User's Manual
Inductive Analog Position Sensor BIL SmartSens

No. 836 508 E • Edition 0802

- **Compact design**
- **Analog output voltage/current**
- **Non-contact**
- **High repeat accuracy**
- **High temperature stability**
- **High linearity**
- **Magnet sensing (AMD0…, EMD0...)**

Safety Advisory

⚠ This analog position sensor is not permitted for use in applications where personal safety depends on proper function of the device (not a safety component according to the EC Machine Directive). Read this manual carefully before using the sensor.

Function Principles

The magneto-inductive linear position sensors are non-contacting. They use a permanent magnet element and sense the change in inductance of a coil induced by this magnetic element. The processing circuitry is built-in, providing an absolute and distance-proportional voltage or current signal of 0...10V or 4...20 mA / 0...20 mA. They are characterized by high repeat accuracy, temperature stability and linearity.

Their versatility, ruggedness and compact design make them standouts for numerous industrial applications. Thanks to their fully analog principles of operation, they are ideal for control and feedback tasks.

The versions with magnet sensing indicate when the position magnet has left the working range. Their unique characteristic output curve makes them ideal for applications in which only part of a motion needs to be detected.

In addition to the recommended position magnets, already existing permanent magnets can often be used (such as found in pneumatic cylinders).

Typical applications range from handling and robotics to conveying and building technology to metering and flow measurement.

U.S. Patent No. 6,714,004

Model Overview

BIL Standard	Output
• Working range 30 mm	
BIL ED0-T030A-01-S75	V / I
• Working range 60 mm	
BIL AD0-P060A-01-S75	V
BIL ED0-P060A-01-S75	V / I
• Working range 160 mm	
BIL ED0-P160A-01-S75	V / I
BIL with magnet sensing	Output
• Working range 60 mm	
BIL AMD0-T060A-01-S75	V
BIL EMD0-T060A-01-S75	V / I

Position Magnets

Standard models

- BIL 000-MH-A
- BIL 001-MH-A

Other position magnets on request

See page 8 for installation instructions

Assembly

When assembling the BIL sensor and position magnet, note the requirement for collinear orientation of the center axes and observe distance D between the sensor and position magnet. Refer to Assembly diagram 1. The supplied mounting brackets and screws are recommended for installing the BIL sensor system, since their design and material guarantee minimal distortion of the output curve.
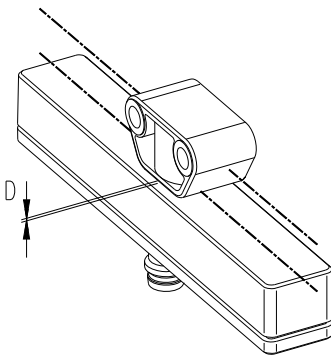

Assembly diagram 1

Installation Instructions

Installing in or on metallic surfaces will – depending on the material properties – result in slight effects on the characteristic parameters. In general, non-magnetizable materials such as alloys, austenitic steels, plastics, etc. are recommended. This applied both to the sensor and the position magnet.
Magnetizable materials (ferrous) affect the geometry and strength of the effective field of the position magnet, and can themselves become magnetized by the motion of the position magnet; this in turn will affect the characteristic parameters in the same way that any nearby magnetic field would.

The sensor may be flush mounted in non-magnetizable metallic material. This will slightly increase the full scale of the output signal. This effect is reduced by increasing distance X (see Installation diagram 1).

The following pages show the recommended distances A, B and C from magnetizable materials for each sensor model (please refer to Installation diagram 2).
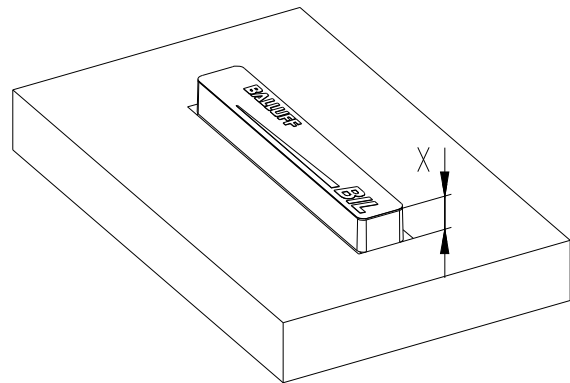
Installation diagram 1
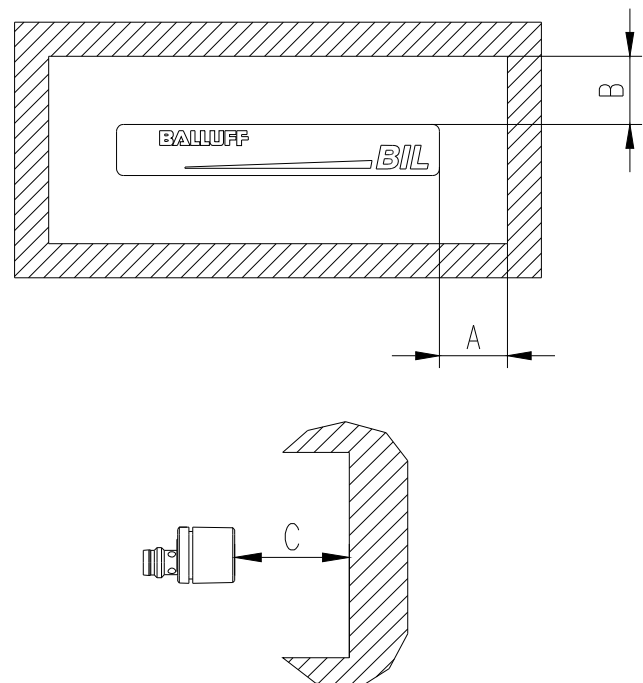
Installation diagram 2

Materials between Sensor and Position Magnet

The sensing principle allows the position magnet to be detected through solid materials (such as glass, light metals, plastics, austenitic steels) without causing noticeable changes in the dynamic properties. As with the installation materials, the characteristic curve may be affected by the material properties. Possible areas of application here include valves, cylinders, level meters, etc.
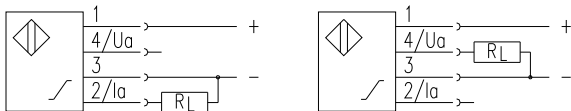It is not possible to sense through magnetizable (ferrous) materials.
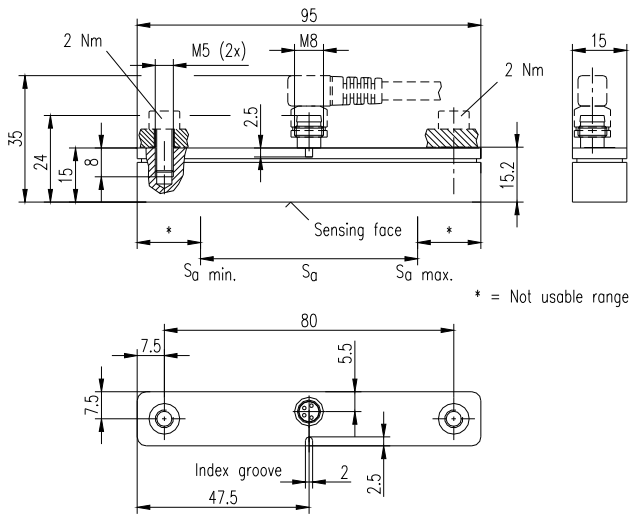
Product View

* = Not usable range

Connection Diagram

Do not use current and voltage output simultaneously.

Pin Configuration
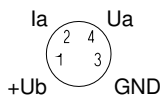
Ia   Ua
+Ub   GND

Characteristic Curve
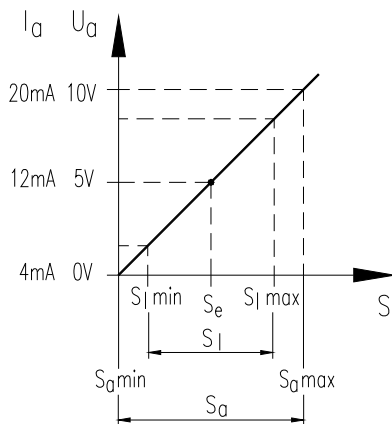
Technical Data

Characteristic Data

Working range s_a	[mm]	0…30
Linear range s_l	[mm]	0…30
Rated operating distance s_e	[mm]	15
Linearity error at s_l	[mm]	±0,3
Repeat accuracy R_{NORM}	[% v. I_a/U_a max.]	≤ 0.1
Repeat accuracy R_{BWN} 1)	[µm]	±30
Ambient temperature T_A	[°C]	-10...+70
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	±2,5

Electrical Data

		I_a / U_a
Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	10...30 / 15...30
Load resistance R_L max.(I_a) / min.(U_a)	[Ω]	500 / 2000
No-load current I_0 at U_e	[mA]	≤ 30
Protected against any wire reversal		⊠
Reverse polarity protected		⊠

Optical Indicators

Supply voltage	-
Position magnet sensing	-

Mechanical Data

Housing material	PA fiberglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: U_e = 24V, R_L = 500 Ω / 10 kΩ (I/U), measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.
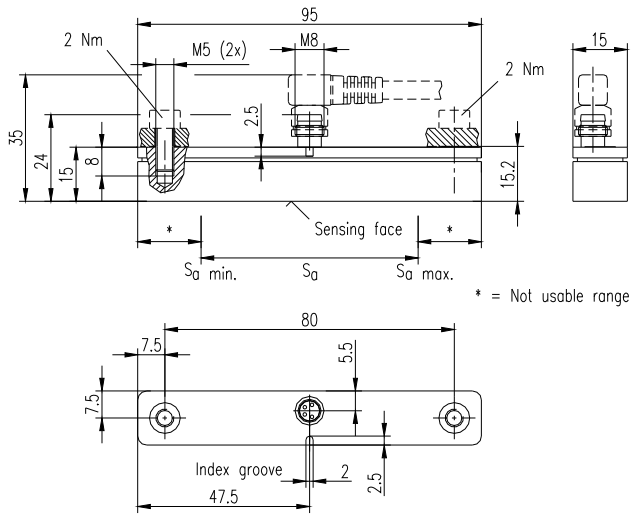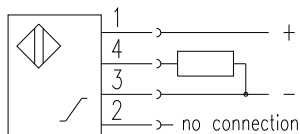
Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44

For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
Appropriate connectors can be obtained from Balluff.

Inductive Analog Position Sensor
BIL AD0-P060A-01-S75

Product View

Connection Diagram

Pin Configuration

Characteristic Curve

Technical Data

Characteristic Data

Working range s_a	[mm]	0...60
Linear range s_l	[mm]	5...55
Rated operating distance s_e	[mm]	30
Linearity error at s_l	[mm]	0,6
Repeat accuracy R_{NORM}	[% v. U_a max.]	$\leq 0,1$
Repeat accuracy R_{BWN} 1)	[µm]	±60
Ambient temperature T_A	[°C]	-10...+75
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	±2

Electrical Data

Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	15...30
Load resistance R_L min.	[Ω]	2000
No-load current I_0 at U_e	[mA]	≤ 30
Protected against any wire reversal		☒
Reverse polarity protected		☒

Optical Indicators

Supply voltage	-
Position magnet sensing	-

Mechanical Data

Housing material	PA fibreglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: U_e = 24V, 10 kΩ, ,measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.

Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44
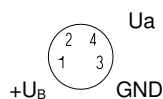
For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
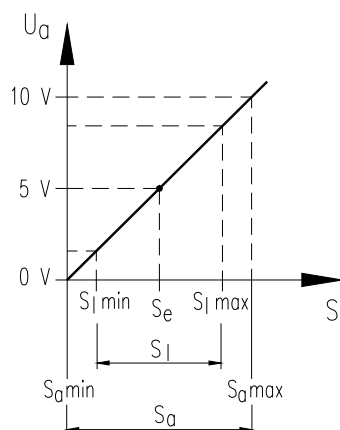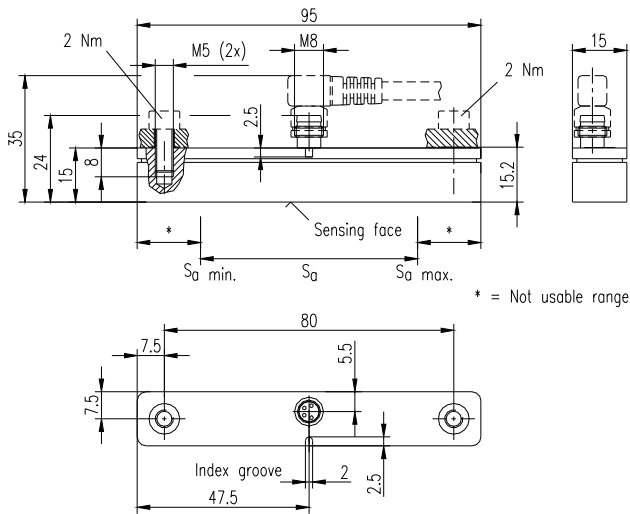Appropriate connectors can be obtained from Balluff.

BALLUFF

Inductive Analog Position Sensor
BIL ED0-P060A-01-S75

Product View
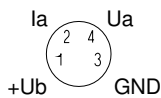

* = Not usable range
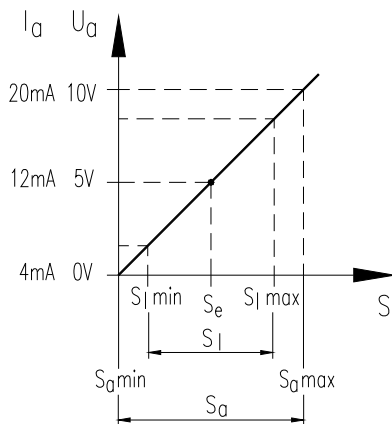
Connection Diagram

Do not use current and voltage output simultaneously.

Pin Configuration

Characteristic Curve

Technical Data

Characteristic Data

Working range s_a	[mm]	0...60
Linear range s_l	[mm]	5...55
Rated operating distance s_e	[mm]	30
Linearity error at s_l	[mm]	0,6
Repeat accuracy R_{NORM}	[% v. I_a/U_a max.]	≤ 0.1
Repeat accuracy R_{BWN} 1)	[µm]	± 60
Ambient temperature T_A	[°C]	-10...+75
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	± 2

Electrical Data

		I_a / U_a
Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	10...30 / 15...30
Load resistance R_L max.(I_a) / min.(U_a)	[Ω]	500 / 2000
No-load current I_0 at U_e	[mA]	≤ 30
Protected against any wire reversal		☒
Reverse polarity protected		☒

Optical Indicators

Supply voltage	-
Position magnet sensing	-

Mechanical Data

Housing material	PA fiberglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: U_e = 24V, R_L = 500 Ω / 10 kΩ (I/U), measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.
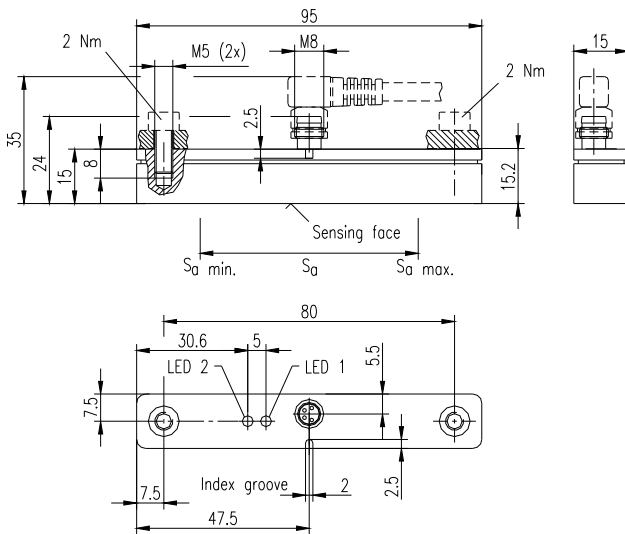
Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44

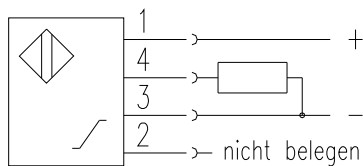For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
Appropriate connectors can be obtained from Balluff.

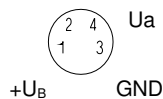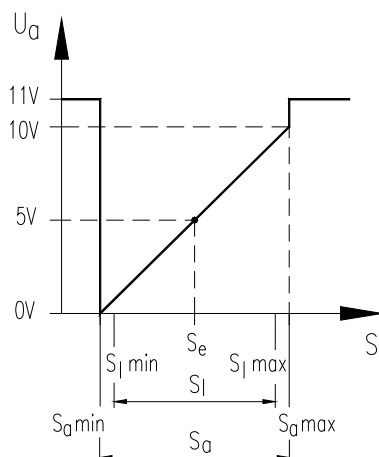# Inductive Analog Position Sensor
BIL AMD0-T060A-01-S75

Product View

Connection Diagram

Pin Configuration

Characteristic Curve

Position Magnet Sensing

The BIL AMD0 is capable of position magnet sensing. If the position magnet is outside the working range, this is indicated in two ways:

- The output signal rises to typ.
  $U_a = 11$ V

- LED 2 comes on

Technical Data

Characteristic Data

Working range s_a	[mm]	0...60
Linear range s_l	[mm]	5...55
Rated operating distance s_e	[mm]	30
Linearity error at s_l	[mm]	1
Repeat accuracy R_{NORM}	[% v. I_a/U_a max.]	$\leq 0,5$
Repeat accuracy R_{BWN} 1)	[µm]	±60
Ambient temperature T_A	[°C]	-10...+75
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	±2.5

Electrical Data

Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	15...30
Load resistance R_L max.(I_a) / min.(U_a)	[Ω]	2000
No-load current I_0 at U_e	[mA]	≤ 30
Protected against any wire reversal		☒
Reverse polarity protected		☒

Optical Indicators

Supply voltage	LED 1
Position magnet sensing	LED 2

Mechanical Data

Housing material	PA fibreglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: $U_e = 24V$, $R_L = 10$ kΩ, measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.
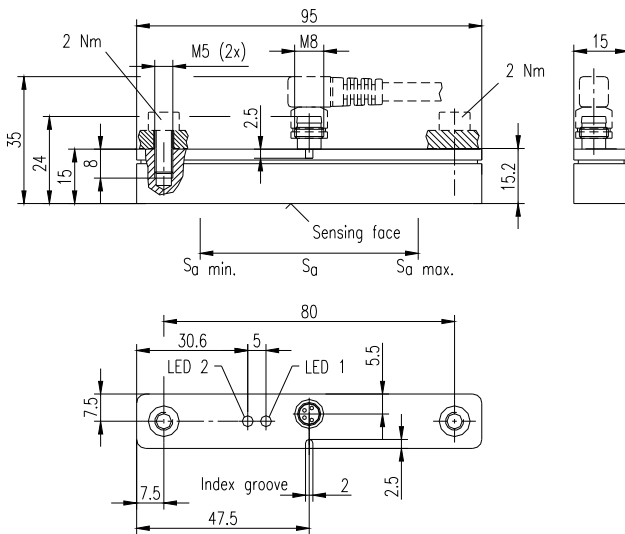
Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44

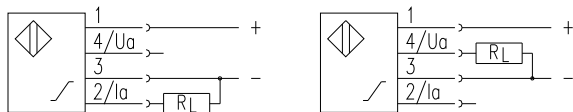For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
Appropriate connectors can be obtained from Balluff.

Inductive Analog Position Sensor
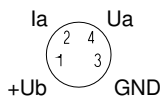# BIL EMD0-T060A-01-S75

Product View
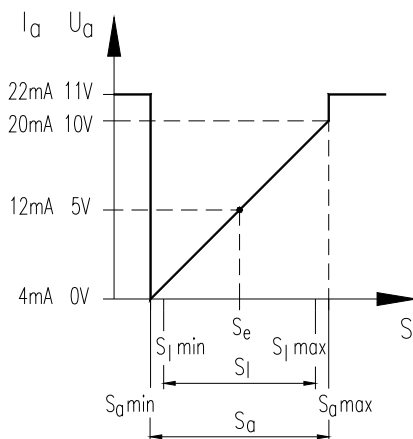

Connection Diagram

Do not use current and voltage output simultaneously.

Pin Configuration

Characteristic Curve

Position Magnet Sensing

The BIL EMD0 is capable of position magnet sensing. If the position magnet is outside the working range, this is indicated in two ways:

- The output signal rises to typ.
  I_a = 22 mA / U_a = 11 V

- LED 2 comes on

Technical Data

Characteristic Data

Working range s_a	[mm]	0...60
Linear range s_l	[mm]	5...55
Rated operating distance s_e	[mm]	30
Linearity error at s_l	[mm]	1
Repeat accuracy R_{NORM}	[% v. I_a/U_a max.]	≤ 0,5
Repeat accuracy R_{BWN} 1)	[µm]	±60
Ambient temperature T_A	[°C]	-10...+75
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	±2.5

Electrical Data

		I_a / U_a
Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	10...30 / 15...30
Load resistance R_L max.(I_a) / min.(U_a)	[Ω]	500 / 2000
No-load current I_0 at U_e	[mA]	≤ 30
Protected against any wire reversal		⊠
Reverse polarity protected		⊠

Optical Indicators

Supply voltage	LED 1
Position magnet sensing	LED 2

Mechanical Data

Housing material	PA fibreglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: U_e = 24V, R_L = 500 Ω / 10 kΩ (I/U), measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.
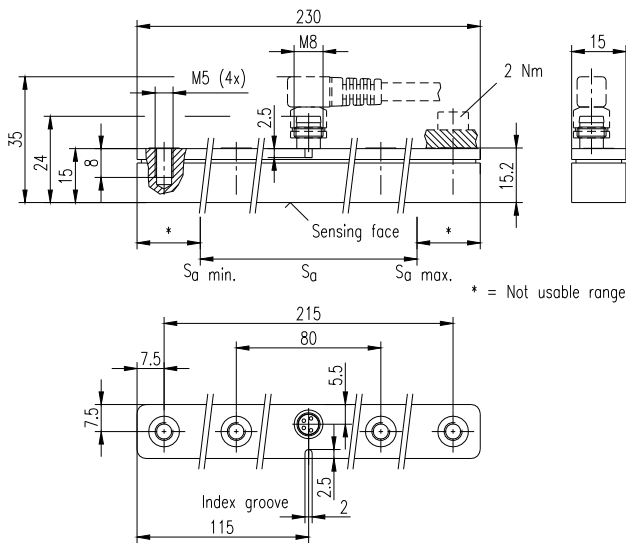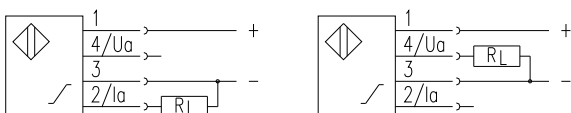
Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44

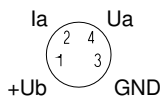For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
Appropriate connectors can be obtained from Balluff.

Inductive Analog Position Sensor
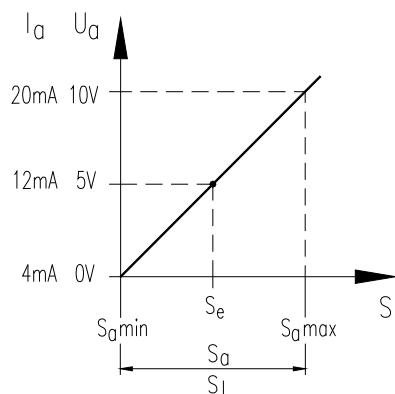# BIL ED0-P160A-01-S75

Product View

* = Not usable range

Index groove

Connection Diagram

Do not use current and voltage output simultaneously.

Pin Configuration

Ia Ua

+Ub GND

Characteristic Curve

Technical Data

Characteristic Data

Working range s_a	[mm]	0...160
Linear range s_l	[mm]	0...160
Rated operating distance s_e	[mm]	80
Linearity error at s_l	[mm]	2.4
Repeat accuracy R_{NORM}	[% v. I_a/U_a max.]	≤ 0.3
Repeat accuracy R_{BWN} 1)	[µm]	±500
Ambient temperature T_A	[°C]	-10...+75
Optimum working temperature	[°C]	+10...+50
Max. temperature drift at s_l	[%]	±3

Electrical Data

		I_a / U_a
Effective operating voltage U_e	[V]	24
Supply voltage U_B	[V]	10...30 / 15...30
Load resistance R_L max.(I_a) / min.(U_a)	[Ω]	500 / 2000
No-load current I_0 at U_e	[mA]	≤ 25
Protected against any wire reversal		⊠
Reverse polarity protected		⊠

Optical Indicators

Supply voltage	-
Position magnet sensing	-

Mechanical Data

Housing material	PA fibreglass reinforced
Enclosure rating	IP 67

Installation Dimensions

A	[mm]	50
B	[mm]	50
C	[mm]	50

Remarks

The rated operating distance se specifies the center of the measuring range. It is indicated on the sensor by an index notch.

1) Measuring conditions: U_e = 24V, R_L = 500 Ω / 10 kΩ (I/U), measured after 15 min. at the index point s_e

The characteristic data are only valid within the defined working range s_a at distance D from the respective position magnet.

Unless otherwise indicated all values are in accordance with IEC 60947-5-7, Balluff Factory Standard BWN PR. 44

For NFPA 79 applications only (machines with a supply voltage of less than 600 volts).
Appropriate connectors can be obtained from Balluff.

BIL 000-MH-A

Product view

Installation Instructions

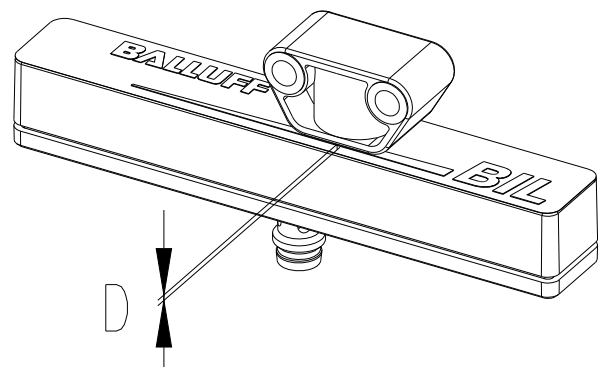BIL 000-MH-A on BIL

BIL 001-MH-A

Product view

Installation Instructions
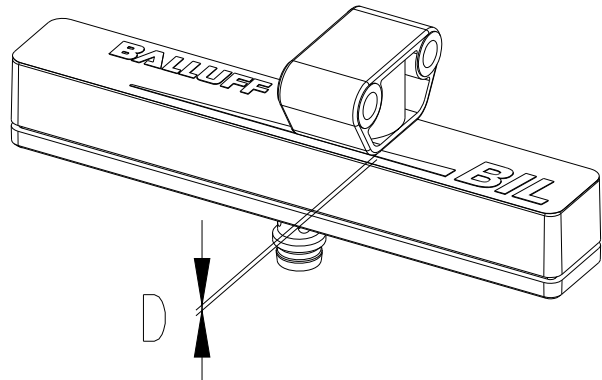
BIL 001-MH-A mounted lateral to center axis.

BIL 001-MH-A mounted axial to center axis.

Characteristic Data

Characteristic Data		
Distance D	[mm]	2
Ambient temperature	[°C]	-25…+100
Material		Hard ferrite
Weight	[g]	5

Characteristic Data

Characteristic Data		
Distance D	[mm]	1
Ambient temperature	[°C]	-25…+100
Material		PA fibreglass reinforced
Weight	[g]	8

Accessories
BIL SmartSens

Brackets

BIL 01-HW-1

Use min. 2 brackets

BIL 01-HW-2

Use min. 2 brackets
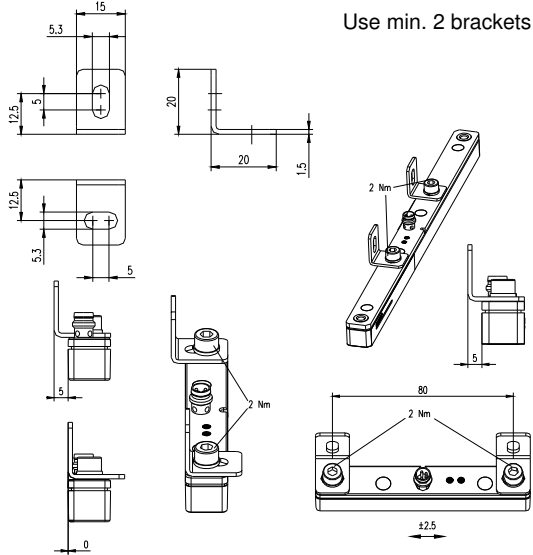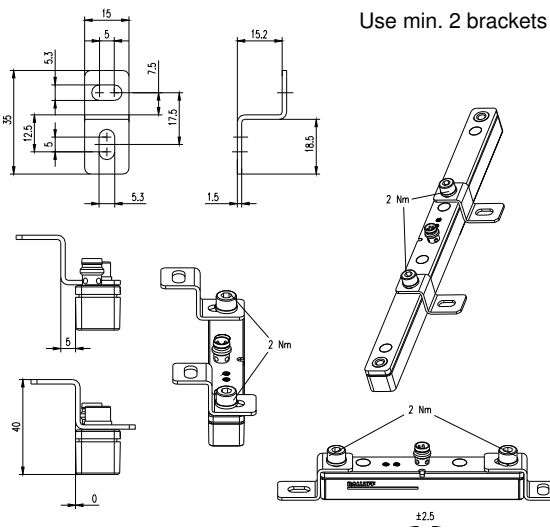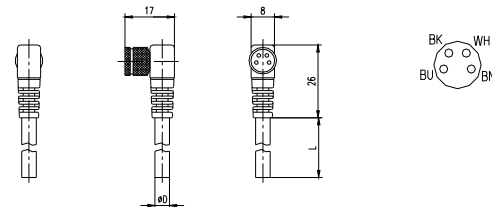
BIL 01-HW-3
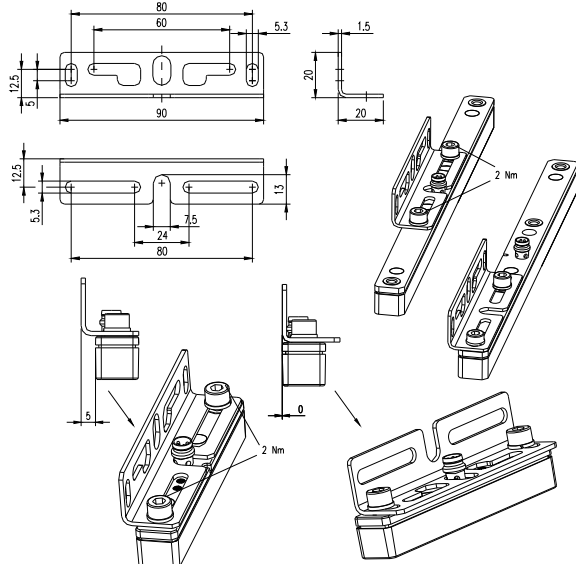
Connectors

BKS S74-3-…
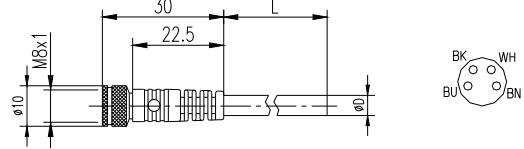
BKS S75-3-…
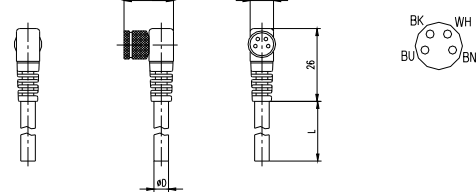
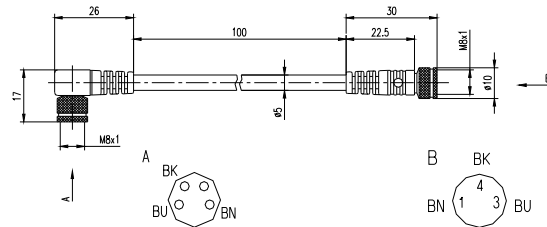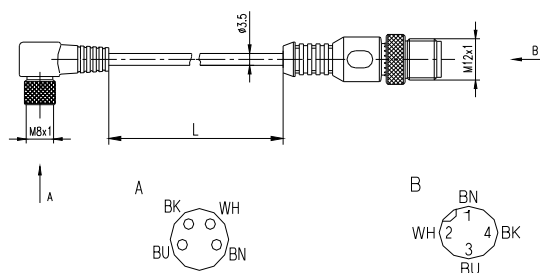### BKS S75-14-… (shielded)

BKS-S75-1/GS49-PU-00,1

BKS-S75-3/GS4-PU-..

For more information about accessories see main catalog "The Sensor Line", CD-ROM or www.balluff.de!