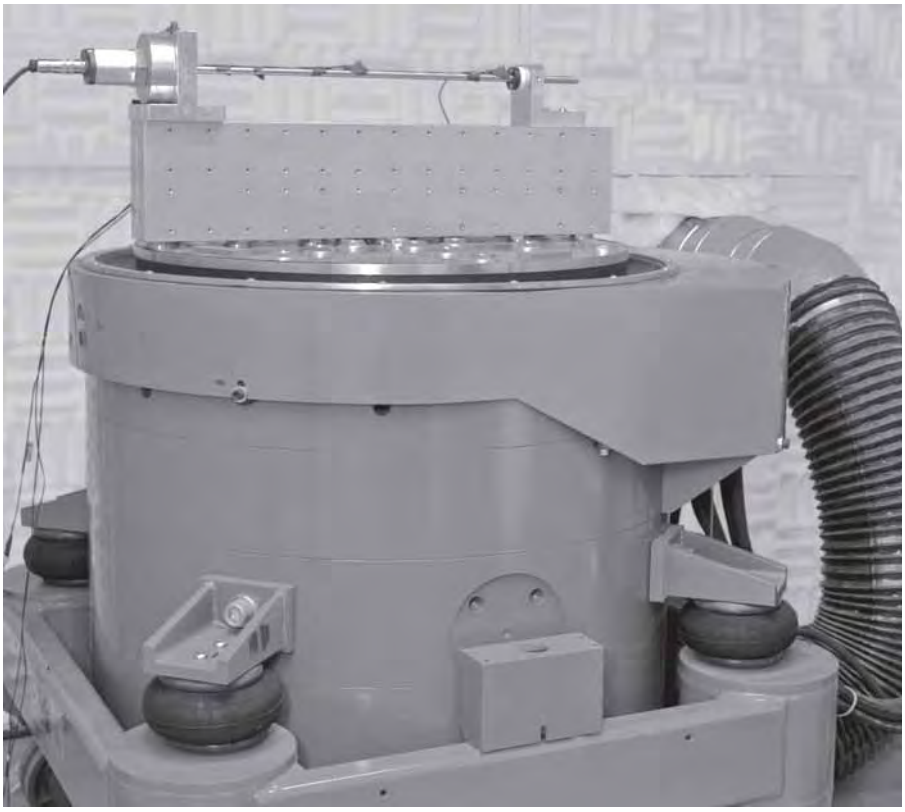
Tests and checks during the development process improve the product and give protection against "surprises" in service.

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

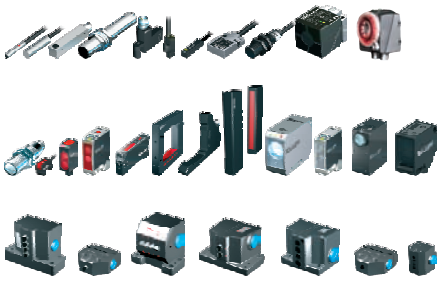
Test equipment in the test laboratory

	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) (EN 60068-2-27; EN 60068-2-29) (EN 60068-2-64)	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
4. Other	X-ray analysis	X-ray inspection equipment RTX 113, HEEB-INOTEC






Object Detection



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