

CMMP Function Activation of Multiturn Encoder for Endless Positioning

Using CMMP-AS in combination with EMMS-AS and multiturn encoders as permanent stored position mode with multiturn encoder for endless positioning.

CMMP-AS- -M3
CMMP-AS- -M0

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1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
CMMP-AS- -M3	From 4.0.1501.2.1	general
CMMP-AS- -M0	From 4.0.1501.2.1	general
EMMS-AS-....-M-....	Multiturn Encoder	general

Table 1.1: Components/Software used

2 Application description

Endless positioning with CMMP-AS Servo controller and motors with multiturn encoder.

Whenever using a multiturn encoder in an application where endless relative movements are necessary, there can be a problem after one or more overflows from the multiturn encoder.

The multiturn encoder can store only 4096 absolute rounds (12 bits). After a power cycle the encoder will give a value which is inside this range (0...4096). This range is mapped into a range from -2048 to +2048 inside the controller. The controller converts this value with the factor group into the user defined position unit or modulo position.

The problem only occurs on unlimited axis or conveyor applications when the encoder range has one or more overflow(s).

After a power cycle the controller didn't know if or how often the overflow occurred. He will get only the new absolute position from the encoder and map and convert it like described.

The solution for this application is storing the last absolute position value in the controller and reload the value after a software reset or power down (weekend shutdown)

That means that the absolute (modulo) position is always correct (before and after a power cycle).

2.1 Example 1: Block diagram of the machine / Conveyor

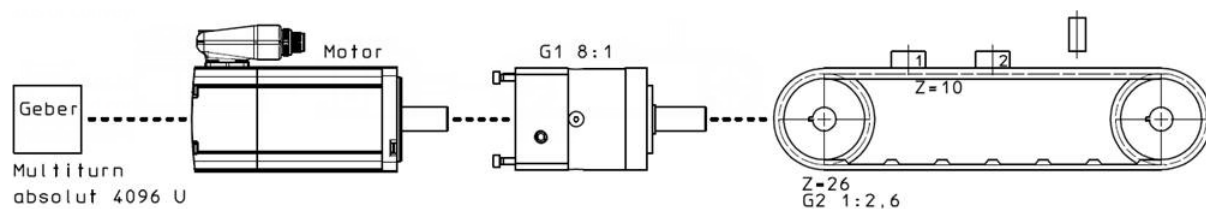


Fig. 2.1

The customer application is an endless rotative positioning system with tooth-belt. On the tooth-belt are goods carriers (nests) to bring the goods to a fixed processing position. The nest pitch is always 100 mm.

The customer denied using any reference switch because the multiturn encoder always delivers the actual position.

Problem: After switching OFF/ON the machine, the encoder position does not fit to the conveyor position.

2.2 Example 2: Block diagram of the machine / rotary table

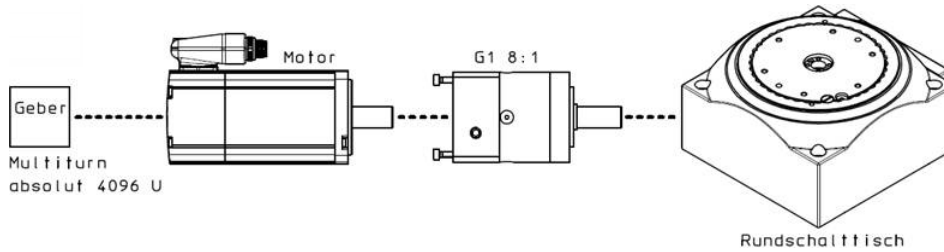


Fig. 2.2

Customer application is an endless rotary table with several working positions.

If the total gear ratio is not an integer number inside the multiturn range, overflows will have an impact.

Problem: After switching OFF/ON the machine, the encoder position does not fit to the rotary table position.

$$\ddot{U} = \frac{1}{8} * 4096 * 4 = 512$$

Value is an integer → good.

Multiturn overflow does not have any impact.

Customer application is an endless rotary table with working positions every 60°. Gear factor 12:1

$$\ddot{U} = \frac{1}{12} * 4096 * 6 = 2048$$

Value is an integer → good.

Customer application is an endless rotary table with working positions every 90°. Gear factor 12:1

$$\ddot{U} = \frac{1}{12} * 4096 * 4 = 1365.33333$$

Value is not an integer → not good.

3 Using the CMMP-AS to support the application

There are no special needs in the FCT-Project for the controller setup. Just set the axis in the configuration to "unlimited".

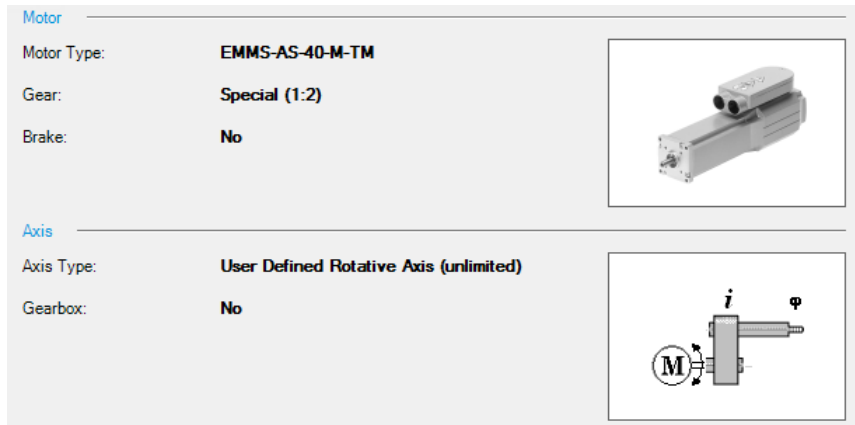


Fig. 3.1

The endless positioning function is selected by the selection hook "working / positioning unlimited". The selection is only for user defined linear - and rotary axes.

3.1 Specification of the required setup

Required hardware: CMMP-AS- M3 controller
 Required firmware: FW_CMMP-AS-M3_4p0p1501p2p1

3.2 Setup of the CMMP-AS / setting of special parameters

There are two different ways to "Switch On" the permanent stored position mode.

The function "Store and restore the actual position" will be switched ON/OFF with set/reset bit 7 in KO 0x0225. The activation is stored in the parameter set.

The activation becomes effective only after Save + reset. After the first activation the controller shows warning 23-0, because there is no current position stored for recovery in the flash memory.

Therefore, there is the following sequence:

1. Activation of the function (in 0x0225 Bit 7 set).
2. Perform SAVE (Store) + RESET (Restart Controller).
3. reference the drive.

From this point, the actual position (and the "referenced" status) also remains obtain a software reset or turning off the 24V.

3.2.1 Activation via CI Terminal

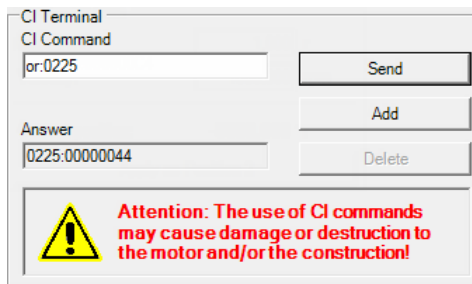


Fig. 3.2

1. Start CI terminal
 2. Read value KO 0x0225
 3. Type or:0225 → Send
- Answer 0025:00000044

To set bit 7 of KO 0x225 you have to add (hex) 80 to the answer value. In this case answer was 00000044.
 $00000044 \text{ (hex)} + 00000080 \text{ (hex)} = 000000C4 \text{ (hex)}$

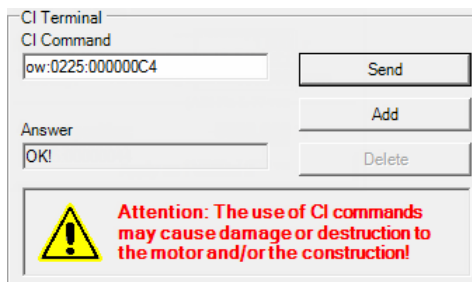
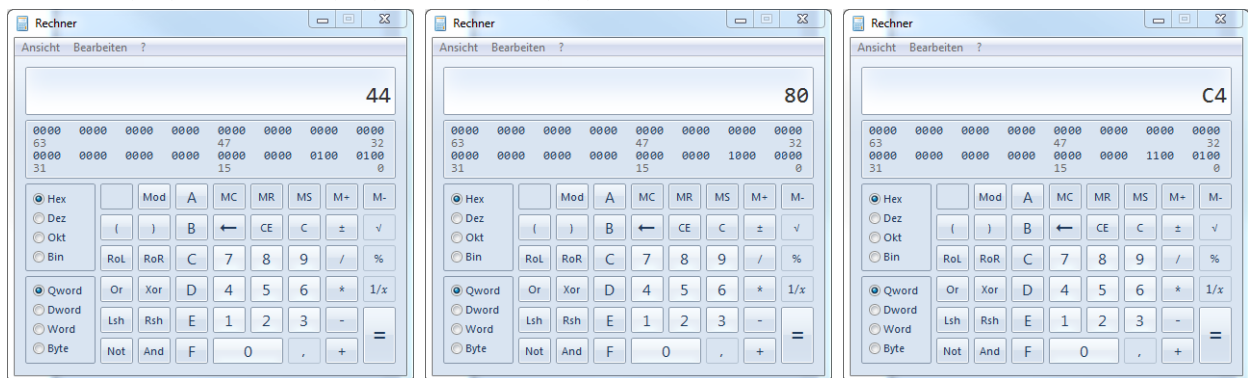


Fig. 3.3

- Type ow:0225:000000C4 → Send
- Answer OK!

Permanent store multiturn mode is switched on.

- Activate permanent stored position mode: Type ow:0225:000000C4
- Deactivate permanent stored position mode: Type ow:0225:00000044
- **After changing a save + reset must be done.**

3.2.2 Activation via FHPP PNU1024

Set the permanent stored position mode is possible using FHPP PNU 1024 Subindex 32

- Activate permanent stored position mode:
 - PNU 1024
 - SUB 32
 - Value 15 (0F hex)

CMMP_AS_PRM_SINGLE Instance: PLC_PRG.A3	
Control	Display
Execute <input checked="" type="checkbox"/>	Done <input checked="" type="checkbox"/>
Write <input checked="" type="checkbox"/>	Fault <input type="checkbox"/>
upper Limit <input type="checkbox"/>	no Error
lower Limit <input type="checkbox"/>	
PNU 1024	Actual PNU 1024
Subindex 32	Actual Subindex 32
Parameter Value write 15	Actual Parameter Value 15
	RETVAl 0

Fig. 3.4

- Deactivate permanent stored position mode:
 - PNU 1024
 - SUB 32
 - Value 240 (F0 hex)

CMMP_AS_PRM_SINGLE Instance: PLC_PRG.A3	
Control	Display
Execute <input checked="" type="checkbox"/>	Done <input checked="" type="checkbox"/>
Write <input checked="" type="checkbox"/>	Fault <input type="checkbox"/>
upper Limit <input type="checkbox"/>	no Error
lower Limit <input type="checkbox"/>	
PNU 1024	Actual PNU 1024
Subindex 32	Actual Subindex 32
Parameter Value write 240	Actual Parameter Value 240
	RETVAl 0

Fig. 3.5

- Save and reset via PNU 127 possible.

PNU 127	Data Memory Control			
Subindex 01 ... 06	Class: Struct	Data type: uint8	from FW 4.0.1501.1.0.1.0	Access: wo
Commands for non-volatile memory (EEPROM, encoder).				
Subindex 01	Delete EEPROM			
Once the object has been written, and after switching power off/on, the data in the EEPROM is reset to the factory settings.				
Value	Significance			
0x10 (16)	Delete data in EEPROM and restore factory settings.			
Note	All user-specific settings will be lost on deletion (factory settings). <ul style="list-style-type: none">• After deleting, always carry out the steps for commissioning the device.			
Subindex 02	Save data			
By writing the object, the data in EEPROM will be overwritten with the current user-specific settings.				
Value	Significance			
0x01 (1)	Save user-specific data in EEPROM			
Subindex 03	Reset device			
By writing the object, the data are read from the EEPROM and adopted as the current settings (EEPROM is not deleted or cleared; it is in the same status as after switching off and on).				
Value	Significance			
0x10 (16)	Reset device			
0x20 (32)	Auto reset upon incorrect bus cycle (deviating from the configured bus cycle time)			
Subindex 06	Encoder Data Memory Control			
Value	Significance			
0x00 (0)	No action (e.g. for test purposes)			
0x01 (1)	Loading of the parameters from the encoder			
0x02 (2)	Saving of the parameters in the encoder without zero offset			
0x03 (3)	Saving of the parameters in the encoder with zero offset			

Tab. B.19 PNU 127

Fig. 3.6

3.3 New Warnings and errors

Error number	Default reaction	Meaning
23-0	warning	B_ST_SAVE_MULTITURN activated but no consumable Record found. Error occurs once after activation, since no data were produced or the controller was not referenced before a reset.
23-1	warning	Record with invalid checksum found.
23-2	warning	Flash content inconsistent.
26-2	PS off	Flash writing failed.
26-3	PS off	Flash sector erase failed.
36-0	warning	B_ST_SAVE_MULTITURN enabled (bit 7 in 0x0225) and linear motor available.
42-4	warning	Actual position was not restored because encoder change detected (existing functionality).

Table 3.1

4 Test results / measurements

Deactivated permanent stored position mode. Run motor to absolute 5000 r.

Projects **Test_M3 ***

Controller		Motor		Axis					
CMMP-AS-C2-3A-M3		EMMS-AS-70-S-RM		User Defined Rotative Axis (Unlimited)					
FCT	No.	Mode	Position [r]	Vel. [rpm]	Accel. [rpm/s]	Decel. [rpm/s]	Smooth [%]	Startcond.	Comman
	1	A	0,000	1000,000	5000,000	5000,000	0	Ignore	End
	2	A	5000,000	1000,000	5000,000	5000,000	0	Ignore	End

Movement Data

Increment: 1,000 r

Velocity: 1008,000 rpm

Current position: **-5000,000 r**

Apply as Position 2

Fig. 4.1

Position after controller restart

Movement Data

Increment: 1,000 r

Velocity: 1008,000 rpm

Current position: **-1527,001 r**

Apply as Position 2

Fig. 4.2

Activated permanent stored position mode. Run motor to absolute 5000 r.

Projects **Test_M3 ***

Controller		Motor		Axis					
CMMP-AS-C2-3A-M3		EMMS-AS-70-S-RM		User Defined Rotative Axis (Unlimited)					
FCT	No.	Mode	Position [r]	Vel. [rpm]	Accel. [rpm/s]	Decel. [rpm/s]	Smooth [%]	Startcond.	Comman
	1	A	0,000	1000,000	5000,000	5000,000	0	Ignore	End
	2	A	5000,000	1000,000	5000,000	5000,000	0	Ignore	End

Movement Data

Increment: 1,000 r

Velocity: 1008,000 rpm

Current position: **-5000,000 r**

Apply as Position 2

Fig. 4.3

Position after controller restart

Movement Data

Increment: 1,000 r

Velocity: 1008,000 rpm

Current position: **-5000,000 r**

Apply as Position 2

Fig. 4.4

5 Limitations

- The coasting or the manual twist is at a standstill at about the number Multi-turn rotations / 2 limited in each direction.
- Without a valid flash memory value the drive is “not referenced”.
- Changing Motor or Encoder will result in a wrong position.
- Encoder error during operation will result in the drive is “not referenced”.
- After changes in drive configuration or gear factors, the drive must be referenced and stored again.



Basically the actual position will not be stored by pressing the reset button on the controller. While pressing the reset button, the controller CPU will immediately go into reset. Pressing the reset button must be therefore effectively excluded.