Magnetics that count

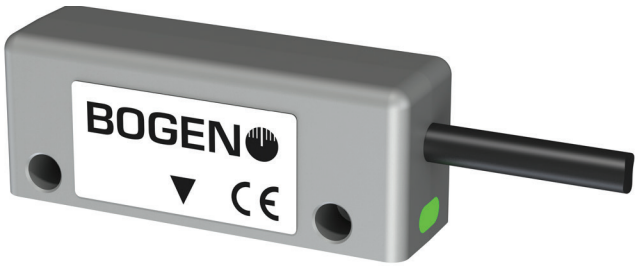
BOGEN

Measuring

Positioning

# IKS9
# Incremental Magnetic Encoder

- For linear applications
- For rotary applications
- For scales with or without reference


## Features

- High accuracy better than 10 µm
- Resolution up to 20 nm
- Movement speed up to 100 m/sec
- Easy adaption to application-specific needs
- Resistant to contamination, vibrations, temperature, fluctuations, humidity
- No wear from usage
- Corresponding scales in various lengths and diameters, with various pole pitches, with or without reference

## Magnetic measuring with IKS9: accurate - fast - customized

BOGEN´s incremental encoder IKS9 impresses customers in all industrial fields where positions, distances and speed have to be measured. An accuracy better than 10 µm, a movement speed up to 100 m per second, an almost unlimited measuring length and a robust design are the characteristics of this encoder. Several adjustable parameters allow an easy modification of the IKS9 to application-specific needs by the customer himself. The protection class IP67 allows the implementation even in harsh environment. In combination with a corresponding scale - linear, rotary-radial or rotary-axial - a highly accurate, reliable and fast collection of measuring data is possible.



**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

## Features

| | |
|---|---|
| Resolution | 0.02 - 1250 µm (depending on the pole pitch) |
| Max. Movement Speed | up to 100 m/s (depending on pole pitch, resolution and maximum output frequency) |
| Energy consumption (without Load) | <65 mA (UB = 5 V) |
| Operating temperature | -20 to +70 °C |
| Storage temperature | -20 to +80 °C |
| Protection class | IP67 |
| LED(1) | green LED: set up ok<br>red LED: LED Error Mode see order codes on Page 6 |
| Adjustable parameters (2) | Resolution/interpolation<br>Interface<br>Length of reference pulse<br>Frequency<br>LED mode<br>Hysteresis<br>Counting direction |
| Weight | Without cable and connector<br>IKS9: 6,5 g<br>IKS9.1: 17,5 g<br>Cable - Drag Chain Quality (T2): approx. 24 g/m |
| Maximum tightening torque for M3 screws (*) | 0.4 Nm (3.5 lbf in) |

(1) for additional information please see LED Mode on Page 6
(2) with optional programming device and software
(*) lbf in = poundforce inch

## Resolution and Speed

Default Values at Output Frequency F = 1000 kHz

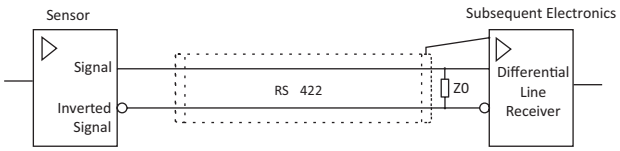
| Pole Pitch P [mm] | Resolution R [µm] | Max. Movement Speed Vmax [m/s] |
|---|---|---|
| 0.5 | 0.25 | 1 |
| 1 | 0.5 | 2 |
| 2 | 1 | 4 |
| 2.54 | 1.27 | 5.08 |
| 5 | 2.5 | 10 |

## Sensing Head Variants

| | |
|---|---|
| Pole pitch | 0.5 mm; 1 mm; 2 mm; 2.54mm; 5 mm |
| Reference | Reference chip for 2nd track (except for 0.5 mm pole pitch) or periodically from the pole pitch |
| Supply voltage | 5 V ± 5 %<br>7 - 36 V |
| Interface (without load) | RS422 (0 to 5 V)<br>Push-Pull HTL (0 V to supply voltage)<br>Push-Pull TTL (0 - 5 V) |
| Cable length of sensing head | 0.1 - 6 m<br>standard: 2 m |
| Connector | D-SUB 9 (male)<br>D-SUB 15 (male)<br>D-SUB 25 (female)<br>D-SUB 15 HD (male)<br>Customer specific connector |

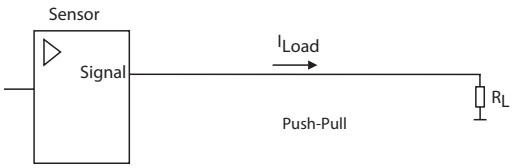
## Output Circuit

RS422

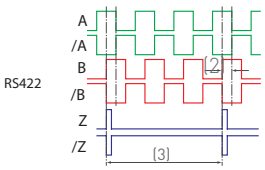


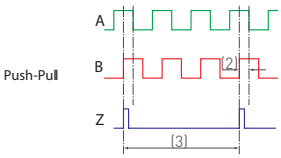

Load resistor Z0 = 120 Ω at the receiving end

Push-Pull (HTL, TTL)




maximum of 50 mA per channel at a supply voltage of 5 V




## Output Signals

| | |
|---|---|
| Signals | A, /A, B, /B, Z, /Z |
| Signal error indicator | High impedance on all output signals (A, /A, B, /B, Z, /Z) |

(2) Phase shift A and B 90° ±10° electrical
(3) Signal period depending on the reference track pattern or as a periodic reference depending on the pole pitch
Z Length default is 50 counts

To avoid EMI please connect housing or threaded bushing to protective earthing!



**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

## Further Selection (Ordering Parameters)

| Pole Pitch P [mm] | | | | | Resolution R [µm] | Resolution Rdpi [dpi] | Maximum Output Frequency per channel F [kHz] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 1 | 2 | 2.54 | 5 | | | 3500 | 1750 | 1000 | 500 | 100 | 60 |
| (0.1 inch) | | | | | | | Max. Movement Speed Vmax [m/s] | | | | | |
| | | | | x | 1250 | 20.32 | >100 | >100 | >100 | >100 | >100 | >100 |
| | | x | | x | 500 | 50.8 | >100 | >100 | >100 | >100 | >100 | >100 |
| | x | x | | x | 200 | 127 | >100 | >100 | >100 | >100 | 80 | 48 |
| x | x | x | | x | 100 | 254 | >100 | >100 | >100 | >100 | 40 | 24 |
| | | x | | | 80 | 317.5 | >100 | >100 | >100 | >100 | 32 | 19.2 |
| x | x | x | | x | 62.5 | 406.4 | >100 | >100 | >100 | >100 | 25 | 15 |
| x | x | x | | x | 50 | 508 | >100 | >100 | >100 | >100 | 20 | 12 |
| | x | x | | x | 40 | 635 | >100 | >100 | >100 | 80 | 16 | 9.6 |
| x | x | x | | x | 25 | 1016 | >100 | >100 | >100 | 50 | 10 | 6 |
| x | x | x | x | x | 20 | 1270 | >100 | >100 | 80 | 40 | 8 | 4.8 |
| x | x | x | | x | 12.5 | 2032 | >100 | 87.5 | 50 | 25 | 5 | 3 |
| x | x | x | x | x | 10 | 2540 | >100 | 70 | 40 | 20 | 4 | 2.4 |
| x | x | x | x | x | 5 | 5080 | 70 | 35 | 20 | 10 | 2 | 1.2 |
| x | x | x | x | x | 4 | 6350 | 56 | 28 | 16 | 8 | 1.6 | 0.96 |
| x | x | x | x | x | 2.5 | 10160 | 35 | 17.5 | 10 | 5 | 1 | 0.6 |
| x | x | x | x | x | 2 | 12700 | 28 | 14 | 8 | 4 | 0.8 | 0.48 |
| x | x | x | x | x | 1 | 25400 | 14 | 7 | 4 | 2 | 0.4 | 0.24 |
| x | x | x | x | x | 0.5 | 50800 | 7 | 3.5 | 2 | 1 | 0.2 | 0.12 |
| x | x | x | x | x | 0.25 | 101600 | 3.5 | 1.75 | 1 | 0.5 | 0.1 | 0.06 |
| x | x | x | x | x | 0.125 | 203200 | 1.75 | 0.875 | 0.5 | 0.25 | 0.05 | 0.03 |
| x | x | x | x | | 0.05 | 508000 | 0.7 | 0.35 | 0.2 | 0.1 | 0.02 | 0.012 |
| x | x | | | | 0.02 | 1270000 | 0.28 | 0.14 | 0.08 | 0.04 | 0.008 | 0.0048 |

Table 1: Maximum output frequency and speed as a function of pole pitch and resolution

## Definition:

Resolution *R* (resolution is after four-edge analyses)
Pole pitch *P* (available 0.5; 1; 2; 2.54 and 5 mm)
Resolution factor *Rf* (resolution factor available from 4 to 65536 in steps of one)
Maximum Output Frequency per channel *F* (available from 60 kHz to 3500 kHz)
Max-Movement-Speed *Vmax*
Interpolation = *Rf / 4*
*R = P / Rf*
Resolution [dpi] *Rdpi*
*Rdpi = 25400 / R*
*Vmax* is limitated by following formulars:
*1. Vmax = 4 * F * R*
*2. Vmax = P * 50 kHz*

## LED Error Codes (Order Parameter E1)

The amount of flashing signs of the red LED indicates the fault. It starts after a fast pulsed light.

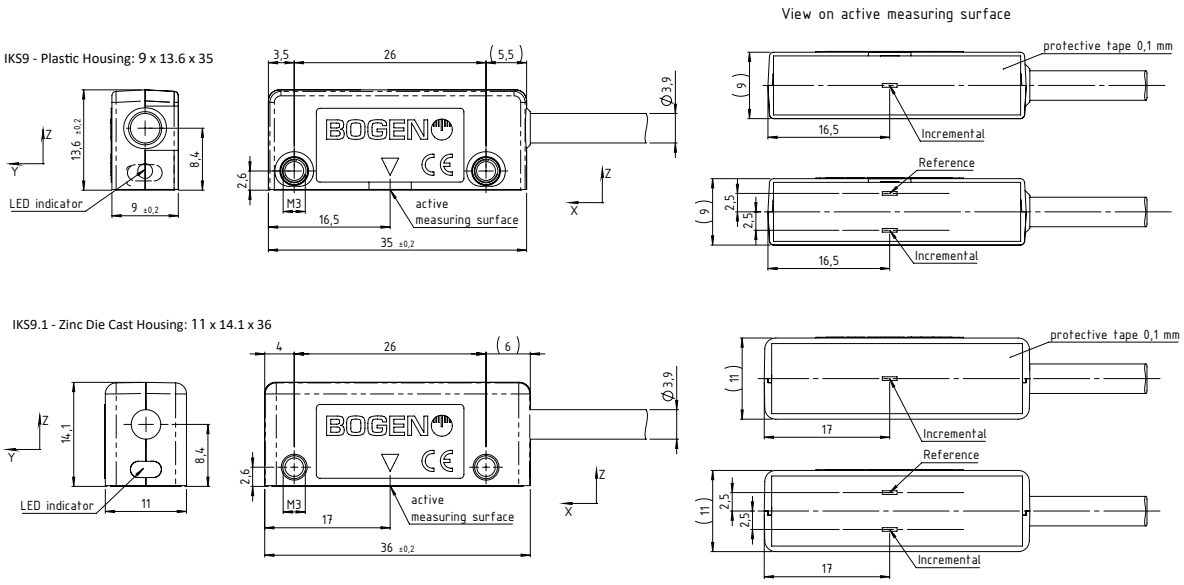

The example displays a weak and fluctuating magnetic field (fault 2 and 3).

| LED flashing signs amount | Description |
|---|---|
| 1 | Magnetic field strength is too high |
| 2 | Magnetic field strength is too low |
| 3 | The range of the magnetic fluctuation is too large |
| 4 | Output frequency is too high |
| 5 | Movement speed is too high |
| 6 | Movement speed is much too high (latched) |
| 7, 8 | Movement speed too high for internal signal processing with current programming (latched) |
| 9, 10, 11 | Internal Error 9, 10, 11 (latched) |



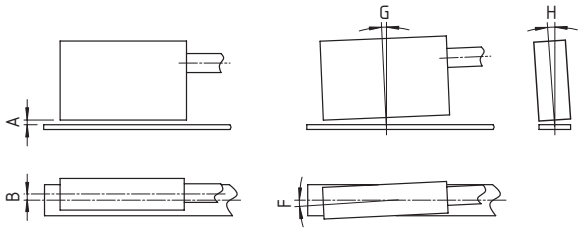
**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

## Dimensions




Dimensions without tolerances: ± 0.1 mm.
Forward movement: in positive direction of X-axis
Backward movement: in negative direction of X-axis

## Installation Tolerances for Linear Applications




| | | | pole pitch | | |
|---|---|---|---|---|---|
| | 0.5 mm | 1 mm | 2 mm | 2.54 mm | 5 mm |
| A [mm] | 0.1 to 0.25 | 0.1 to 0.5 | 0.1 to 1.0 | 0.1 to 1.25 | 0.1 to 2.5 |
| B [4] [mm] | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| B [5] [mm] | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| G | 0.5° | 1° | 1° | 1° | 1° |
| H | 3° | 3° | 3° | 3° | 3° |
| F | 3° | 3° | 3° | 3° | 3° |

[4] relative to 10 mm scale width (1-track)
[5] relative to 10 mm scale width (2-track)

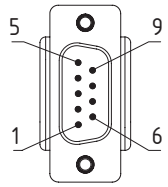


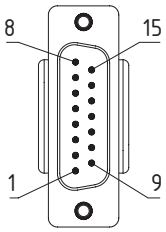
**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

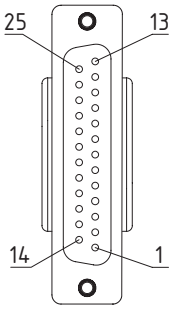
## Pin Assignment

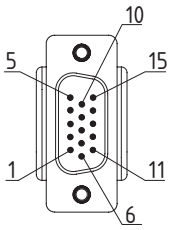
| Signal | Color | C3 D-SUB 9 (male) | C4 D-SUB 15 (male) | C5 D-SUB 25 (female) | C6 D-SUB 15 HD (male) |
|---|---|---|---|---|---|
| V - | blue | 9 | 2 | 2 + 16 [6] | 2 |
| V + | red | 5 | 7 | 1 + 14 [6] | 7 |
| A | brown | 4 | 14 | 3 | 14 |
| /A | green | 8 | 6 | 4 | 6 |
| B | grey | 3 | 13 | 6 | 13 |
| /B | yellow | 7 | 5 | 7 | 5 |
| Z | pink | 2 | 12 | 17 | 12 |
| /Z | white | 6 | 4 | 18 | 4 |
| Shield | - | Case | Case | Case | Case + 15 |

[6] PIN 1 with Pin 14 and Pin 2 with Pin 16 connected through solder bridge




C3: D-SUB 9 (male) C4: D-SUB 15 (male) C5: D-SUB 25 (female) C6: D-SUB 15 HD (male)

For detailed technical features on optional accessories such as rotary and linear scales please see separate data sheets.

## Optional Accessory

- Programming unit for IKS9 [00053024]
- Linear and rotary scales (for detailed information see separate data sheets)
  - » LMS: Linear magnetic scale from few mm to many meters
  - » LMSBI: Linear magnetic scale bar incremental for high accuracy applications
  - » RMSI: Rotary magnetic scale incremental in diameters from 10 mm to 1 m
  - » Recommended width without reference track: 5 mm, 6 mm, 8 mm, 10 mm
  - » Recommended width with reference track: 8 mm, 10 mm
  - » Available accuracy classes: A3, A10, A20, A40, A100
  - » Available pole pitches: 0.5 mm, 1 mm, 2 mm, 2.54 mm, 5 mm



**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

## Order Code

Parameters

| IKS9 | W | - | Z | P | V | D | R | F | T | L | C | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | Code [8] | Explanation [8] | |
|---|---|---|---|---|
| W | Width [mm] | | 9 mm (Plastic case) | |
| | | .1 | 11 mm (Metal case) | |
| Z | Reference Signal [9,10] | **Z1.50** | **Periodic reference signal from the pole pitch, length of reference signal 50 counts** | |
| | | Z1. ... | Periodic reference signal from the pole pitch, length of reference signal ... counts [11] | |
| | | Z2. ... | From reference marks (requires 2-track magnetic tape with incremental track and reference track), length of reference signal ... counts [11] | |
| P | Pole Pitch [mm] | P0.5 | 0.5 mm (not interoperable with Z2) | |
| | | P1 | 1 mm | |
| | | **P2** | **2 mm** | |
| | | P2.54 | 2.54 mm | |
| | | P5 | 5 mm | |
| V | Supply Voltage [V] | **V5** | **5 V** | |
| | | V24 | 7...32 V | |
| D | Interface [9] | **D1** | **RS422** | |
| | | D2 | Push-Pull HTL | |
| | | D3 | Push-Pull TTL | |
| R | Resolution [9, *] | R0.25 | 0.25 µm (Standard for pole pitch 0.5 mm) | |
| | | R0.5 | Standard for pole pitch 1 mm | |
| | | **R1** | **Standard for pole pitch 2 mm** | |
| | | R#... | ...dpi (Standard for pole pitch 2.54 mm) | |
| | | R2.5 | Standard for pole pitch 5 mm | |
| | | R ... | Other non-standard resolutions, see section "Resolution and Speed" in table 1 on page 2 | |
| F | Maximum Output Frequency per channel [9] [kHz] | **F1000** | **1000 kHz** | |
| | | F ... | Other non-standard output frequencies, see section "Resolution and Speed" in table 1 on page 2 | |
| T | Cable Type | **T2** | **Drag chain quality (4 mm diameter)** | |
| | | T99 | Customer specific cable | |
| L | Cable Length [m] | L2 | 2 m | |
| | | L ... | ... m (maximum cable length: 6 m) | |
| C | Connector (others on request) | C3 | D-SUB 9 (male) | |
| | | **C4** | **D-SUB 15 (male)** | |
| | | C5 | D-SUB 25 (female) | |
| | | C6 | D-SUB 15 HD (male) | |
| | | C99 | Customer specific connector | |
| E | LED Mode [9] | E0 | LED Green: | Low -> sufficient magnetic field |
| | | | | Bright -> best performance |
| | | | LED RED: | Error signalization with LED on |
| | | **E1** | **LED Green:** | **Low -> sufficient magnetic field** |
| | | | | **Bright -> best performance** |
| | | | **LED RED:** | **Error signalization with blinking codes, see on page 3** |

[8] standard parameters are bold
[9] user programmable parameters (optional IKS-Programming device necessary)
[10] if no index signal is needed, please do not connect pin "Z" an "/Z" on delivered connector
[11] length of index signal available from 1 to 256
[*] R... for metric based pole pitches / R#... for inch based pole pitches



**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com

## Ordering Example

| | |
|---|---|
| IKS9-Z1.50P2V5D1R1F1000T2L2C4E1 | IKS9 Magnetic Sensing Head, width 9 mm, with periodic reference signal, reference length 50 counts, 2 mm pole pitch, voltage 5 V, interface RS422, 1 µm resolution, max. output frequency 1000 kHz, Drag chain quality (4 mm diameter), cable length 2 m, D-SUB 15 (male) connector, error signalization with blinking error codes |
| IKS9.1-Z2.1P5V24D3R125F100T2L5.5C5E0 | IKS9 Magnetic Sensing Head, width 11 mm, with reference signal from reference marks (2-track magnetic tape), reference length 1 count, 5 mm pole pitch, voltage 7 - 32 V (broad-range), interface Push-Pull TTL, 125 µm resolution, max. output frequency 100 kHz, Drag chain quality (4 mm diameter), cable length 5.5 m, D-SUB 25 (female) connector, error signalization with LED RED on |

BOGEN can provide customised resolutions and cables. Here is an ordering example for a customized order code:

| | |
|---|---|
| IKS9.1-Z2.50P2V5D1R0.244140625F3500T99L0.3C4E1 | IKS9 Magnetic Sensing Head, width 11 mm, with reference signal from reference marks (2-track magnetic tape), reference length 50 count, 2 mm pole pitch, voltage 5 V, interface RS422, 0.244140625 µm resolution, max. output frequency 3500 kHz, customer specific cable, cable length 0.3 m, D-SUB 15 (male) connector, error signalization with blinking error codes |





**BOGEN Magnetics GmbH** · Potsdamer Straße 12-13 · 14163 Berlin · Germany
Fon +49 (0) 30 81 00 02 - 0 · Fax +49 (0) 30 81 00 02 - 60 · magnetics@bogen-magnetics.com · www.bogen-magnetics.com