

General descriptions

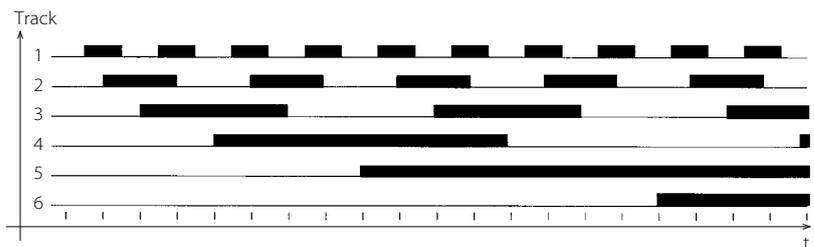
Absolute rotary encoders are optoelectronic sensors collecting and encoding angles or distances. A digitally coded value is assigned to each measuring step defined by the division on a measuring body (code disk). This absolute measured value can be read as often as desired, is reproducible and not corrupted by power failures.

The one-step gray code is basically used with the code disk (measuring body). The one-step coding has the advantage of avoiding intermediate values while measuring step changes.

Output codes

Gray code

This is a one-step format code whose individual positions have no significance. Only 1-bit changes during measure value change thus avoiding intermediate values that can occur in multi-step output codes. The number of positions to represent a position value corresponds to those of the binary codes.



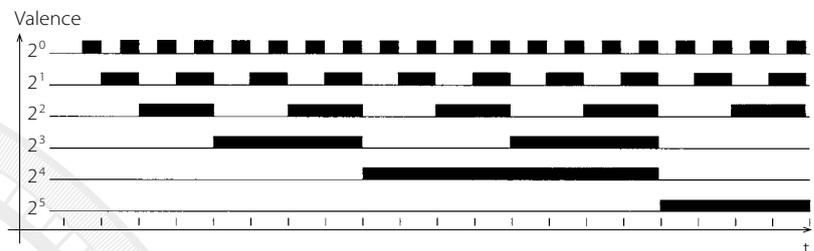
Gray excess codes

The one-step coding of the gray code applies to resolutions that can be represented as potency (x) to the base 2 (2^x). A central part is taken from the gray code for other resolutions, which guarantees that the one-step coding is maintained. This output code is known as gray excess code.

It should be observed that the representation range no longer begins at "0", but shifts by a certain value (e.g. resolution 360 steps/revolution corresponds to 76 - 435 range).

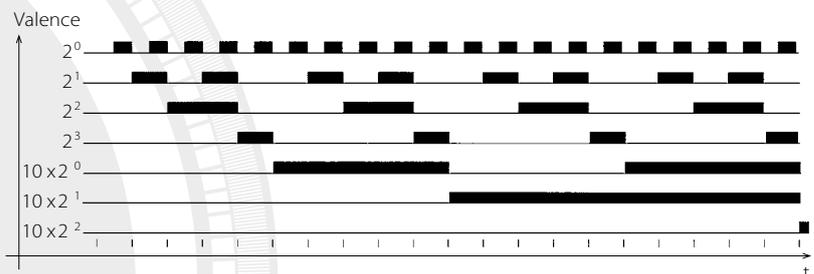
Binary code

With this assessable output code, a precise valence with the potency (x) to the base 2 (2^x) is assigned to each position value.



BCD code (8-4-2-1 code)

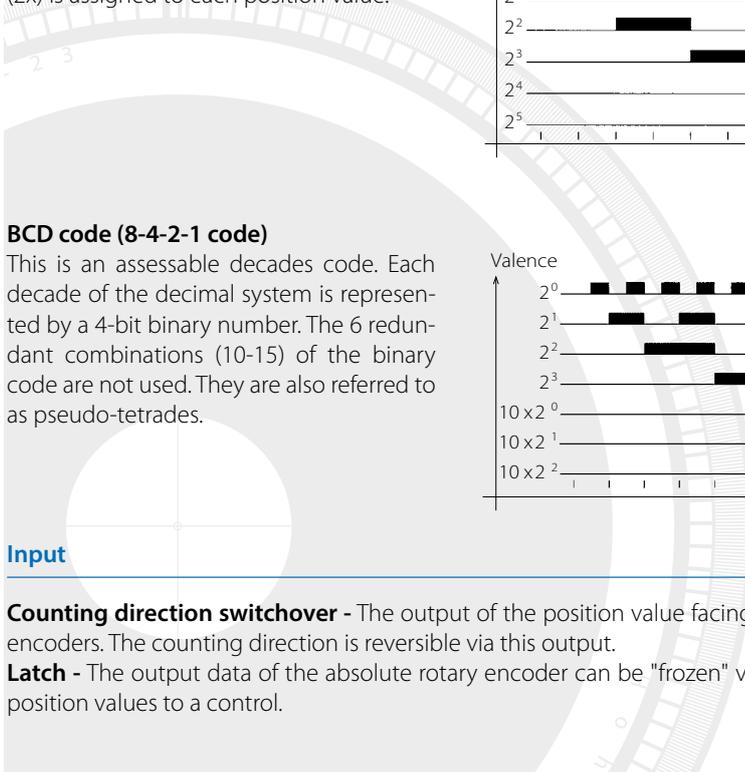
This is an assessable decades code. Each decade of the decimal system is represented by a 4-bit binary number. The 6 redundant combinations (10-15) of the binary code are not used. They are also referred to as pseudo-tetradecades.



Input

Counting direction switchover - The output of the position value facing the shaft clockwise is ascending with absolute rotary encoders. The counting direction is reversible via this output.

Latch - The output data of the absolute rotary encoder can be "frozen" via this input. This enables an error-free takeover of the position values to a control.



Calculation of permissible speed

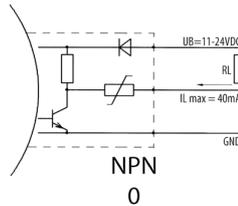
Depending on the max. step frequency of 10 kHz, the permissible speed is roughly calculated according to the following Formula:

$$n \left(\frac{u}{\min} = \frac{f_{\max} \text{ (Hz)}}{\text{Resolutions}} \right) \times 60$$

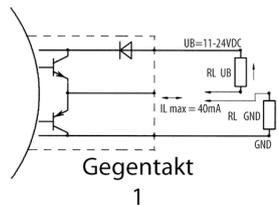
Attention: This calculation does not take into account the influence of the cable length; in addition, the permissible mechanical speed should be observed!!

Output circuits

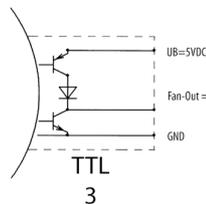
0 Darlington Driver
ULN 2003 o.ä.
max. 40 mA per channel
short-circuit-proof



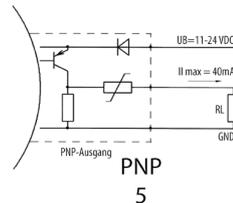
1 Push-pull
max. ±10 mA



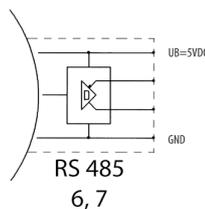
3 TTL
max. 1,6 mA per channel
(1 TTL-Load)



5 High Current Source
Driver UDN 2982 or.sim



6,7 serial output SSI

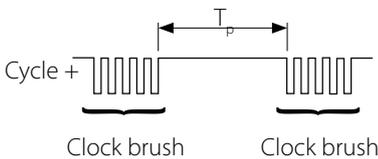


Synchronous serial transmission (SSI) for absolute rotary encoders

Absolute rotary encoders are, in many cases, subject to severe mechanical stresses, electrical and magnetic fields contaminating the operating site. Special constructive measures are, therefore, required to combat dirt, dust and liquids in the industrial environment. Our absolute rotary encoders have a mechanically robust design according to the latest technologies, and the electronics are designed as compact as possible.

The main focus in the interference resistance applies to the data transmission from the rotary encoder to the control. The measuring data of the rotary encoder must be read error-free from the control. Under no circumstances should undefined data be transmitted, e.g. at the changeover point. The concept described here for synchronous serial data transfer for absolute rotary encoders differs essentially from the parallel and asynchronous serial transmission types by:

- fewer electronic components
- fewer cables for data transfer
- the same interface hardware, regardless of the resolution (word lengths) of the absolute rotary encoder
- galvanic isolation of the rotary encoder of the control by octocoupler
- line breakage monitoring by constant current
- data transfer rates up to 1.5 Mbit/s (depending on the cable length)
- Ring register operation possible



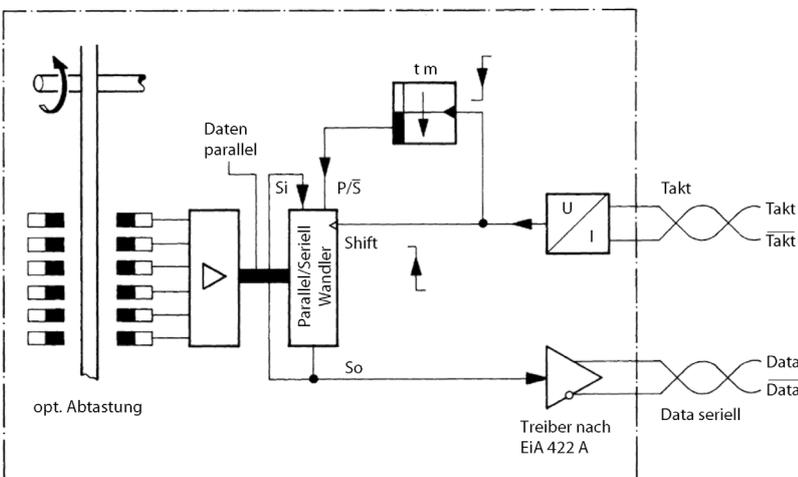
Transfer procedure

For correct data transfer, it is necessary to apply a defined number of pulses (clock brushes) at the input of the absolute rotary encoder. A TP pause must be observed thereupon. As long as no clock signal is applied to the rotary encoder, the encoder's internal parallel/serial shift register is switched to parallel. The data are free-running and correspond respectively to the position of the rotary encoder shaft. As soon as a clock brush is reapplied, the current angle information is stored.

The first change of the clock signal from high to low actuates the rotary encoder's internal retriggerable monoflop, whose t_m monoflop timeout must be greater than the period duration T of the clock signal.

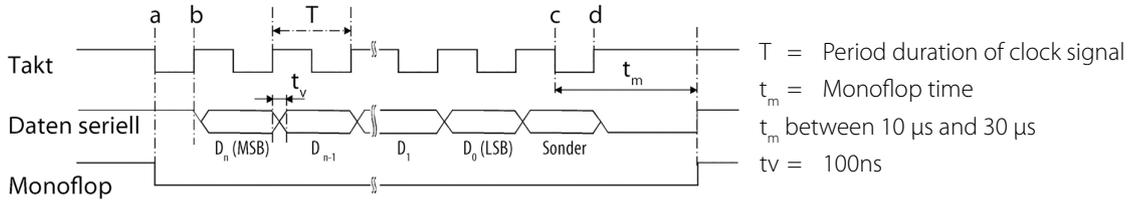
The output of the monoflop controls the parallel/serial register via the P/S (parallel/serial) port.

Block diagram of an absolute rotary encoder



Synchronous serial transfer

The number of clocks required for data transfer is independent of the resolution of the absolute rotary encoder. The cycle can be interrupted at any point, or continued for multiple queries in the ring register operation.

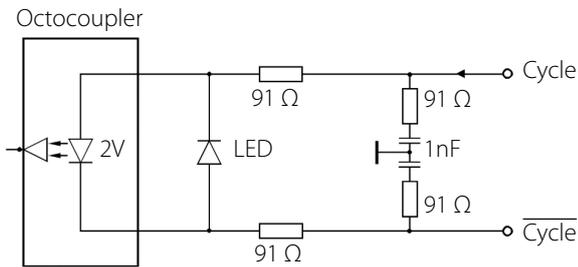


The first change of the clock signal from low to high b applies the most significant bit (MSB) of the angle information to the serial data output of the rotary encoder.

Each succeeding rising edge shifts the next least-significant bit to the data output. After transfer of the next least-significant bit (LSB), the alarm bit or other special bits are transferred, depending on the configuration. Then the data line switches from low c until the t_m time has elapsed.

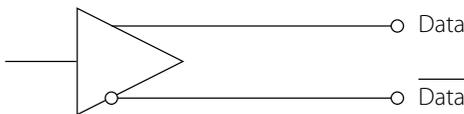
Another data transfer can only be started when the data line is switched to high d again. If the clock change is not interrupted at the point c, the ring register operation is activated automatically. That is, the information stored during the first clock change is returned via the S0 port onto the serial input S1. As long as the cycle is not interrupted at c, the data can be read out as often as desired.

Input circuit



Output circuit

Driver according to EIA 422 A



Recommended data transfer rate

The maximum data transfer rate depends on the cable length.

Cable length	Baud rate
< 50 m	< 400 kHz
< 100	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz