BALLUFF

sensors worldwide

Magnetic Linear Encoder Systems BML

... Non-Contacting and High-Resolution

Balluff is a worldwide leader in position sensing.

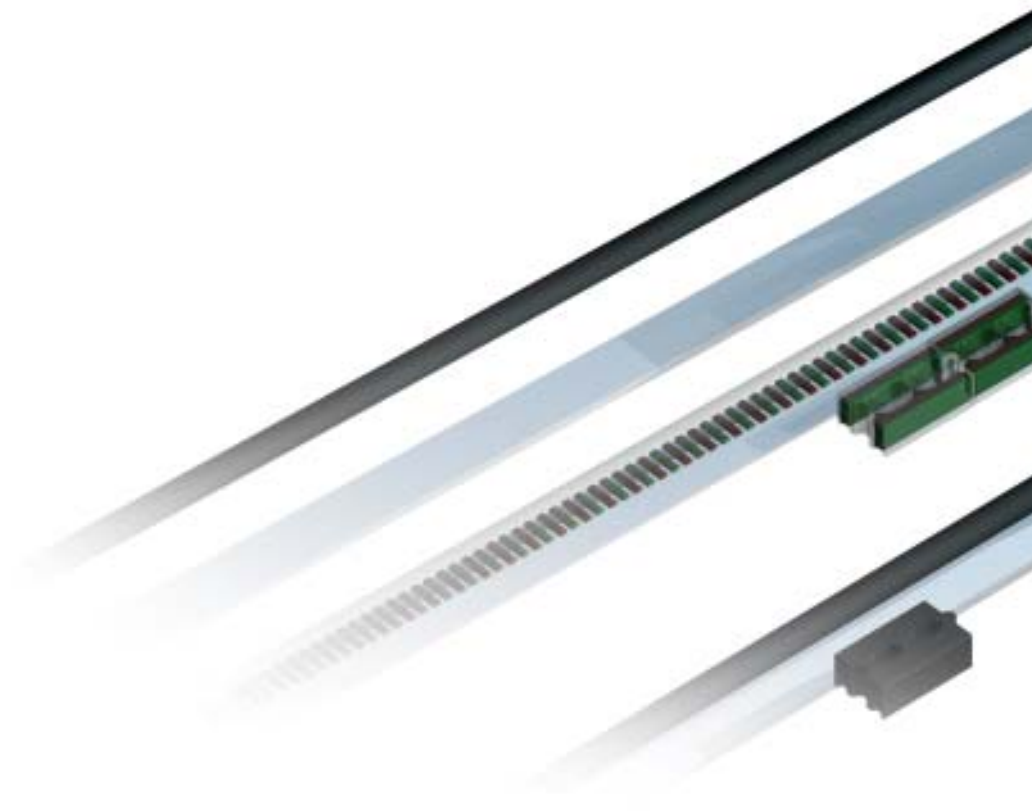
Our product lines include electronic sensors, transducers employing various operating principles, identification systems, bus-capable sensors as well as mechanical and inductive multiple and single position switches. Balluff products are found wherever accuracy and reliability are demanded.

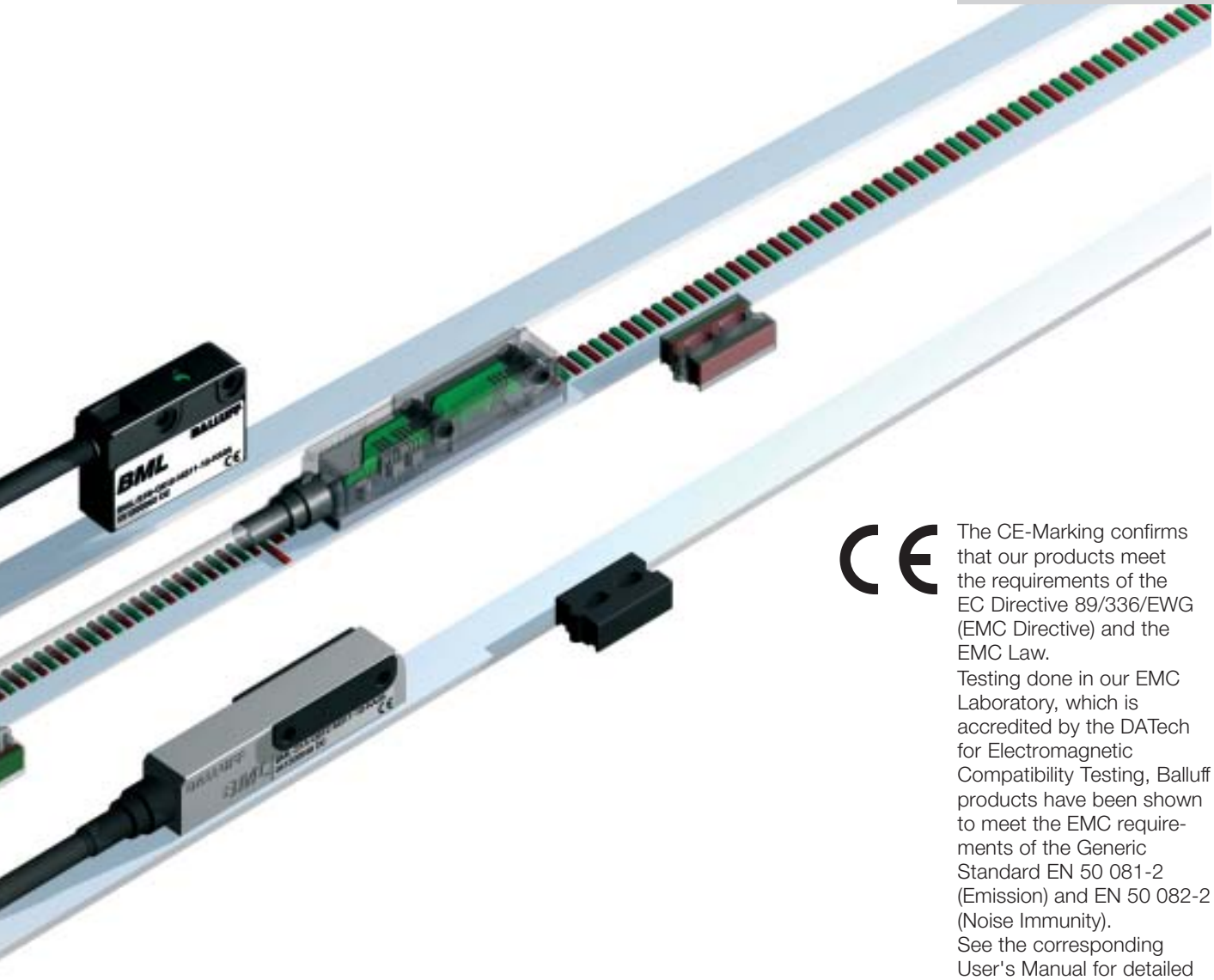
Wherever there is a need to automate, sense objects, or report linear and rotary motion to controllers – Balluff is always the right partner.

Our QM system meets the requirements of DIN EN ISO 9001:2000. Eleven Balluff companies have a certified QM system, two a certified environmental protection system. By mastering process-capable production and assembly techniques and statistical process control we achieve consistently high product quality. Intensive testing prior to series production ensures reliable function.

With more than 50 years of experience in the field of sensors, the Balluff Group is today one of the most capable manufacturers of standard as well as custom position switches. Innovative technology and application-specific customer solutions are the hallmarks of the entire product range.

Highly qualified development engineers and experienced designers work closely with the manufacturing side to ensure mature series products that are used successfully in every area of automation – even under extreme and aggressive operating conditions.





CE

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.

BML-S1A

Series	BML-S1A_-Q... digital	BML-S1A_-A... analog sin/cos, 1 V_{pp}
Resolution	1...10 µm	
System accuracy	±10 µm/±20 µm	±10 µm/±20 µm
Distance to tape	0.1...0.35 mm	0.1...0.35 mm
Output signal digital RS422 (TTL)	■	
Output signal digital HTL (same as supply voltage 10...30 V)		
Output signal analog sin/cos (1 V_{pp})		■
Linear tape	■	■
Rotating tape (magnet ring)		
Limit switches	■ Cable version only	■ Cable version only
Operating voltage	5 V ±5 %	5 V ±5 %
starting page	6	6

BML-S1B
BML-S1E

BML-S1C

	BML-S1B0-Q... digital	BML-S1E0-Q... digital	BML-S1C0-Q... digital
	5...50 µm	5...50 µm	100...2000 µm
	±50 µm/±60 µm	±100 µm	±100 µm
	0.1...2 mm	0.1...2 mm	0.1...2 mm
	■	■	
	■	■	■
	■	■	■
	■	■	■
	■	■	
	5 V ±5 %/10...30 V	5 V ±5 %/10...30 V	10...30 mm
	12	12	14

Magnetic Linear Encoder Systems BML

... non-contacting and high-resolution

The high-precision incremental BML Magnetic Linear Encoder System consists of a sensor head and a magnetically encoded tape. The sensor head glides over the tape, which is magnetized with alternating polarity, with a gap of up to 2 mm. The period changes on the sensor output are available as standard square wave or sinusoidal signals. Counting or processing of the signals is accomplished using standard incremental or sinus signal counter inputs on the processing electronics.

Magnetic linear encoder systems are highly accurate and realtime-capable

Displacement sensors with a magnetically encoded tape are a highly precise, fast-response and very rugged measuring system. Resolution is up to 1 µm. In addition, accuracy classes of 10...20 µm are achieved. The permissible traverse speed is up to 20 m/s. The measured position value is made available in fractions of microseconds. The controller receives the position signal in realtime.

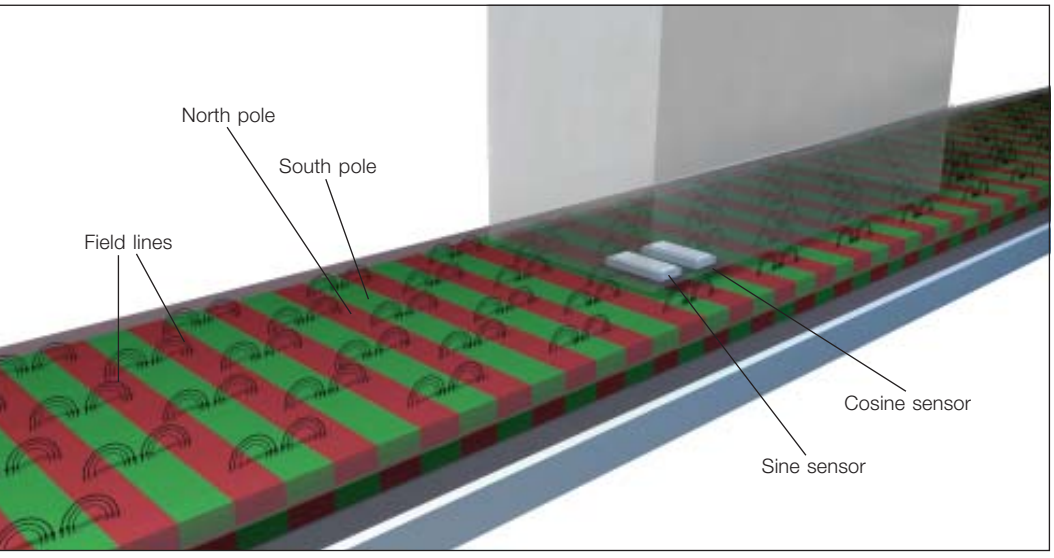
Non-contacting and highly rugged for harsh applications

In spite of the high accuracy and realtime capability, distances (gaps) of up to 2 mm (approx. 30 % of the pole width) above the magnetic tape are permitted. Since the system works on the principle of magnetism, unlike optical systems it is highly immune to contamination from oils, dust etc. These properties make it ideal for use in harsh, dusty industrial environments such as found in the wood industry.

System features

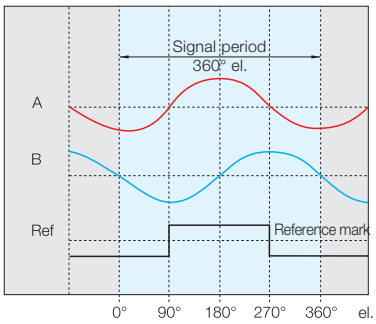
- Non-contact operating principle
- Resolution to 1 µm
- System accuracy to ±10 µm
- Digital square wave signals RS422 or 10...30 V
- Sinusoidal analog signals 1 V_{pp}
- Gap between sensor and tape up to 2 mm
- Reference and limit switch function
- Cable or connector version

Operating principle of Magnetic Linear Encoder System BML



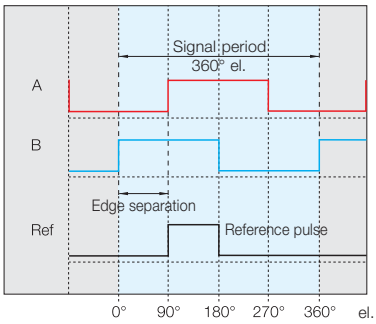
Output signals

Sinusoidal analog signals 1 V_{pp}



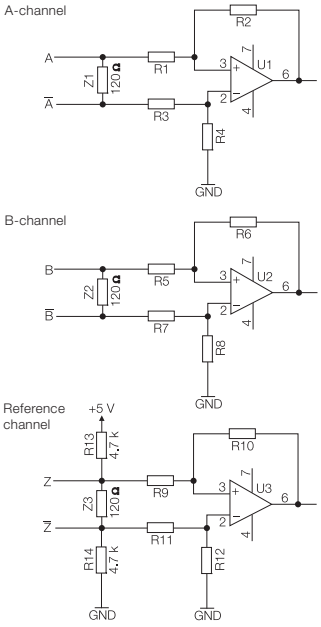
- Sinusoidal voltage signals with inversion
- Signal period 360° electrical = 1000 µm
- Termination resistance 120 Ohms

Digital square wave signals RS422

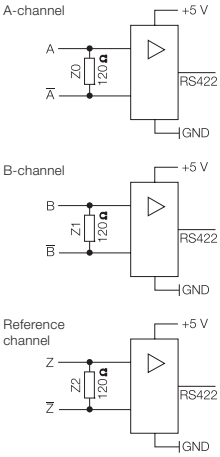


- Square wave signals RS422 to DIN 66259 90° phase shifted
- Edge separation A/B corresponds to resolution of sensor head
- Differential signal (BML-S1A...)
- Termination resistance 120 Ohms

Processing electronics

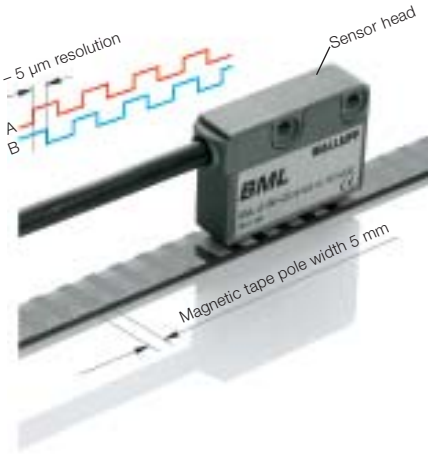


Processing electronics



BML sensor head with integrated interpolator

Example: BML-S1B... 5 µm resolution

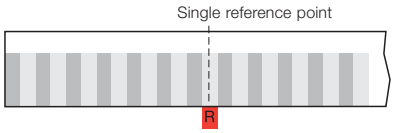


Reference points

The **pole-periodic** magnetic tape has alternating magnetic south and north poles but no integrated reference point. The reference point function is implemented by means of a reference switch.

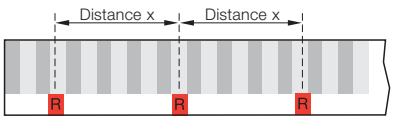
Suitable for all sensor heads

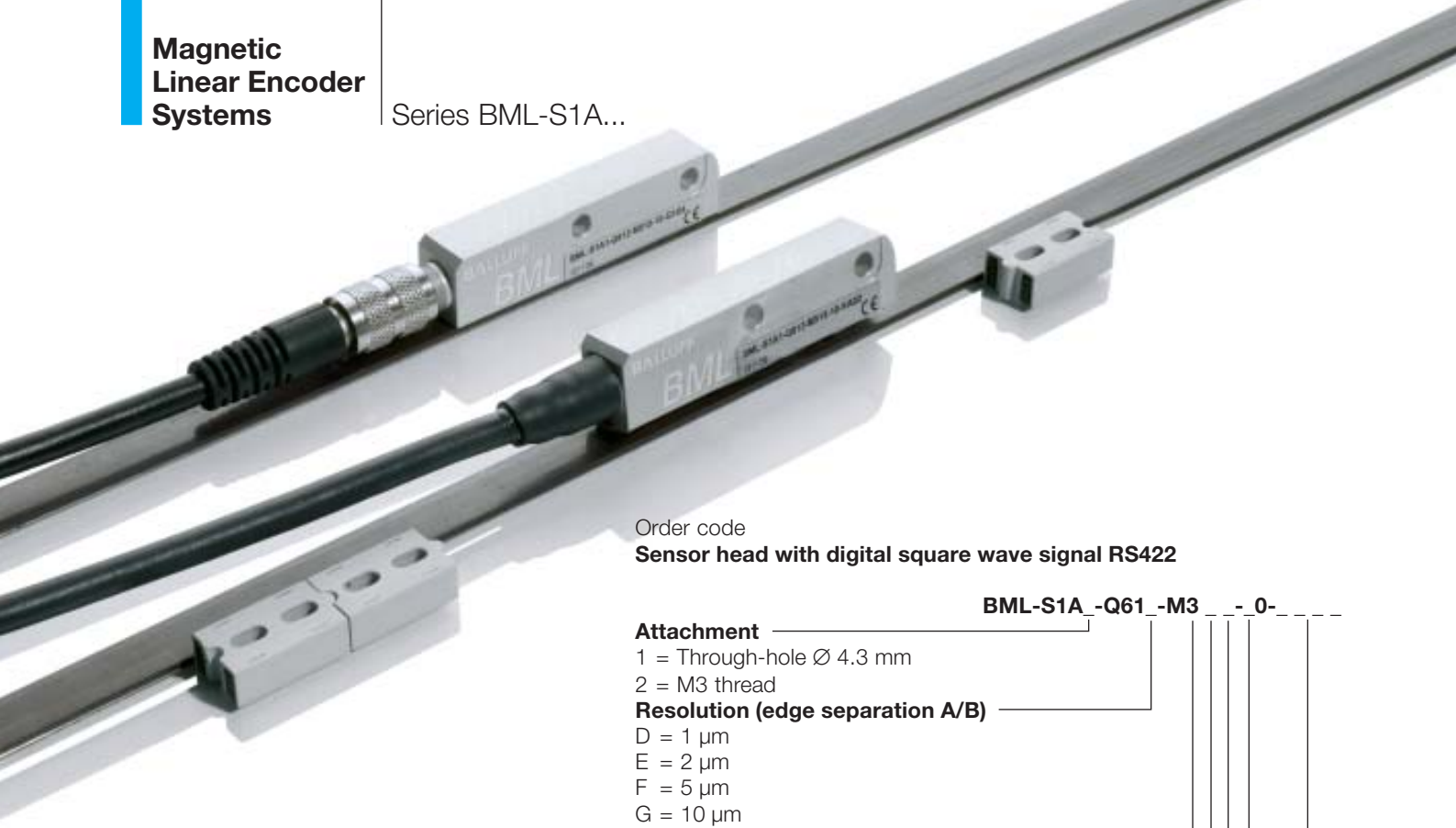
For the magnetic tape with **single reference point** the reference point may be integrated as desired at any location. To determine the exact position, the reference move must cover the entire length of the tape up to the reference point.



Not suitable for BML-S1C...

For tapes with **fixed-periodic reference points** the reference points are integrated across the entire length of the tape at certain constant intervals, such as every 10 cm. To determine the exact position, the reference move must cover the entire length of the tape up to the external reference switch.





For detailed technical description and installation instructions, see user's guide at www.balluff.com

Features

- ±10 µm system accuracy
- 1 µm resolution for digital
- 20 m/s maximum traverse speed
- Gap between sensor and tape up to 0.35 mm
- Digital square wave signals RS422 or sinusoidal analog signals
- Two limit switches (cable version only)
- Reference signal
- Cable or connector version
- Compact
- Rugged metal housing
- Easy installation using mounting thread or through-hole
- Insulator for installing the sensor where EMC conditions are extreme

Selecting the right BML system
Speeds depending on mechanical resolution and edge separation,
see page 11

Order code
Sensor head with digital square wave signal RS422

BML-S1A_-Q61_-M3 _ _-_ 0-_ _ _ _

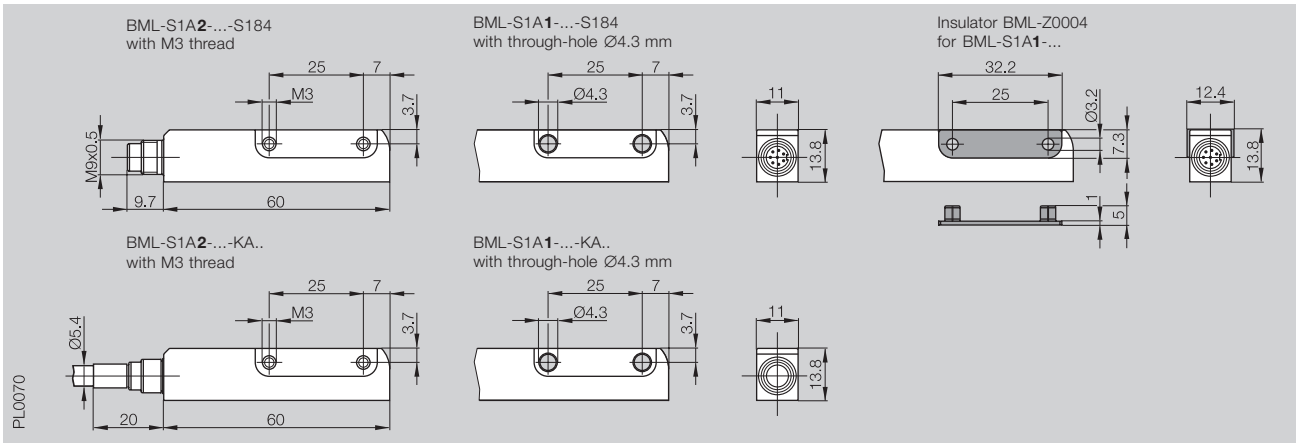
Attachment
1 = Through-hole Ø 4.3 mm
2 = M3 thread
Resolution (edge separation A/B)
D = 1 µm
E = 2 µm
F = 5 µm
G = 10 µm
Pole width
3 = 1 mm
Reference signal
0 = none
1 = single or fixed-periodic
2 = pole-periodic
Limit switches
0 = no limit switch
3 = two limit switches (cable version only)
min. edge separation
D = 0.12 µs
E = 0.29 µs
F = 0.48 µs
G = 1 µs
H = 2 µs
K = 4 µs
L = 8 µs
N = 16 µs
P = 24 µs
Connection type
S184 = Connector
KA05 = PUR cable 5 m (example)
possible cable lengths 2, 5, 10, 15 or 20 m

Order code
Sensor head with sinusoidal analog output sin/cos, 1 V_{pp}

BML-S1A_-A62Z-M3 _ _-90-_ _ _ _

Attachment
1 = Through-hole Ø 4.3 mm
2 = M3 thread
Pole width
3 = 1 mm
Reference signal
0 = none
1 = single or fixed-periodic
Limit switches
0 = no limit switch
3 = two limit switches (cable version only)
Connection type
S184 = Connector
KA05 = PUR cable 5 m (example)
possible cable lengths 2, 5, 10, 15 or 20 m

Series	**BML-S1A_-Q...**	**BML-S1A_-A...**
Interface	incremental	incremental
Output signal	**digital square wave signals RS422**	**sinusoidal analog signals sin/cos**
Resolution	1 µm, 2 µm, 5 µm or 10 µm	depending on processing

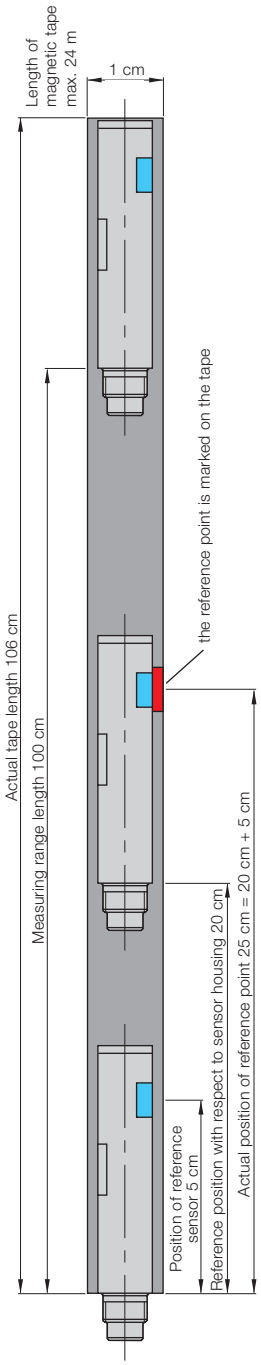


Order code	BML-S1A_-**Q**_ _ _-M3 _ _-_0-_ _ _ _	BML-S1A_-**A**_ _ _-M3 _ _-_0-_ _ _ _
Output voltage (A/B/Z)	RS422 to DIN 66259	1 V_{pp}
Output voltage of limit switch, U_{max} = 28 V, I_{max} = 25 mA	GND-switching NC (cable break monitoring)	GND-switching NC (cable break monitoring)
Hysteresis depending on working distance	1...5 µm	1...5 µm
Temperature coefficient (steel)	ca. 10.5×10^{-6}/K	ca. 10.5×10^{-6}/K
Max. non-linearity (Lin 1) of the processing electronics, unidirectional	±2 µm	min. ±2 µm (depending on processing electronics)
Max. non-linearity of the magnetic tape (Lin2), unidirectional, measuring length max. 48 m	±8 µm or ±18 µm	±8 µm or ±18 µm
Overall system accuracy (Lin1 + Lin2)	±10 µm or ±20 µm	±10 µm or ±20 µm
Supply voltage	5 V ±5 %	5 V ±5 %
Current draw at 5 V operating voltage	< 50 mA + current draw of the controller (depending on internal resistance)	< 50 mA + current draw of the controller (depending on internal resistance)
Permissible distance between sensor and tape	0.01...0.35 mm	0.01...0.35 mm
Traverse speed max.	20 m/s	> 20 m/s
Operating temperature, cable style	–20...+80 °C	–20...+80 °C
Operating temperature, connector style	–20...+70 °C	–20...+70 °C
Recommended processing temperature for tape	0...+40 °C	0...+40 °C
Housing material	GD-Zn	GD-Zn
Cable type	LIf12YFCF11Y 6×2×0.08 mm^2	LIf12YFCF11Y 6×2×0.08 mm^2
Reference signal	none, single, fixed or pole-periodic	none or fixed-periodic
Degree of protection	IP 67	IP 67

Pin configuration	Pin	Color connector style	Color cable style	Digital signal	Analog signal
Output signals	1	WH	WH	A	A (sin)
	2	BN	BN	$\overline{A}$	$\overline{A}$ (–sin)
	3	GN	GN	B	B (cos)
	4	YE	YE	$\overline{B}$	$\overline{B}$ (–cos)
	5	GY	GY	Z	Z
	6	PK	PK	$\overline{Z}$	$\overline{Z}$
Operating voltage	7	BU	BU	0 V	0 V
	8	RD	RD	5 V	5 V
			BK	0 V sense	0 V sense
			VT	5 V sense	5 V sense
			GYPK	Front limit switch	Front limit switch
			RDBU	Rear limit switch	Rear limit switch

Shield connected to housing

Position of single reference point using example of BML-M01-I34-A3-M0106-R0020
Length in cm: 0106,
reference point position in cm: 0020



Order code
Pre-assembled magnetic tape

BML-M_ _-I3_ -A_-M_ _ _ _-R_ _ _ _

Construction
01 = 10 mm wide, 1.7 mm thick
02 = 10 mm wide, 1.55 mm thick
for lengths up to 48 m

Type
I = incremental

Pole width
3 = 1 mm (for BML-S1A)

Accuracy class
4 = 8 µm, overall accuracy ±10 µm
5 = 18 µm, overall accuracy ±20 µm

Cover Strip
3 = with cover strip
0 = without cover strip

Length in cm
Order length = effective measuring length + 6 cm
e.g. 100 cm effective measuring length + 6 cm = 106 cm order length

Reference point type
R = no reference point or
1 reference point or
pole-periodic reference point
C = fixed-periodic reference point

Reference point position
0000 = none or pole-periodic
xxxx = only type **R** with 1 reference point: for xxxx cm from back end of tape, in example 20 cm effective measuring length
xxxx = only type **C**: 0002, 0005, 0010, 0020 or 0050 (every 2, 5, 10, 20 or 50 cm)

Order code
Magnetic tape by the roll

BML-M_ _-I3_-A0-T_ _ _ _-R0000

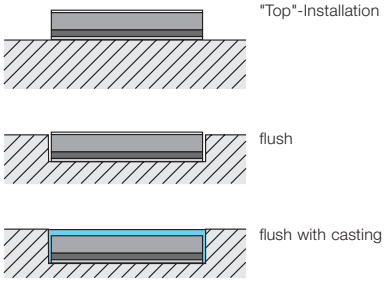
Construction
01 = 10 mm wide, 1.7 mm thick
02 = 10 mm wide, 1.55 mm thick

Pole width
3 = 1 mm (for BML-S1A)

Accuracy class
4 = 8 µm, overall accuracy ±10 µm
5 = 18 µm, overall accuracy ±20 µm

Length
0500 = 5 m
1000 = 10 m
2400 = 24 m
4800 = 48 m, only BML-M02

Magnetic tape mounting options
(also in magnetizable material)



Select the right BML system for your controller or determine the right controller for your BML system

Table 1 shows the relationship between the min. edge separation, the resolution and the max. traverse speed for BML systems using a magnetic tape.

Important!
The controller/display must be able to count the minimum edge separations (time) indicated in the table. Please be aware of the counting frequency of your controller!

The min. edge separation may even be present in the stopped state due to the internal interpolation procedure.
If the controller cannot count the min. edge separation, select a BML with a greater edge separation.

Determining the suitable BML system for a given controller
(see Table 1)

Assumptions:
- Your controller can detect a min. edge separation of 0.5 µs.
- The max. traverse speed of the system should be 1 m/s.

Determining the appropriate BML:
- You need a BML with min. edge separation 1 µs (G-type).
- To be able to traverse at max. 1 m/s, select the model with 2 µm resolution (E-type).

Determining the max. counting frequency of the required controller
(see Table 1)

The period of the input signal is 4× the edge separation. The max. frequency of the input signal is then 1/(4× edge separation).

Example:
For edge separation 1 µs of a type G BML the max. frequency of the input signal is 1/4 µs = 250 kHz.
The max. counting frequency for 4× evaluation is 1/edge separation = 1/1 µs = 1 MHz.

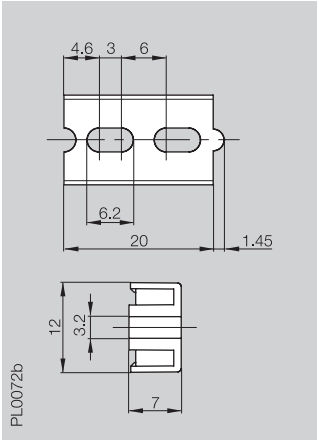
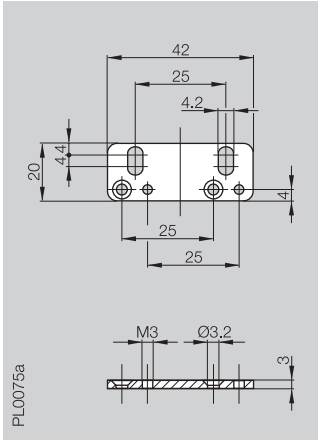
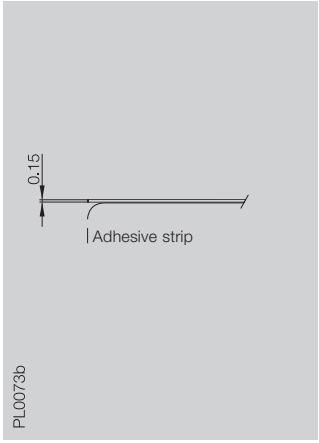
The maximum traverse speed depends on the edge separation and on the resolution (see Table 1).

In the table the **X** indicates the min. edge separation in time of the BML type and **Y** the mechanical resolution (see part numbering code).

BML - S1A1 - Q61**Y** - M313 - **X**0 - KA05
mech. **resolution Y** (see table for codes)
min. **edge separation X** (see table for codes)

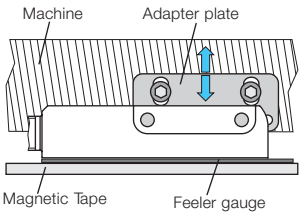
	Mechanical resolution Y:			
	D = 1 µm	**E** = 2 µm	**F** = 5 µm	**G** = 10 µm
min. edge separation X	**V_{max} based on edge separation and resolution**			
D = 0.12 µs	5 m/s	10 m/s	20 m/s	20 m/s
D = 0.29 µs	2 m/s	4 m/s	10 m/s	10 m/s
F = 0.48 µs	1 m/s	2 m/s	5.41 m/s	5.41 m/s
G = 1 µs	0.65 m/s	1.3 m/s	2.95 m/s	2.95 m/s
H = 2 µs	0.3 m/s	0.6 m/s	1.54 m/s	1.54 m/s
K = 4 µs	0.15 m/s	0.3 m/s	0.79 m/s	0.79 m/s
L = 8 µs	0.075 m/s	0.15 m/s	0.34 m/s	0.34 m/s
N = 16 µs	0.039 m/s	0.079 m/s	0.19 m/s	0.19 m/s
P = 24 µs	0.026 m/s	0.052 m/s	0.13 m/s	0.13 m/s

Table 1: BML-S1A... with defined min. edge separations.

Accessories	Limit switch magnet	Adapter plate	Cover strip by the roll
			
Order code	BML-Z0002	BML-Z0005	BML-A013-T_ _ _ _

The adapter plate allows you to set the vertical distance from the tape. It can be attached on the left or right of the sensor head.

Installation example



To prevent damage to the tape from things like chips or chemicals, it may be covered with a strip of stainless steel. Note that the permissible air gap between the sensor head and tape is reduced by the thickness of the cover strip with adhesive film (0.15 mm).

Ship configurations:
Cover strip and magnetic tape can be ordered together in matching lengths (see ordering code for tape).

Cover strip by the roll can be ordered in 4 defined lengths.

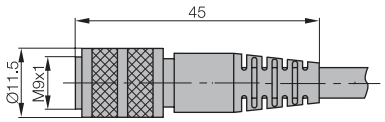
Ordering example

BML-A013-T_ _ _ _

Length
0500 = 5 m
1000 = 10 m
2400 = 24 m
4800 = 48 m

For detailed technical description and installation instructions, see user's guide at www.balluff.com

Connector BKS-S184-PU-_ _



Version	8-pin, straight female
Housing and cable material	PUR
Contact	CuSn
Contact surface	Au
Cable diameter	5.5 mm
No. of conductors x cross-section	8×0.14 mm²
Cable type	(4×(2×Lif.PP.F)) +V.C.V.M-PUR/0.14/5.3)
Enclosure rating per IEC 60529	IP 67 (when threaded together)
Knurled nut	CuZn
Least bending radius	dynamic 15×D, static 7.5×D
Temperature range	–25...+70 °C

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

Please append cable length to ordering code!
Possible cable lengths 2, 5, 10 or 15 m

For detailed technical description and installation instructions, see user's guide at www.balluff.com

Features

- 5 µm resolution
- 20 m/s maximum traverse speed
- Distance between sensor and tape up to 2 mm
- Digital square wave signals RS422 or output voltage 10...30 V
- Two freely positionable limit switches
- Reference signal
- Cable connection

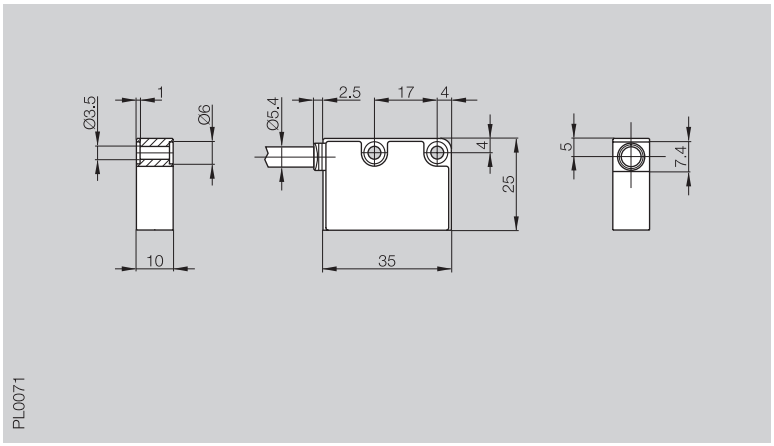
Order code
sensor head

BML-S1_0-_ _ _ _-M4 _ _-_0-_ _ _ _

Series
B
E
Output signal
Q = incremental (digital)
Operating voltage
5 = 10...30 V
6 = 5 V
Output voltage
1 = digital square wave signal RS422
3 = level same as operating voltage (only for 10...30 V)
Resolution (edge separation A/B)
F = 5 µm
G = 10 µm
H = 25 µm
K = 50 µm
Pole width
4 = 5 mm
Reference signal
0 = none
1 = single
2 = pole-periodic
Limit switches
0 = no limit switch
3 = two limit switches
min. edge separation
D = 0.12 µs
E = 0.29 µs
F = 0.48 µs
G = 1 µs
H = 2 µs
K = 4 µs
L = 8 µs
N = 16 µs
P = 24 µs
Connection type
KA05 = PUR cable 5 m (example)
possible cable lengths 2, 5, 10, 15 or 20 m

Selecting the right BML system
Speeds depending on mechanical resolution and edge separation, see page 19)

Series	**BML-S1B0-...**	**BML-S1E0-...**
Interface	incremental	incremental
Output signal	**digital square wave signals**	**digital square wave signals**
Resolution	5 µm, 10 µm, 25 µm or 50 µm	5 µm, 10 µm, 25 µm or 50 µm



Order code	BML-S1B0-_ _ _ _-M4_ _-_0-_ _ _ _	BML-S1E0-_ _ _ _-M4_ _-_0-_ _ _ _
Output voltage (A/B/Z)	RS422 to DIN 66259 or same as supply voltage 10...30 V (without $\overline{A}/\overline{B}/\overline{Z}$)	RS422 to DIN 66259 or same as supply voltage 10...30 V (without $\overline{A}/\overline{B}/\overline{Z}$)
Output voltage of limit switch, U_{max} = 28 V, I_{max} = 25 mA	GND-switching NC (cable break monitoring)	GND-switching NC (cable break monitoring)
Hysteresis depending on working distance	3...7 µm	3...7 µm
Temperature coefficient (steel)	ca. 10.5×10^{-6}/K	ca. 10.5×10^{-6}/K
Max. non-linearity (Lin1) f the processing electronics, unidirectional	at 0.1...1 mm distance from tape ±30 µm at 1...2 mm distance from tape ±40 µm	at 0.1...2 mm distance from tape ±50 µm
Max. non-linearity of the magnetic tape (Lin2), unidirectional, measuring length max. 24 m	±18 µm	±50 µm
Overall system accuracy (Lin1 + Lin2)	±50 µm or ±60 µm	±100 µm
Supply voltage	10...30 V or 5 V ±5 %	10...30 V or 5 V ±5 %
Current draw at 5 V operating voltage	< 50 mA + current draw of the controller (depending on internal resistance)	< 50 mA + current draw of the controller (depending on internal resistance)
Current draw at 10...30 V operating voltage	< 40 mA + current draw of the controller (depending on internal resistance)	< 40 mA + current draw of the controller (depending on internal resistance)
Permissible distance between sensor and tape	0.01...2 mm	0.01...2 mm
Traverse speed max.	20 m/s	20 m/s
Operating temperature	–20...+80 °C	–20...+80 °C
Recommended processing temperature for tape	0...+40 °C	0...+40 °C
Housing material	PBT	PBT
Cable type	LIf12YFCF11Y 6×2×0.08 mm²	LIf12YFCF11Y 6×2×0.08 mm²
Reference signal	none, individual or periodic	none, individual or periodic
Degree of protection	IP 67	IP 67

Wiring configuration	Color	
Output-signals	WH	A
	BN	$\overline{A}$ (not connected for BML-S1B0/E0-Q53...)
	GN	B
	YE	$\overline{B}$ (not connected for BML-S1B0/E0-Q53...)
	GY	Z
	PK	$\overline{Z}$ (not connected for BML-S1B0/E0-Q53...)
Supply voltage	BU	0 V
	RD	10...30 V or 5 V
	BK	0 V sense
	VT	10...30 V or 5 V sense
	GYPK	Front limit switch
	RDBU	Rear limit switch

For detailed technical description and installation instructions, see user's guide at www.balluff.com

Features

- ±100 µm system accuracy at 0.1...2 mm distance from tape
- High repeat accuracy ±1 increment
- 0.1 mm resolution
- 10 m/s maximum traverse speed
- Distance between sensor and tape up to 2 mm
- Digital square wave signals output voltage 10...30 V (HTL)
- Cable connection
- 10...30 V DC output voltage

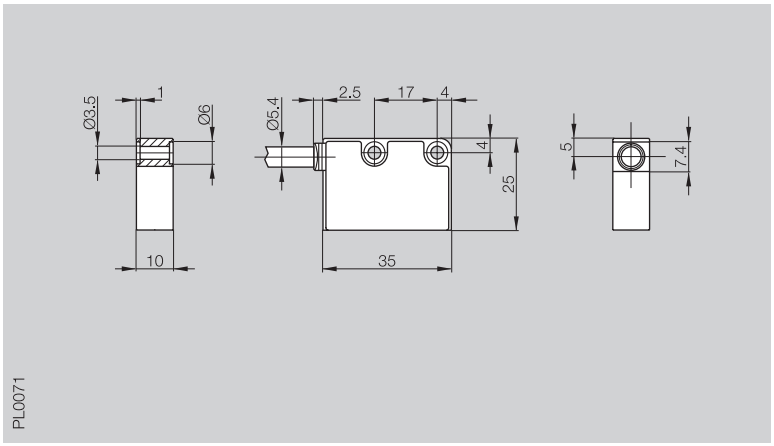
Order code
Sensor head

BML-S1C0-Q53_-M400-_0-KA_ _

Output signal
Q = incremental (digital)
Operating voltage
5 = 10...30 V
Output voltage
3 = Level same as supply voltage
Resolution (edge separation A/B)
L = 0.1 mm
M = 0.2 mm
N = 0.5 mm
P = 1.0 mm
R = 2.0 mm
Pole width
4 = 5 mm
Reference signal
0 = none
Limit switches
0 = no limit switch
min. edge separation
M = 10 µs
R = 100 µs
Connection type
KA05 = PUR cable 5 m (for example)
possible cable lengths 2, 5, 10, 15 or 20 m

Selecting the right BML system
Speeds depending on mechanical resolution and edge separation, see page 19)

Series	**BML-S1C0-...**
Interface	incremental
Output signal	**digital square wave signals**
Resolution	0.1 mm, 0.2 mm, 0.5 mm, 1 mm or 2 mm



Order code	BML-S1C0-Q53_-M400-_0-KA_ _
Output voltage (A/B)	same as supply voltage 10...30 V without $\overline{A}/\overline{B}$ (HTL)
Hysteresis	< 1 increment
Temperature coefficient (steel)	approx. 10.5×10^{-6}/K
Max. non-linearity (Lin1) of the processing electronics, unidirectional	±50 µm
Max. non-linearity (Lin 2) of the magnetic tape, unidirectional, measuring length max. 24 m	±50 µm
Overall system accuracy(Lin1 + Lin2)	±100 µm
Supply voltage	10...30 mm
Current draw at 10...30 V operating voltage	< 40 mA + current draw of the controller (depending on internal resistance)
Permissible distance between sensor and tape	0...2 mm
Traverse speed max.	10 m/s
Operating temperature	–20...+80 °C
Recommended processing temperature for tape	0...+40 °C
Housing material	PBT
Cable type	LiF9Y-FCV-F11Y-O 4×0.14 mm²
Degree of protection	IP 67

Wiring configuration	Color	
Output signals	WH	A
	GN	B
Supply voltage	BU	0 V
	RD	10...30 mm

Order code
Pre-assembled magnetic tape

BML-M_ _- I4_-A_-M_ _ _ _-R_ _ _ _

Construction
01 = 10 mm wide, 1.7 mm thick
02 = 10 mm wide, 1.55 mm thick
for lengths up to 48 m

Type
I = incremental

Pole width
4 = 5 mm

Accuracy class
5 = 18 µm, overall accuracy ±20 µm
6 = 50 µm, overall accuracy ±100 µm
(only BML-S1E and -S1C)

Cover Strip
3 = with cover strip
0 = without cover strip

Length in cm
Order length = effective measuring length + 6 cm, e.g. 100 cm
effective measuring length + 6 cm = 106 cm order length

Reference point type[1)]
R = No reference point or
1 reference point or
pole-periodic reference point

Reference point position[1)]
0000 = None or pole-periodic
xxxx = only type **R** with 1 reference point: for xxxx cm from back end of tape, in the example 20 cm effective measuring length

[1)] For BML-S1C only R0000 (no reference point)

Order code
Magnetic tape by the roll

BML-M_ _-I4_-A0-T_ _ _ _-R0000

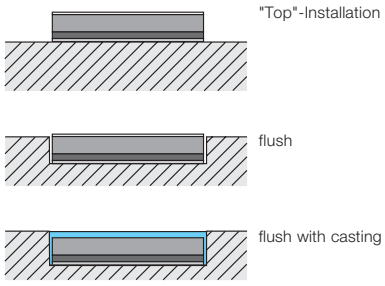
Construction
01 = 10 mm wide, 1.7 mm thick
02 = 10 mm wide, 1.55 mm thick

Pole width
4 = 5 mm

Accuracy class
5 = 18 µm, overall accuracy ±20 µm
6 = 50 µm, overall accuracy ±100 µm (only BML-S1E)

Length
0500 = 5 m
1000 = 10 m
2400 = 24 m
4800 = 48 m, only BML-M02

Magnetic tape mounting options
(also in magnetizable material)



Select the right BML system for your controller or determine the right controller for your BML system

Tables 2 and 3 show the relationship between the min. edge separation, the resolution and the max. traverse speed for BML systems using a magnetic tape.

Important!
The controller/display must be able to count the minimum edge separations (time) indicated in the table. Please be aware of the counting frequency of your controller!

The min. edge separation may even be present in the stopped state due to the internal interpolation procedure.
If the controller cannot count the min. edge separation, select a BML with a greater edge separation.

Determining the suitable BML system for a given controller
(see Table 2)

Assumptions:
- Your controller can detect a min. edge separation of 1.8 µs.
- The max. traverse speed of the system should be 2 m/s.

Determining the appropriate BML:
- You need a BML with min. edge separation 2 µs (type H).
- To be able to traverse at max. 2 m/s, select the model with 10 µm resolution (G-type).

Determining the max. counting frequency of the required controller
(see Table 2)

The period of the input signal is 4× the edge separation. The max. frequency of the input signal is then 1/(4× edge separation).

Example:
For edge separation 1 µs of the type G BML the max. frequency of the input signal is 1/4 µs = 250 kHz.
The max. counting frequency for 4× evaluation is 1/edge separation = 1/1 µs = 1 MHz.

The maximum traverse speed depends on the edge separation and on the resolution (see Tables 2, 3).

In the tables the **X** indicates the min. edge separation in time of the BML type and **Y** the mechanical resolution (see part numbering code).

BML - S1B0 - Q53**Y** - M413 - **X**0 - KA05
mech. **resolution Y** (see table for codes)
min. **edge separation X** (see table for codes)

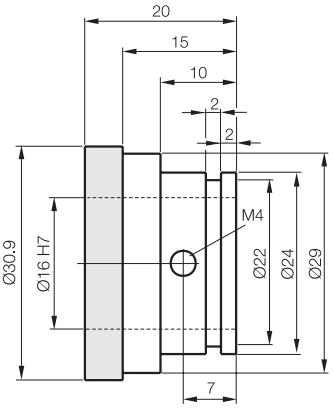
	Mechanical resolution Y:			
	F = 5 µm	**G** = 10 µm	**H** = 25 µm	**K** = 50 µm
min. edge separation X	**V_{max} based on edge separation and resolution**			
D = 0.12 µs	20 m/s	20 m/s	20 m/s	20 m/s
E = 0.29 µs	10 m/s	20 m/s	20 m/s	20 m/s
F = 0.48 µs	5 m/s	10 m/s	20 m/s	20 m/s
G = 1 µs	3.25 m/s	6.5 m/s	14.75 m/s	14.75 m/s
H = 2 µs	1.5 m/s	3 m/s	7.7 m/s	7.7 m/s
K = 4 µs	0.75 m/s	1.5 m/s	3.95 m/s	3.95 m/s
L = 8 µs	0.375 m/s	0.75 m/s	1.7 m/s	1.7 m/s
N = 16 µs	0.195 m/s	0.395 m/s	0.95 m/s	0.95 m/s
P = 24 µs	0.13 m/s	0.26 m/s	0./65 m/s	0.65 m/s

Table 2: BML-S1B... , -S1E... with defined min. edge separations.

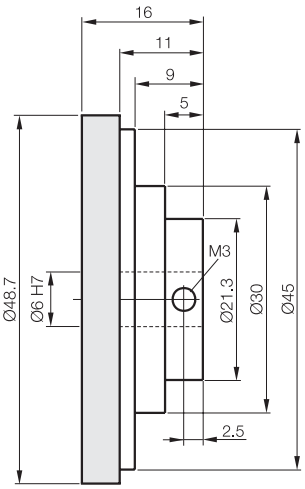
	Mechanical resolution Y:				
	L = 100 µm	**M** = 200 µm	**N** = 500 µm	**P** = 1000 µm	**R** = 2000 µm
min. edge separation X	**V_{max} based on edge separation and resolution**				
M = 10 µs	8 m/s	10 m/s	10 m/s	10 m/s	10 m/s
R = 100 µs	0.9 m/s	1.8 m/s	4.2 m/s	8.8 m/s	10 m/s

Table 3: BML-S1C0... with defined min. edge separations.

BML-M22-I40-A0-M031/016-R0



BML-M21-I40-A0-M048/006-R0



BML-M20-I40-A0-M031/021-R0 (Fig. 1)
BML-M20-I40-A0-M048/037-R0 (Fig. 2)
BML-M20-I40-A0-M072/054-R0 (Fig. 3)

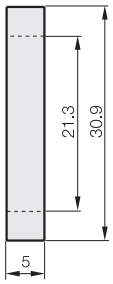


Fig. 1

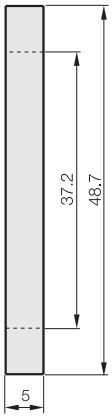


Fig. 2

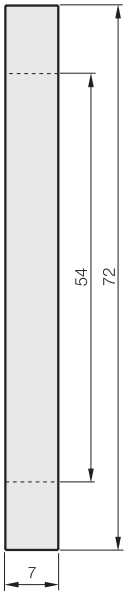


Fig. 3

PL0089

Magnet ring	with boss	without boss
Pole width	5 mm	
Reference mark	without	

For detailed technical description and installation instructions, see user's guide at www.balluff.com

Determining resolution and max. rotational speed for BML systems with magnet ring

Step 1
First decide how many pulses per revolution your application requires. This will be used to select the magnet ring outside diameter, the resolution of the sensor head, and the sensor head model (BML-S1B..., -S1E..., S1C...).

Tables 4 and 5 show the relationship between the outside diameter of the individual magnet rings, the number of pulses per revolution, and the sensor head resolution.

Example (see Table 4):
- The application requires 10,000 pulses/revolution.
- These pulses are provided by the BML system, consisting of a sensor head with a resolution of 10 µm (G-type) and a magnet ring with 31 mm outside diameter.

	∅ Magnet ring O.D.	31 mm	49 mm	72 mm
	No. of poles	20	32	46
Resolution Y sensor head	**Pole width magnet ring**	**Pulses with 4× evaluation**		
F = 5 µm	5 mm	20,000	32,000	46,000
G = 10 µm	5 mm	10,000	16,000	23,000
H = 25 µm	5 mm	4,000	6,400	9,200
K = 50 µm	5 mm	2,000	3,200	4,600

Table 4: Pulses/revolution of a BML-S1B... /-S1E... system with magnet rings.

	∅ Magnet ring O.D.	31 mm	49 mm	72 mm
	No. of poles	20	32	46
Resolution Y sensor head	**Pole width magnet ring**	**Pulses with 4× evaluation**		
L = 100 µm	5 mm	1.000	1.600	2.300
M = 200 µm	5 mm	500	800	1.150
N = 500 µm	5 mm	200	320	460
P = 1000 µm	5 mm	100	160	230
R = 2000 µm	5 mm	50	80	115

Table 5: Pulses/revolution of a BML-S1C... system with magnet rings.

Step 2A
If the rotational speed is a given for your application, select the sensor head with the minimum edge separation which corresponds to the specified pulse count/revolution and based on the magnet ring and resolution you selected in Step 1.

Example (see Table 6):
Assumptions:
– The specified pulse number is 10,000/revolution (see Step 1: Ring with 31 mm outside diameter and BML resolution 10 µm).
– The max. rotational speed should be 5000 rpm.

Determining the appropriate BML system:
– The speed is to be achieved using the BML system consisting of a magnet ring with 31 mm outside diameter and a sensor head with 10 µm resolution (G-type) and an edge separation of 0.48 µm (F-type).

Step 2B
If there is a controller with the min. edge separation, a max. speed results from a selected resolution (pulses/revolution).

Example (see Table 6):
Assumptions:
– Let the min. edge separation be 0.9 µs.

Determining the appropriate BML system:
– The edge separation is provided by the BML system consisting of a magnet ring with 31 mm outside diameter and a sensor head with 1 µm edge separation (G-type) and a resolution of 10 µm (G-type). Using this system a max. speed of 3,900 rpm is possible.
If this speed is not sufficient, the number of pulses per revolution (resolution) needs to be reduced, e.g. to 4000 (H-type).
Using this system a max. speed of 8,850 rpm is possible.

Tables 6 and 8 show the relationship between the min. edge separation, the resolution and the max. rotational speed for BML systems using magnet rings.

BML - S1E0 - Q53**Y** - M413 - **X**0 - KA05
mech. **resolution Y** (see table for codes)
min. **edge separation X** (see table for codes)

	Mechanical resolution Y	**F** = 5 µm	**G** = 10 µm	**H** = 25 µm	**K** = 50 µm
	Pulses/revolution	20,000	10,000	4,000	2,000
min. edge separation X	**max. kHz/channel**	**max. speed for magnet ring with 31 mm O.D.**			
D = 0.12 µs	2,100	12,000	12,000	12,000	12,000
E = 0.29 µs	860	6,000	12,000	12,000	12,000
F = 0.48 µs	520	3,000	6,000	12,000	12,000
G = 1 µs	250	1,950	3,900	8,850	8,850
H = 2 µs	125	900	1,800	4,620	4,620
K = 4 µs	63	450	900	2,370	2,370
L = 8 µs	32	225	450	1,020	1,020
N = 16 µs	16	117	237	570	570
P = 24 µs	10	78	156	390	390

Table 6: Max. speeds as a function of edge separation and resolution for magnet ring with O.D. 31 mm.

	Mechanical resolution Y	**F** = 5 µm	**G** = 10 µm	**H** = 25 µm	**K** = 50 µm
	Pulses/revolution	32,000	16,000	6,400	3,200
min. edge separation X	**max. kHz/channel**	**max. speed for magnet ring with 48 mm O.D.**			
D = 0.12 µs	2,100	7,500	7,500	7,500	7,500
E = 0.29 µs	860	3,750	7,500	7,500	7,500
F = 0.48 µs	520	1,875	3,750	7,500	7,500
G = 1 µs	250	1,219	2,438	5,531	5,531
H = 2 µs	125	563	1,125	2,888	2,888
K = 4 µs	63	281	563	1,481	1,481
L = 8 µs	32	141	281	638	638
N = 16 µs	16	73	148	356	356
P = 24 µs	10	49	98	244	244

Table 7: Max. speeds as a function of edge separation and resolution for magnet ring with O.D. 48 mm.

	Mechanical resolution Y	**F** = 5 µm	**G** = 10 µm	**H** = 25 µm	**K** = 50 µm
	Pulses/revolution	46,000	23,000	9,200	4,600
min. edge separation X	**max. kHz/channel**	**max. speed for magnet ring with 72 mm O.D.**			
D = 0.12 µs	2,100	5,217	5,217	5,217	5,217
E = 0.29 µs	860	2,609	5,217	5,217	5,217
F = 0.48 µs	520	1,304	2,609	5,217	5,217
G = 1 µs	250	848	1,696	3,848	3,848
H = 2 µs	125	391	783	2,009	2,009
K = 4 µs	63	196	391	1,030	1,030
L = 8 µs	32	98	196	443	443
N = 16 µs	16	51	103	248	248
P = 24 µs	10	34	68	170	170

Table 8: Max. speeds as a function of edge separation and resolution for magnet ring with O.D. 72 mm.

Accessories

Cover strip by the roll

Order code

BML-A013-T_ _ _ _
Length
0500 = 5 m
1000 = 10 m
2400 = 24 m
4800 = 48 m

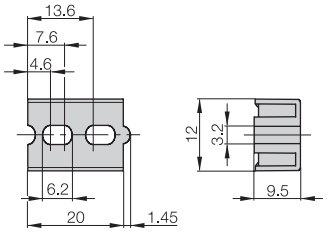
To prevent damage to the tape from things like chips or chemicals, it may be covered with a strip of stainless steel.
Note that the permissible air gap between the sensor head and tape is reduced by the thickness of the cover strip with adhesive film (0.15 mm).

Ship configurations:
Cover strip and magnetic tape can be ordered together in matching lengths (see ordering code for tape).

Cover strip by the roll can be ordered in 4 defined lengths.

Limit switch magnet BML-Z0006

for BML-S1B..., BML-S1E...




BML
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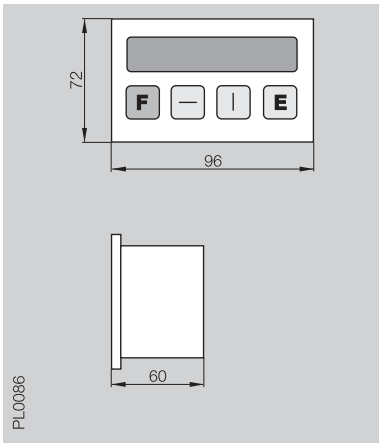
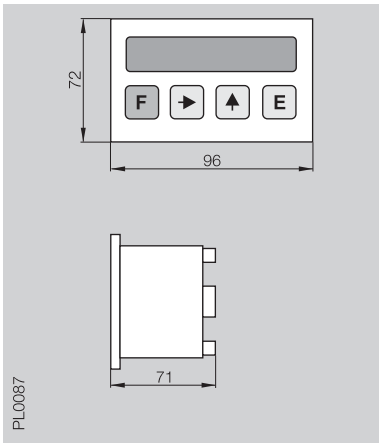
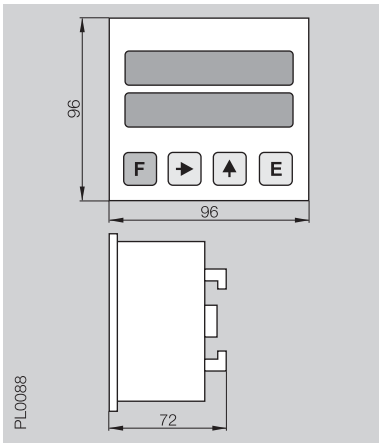
	BDD 610	BDD 611	BDD 622
	Single-axis counter for BML-S1B..., BML-S1C... and BML-S1E...	Single-axis counter for BML-S1A..., BML-S1B..., BML-S1C... and BML-S1E...	Double-axis counter for BML-S1B..., BML-S1C... and BML-S1E...
			
Order code	BDD 610-R3Q3-0-_ _-N-00	BDD 611-R_Q4-0-_ _-N-00	BDD 622-R_Q4-0-_ _-N-00
Functions	– Set value – Power down memory – Factor calculation – Reverse count direction – Up to 3 decimal places – Assignable key functions – Reset and set logic – In- and outputs logic – Security code	– Set value – Power down memory – Factor calculation – Edge evaluation – Reverse count direction – Up to 3 decimal places – Assignable key functions – Reset and set logic – Absolute and incremental – Offset logic – Saw blade correction – In- and outputs logic – Security code – Reference pulse	– Set value – Power down memory – Factor calculation – Edge evaluation – Reverse count direction – Up to 3 decimal places – Assignable key functions – Reset and set logic – Absolute and incremental – Offset logic – Saw blade correction – In- and outputs logic – Security code
Features	– 1×6 decade LED display – Digit height 14 mm – Incremental measuring system with tracks A, B – max. 25 kHz – Supply voltage 24 V DC – 2 digital inputs or 2 digital outputs	– 1×6 decade LED display – Digit height 14 mm – Incremental measuring system with A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$ or A, B, Z – max. input frequency: Signal A or B: 1 MHz – min. edge separation for – 4× evaluation: 250 ns – 4 digital inputs – 2 digital outputs (BDD 611-R3Q4-0-52-N-00)	– 2×6 decade LED display – Digit height 14 mm – Incremental measuring system with tracks A, B – min. edge separation: 250 ns – 4 digital inputs – 2 digital outputs (BDD 622-R3Q4-0-52-N-00)
Version	for BML-S1B0..., BML-S1E0... and BML-S1C0-..., min. edge separation Code M, N, P, R	for BML with supply voltage 5 V/10...30 V, output voltage RS422/HTL, min. edge separation Code E, F, G, H, K, L, M, N, P, R	for BML with supply voltage 5 V/10...30 V, output voltage RS422/HTL, min. edge separation Code E, F, G, H, K, L, M, N, P, R

Order code

BDD 610-R3Q3-0-_ _-N-00
Options
51 = 2 digital inputs
53 = 2 digital outputs

BDD 611-R_Q4-0-_ _-N-00
Supply voltage
3 = 24 V DC
4 = 115/230 V
Options
52 = Sensor supply 5 or 24 V DC with supply voltage 24 V DC (3)
54 = Sensor supply 5 or 12 V DC with supply voltage 115/230 V (4)

BDD 622-R_Q4-0-_ _-N-00
Supply voltage
3 = 24 V DC
4 = 115/230 V
Options
52 = Sensor supply 5 or 24 V DC with supply voltage 24 V DC (3)
54 = Sensor supply 12 V DC with supply voltage 115/230 V (4)

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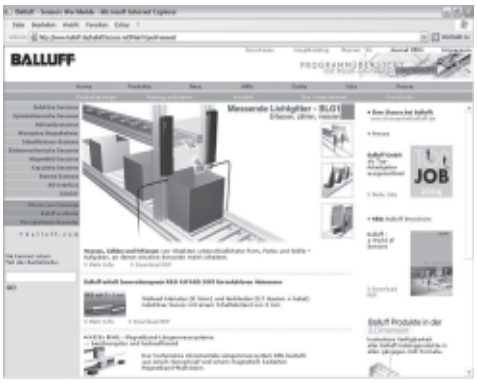

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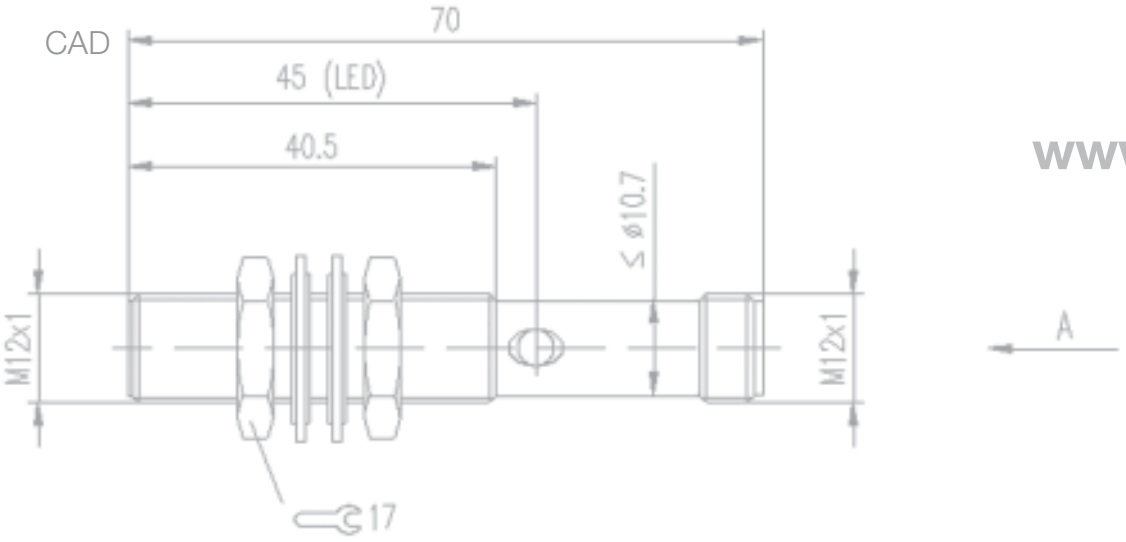
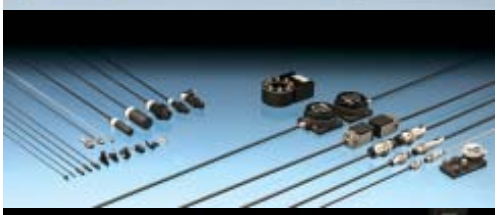
CAD



Inductive Sensors
Inductive Sensors BES
Inductive Limit Switches BES
Analog Sensors BAW
Magneto-Inductive Distance Sensors BIL

Photoelectric Sensors
Diffuse, Retro-Reflective, Through-Beam Sensors BOS
Fiberoptic Systems BFO
Slot/Dynamic Optical Window Sensors BGL/BOWA
L-Shaped Through-Beam Sensors BWL, Light Grids BLG
Distance Sensors BOD, Color Sensors BFS
Contrast Sensors BKT, Luminescence Sensors BLT



Magnetic Field Sensing,
Capacitive and Remote Sensors
Sensors for Pneumatic Cylinders BMF
Magnetic Field Sensors BMF
Capacitive Sensors BCS
Remote Sensors

Accessories
Connectors BKS
Fasteners
Mounting System
Electronic Devices

Mechanical and Inductive Sensors
Mechanical Multiple and Single Position Switches BNS
Inductive Multiple and Single Position Switches BNS
Mechanical and Inductive Switch Elements BSE/BES
Cam Trays BNL and Cams BNN/BEN
Precision Rotary Cam Switches BSW

Transducers,
Absolute and Incremental Encoders
Micropulse Transducers BTL
Linear Position Encoders BML
Incremental Encoders BDG
Absolute Encoders BRG
Micropulse Transducer BIW

Industrial RFID Systems
Non-Contact Data Communication – BIS C
Non-Contact Data Communication at 125 kHz – BIS L
Non-Contact Data Communication at 13.56 MHz – BIS M
Non-Contact Data Communication at High Speed – BIS S

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No. 856333 E · Edition 0705; Subject to modification.