Application Note

FESTO

CMMT-AS-xx with Multiturn Motor and 2nd incremental encoder (for Homing Method with zero pulse)

CMMT-AS

This Application Note describes how to configure and run the CMMT-AS-xx with Multiturn Motor and 2nd incremental encoder by using the homing method 'zero pulse'. The 2nd incremental encoder is increasing the absolute accuracy of the linear axis (direct position measurement) and is providing the zero pulse for the homing. The internal multiturn motor encoder gives the possibility to detect the defined and fixed zero pulse for the homing process of the 2nd incremental encoder.

With this strategy we have an accurate reference point and do not need any HW-limit switches, HW-reference switches or any mechanical stops for the needed homing process.

Title .....CMMT-AS-xx with Multiturn Motor and 2nd incremental encoder (for Homing Method with zero pulse)
Version 1.10
Document no. 100354
Original .....en
Author .....Festo

Last saved 25.10.2021

Copyright Notice

Legal Notice

Table of contents

1 Components/Software used

1.1 Softwares Used

Type/Name	Software Version
FAS...Festo Automation Suite	V2.2.0.660
CMMT-AS Plug-in (FAS)	V2.2.1.4

Table 1.1: Software used

1.2 Hardware Used

Type/Name	Firmware Version
CMMT-AS-xx	FW V20.05.xx
EGC-80-250-TB-KF-0H-GK-M1	Toothed belt drive with displacement encoder (M1: resolution 2,5 µm with 4-fold evaluation)

Table 1.2: Hardware used

2 APPLICATION DESCRIPTION

2.1 Use Case example:

Pressing application where a precise absolute positioning accuracy is required.

To compensate the feed constant tolerances of the linear drive and all the flexibility within the system a 2nd linear encoder is needed to change the place for getting the actual position from the motor encoder (indirect position measurement) to the slide of the linear with a direct position measurement. To this an additional requirement is demanded **for not** using any HW-Limit-Switches, HW-Reference-Switches or mechanical stops for referencing the system as a homing method. Based on the fact, that the CMMT-AS does only support incremental systems for the 2nd encoder a homing process is always required after each power-on cycle to reference the 2nd encoder.

2.2 Realization

To achieve the defined target, we are using here a motor with multiturn feedback system and using a defined zero pulse from the external encoder (Homing to zero pulse).

Important is a precise referencing accuracy (homing accuracy) to get an accurate reference point of this external linear encoder. This we reach with any defined zero pulse of the 2nd encoder for homing the system and the multiturn motor is supporting the system to get this defined zero pulse of the external encoder after power-on cycle.

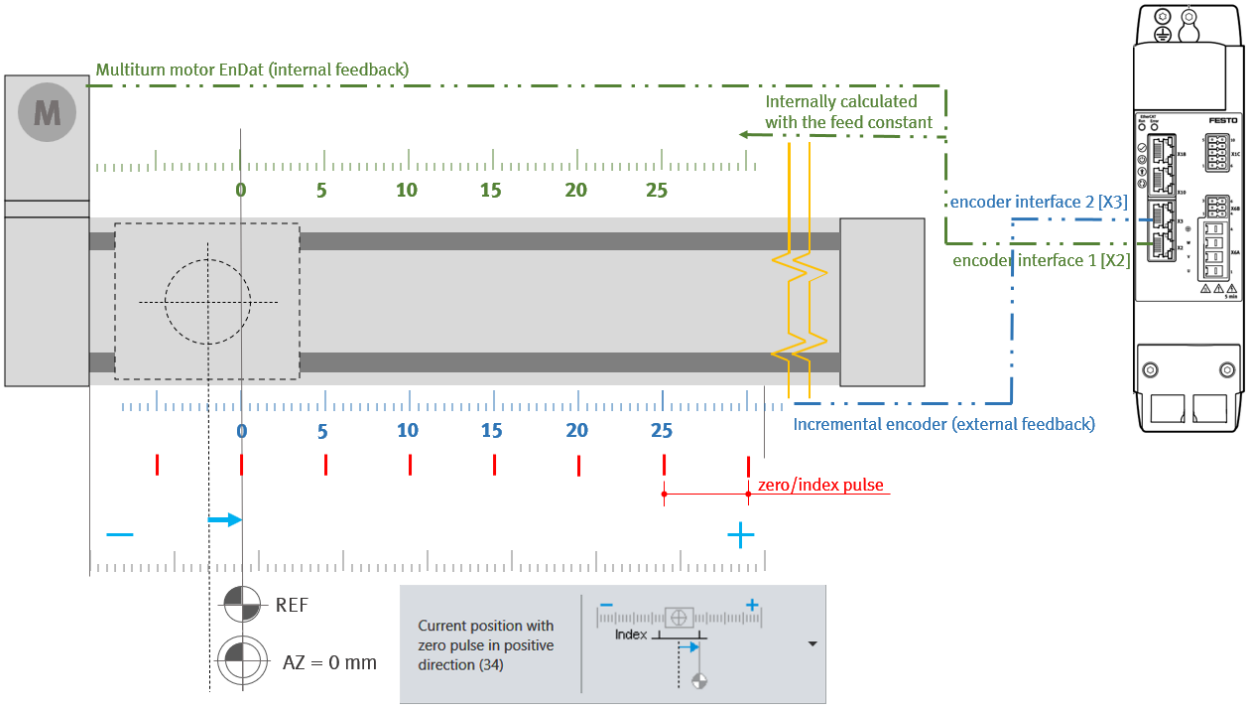


Fig. principal schematic (REF...reference point; AZ...Axis Zero Point Offset)

2.3 Main principle

The actual position of the external incremental encoder is being initialized with the actual position value from the multiturn motor during power-on cycle (function of the CMMT-AS drive).

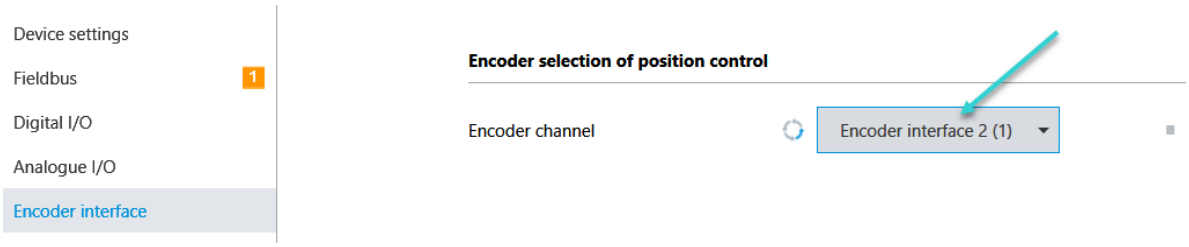
Therefore, it is known where the linear drive is approximately standing (within the absolute accuracy of the internal feedback system/motor). With this start position we can reference the system to a fixed defined zero pulse from the external encoder without additional HW-switches or mechanical stops (blocks).

3 Commissioning with FAS (Festo Automation Suite)

3.1 Parameterization of the 2nd encoder

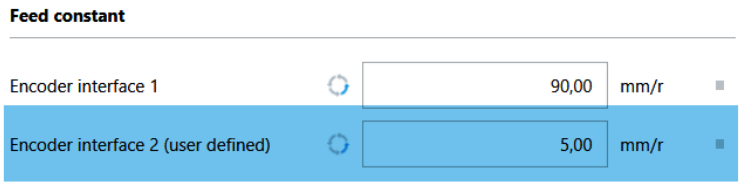
3.1.1 Encoder interface ›› Encoder selection of position control

Here we set the encoder channel to encoder interface 2 [X3] to evaluate the actual position information from the 2nd encoder for the position controller (direct position measuring of the slide).
Parameter P1.122.0.0 Encoder Channel.



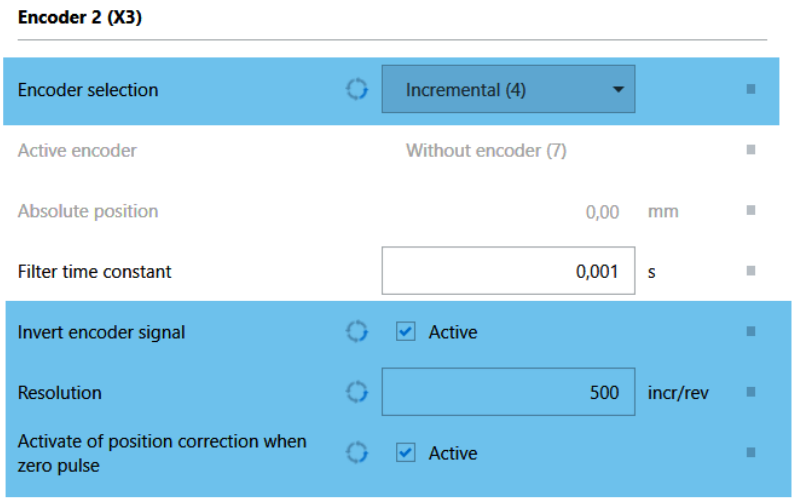
3.1.2 Encoder interface ›› Feed constant

Set ‘Encoder interface 2’ to 5,0 mm/r (please see appendix ‘Displacement encoder EGC-M1/2’)



3.1.3 Encoder interface ›› Encoder 2 [X3]

- Set parameter P0.11616.1.0 (Encoder selection) to ‘Incremental (4)’
- If needed, invert the encoder signal with parameter P1.1171.0.1 (Invert encoder signal)
- Set parameter P0.10040.1.0 (resolution) to 500 inc/rev (please see appendix ‘Displacement encoder EGC-M1/2’)
- Activate the zero pulse by activating the parameter P0.10044.1.0 (activation of position correction for Zero pulse)

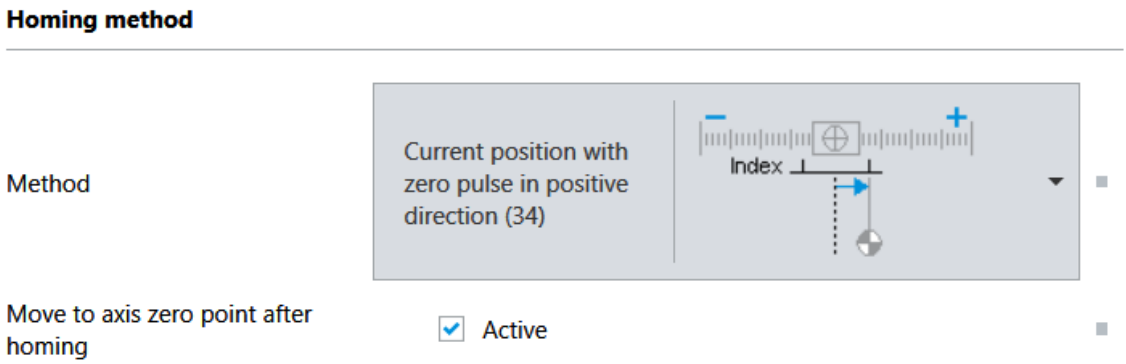


4 Parameterization for the Homing process

4.1 Axis 1 ›› Homing Method

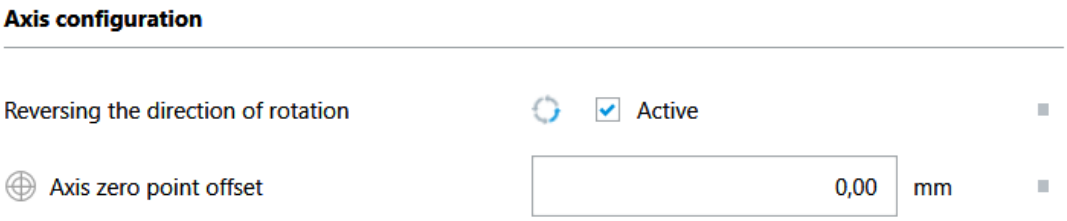
For using the zero pulse of the 2nd encoder we parameterize following homing method.

P1.8417.0.0 Homing method ‘Current position with zero pulse in positive direction (34)’



4.2 Axis 1 ›› Axis ›› Axis configuration

P1.8416.0.0 Axis Zero Point Offset AZ = 0,0 mm



4.3 Homing process

In this step we are homing/referencing the multiturn motor with the final command ‘Save offset to encoder’. This belongs still to our commissioning part and shall be performed once.

4.3.1 Sequence

- Enable the system
- Move your axis to any needed position by jog mode
- Command the homing
- Save offset to encoder
  - ⇨ Then the multiturn motor is getting the state ‘Drive referenced’ permanently P0.3237.0.0
  - ⇨ The Zero Point Offset is permanently stored P0.3223.0.0
- Save FAS-Project on your laptop and on the drive

✓ Commissioning done!

5 Operation process after each power-on cycle

When power-on the system the drive is coming up with the status ‘Drive referenced’ and the position of the 2nd encoder (P0.11601.1.0 Absolute Position) is being initialized with the absolute position value from the multiturn motor.

Therefore, it is known where the axis is approximately located (i.e., with the absolute accuracy of the internal encoder). Please see following figure the absolute position shift d.

With this information we can command the axis to move to our defined zero pulse of the external encoder, but only approximately. This means in this case that our absolute position 0 mm is not perfectly aligning to the zero pulse from the external encoder, but good enough to get it with our next homing method ‘Current position with zero pulse in positive direction (34)’. For secure identification of the "zero pulse" from the external encoder, we select the target position (i.e., the starting position for homing) centrally between two zero pulses. This means in our case then 2,5 mm (zero pulse pitch 5 mm * 0,5 = 2,5 mm). In case that an Axis Zero Point Offset AZ different from zero is used, we choose as target position: 0.5 * (zero pulse pitch) - (Axis Zero Point Offset AZ). In our example with the homing method ‘Current position with zero pulse in positive direction (34)’ we have to change the sign to negative (-2,5 mm) to get then the same index pulse as we detected from our homing process during commissioning.

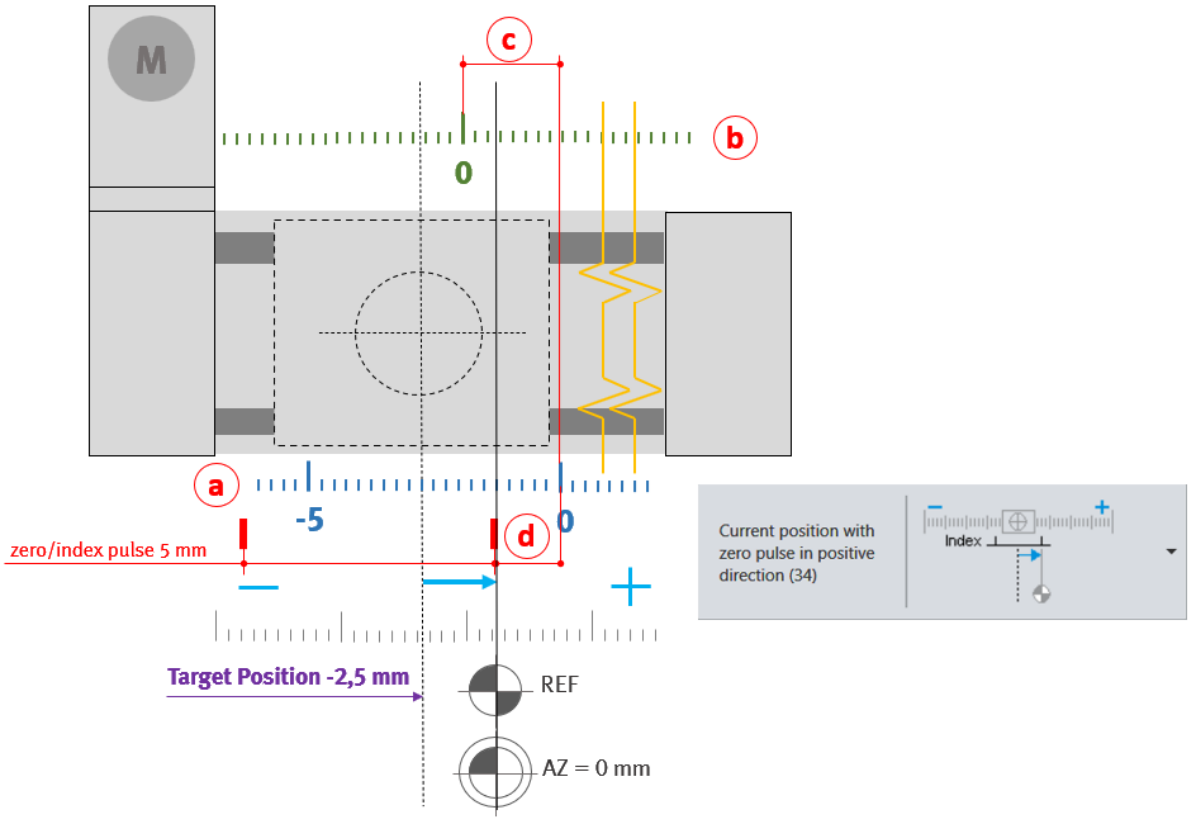


Fig. situation after power reset and before homing

a position scale of the external encoder

b position scale of the multiturn

c position shift between external and internal encoder (e.g., due to feed constant tolerances, etc.)

d position shift of the external encoder related to the fix zero pulse due to the initialization with the not ‘fully’ correct multiturn position. (After homing the absolute position 0 mm of the external encoder is aligned again to the zero pulse)

Note

In the above described situation, we are using the start position during initialization from the multi-turn motor, which has not the required absolute position accuracy. When the position shift between multiturn scale and external scale during the axis stroke is close or bigger than zero pulse pitch, then we do not get securely our defined zero pulse. In such cases it is a good idea to adapt the real feed constant of the axis in the FAS-project (Encoder interface ‹‹ Feed constant ‹‹ Encoder interface 1).

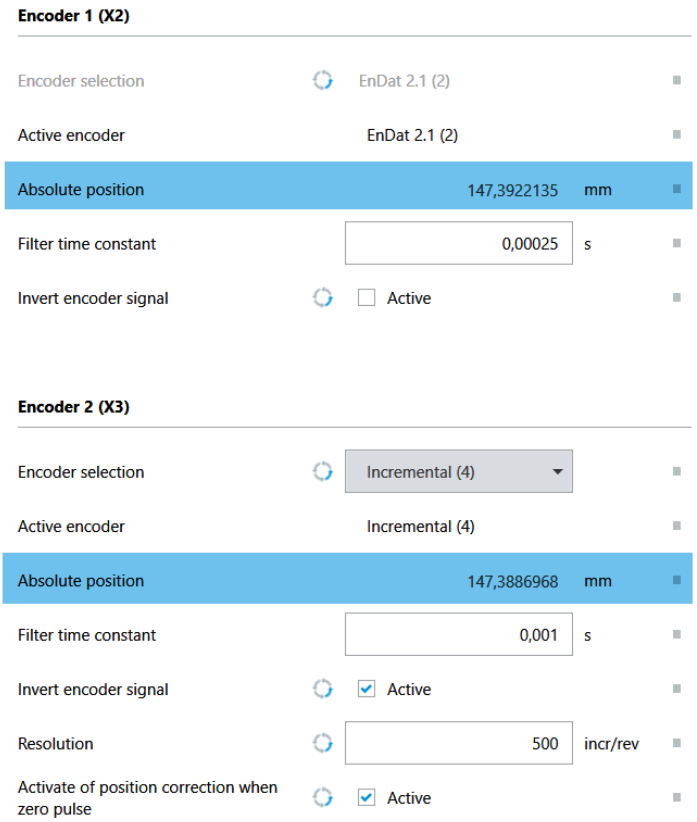


Fig. When power-on the system the absolute position of the Encoder 2 [X3] (2nd encoder) is being initialized with the absolute position value from Encoder 1 [X2] (multiturn encoder)

Sequence

- Power-on
- Enable the system
- Command absolute position to -2,5 mm
- Command the homing
- Save offset to encoder: No need anymore
  - ✓ Now we have referenced our external encoder with the help of the zero pulse. From now on our system is ready for operation and control the position by evaluating the actual position from the external encoder and we have a precise homing accuracy by using the defined zero pulse from the external encoder

Note

After Power-On-Cycle, the actual position of the second encoder is initialized with the actual position of the multiturn feedback. This is done internally within the drive via the zero point offset with the corresponding value in the parameter P0.32231.0 Encoder (1) 2 [X3].

This basically results in a mismatch between the FAS in the project and the drive when you go back online after a power reset. The value of the zero offset depends on the set feed constant and the actual position of the multiturn feedback during initialization.

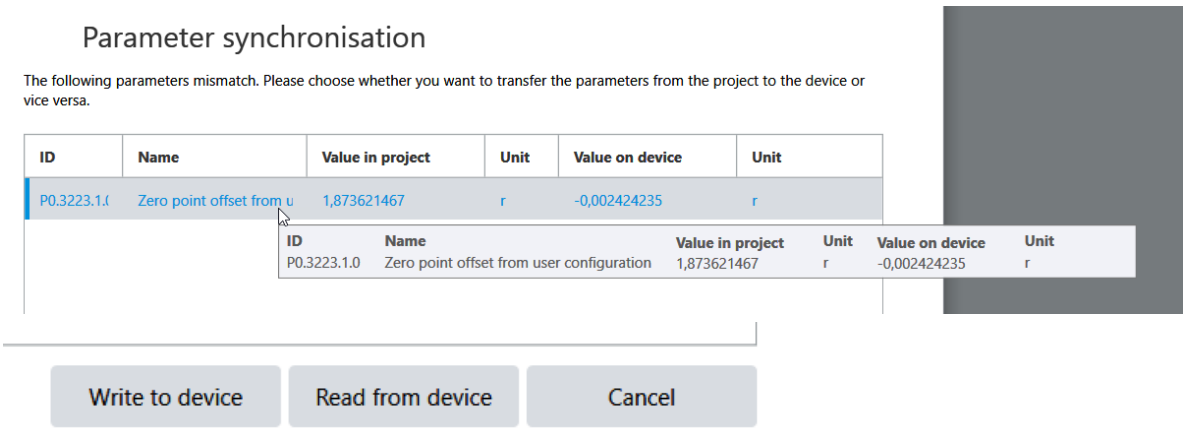


Fig. FAS Parameter synchronisation when going online

Please use then the button ‘Read from device’

6 Displacement encoder EGC-M1/2

In general, the value for the feed constant and resolution depends on the encoder type used. The feed constant for a linear encoder type refers to the length between 2 zero pulses or the pole pitch.

EGC-M1
Zero pulse = cyclically every 5 mm
Resolution encoder 2 = Feed Constant Encoder 2 / graduation period each channel without quadric evaluation
= 5,00 mm / 0,01 mm = 500

EGC-M2
Zero pulse = cyclically every 5 mm
Resolution encoder 2 = Feed Constant Encoder 2 / graduation period each channel without quadric evaluation
= 5,00 mm / 0,04 mm = 125

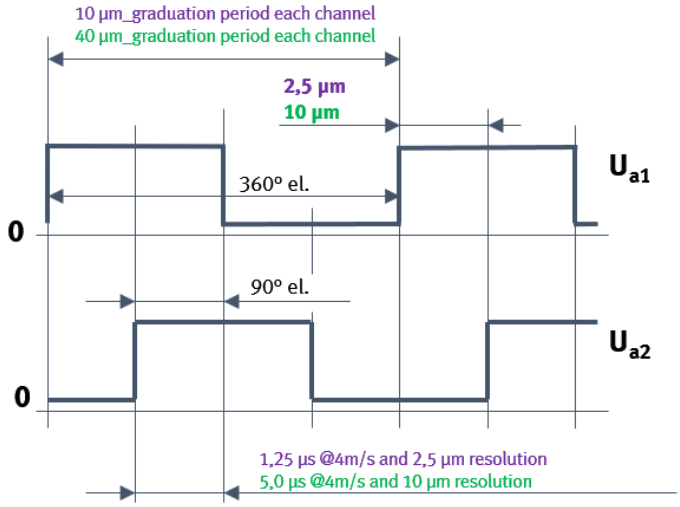


Fig. Resolution
EGC-M1: 2,5 µm_4 fold evaluation
EGC-M2: 10 µm_4 fold evaluation

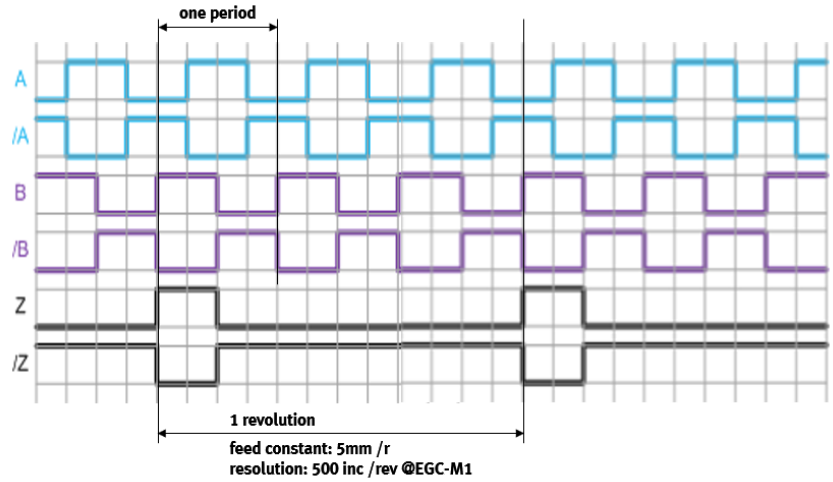


Fig. zero pulse and feed constant

7 Example: Demonstration of the position shift between encoder1/2

Target position 180,00 mm

Result:
P0.11600.1.0 Absolute Position [X2] 179,63 mm (multiturn encoder motor)
P0.11601.1.0 Absolute Position [X3] 180,00 mm (incremental encoder)

/System/Encoder interface group[0] (34)			
P0.11601.0.0	Absolute position in user units	179,6389222	mm
/System/Encoder interface group[1] (34)			
P0.11601.1.0	Absolute position in user units	180,0000073	mm

We can here see that the set feed constant with 90 mm/r does not fit perfectly to the real axis. It is a mismatch of :(180,00 mm – 179,63 mm)/2 = 0,185 mm. An adapted feed constant of 90,185 mm leads to a better result. But this is not needed in our system. Just to show the effect of the direct and indirect position measurement of the actual position (motor encoder versus linear incremental encoder).