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Design Recommendation

for Gear Determination Sensor Systems

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Project: tbd

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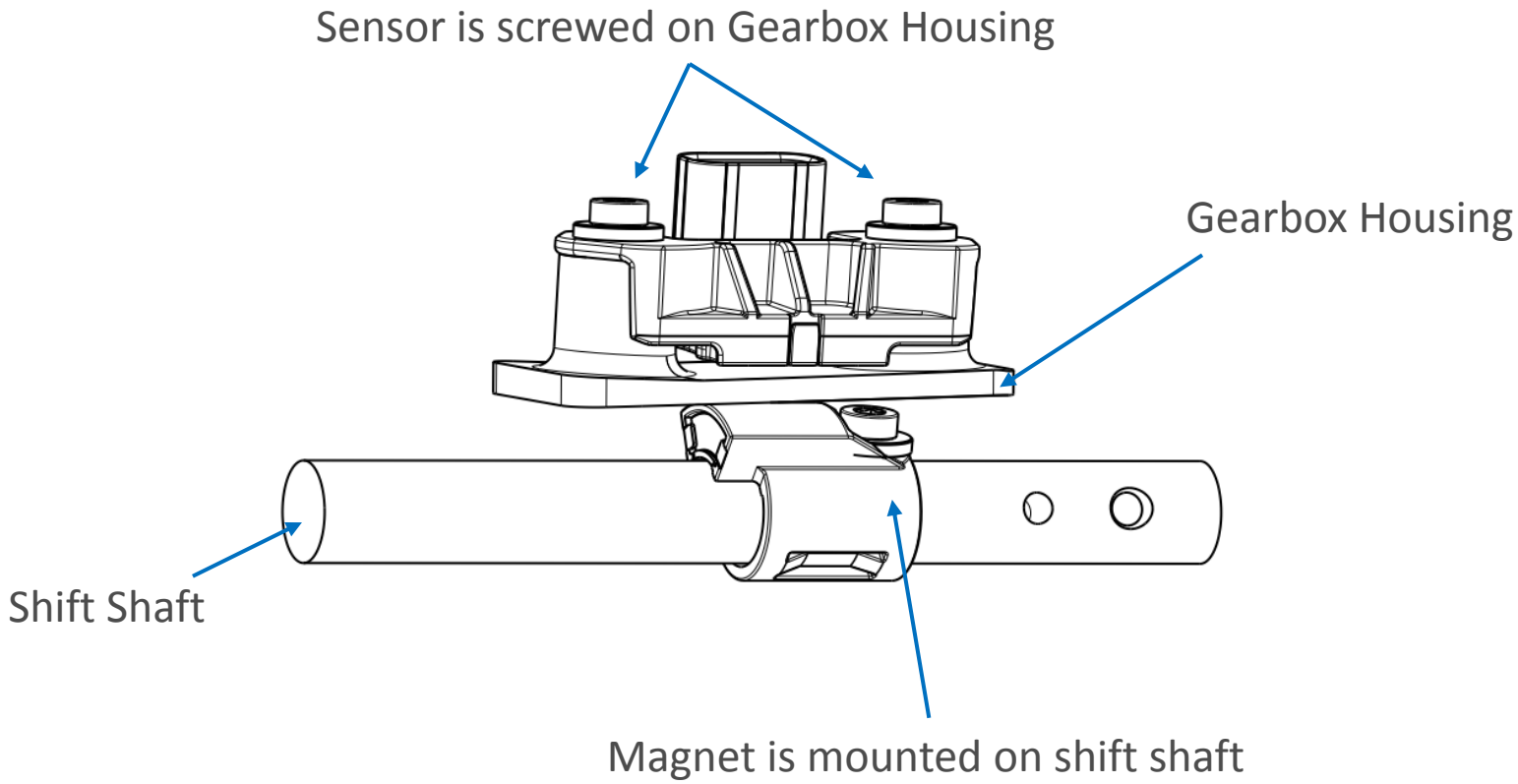
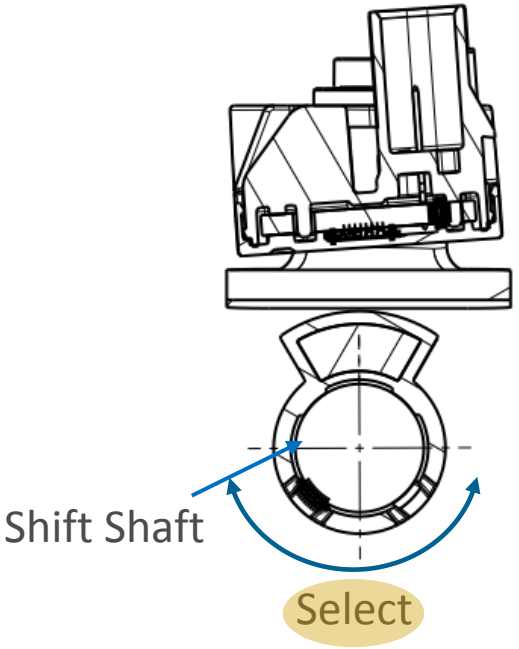
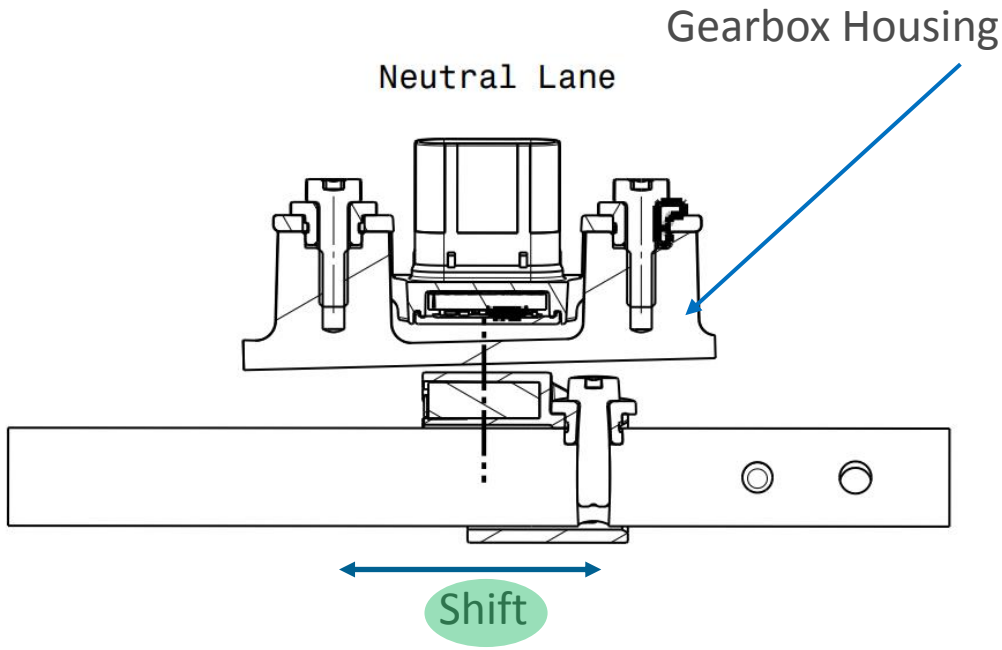
Boundary Conditions



Boundary Conditions

- A 3D Hall Sensor measures Shift and Select direction of the Shift Shaft
- The Gearbox Housing material should not contain any ferromagnetic components





Shift conditions

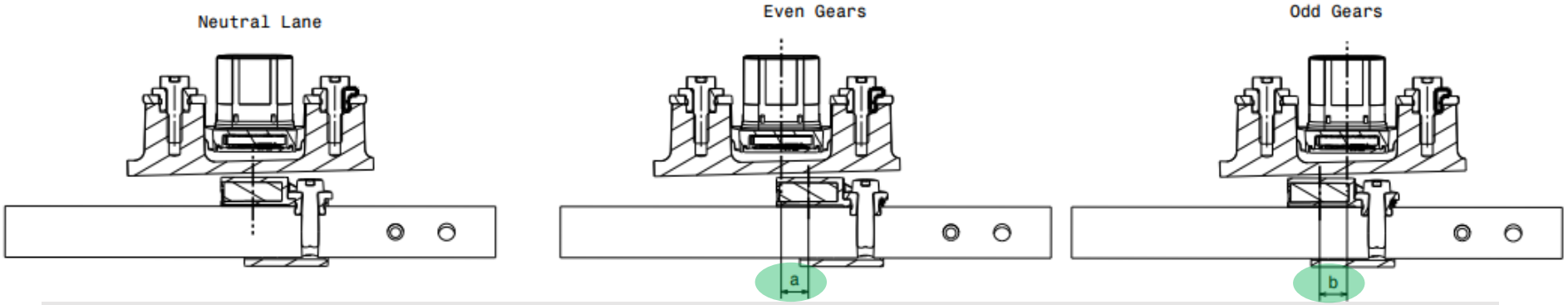
- The length of the shift travel is directly related to the shift gradient

$$Gradient = \frac{used\ PWM\ Range}{\Delta\ Shift\ Travel}$$

For example:

$$Gradient_{Shift} = \frac{80\%_{PWM}}{20\ mm} = 4.0\,\frac{\%_{PWM}}{mm}$$

- A smaller gradient leads to a smaller influence of mechanical inaccuracies on the output signal
- **Values a and b including mechanical tolerances for installation and wear out during lifetime is needed by JOPP to design the sensor system**



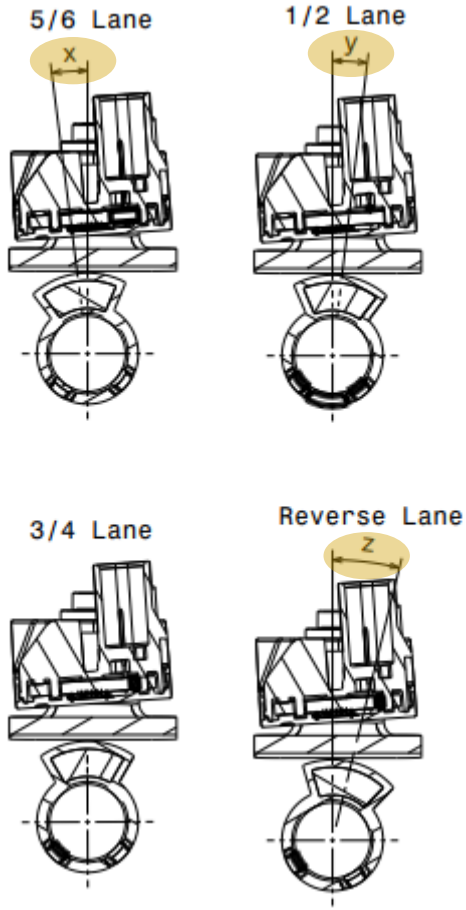
Select conditions

- The size of the select angle is directly related to the select gradient

$$Gradient = \frac{used\ PWM\ Range}{Select\ Angle}$$

For example:

$$Gradient_{Select} = \frac{60\%_{PWM}}{21°mech} = 2.86\,\frac{\%_{PWM}}{°mech}$$

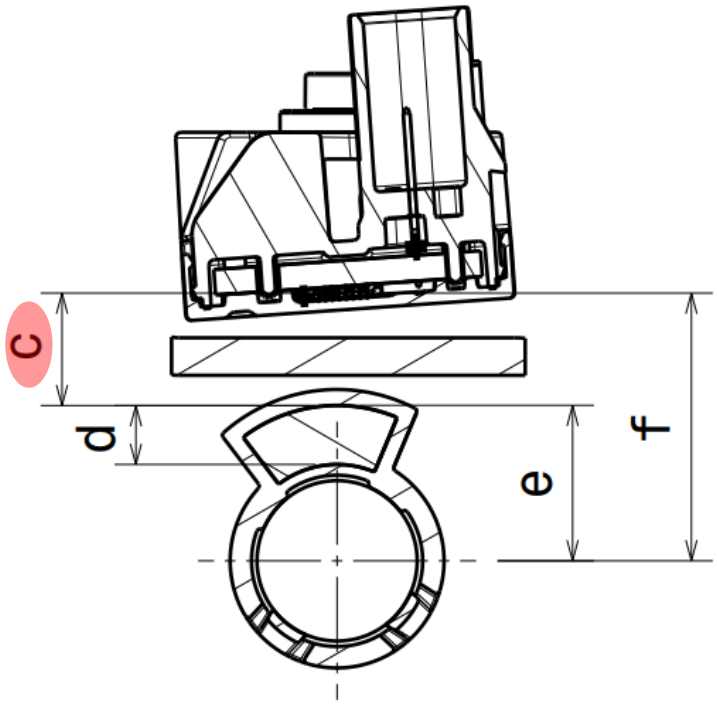


- The larger the select angle, the smaller the gradient
- A smaller gradient leads to a smaller influence of mechanical inaccuracies on the output signal
- **Values x, y and z including mechanical tolerances for installation and wear out during lifetime is needed by JOPP to design the sensor system**

Distance Magnet - Sensor

- In general the distance between Sensor and Magnet should as small as possible.

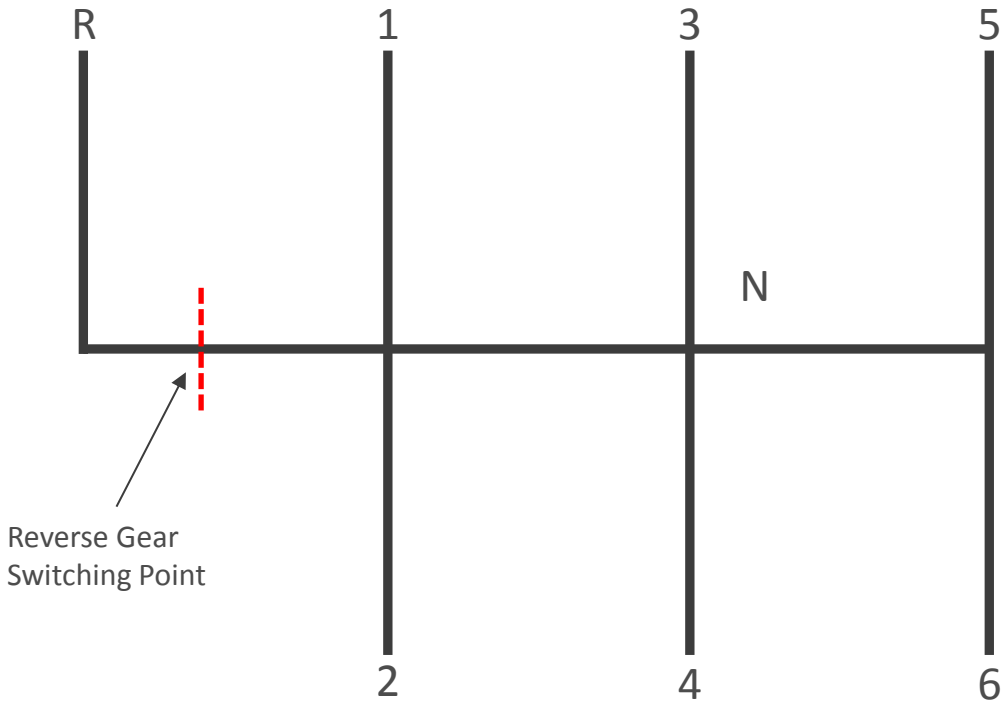
- **Most considered is Value “c”, which should not exceed 10mm**



Example

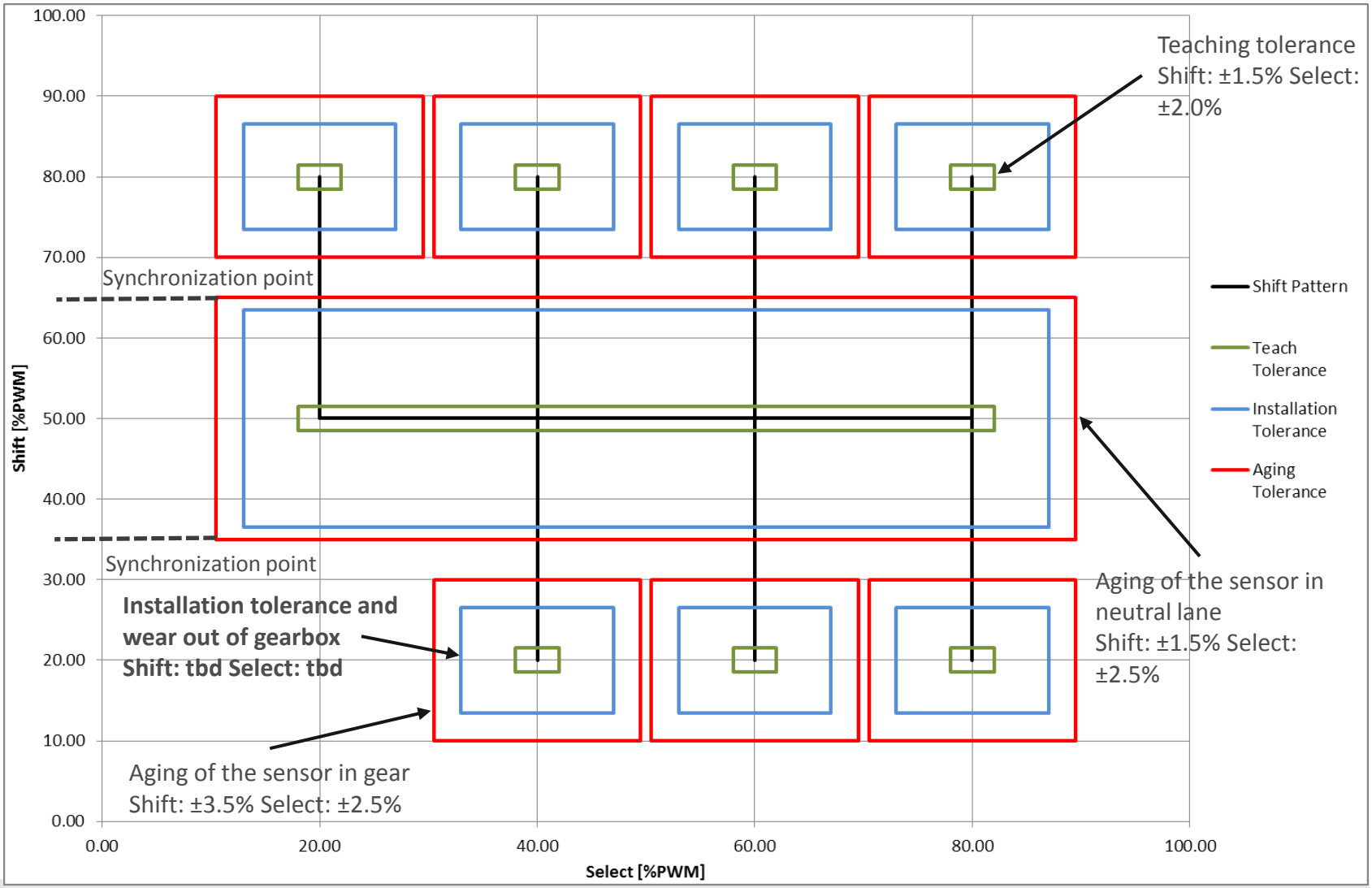
Exemplarily shown is the shift pattern with the corresponding values for shift and select in the next slide.

There is also the possibility to add a reverse gear switch emulation on a separate output pin.



Example

Teaching-, assembly- and aging tolerances



Example

Teaching-, assembly- and aging tolerances

The **teach tolerance** is the tolerance band which is needed, to find a parameter set by the calculation routine.

The **aging tolerance** is the total signal deviation of the sensor system, that is allowed over lifetime.

The **assembly tolerance** is the signal deviation due to mounting the sensor and magnet into the gearbox.

Each tolerance has to be defined, and is depending to parameters discribed in Select- and Shift Conditions (see above).

Conclusion

The feasibility of such an “All Gear Sensor System” depends primarily on installation space and mechanical accuracy respectively close tolerances.

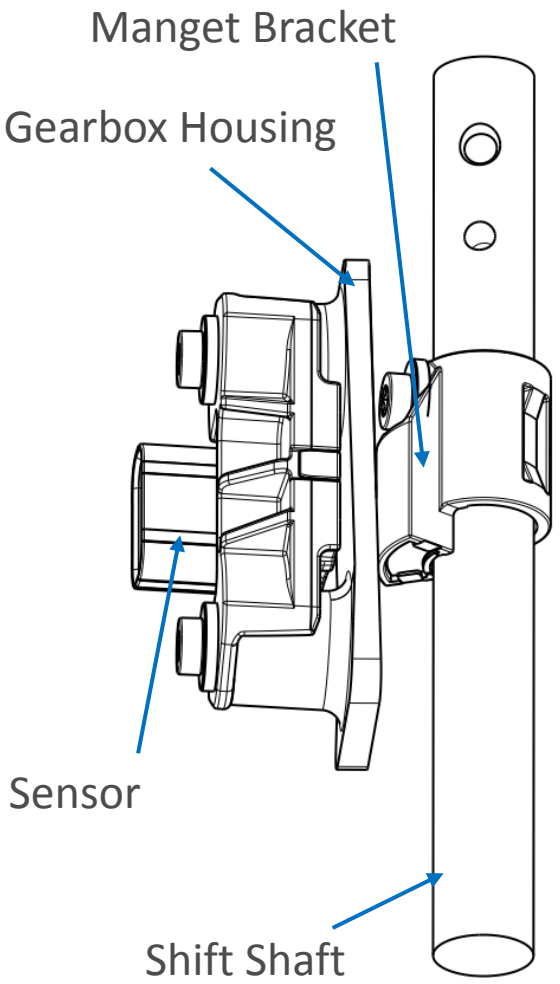
Example:

$$Shift\ Gradient = 4.0\ \frac{\%_{PWM}}{^{\circ}_{mech}}$$

$$Assembly\ Tolerance = 5.0\ \%_{PWM}$$

Maximum permissible deviation from the standard value in degrees due to assembling and variation over lifetime[1]:

$$\frac{5.0\%}{4.0\ \%/_{\circ}} = \pm 1.25^{\circ}$$



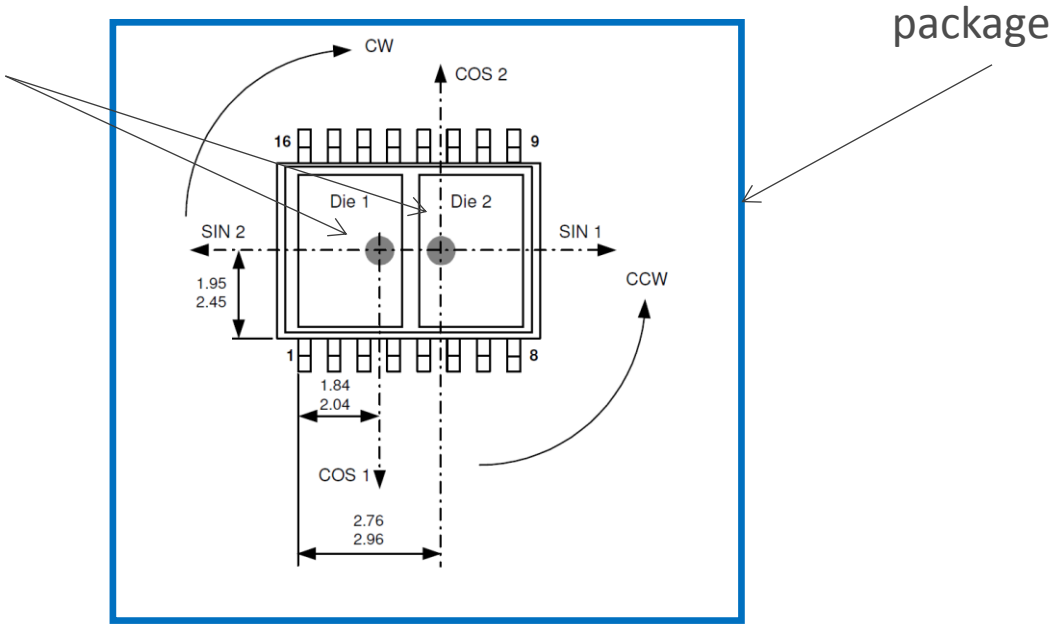
[1]additional aging of the mechanical parts through wear and tear

Sensor Concept

Redundancy

Two active sensor die`s in one housing package

2 independent die`s for sensing the magnet positon separately, completely independently with separate output signals.



Required information

To be completed by the costumer

Please look at the presentation and fill in the open variables with data.

Which direction is Select and Shift?
Lane 3/4 should be the neutral lane.

A:
B:
C:
D:
E:
F:

X:
Y:
Z:

For optimal design, we need a 3D model with all shift positions.

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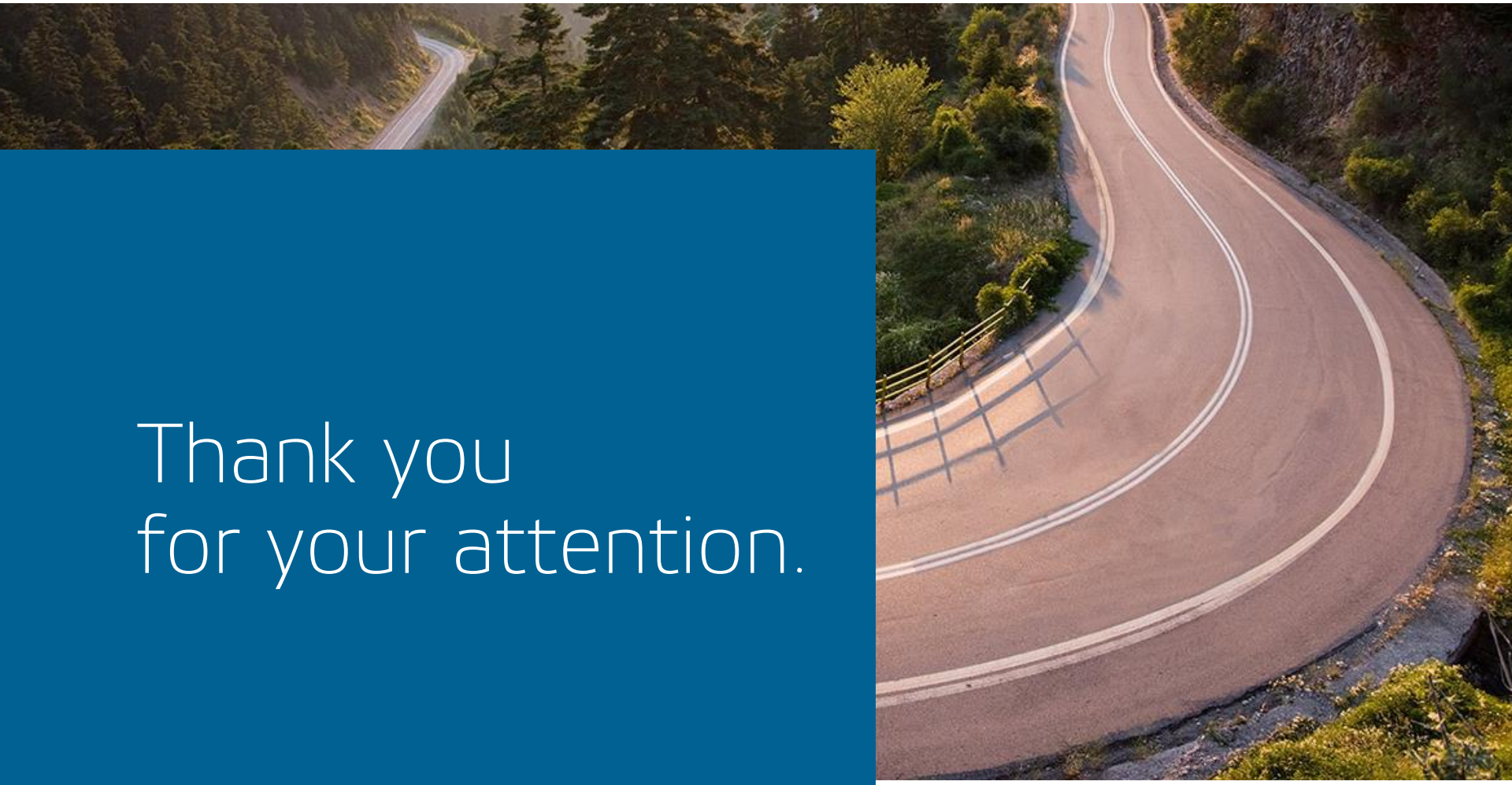

Thank you for your attention.

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