- **Contactless sensor technology, free of wear**

- **Compact, low cost design for mechanical engineering and instrumentation**

- **Digital and analogue output interfaces**

- **Nominal operating voltage 24 VDC**

- **Resolutions 9 Bits and 12 Bits per 360°**

- **RXM 36 with external magnetic actuator**

- **RXW 36 with shaft and ball bearings**

- **Additional potting for protection grades up to IP 68**

Construction and function

The sensor system consists of an ASIC with integral Hall elements to convert the rotary motion of an external permanent magnet into a proportional sine-cosine output signal for the range of 360°.

Integral electronic circuits of different layouts transform this signal into digital or analogue data for transmission to displays or control units.
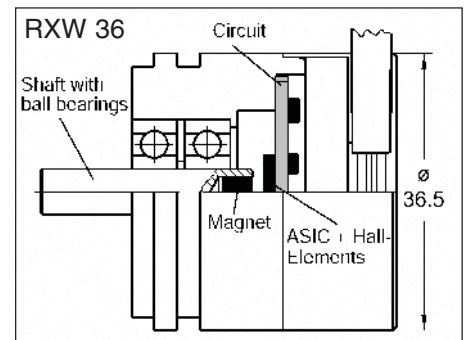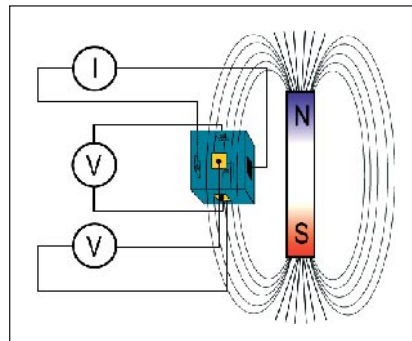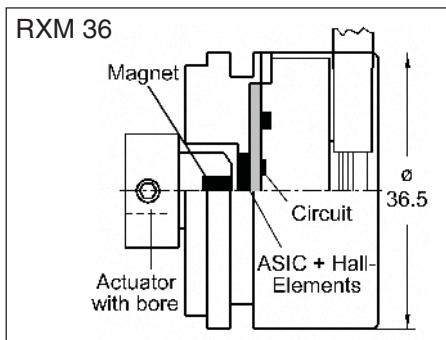
Two different mechanical versions are available: RXM 36 series has no moving parts within its case. The system is activated by an external stainless steel actuator incorporating a small permanent magnet. The actuator must be fixed to the driving shaft of a rotating device. This layout has no friction. It requires no individual torque.

RXW 36 series is a conventional construction with shaft and ball bearings. It must be coupled to a driving shaft.

The cases are in aluminium. Standard items have a 1 meter cable lead with a D-subminiature plug. For positive protection against shock, vibration and humidity the cases can be potted before delivery.

Electrical interfaces

- **Model RBX 36:** Absolute / nat. binary
  - ☐ Variant E: *SSI* (synchronous serial), page 3
  - ☐ Variants A and D: Parallel, page 4
  - ☐ Variant B: *BISS* (data sheet RBX 11396)

- **Model RIX 36:** Incremental, page 5

- **Mechanical and environmental data:** page 2

- **Model RNX 36:** CANopen, page 6
- **Model RAX 36:** Analogue - **9 Bits** / 360°, page 7
- **Model RAX 36:** Analogue - **12 Bits** / 360° (data sheet RAX 11412)

- **Dimensions and accessories:** page 8

Mechanical data

Series	RXM 36	RXW 36
Diameter of shaft	n.a.	6 mm (6^{h6})
Magnetic actuator for shaft diameters	6 mm (4, 8 or 10) [1]	n.a.
Operating speed	20.000 rpm max.	
Driving torque at 1000 rpm	n.a.	A: 2.5 Ncm B & C: 3.5 Ncm [2]
Starting torque	n.a.	A: 1.5 Ncm B & C: 2.5 Ncm [2]
Permissible angular acceleration	n.a.	10^5 rad/s^2 max.
Inertia (rotor)	n.a.	0.36 gcm^2
Permissible shaft load	n.a.	20 N radial 10 N axial
Bearing life (typical)	n.a.	10^9 revolutions at 20 N radial load
Mass including lead and D-sub plug	100 g approx. + 12 g actuator	A: 130 g approx. B & C: 155 g approx.
Lead exit and lead diameter	radially Ø 5 mm approx.	radially Ø 5 mm approx.

1) At option   2) With PTFE o-ring,   3) With packing ring,   n.a. = not applicable

Environmental data

Series	RXM 36	RXW 36
Behaviour within magnetic fields	Up to 0,1 Tesla without influence (all 3 axis)	
Operating temperature range	- 25°C to + 85°C (+ 125° at option)	
Storage temperature range	- 20°C to + 70°C (dependant on packing material)	
Resistance against shock	2000 m/s^2; 11 ms	200 m/s^2; 11 ms
	to DIN EN 60068-2-27	
Resistance aganist vibration	10 Hz to 2000 Hz; 500 m/s^2 to DIN EN 60068-2-6	
Protection grades	Front plate IP 68 Case IP 64 with potting IP 68	A: IP 53 B: IP 64 C: IP 68 with potting

RXW 36 series with shaft and ball bearings

Variants A, B and C are available with different sealings and with different protection grades. Please refer to drawings page 8.

RXM 36 series with external magnetic actuator

Standard magnetic actuators have an internal bore to accept shafts of 6 mm dia. Actuators with 4, 8 or 10 mm dia must be ordered **separately,** e.g. RBM-N08, for quantities up to 24 pieces. For larger quantities such actuators will become part of the standard item as per the order code, e.g. RBM36-**08**-512RK1 E01.

Mounting specifications

Position tolerances for the magnet:

- Vertical deviation: $\leq 1 \pm 0{,}1$ mm
- Coaxial deviation: $\leq 0{,}1$ mm (⊕)
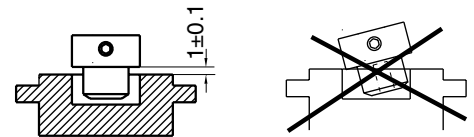
- A sloping position of the actuator will impair the measurement signal
- After removing the actuator the encoder will deliver an arbitrary measurement signal.

General note

- Remote magnetic fields may have an influence on the behaviour of the sensor system via ferromagnetic pieces close to the encoder.
- Standard items include 1 meter lead and a D-subminiature plug without mating socket. Different lead lengths and different connectors can be made available upon request.
- Connecting diagrams will be supplied with each item.

- EMC standards: EN 50081-2,
                            EN 50082-2

Model RBX 36: Synchronous Serial Interface - 9 or 12 Bit / 360°⨍

SSI

Function

The absolute angle information derived by the encoder is converted into serial information by an internal parallel-serial converter and then transmitted to a receiving electronic circuit in synchronism with a clock. Important advantages are : Low number of data lines and high reliability.

Maximum data transmission rate

The date rate ist defined by the following factors:

☐ Clock frequency 1 MHz max up to 40 meters connection line

☐ Delay time of the overall electronics (between 40 and 150 meters)

$$t_{GV} = t_C + 2t_K + t_E$$

t_{GV}: Total delay time

t_C: Delay time of the encoder electronics, e. g. ≤ 300 ns

t_K: Delay time of lead, depending on type and length, e. g. speed 6.5 ns/m

t_E: Delay time of receiving electronics, e. g. 150 ns

Admitting a security gap of 50 ns between the periods of clock t_T and the delay time of the overall electronics t_{GV} the result is shown as follows:
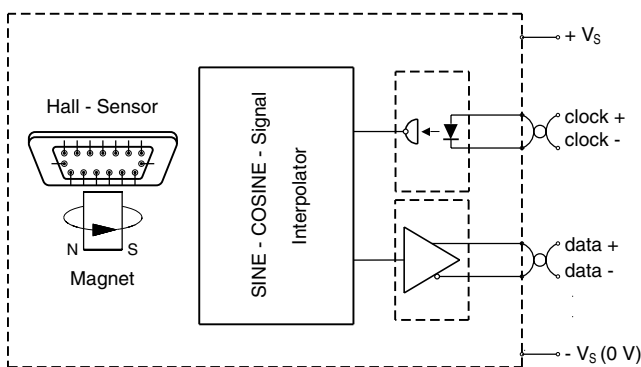
$$t_T = t_{GV} + 50\ ns = 500\ ns + 2t_K$$

The maximum clock frequency is defined by the following formula: $f_{max.} = 1/t_T$
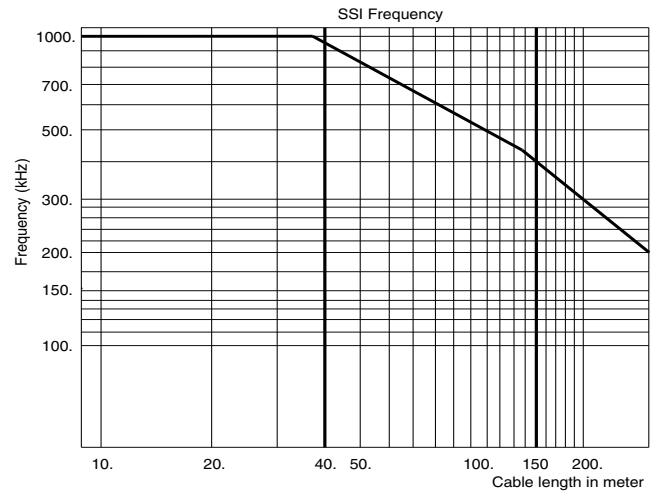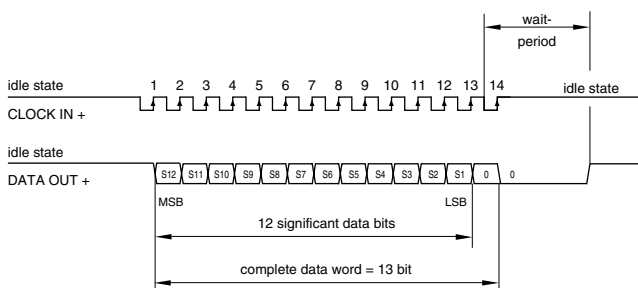
☐ To RS422 specification starting at 150 m approximately

The opposite diagram is based on the above data.

Block diagram

Interface profile SSI - 13 Bit / natural binary

SSI Frequency

Electrical data

- Operating voltage: + 11 VDC to + 28 VDC
- Operating current: 50 mA typ. / 80 mA max.
- Resolution (standard): 512 positions / 360°⨍ - (9 Bits)
  4096 positions / 360°⨍ - (12 Bits)
- Output code: Natural binary
- Code sense: CW (CCW at option)
- Serial output *SSI*: Differential data output to RS 422
- Clock *SSI*: Differential data input (opto-coupler) to RS 422
- Monoflop time: 20 ±10 μs (standard)
- Clock frequency: max. 1 MHz

Order code format

Model RBM 36 (with external magnetic actuator)

RBM36 - 06 - 512 R K1 E 01

— Electrical and / or mechanical variants *

— E = *SSI* (to RS 422)

— Electrical connections
K1 = lead (1m) with connector DE 9 P

— R = Natural binary

— Resolution / 360°⨍
512 or 4096 positions

— Ø 6 mm bore
(options: 4, 8 or 10 mm)

RBM 36 only

— RBM 36 series
or   RBW 36A: IP 53
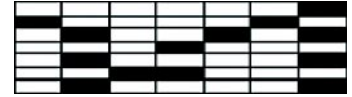   RBW 36B: IP 64
    RBW 36C: IP 68

Model RBW 36 (with shaft and ball bearings)

Example of order code for IP 53 version:

RBW36 A - 512 R K1 E 01

* The basic versions in accordance with the data sheet bear the code number 01. Variations of the basic version are indicated by a consecutive number and are documented in our works.

## Model RBX 36: Parallel output - 9 Bit / 360° ⌇

Electrical data

- Max. Resolution: 512 positions / 360°⌇ (9 Bits)
- Output code: Natural binary
- Output circuits: A or D (see below)
- Measuring position deviation: ± 1 LSB (at 9 Bits)
- Repeatability: ≤ 0,1 LSB (at 9 Bits)
- Latch-Enable: activ high: $U_{LE} ≥ 2,4$ VDC
- Code sense: CW *
- Operating voltage: + 11 VDC to + 28 VDC
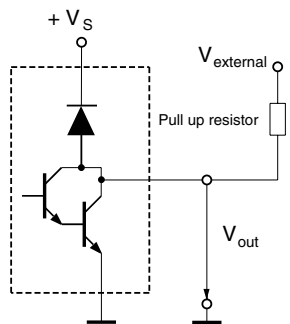- Operating current: 30 mA typ. / 40 mA max.

* Increasing signal when turning clockwise with view on flangeside.
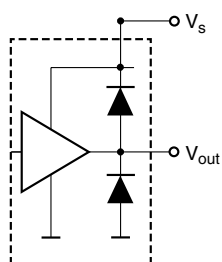
Block diagram

Hall - Sensor

SINE - COSINE - Signal Interpolator Driver

N   S

Magnet

+ V_S

output (1-9)

- V_S (0 V)
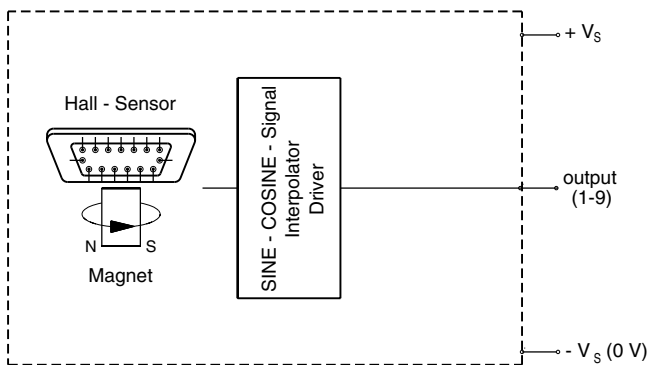
Output circuits

Output "A" - Open Collector

+ V_S

$V_{external}$

Pull up resistor

V_{out}

Log1 = V_s at - I_H ≤ 10 mA
Log 0 ≤ 1 V at I_L ≤ 10 mA

Output "D" - Push pull

V_s

V_{out}

I max. = 10 mA
Log 1 = V_S -3 V
Log 0 max. ≤ 4 V

Timing-Diagram

Latch - Enable

Data

Latch

t_R t_R
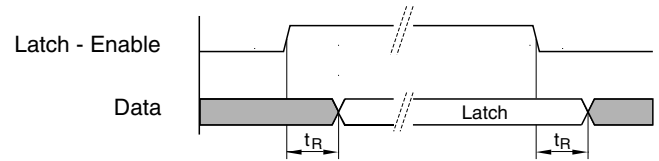
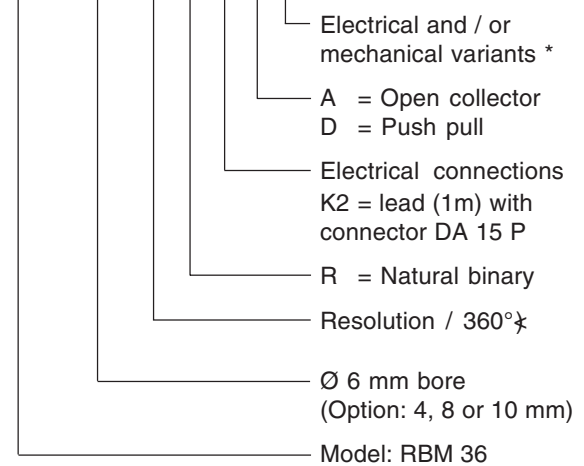t_R = Reaction time ≤ 1 µs

Order code format

Model RBM 36 (with external magnetic actuator)

RBM 36 - 06 - 512 R K2 A 01

Electrical and / or mechanical variants *

A = Open collector
D = Push pull

Electrical connections
K2 = lead (1m) with connector DA 15 P

R = Natural binary

Resolution / 360°⌇

Ø 6 mm bore (Option: 4, 8 or 10 mm)

Model: RBM 36

Model RBW 36 (with shaft and ball bearings)

RBW 36A - 512 R K2 A 01
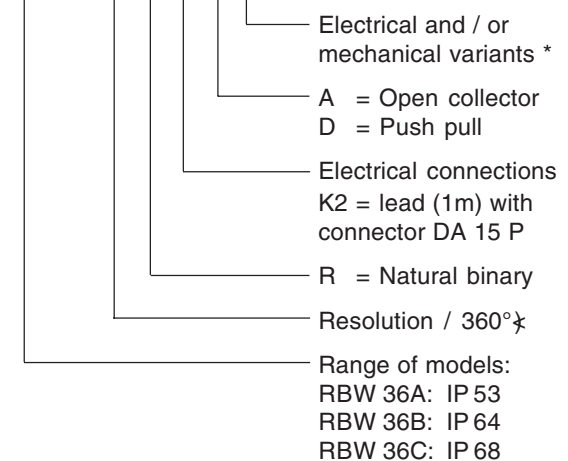
Electrical and / or mechanical variants *

A = Open collector
D = Push pull

Electrical connections
K2 = lead (1m) with connector DA 15 P

R = Natural binary

Resolution / 360°⌇

Range of models:
RBW 36A: IP 53
RBW 36B: IP 64
RBW 36C: IP 68

*   The basic versions in accordance with the data sheet bear the code number 01. Variations of the basic version are indicated by a consecutive number and are documented in our works.
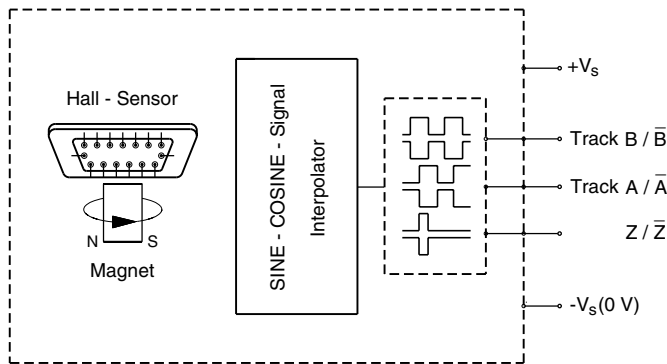
Model RIX 36: Inkremental output

Electrical data

- Number of counts (standard): 1024 per rev.
- Output channels: Tracks A, B and zero plus inversions
- Form of signals: Square
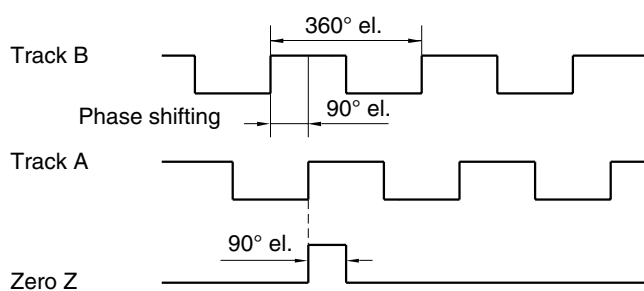- Signal data: D, T or U (see below)

- Other numbers of counts at option

1	10	32	80	200	500
2	16	40	100	250	512
4	20	50	125	256	**1024**
8	25	64	128	400	2048*

* under development

Block diagram

Signal output when CW turning (view on shaft)

Order code format

Model RIM 36 (with external magnetic actuator)

RIM 36 - 06 - 1024 K1 D 01

- Electrical and / or mechanical variants *
- Signal data (nominal)
  D: U_B = 24 V and U_A = 24 V
  T: U_B = 5 V and U_A = 5 V
  U: U_B = 24 V and U_A = 5 V
- Electrical connections
  K1 = lead (1m) with connector DE 9 P
- 1024 counts / 360°
- Ø 6 mm bore (Option: 4, 8 or 10 mm)
- Model: RIM 36
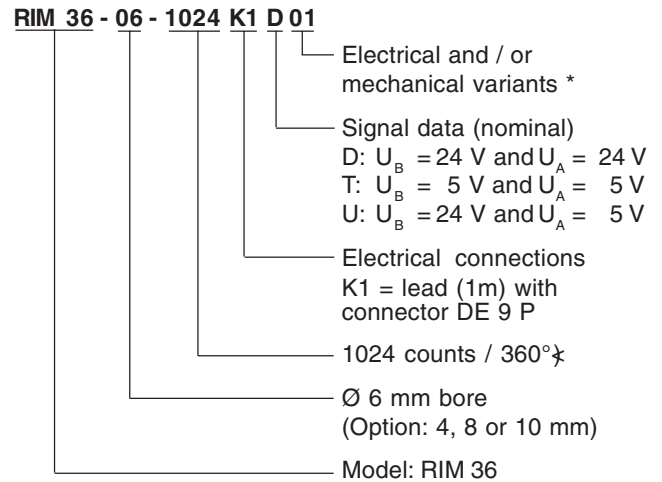
Model RIW 36 (with shaft and ball bearings)

RIW 36A - 1024 K1 D 01

- Electrical and / or mechanical variants *
- Signal data (nominal)
  D: U_B = 24 V and U_A = 24 V
  T: U_B = 5 V and U_A = 5 V
  U: U_B = 24 V and U_A = 5 V
- Electrical connectors
  K1 = lead (1m) with connector DE 9 P
- 1024 counts / 360°
- Range of models:
  RIW 36A: IP 53
  RIW 36B: IP 64
  RIW 36C: IP 68

*   The basic versions in accordance with the data sheet bear the code number 01. Variations of the basic version are indicated by a consecutive number and are documented in our works.

Signal data

Signal code	D	T*	U
Supply voltage range U_B	11 to 26 VDC	5 VDC ± 5 %	11 to 26 VDC
Signal current I_A	10 mA	20 mA	5 mA
Signal level (high)	U_B - 3 VDC	> 2,8 VDC	> 2,8 VDC
Signal level (low)	< 5 VDC	< 0,5 VDC	< 0,5 VDC
Max. pulse frequency	max. 250 kHz		
Pulse rate	1:1 ± 30%		
Phase shift	90° ± 30°		
Length of zero pulse	90° (others upon request)		
Turning sense	CW (standard)		

* compatible to RS 422

CANopen

# Model RNX 36: CANopen interface - 12 Bits / 360° ⌘

Electrical data

To CANopen Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.1 and to "Device Profile for Encoders CiA Draft Standard Proposal 406 Version 3.0" and CANopen Layer setting Services and Protocol (LSS), CiA DSP 305 (CiA-Certificate 200312-301V402).

- Supply voltage range: + 11 VDC to + 28 VDC
- Supply current: 50 mA typ. / 80 mA max.
- Max. Resolution: 4096 positions / 360° ⌘ - (12 Bits)
- Outputcode: Natural binary
- Code sense: CW or CCW *
- Reference value: 0 - (Resolution less 1)
- CAN-interface: to ISO/DIS 11898
- Adressing: via SDO / LSS
- Termination resistance: by separate implementation
- Max. transmission length: 200 m **

* To be set via the bus net
** No galvanic isolation between power supply and bus (see CiA DS301)
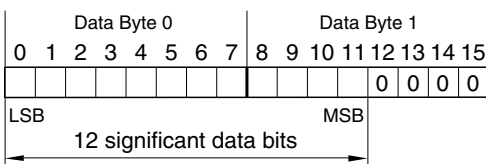
Block diagram
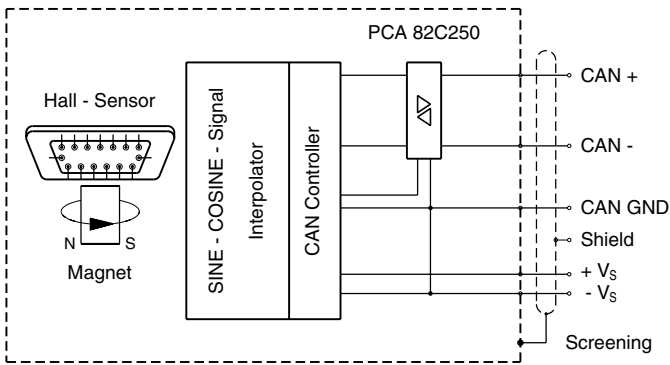
Bus configuration ISO / DIS 11898

* Termination resistances
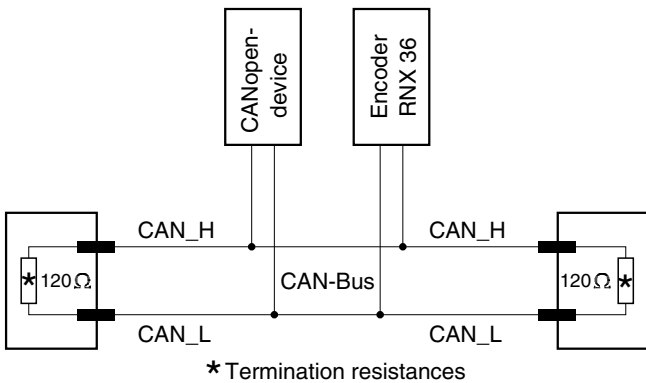
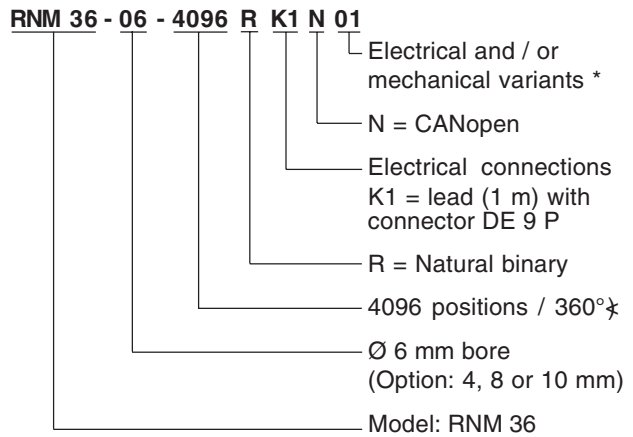## Data profile CANopen

PDO 1 und PDO 2

CANopen Features

- NMT Master: no
- NMT-Slave: yes
- Maximum Boot up: no
- Minimum Boot up: yes
- COB ID Distribution: Default, SDO
- Node ID Distribution: via Index 2000 oder LSS
- No of PDOs: 2 Tx
- PDO-Modes: sync, async, cyclic, acyclic
- Variables PDO-Mapping: no
- Emergency Message: yes
- Heartbeat: yes
- No. of SDOs: 1 Rx / 1 Tx
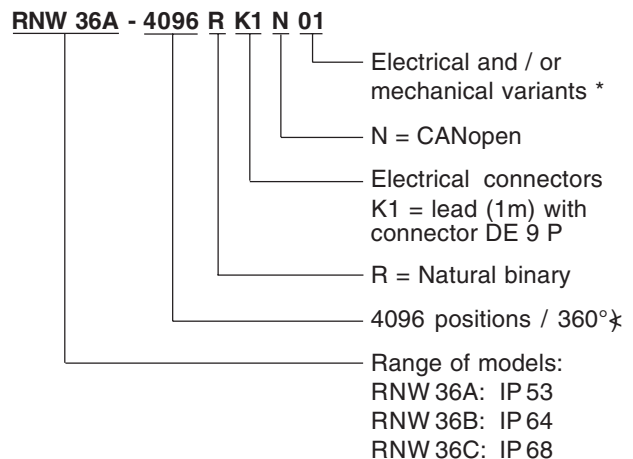- Device Profile: CiA DSP 406 Version 3.0

For detailed description of the CANopen profile pl. refer to application manual RNX 11197.

Order code format

Model RNM 36 (with external magnetic actuator)

RNM 36 - 06 - 4096 R K1 N 01

- Electrical and / or mechanical variants *
- N = CANopen
- Electrical connections K1 = lead (1 m) with connector DE 9 P
- R = Natural binary
- 4096 positions / 360° ⌘
- Ø 6 mm bore (Option: 4, 8 or 10 mm)
- Model: RNM 36

Model RNW 36 (with shaft and ball bearings)

RNW 36A - 4096 R K1 N 01

- Electrical and / or mechanical variants *
- N = CANopen
- Electrical connectors K1 = lead (1m) with connector DE 9 P
- R = Natural binary
- 4096 positions / 360° ⌘
- Range of models: RNW 36A: IP 53 RNW 36B: IP 64 RNW 36C: IP 68

* The basic versions in accordance with the data sheet bear the code number 01. Variations of the basic version are indicated by a consecutive number and are documented in our works.

Model RAX 36: Analogue outputs 0(4)-20 mA, 0-10 VDC, ±10 VDC - 9 Bit / 360° ⚡

The electro-magnetic sensor system of the encoder is completed by a 9 Bit D/A converter to transform the angular position into an analogue signal of either 0(4) to 20 mA, 0 to 10 VDC or ±10 VDC. If not otherwise specified the transducer will be supplied with a measuring range of 0 to 360° ⚡ and CW signal sense, i.e. increasing output signal with view on shaft end, when turning clockwise.

≤ 360° ⚡
0(4) ... 20 mA
0 ... 10 VDC
± 10 VDC

Electrical data of all outputs

- Resolution: 9 Bits / 360° ⚡
  (12 Bits to data sheet RAX 11412)
- Measuring range: 360° ⚡, 180° or 90°
  (other ranges upon request)
- Output signals: A: 0 to 20 mA,   C: 0 to 10 VDC
  B: 4 to 20 mA,   D: ± 10 VDC
- Linearity: < ± 2 % based on 360° ⚡
- Temperature drift: 0,02 %/K typ.
- Code sense: CW* (CCW at option)
- Supply voltage ranges
  - outputs A, B, C: 24 to 30 VDC
  - output D: ±13 to ±16 VDC
- Supply current: 50 mA typ. / 70 mA max.

* Increasing signal when turning clockwise with view on flange side.

- **Current outputs A and B:**
  Tolerances   0 mA ± 150 µA typ./ ± 250 µA max.
                      4 mA ± 150 µA typ./ ± 250 µA max.
                     20 mA ± 150 µA typ./ ± 250 µA max.
- Load resistance: 0 - 1000 Ω (V_S = 24 VDC - 30 VDC)

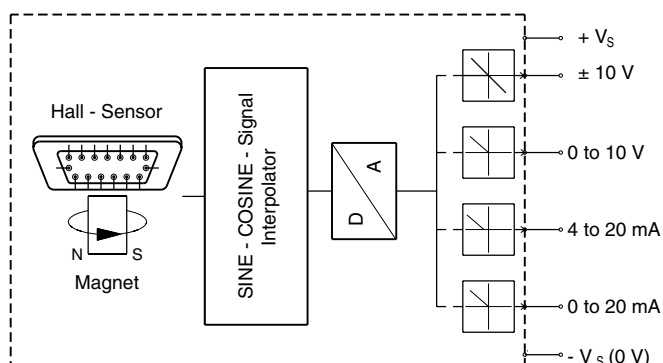
- **Voltage output C:**
  Tolerances   0 V + 100 mV typ./ ± 200 mV max.
                    10 V ± 100 mV typ./ ± 200 mV max.
- Output current: max. 5 mA (load resistance ≤ 2 kΩ)
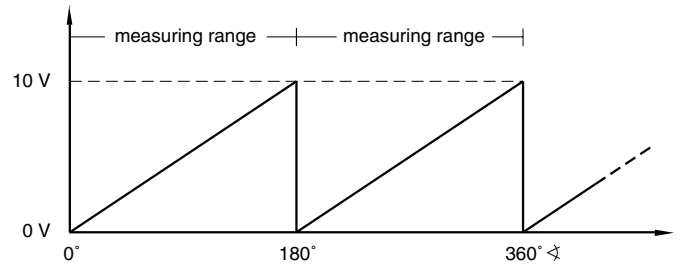

- **Voltage output D:**
  Tolerances   +10 V ± 100 mV typ./ ± 200 mV max.
                -10 V ± 100 mV typ./ ± 200 mV max.
- Output current: max. 5 mA (load resistance ≤ 2 kΩ)

Block diagram

Hall - Sensor
N S
Magnet
SINE - COSINE - Signal Interpolator
D/A
+ V_S
± 10 V
0 to 10 V
4 to 20 mA
0 to 20 mA
- V_S (0 V)

Example: Measuring range 180°

measuring range   measuring range
10 V
0 V
0°   180°   360° ⚡

Order code format

Model RAM 36 (with external magnetic actuator)

**RAM 36 - 06 - 360 K1 W A 01**

- Electrical and / or mechanical variants *
- Output signals:
  A = 0 - 20 mA, C = 0-10 VDC
  B = 4 - 20 mA, D = ±10 VDC
- Signal sense
  W = CW, C = CCW (option)
- Electrical connections
  K1 = lead (1m) with connector DE 9 P
- 360° ⚡, (90°, 180°)
- Ø 6 mm bore
  (Option: 4, 8 or 10 mm)
- Model: RAM 36

Model RAW 36 (with shaft and ball bearings)

RAW 36A - 360 K1 W A 01

- Electrical and / or mechanical variants *
- Output signals:
  A = 0 - 20 mA, C = 0-10 VDC
  B = 4 - 20 mA, D = ±10 VDC
- Signal sense
  W = CW, C = CCW (option)
- Electrical connections
  K1 = lead (1m) with connector DE 9 P
- 360° ⚡, (90°, 180°)
- Range of models:
  RAW 36A: IP 53
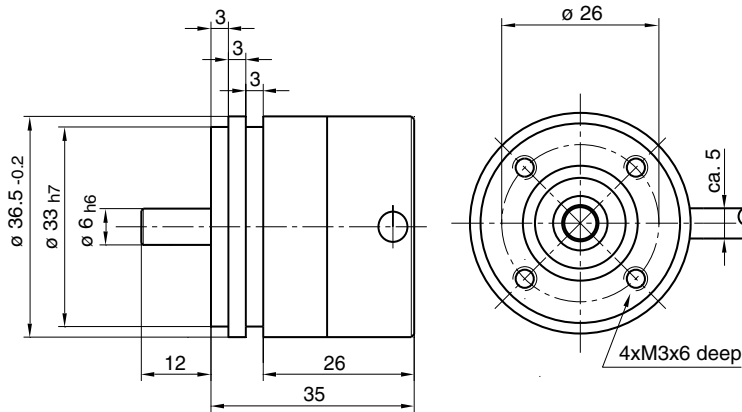 RAW 36B: IP 64
  RAW 36C: IP 68

* The basic versions in accordance with the data sheet bear the code number 01. Variations of the basic version are indicated by a consecutive number and are documented in our works.
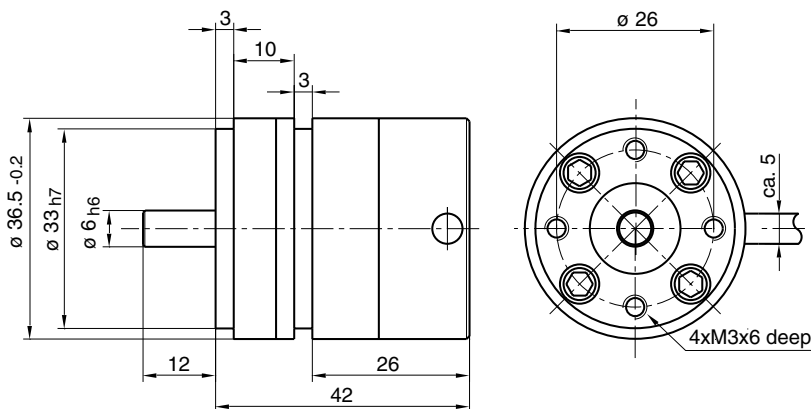
Dimensions in mm

Models RXM 36 series IP 64/68)
with external magnetic actuator
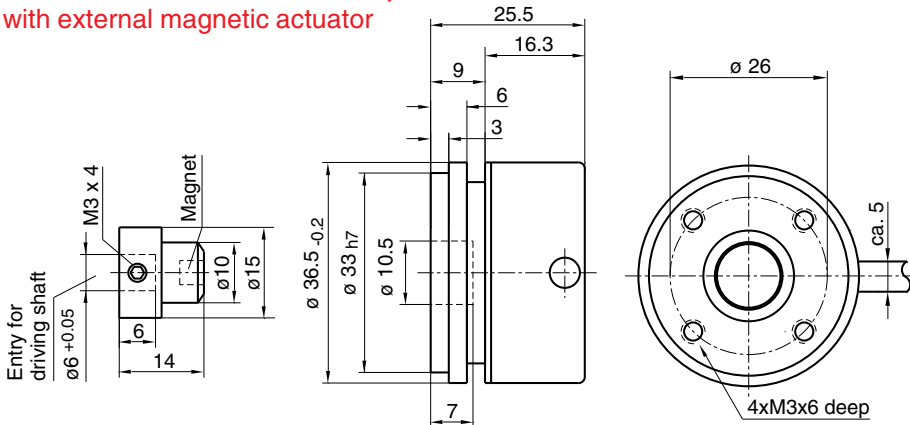
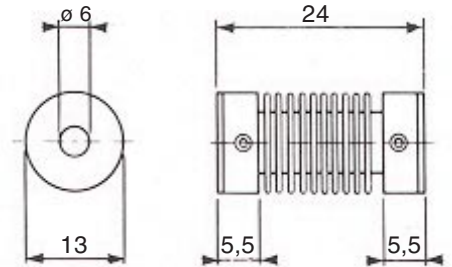### Models RXW 36A series / IP 53
with shaft and ball bearings

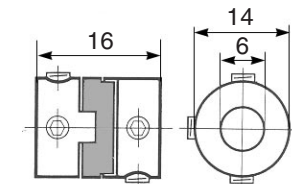### Models RXW 36B series (IP 64) and RXW 36C sieres (IP68)
with shaft and ball bearings

Accessories

(to be ordered separately)

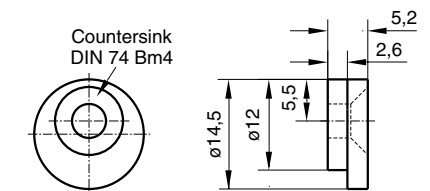### Bellow coupling 420/6
(brass / bronze)

Oldham coupling 413 / 6
(aluminium / plastic)

To fit different driving shafts the
following bores can be provided:
3, 4, 5, 6 and 6.35 mm (e.g. 413 / 6-3).

Mounting clamps KL66-2
(3 pcs per item)

☐ Reference circle: 51⁺⁰⁵ mm
☐ Screws to be used: M 4 toDIN 7991
☐ Material: brass, nickel plated

Countersink
DIN 74 Bm4

Counter plugs DE 9S or DA 15S
to be ordered separately

Please note: This data sheet supersedes the following data sheets: 10978, 10923, 11091, 11196.

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