Control technology in drive systems

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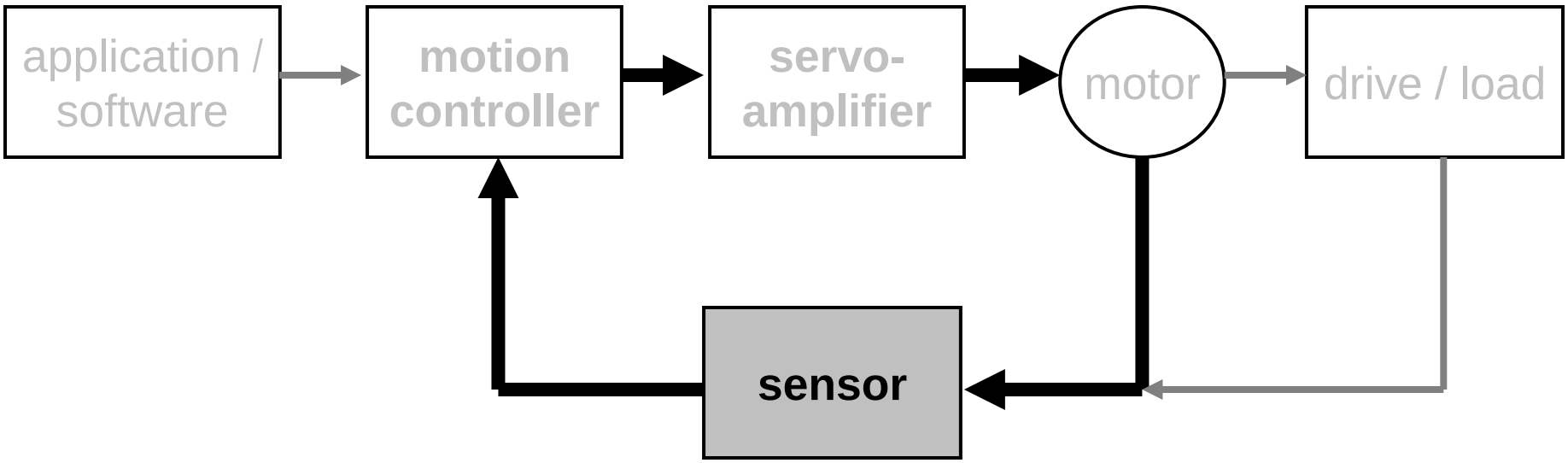
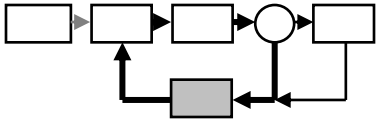
maxon motor

Agenda

- Sensors
  - Encoders, DC tacho, Resolver
- Goal and purpose
  - What are the properties of incremental encoders?
  - And how do the Signals look like?

Drive system

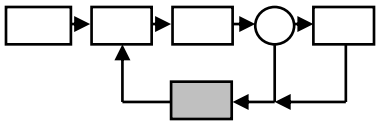


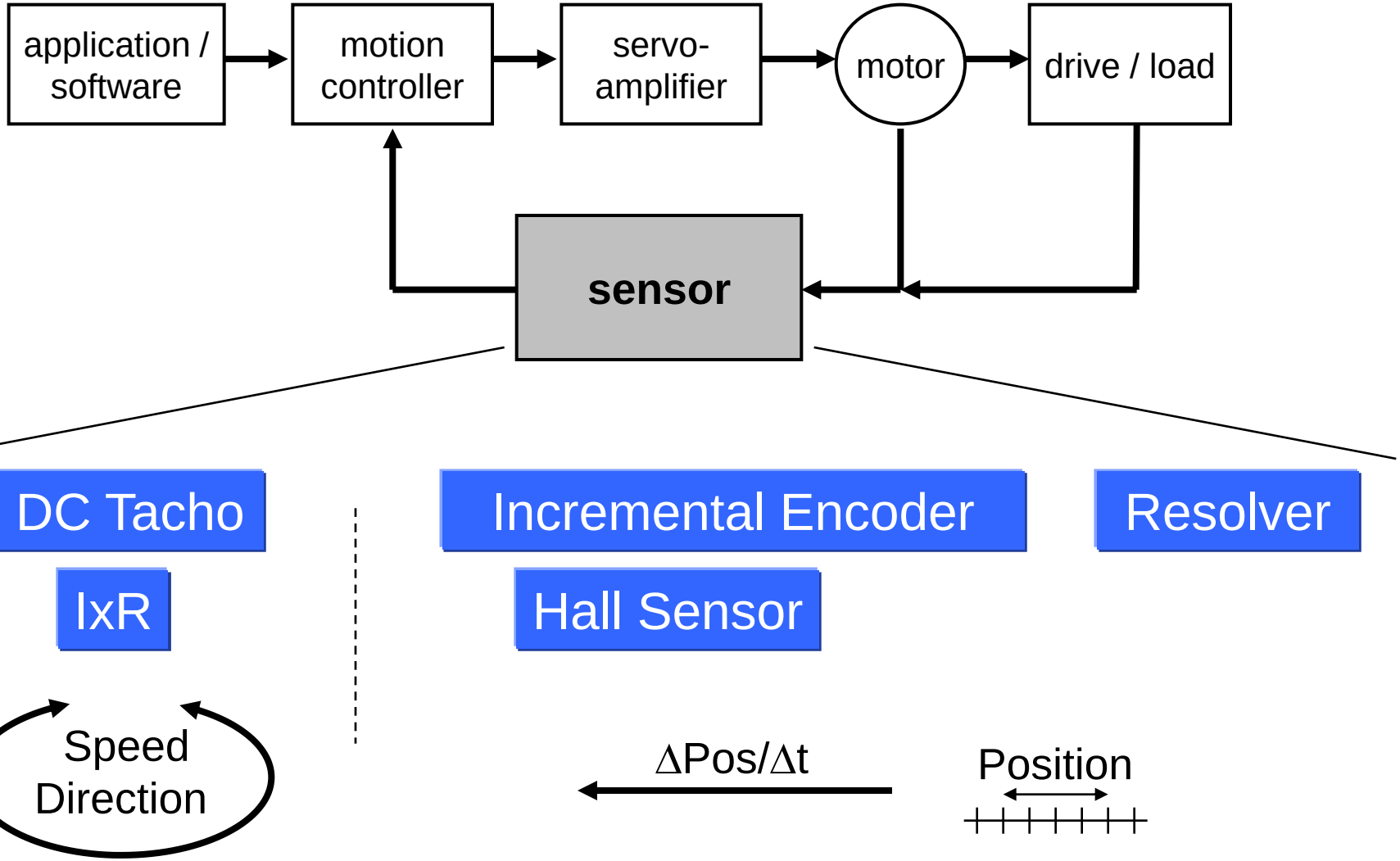


Goal and purpose

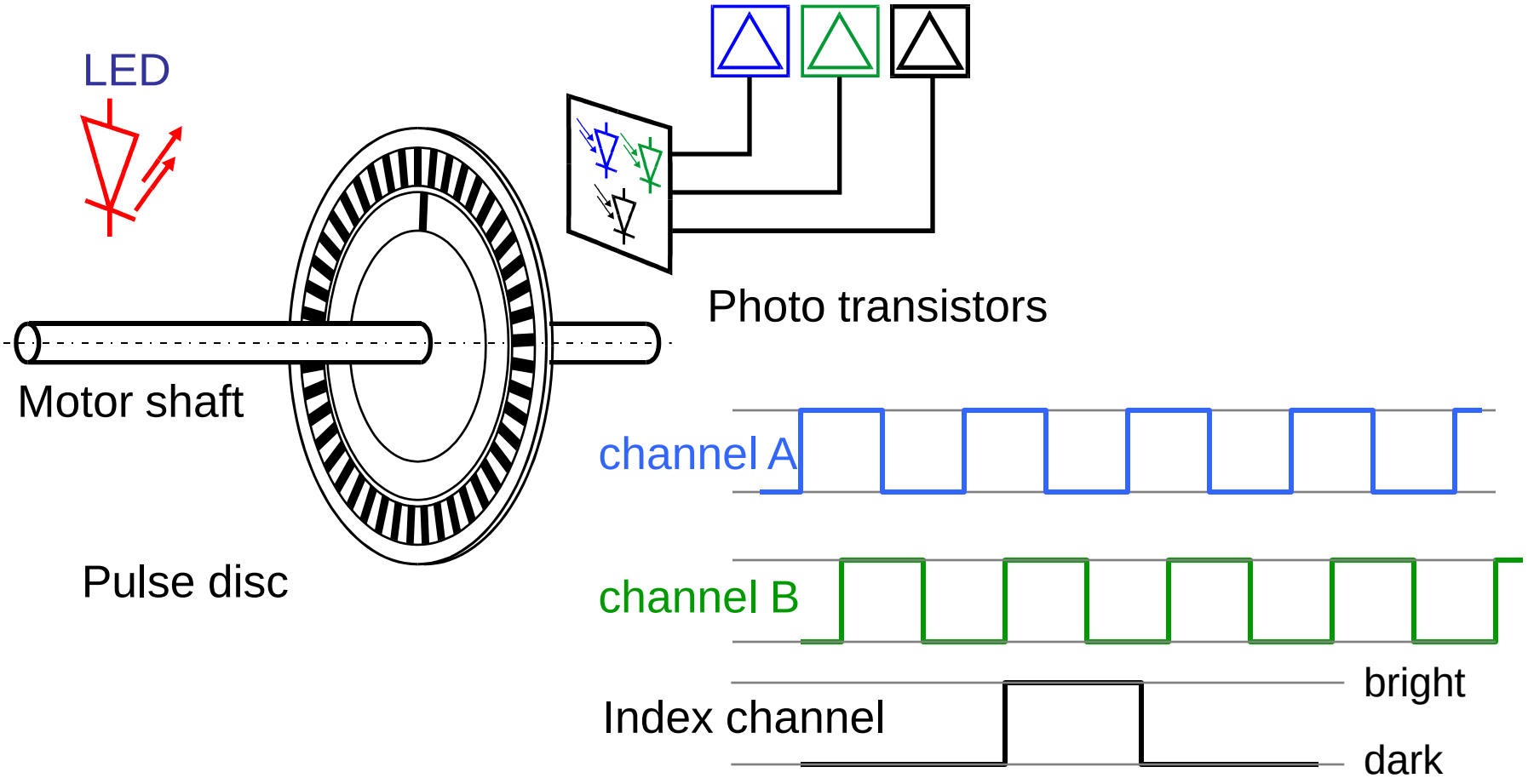
- What are the properties of incremental encoders? And how do the Signals look like?
- What are criteria for the selection?
- Which properties do motion and servo controllers have?
- **Goal: Finding the right controller and the right sensor.**

Sensors

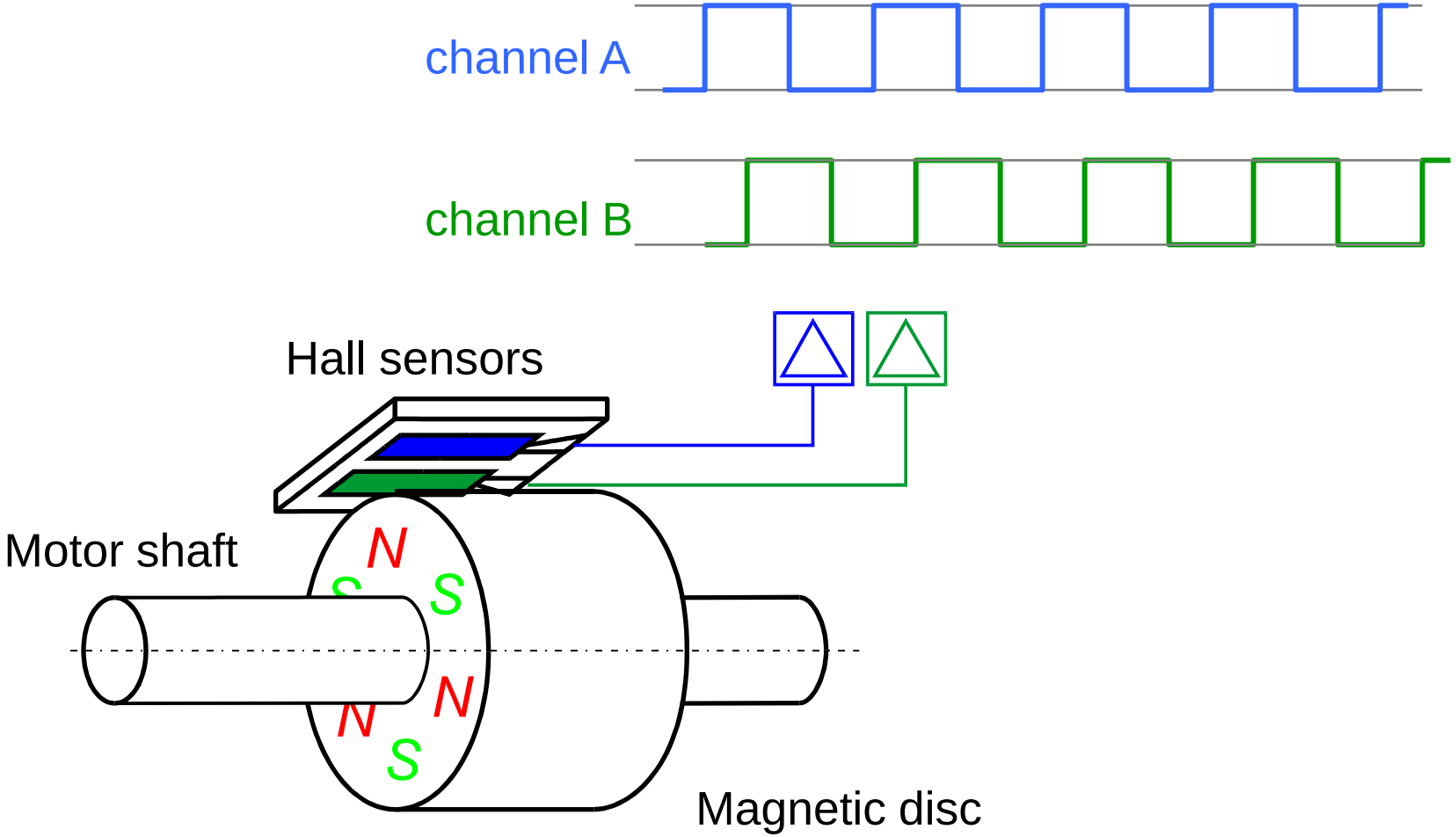



application / software
motion controller
servo-amplifier
motor
drive / load
sensor
DC Tacho
IxR
Incremental Encoder
Hall Sensor
Resolver
Speed
Direction
ΔPos/Δt
Position

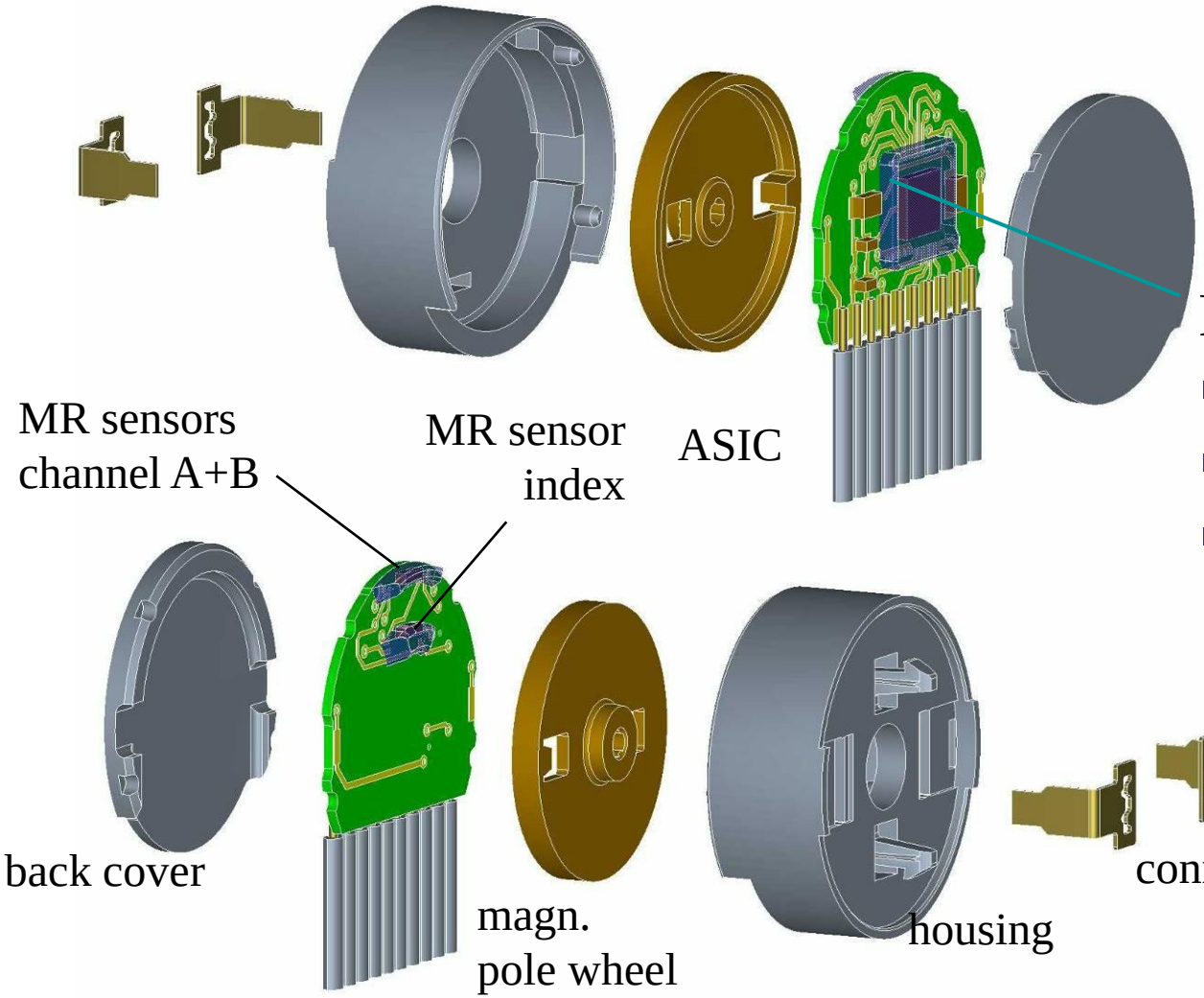
Optical Encoder



Magnetic encoder with Hall sensors



Magnetic encoder (maxon MR)

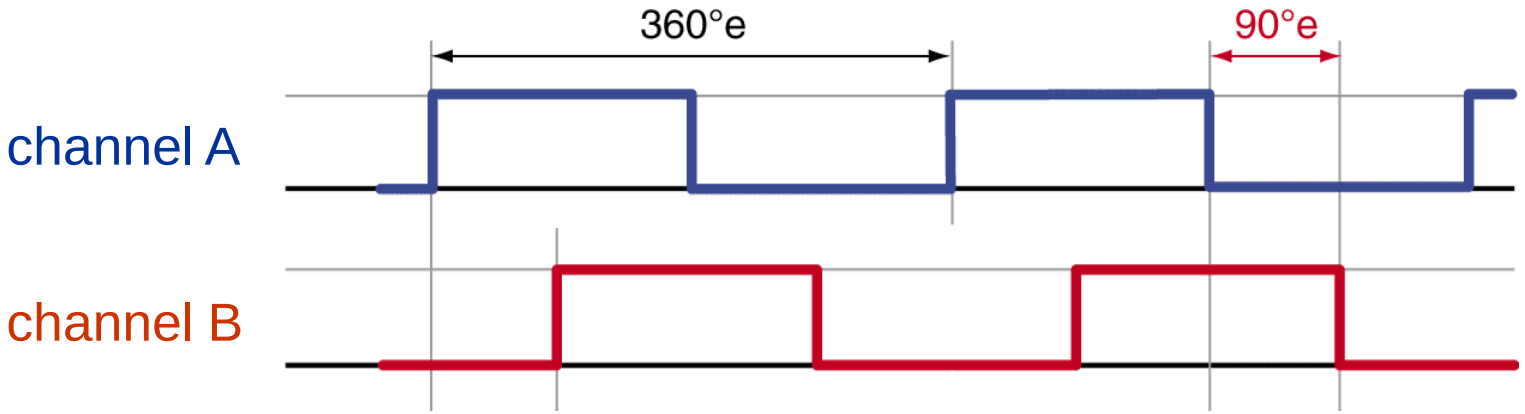


PCB with ASIC

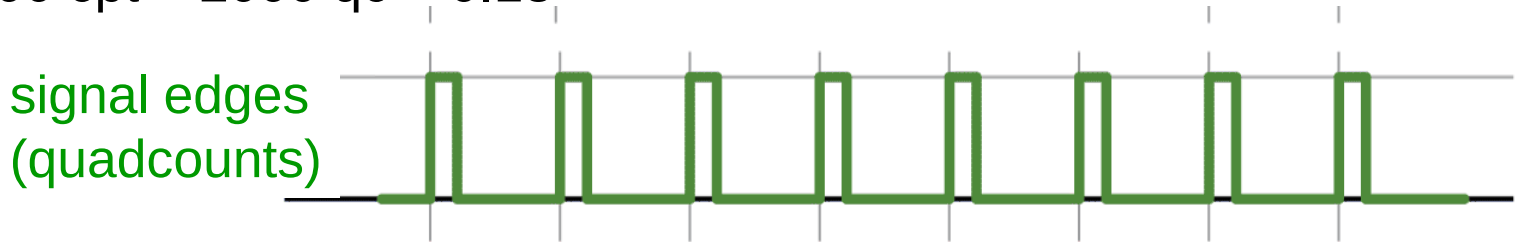
- signal conditioning
- signal multiplication
- line driver

Encoder signals

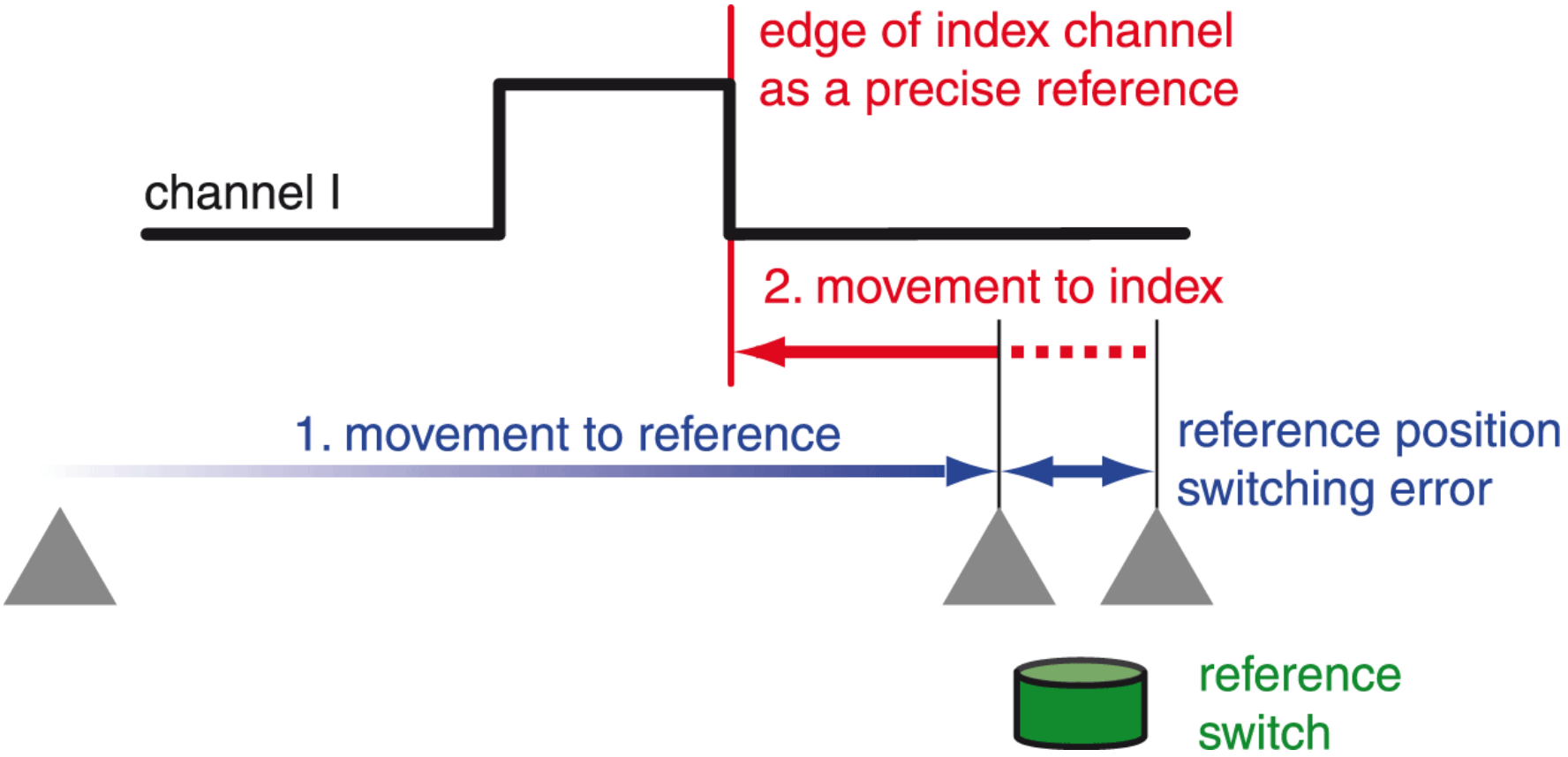
- 2 channels A and B with each **N** counts per turn (cpt)
- direction of rotation (signal A or B leads)



- 4 times higher resolution than nominal: Quadcounts (qc)
  - 500 cpt = 2000 qc = 0.18°

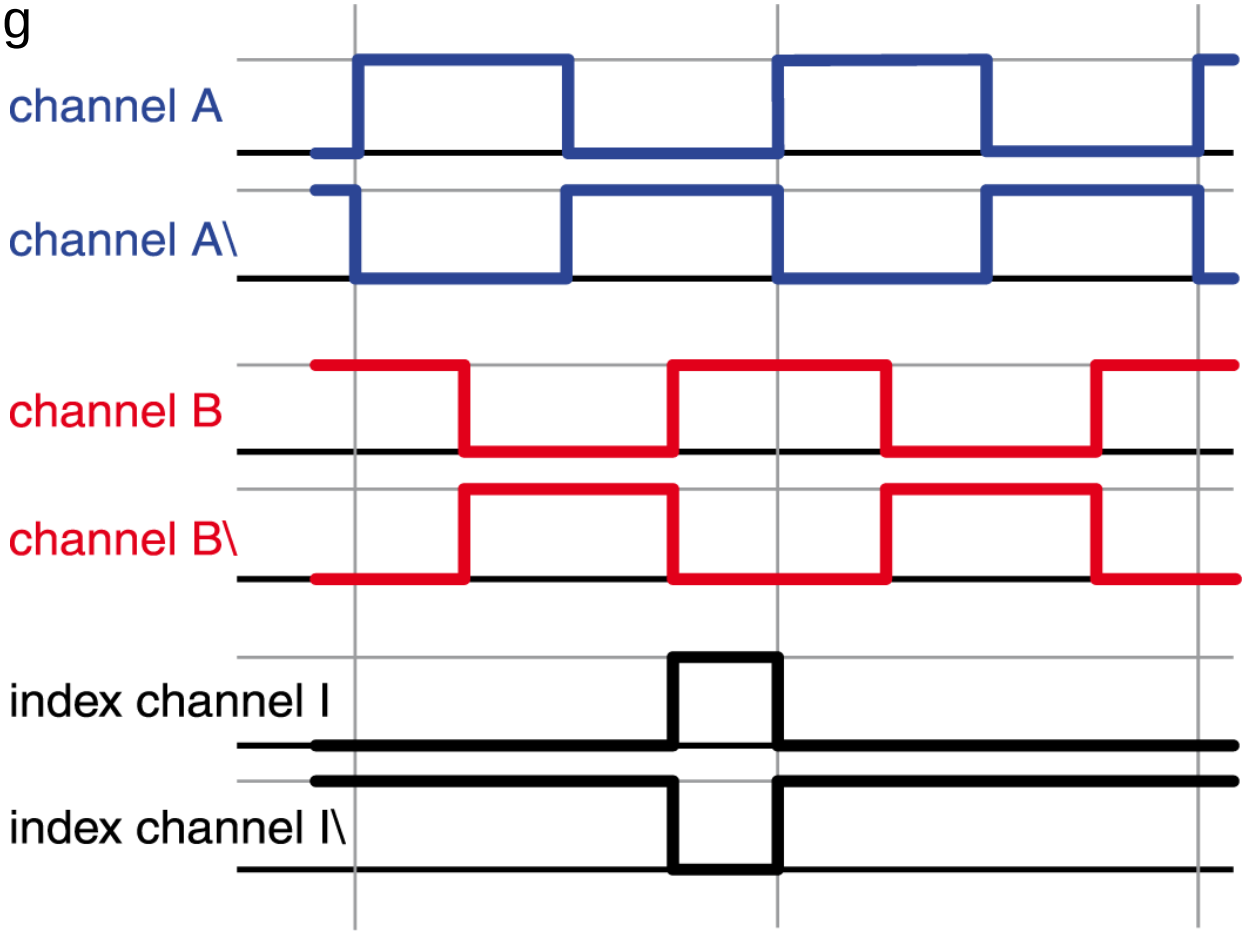


Index channel, Homing

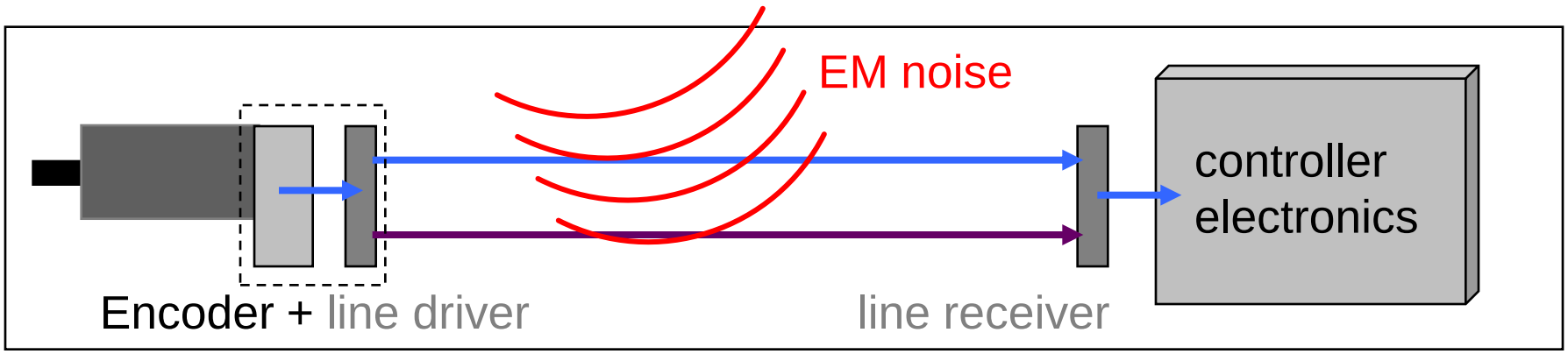


Complementary signals, Line Driver

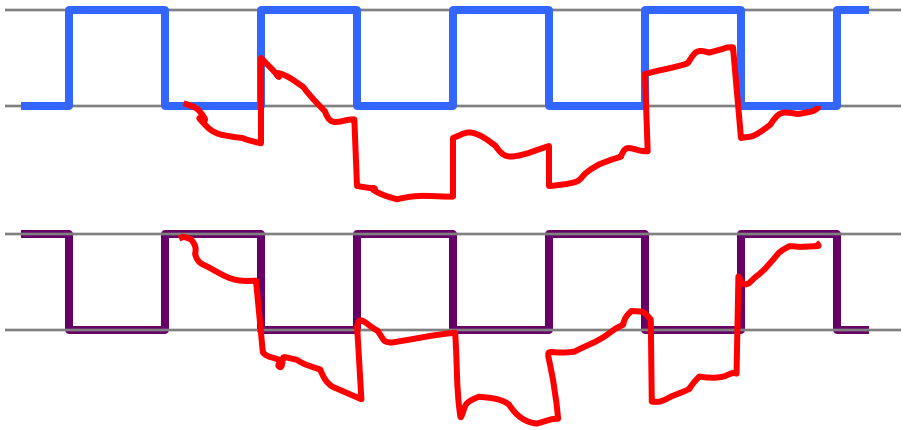
- driver: for transmission over long distances
- complementary signals for elimination of electromagnetic interferences during transmission



Line Driver

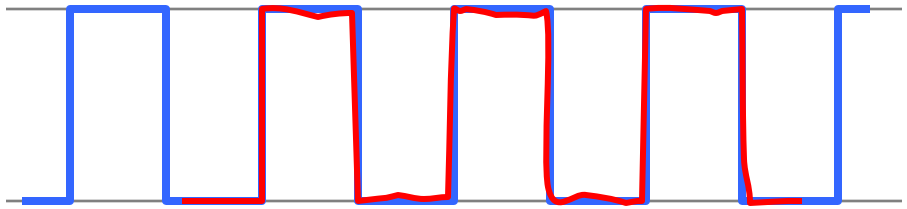


original signal



complementary signal

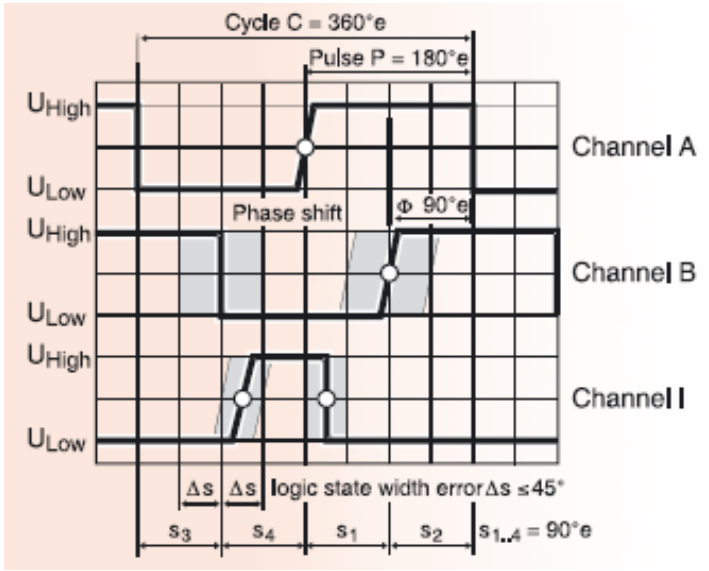
restored signal



removed EMI noise

Encoder properties

- signal and driver characteristics
  - electrical standard: RS 422, TTL
  - distance of signal edges
  - signal rise and fall times
- electrical supply
  - supply voltage
  - current uptake for LED, Line driver, …
- max. frequency
  - maximum resolvable speed
  - N: number of counts
  - N = 500; f_{max} = 100 kHz ergibt



$$n_{max} = \frac{f_{max}}{N} \cdot 60$$

n_{max} = 12´000 min^{-1}

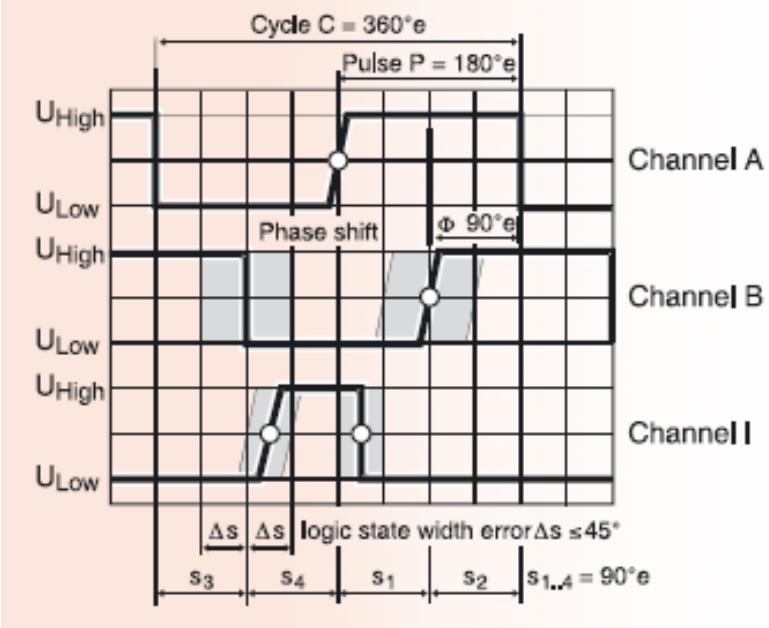
maxon Encoder data

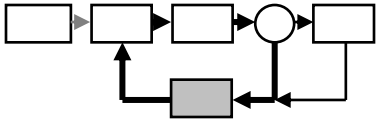
Stock program
Standard program
Special program (on request!)

Type	Order Number 225771	225773	225778
Counts per turn	128	256	500
Number of channels	3	3	3
Max. operating frequency (kHz)	80	160	200

Technical Data	
Supply voltage V_{CC}	5 V ± 5 %
Output signal	TTL compatible
Index pulse width (nominal)	90°e
Operating temperature range	-25 ... +85°C
Moment of inertia of code wheel	≤ 0.7 gcm²
Output current per channel	max. 5 mA

Attention: The index signal I is synchronised with channel A or B





Encoder selection

- number of pulses (counts per turn)
  - high: accurate positioning, low speeds
  - low: high speeds, positioning with gearheads
- number of channels
  - 1: simple drives, direction information not available
  - 2: direction information, quadcounts
  - 3: additional index channel for position homing
- Line driver
  - generally for long cables
  - harsh ambient conditions
  - mandatory for positioning

- Lunch Break
- Start again @ 13.20 h.