

# Application Notes

## ServoOne - SIEMENS TIA Technology Objects

### KeDrive

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#### Disclaimer

The recommendations for action on which these Application Notes are based have been developed within the framework of tests under the ambient conditions specified in the operating instructions. The user is responsible for compliance with and verification of these environmental conditions in the specific application.

These Application Notes are intended for qualified personnel who commission and maintain drive and automation components. According to IEC 60364 or CENELEC HD 384, qualified personnel are persons who have the appropriate qualifications and are familiar with the installation, assembly, commissioning and operation of KEBA products (electrical devices) and who are familiar with all accident prevention regulations, directives and laws applicable at the place of use.

The safety instructions contained in the device documentation of the respective device must be observed.

The screenshots shown in these Application Notes are only examples to illustrate the individual steps.

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All information is subject to change at any time. Liability for correctness and completeness is excluded.

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Version info

PLC	SIEMENS S7-1500 CPUs ( <i>here: 1511, 1515F</i> )
Tool	≥ SIEMENS TIA Portal V15.1, TO Version ≥ 2.0
Tool	Current KEBA KeStudio DriveManager 5.x Version
Drive	ServoOne / ServoOne junior / ServoOne Safety ≥ FW Version 4.35-17
Device Description	GSDML-V2.34-LTI-ServoOne-20180530.xml

Change Index: 25

Attachments:

[Example Project Package on DocuPortal](#)

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# 1 Description

ServoOne with SIEMENS TIA Technology Objects (or SINUMERIK) via PROFINET.

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## 2 Introduction

This document offers a way how to configure KEBA ServoOne drives in SIEMENS TIA Portal with **Technology Objects (TO)** “*Speed\_Axis*” and “*Positioning\_Axis*”. For this, a PROFINET IRT configuration is needed and with it a telegram, which enables IRT.

Beside PLCopen, there are additional libraries from SIEMENS available for device status and device control (Technology Axis) available:

- ["LAxisBasics" library](#)
- ["LAxisCtrl" library](#)

### Note: Byte Format

- The ServoOne works in little endian byte order format, the PROFINET in big endian byte format. For this reason, the bytes are swapped when the data is received.

### Note: FW Change or SIEMENS TIA Project Change

- The ServoOne needs a SW-Restart or 24V-Restart when a new firmware version was loaded to the drive or after a complete new TIA project configuration download.

## 3 What are Technology Objects (TO)

Technology Objects (further called *TO*) are a collection of repeatedly used functionalities, like PID-Control, Counters or Motion Control. In this case, Motion Control is the focused part with speed- and position control.

An created Motion-TO in the TIA Portal offers the possibility to link a drive (telegram) with a PLC functionality. With it, the PLCopen and other motion related function blocks can be used to handle the axis. TOs then deliver an axis interface. The drive is then controlled according to PROFIdrive mechanisms.

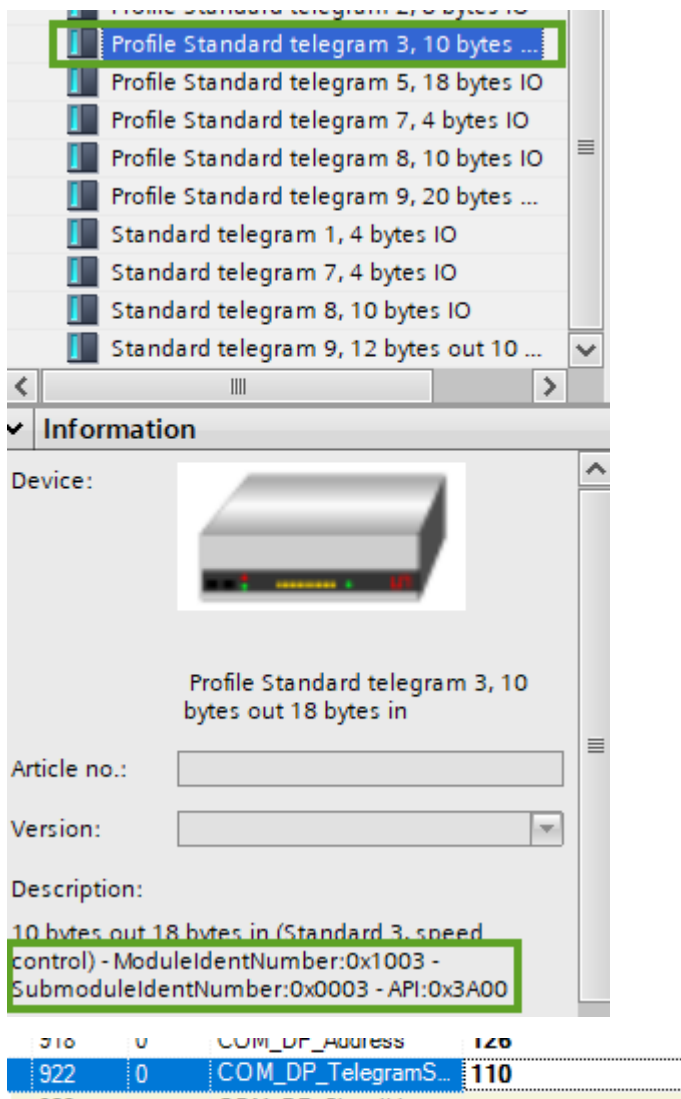
Here, the PLC **S7-1500** series by company SIEMENS will be used in combination with the TIA Portal.

Also note the SIEMENS documentations in the web for TOs.

## 4 TOs with ServoOne Single Axis Drive

### 4.1 Using the right telegram

The use of TOs is coupled to some restrictions. The main restriction is the selection of the telegram itself in TIA Portal. The GSDML delivers all telegrams which are supported by the drive. You can find this collection in the TIA catalog by downloading from the [KEBA Data Portal](#) and import. All telegrams are identified by a *telegram number*, *ModuleIdentNumber* and *SubmoduleIdentNumber*.



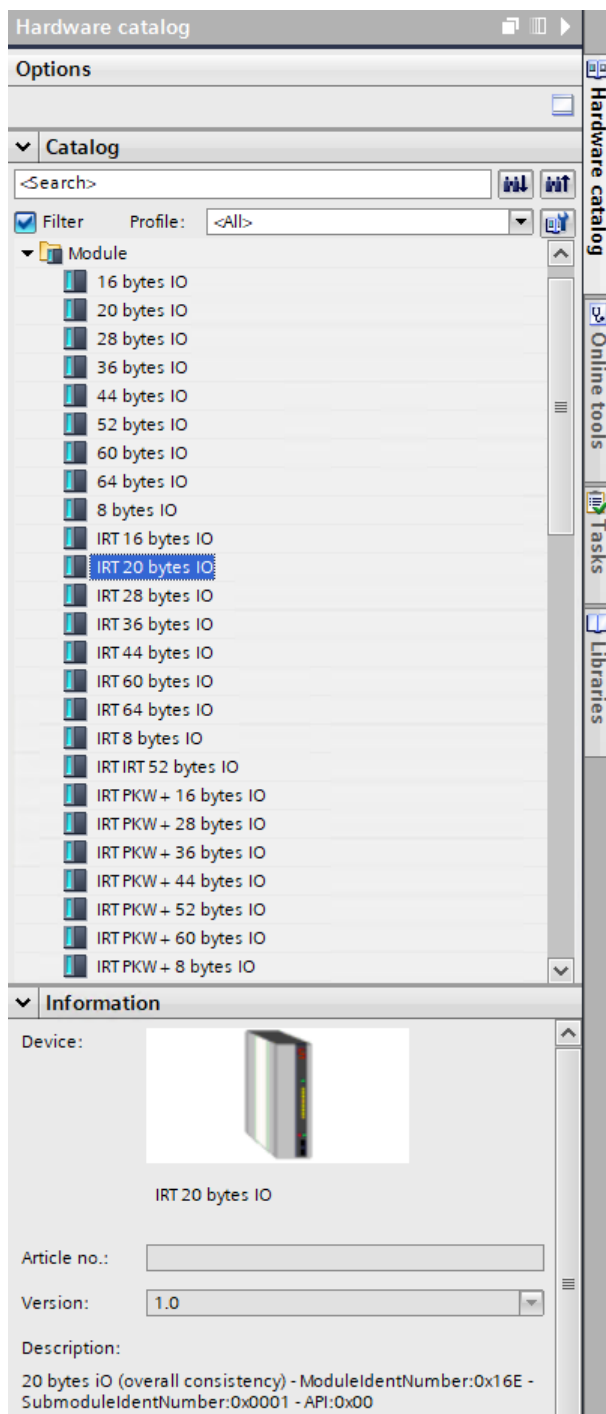
The drive target values are given cyclic by the PLC via PROFINET IRT to guarantee a deterministic behavior. A speed axis needs other information than a positioning axis. Thus, the drives supports a bunch of IRT and user telegrams. The different telegrams contain different information (object mapping). Standard telegrams contain a fix content of data in a fixed order. KEBA drive also supports telegrams with different user telegrams with differing payload length, where user defined data can be aligned freely.

#### Restrictions for TOs:

1. Different SIEMENS CPU types (Firmware-Versions) support different TO-Library Versions and with it more or less motion functionality
2. *MC\_TorqueLimiting* was introduced by SIEMENS since TO V3.0, which requires a CPU firmware  $\geq 2.0$  and at least TIA V14. Before TO V3.0, there is no torque scaling via TO possible.
3. The used telegram must support IRT
4. Standard Telegram 3 (Speed Control, Position Control)
5. Standard Telegram 5 (Speed Control, Position Control with DSC)
6. Telegram 102 (Speed Control, Position Control with Torque Scaling)
7. Telegram 105 (Speed Control, Position Control with DSC and with Torque Scaling)

8. Use telegram 102/105 (structure) for speed or positioning axis with online torque reduction via function block *MC\_TorqueLimiting*, this telegram has to be depicted with a free mappable telegram (e.g. telegram 110 = “*IRT 20 Byte IO*” without PKW channel, *ModuleIdentNumber: 0x16E*, *SubmoduleIdentNumber:0x0001*)

Use at least this telegram *IRT 20 bytes IO* for depicting telegram 102 or 105. Bigger telegrams can be used with additional user payload at the end. These will be not recognized by the TO anymore.



The effective telegram number (by PLC configuration) can be taken from connected KeStudio DriveManager, PNU 922.

## 4.2 Operation Modes with telegrams (Application Class)

The SIEMENS PLC is basically working with a speed control loop. With it, a derived position control is realized. This means, the drives are working in SCON Velocity Control Mode ( $P300[0] = SCON$ ) and will be selected automatically by using a standard telegram. While using the standard telegrams, the ServoOne will notice the telegram number in PNU 922 *COM\_DP\_TelegramSelection* and automatically set the correct mapping, interpolation mode and control mode. When using a user defined telegram, these parameters have to be set via KeStudio DriveManager or PLC (acyclic write):

- $P300[0] = SCON$ , PCON for DSC
- $P301[0] = \text{Profile Mode IP}$  (Interpolation, no drive internal Profile generator will be used)
- $P370[0] = \text{Interpolation type}$  (default = NonIPspline)
- $P306[0] = \text{Cycle Time} = S7 \text{ IO Cycle}$ , *here 1 ms*

Additionally, you have to check the source parameters for PROFINET:

- Control Selector:  $P159[0] = \text{PROFIdrive (7)}$
- Reference Selector:  $P165[0] = \text{PROFIdrive (9)}$
- $\text{PLC\_Mode}$  in  $P1258[0]$

## 4.3 Configuration of PLC\_Mode

The Parameter  $P1258 \text{ PLC\_Mode}$  changes the meaning of the Controlword (STW1) and Statusword (ZSW1) in PNU 967 and PNU 968, example:

- $\text{PLC\_Mode} = 0$ : Needed for running SIEMENS SIMOTION
- $\text{PLC\_Mode} = 1$ : Needed for SIEMENS TIA Technology Objects, according to PROFIdrive specification

**Example:  $\text{PLC\_Mode} = 1$  with IRT standard telegram 5**



**Example:  $\text{PLC\_Mode} = 0$  with IRT standard telegram 5**

- The transmission byte format will be not changed
- The  $\text{PLC\_Mode}$  default value is 0
- The  $\text{PLC\_Mode}$  will be influenced by the telegram selection
- When a standard telegram is configured, the  $\text{PLC\_Mode}$  will be automatically set to 1 at next device or bus startup/restart
- When a user specific telegram is used, the  $\text{PLC\_Mode}$  must be set manually
- A change of  $\text{PLC\_Mode}$  acts immediately

## 4.4 Process Data Mapping

While using the standard telegrams, the ServoOne device will notice the telegram number in PNU 922 *COM\_DP\_TelegramSelection* and automatically sets the correct mapping. The mapping in the drive is done by parameters / PNUs 915 and 916 (see in *KeStudio DriveManager*). When a parameter has 4 byte length, the parameter number is inserted twice. With telegram 102 and 105, the mapping must be done manually.

*Siemens telegram overview (some selection):*

Tele-gram	1		2		3		5		102		105						
Appl. class	1		1		1, 4		4		1, 4		4						
PZD1	STW1	ZSW1	STW1	ZSW1	STW1	ZSW1	STW1	ZSW1	STW1	ZSW1	STW1	ZSW1					
PZD2	NSOLL_A	NIST_A	NSOLL_B	NIST_B	NSOLL_B	NIST_B	NSOLL_B	NIST_B	NSOLL_B	NIST_B	NSOLL_B	NIST_B					
PZD3	 Receive telegram from PROFINET	 Send telegram to PROFINET															
PZD4			STW2	ZSW2	STW2	ZSW2	STW2	ZSW2	STW2	ZSW2	STW2	ZSW2					
PZD5					G1_STW	G1_ZSW	G1_STW	G1_ZSW	MOMRED	MELDW	MOMRED	MELDW					
PZD6						G1_XIST1	XERR	G1_XIST1	G1_STW	G1_ZSW	G1_STW	G1_ZSW					
PZD7																	
PZD8																	
PZD9						G1_XIST2	KPC	G1_XIST2		G1_XIST2	KPC	G1_XIST2					
PZD10																	

*Automatic mapping for standard telegram 3:*

Drive Para.-Nr.	Drive Parameter Name	Drive Data Type	Telegram PCD / PZD	Object Description
<b>PNU 915 - Drive Input</b>				
967	COM_DP_Contr olword	WORD	STW1	PROFIdrive control word 1
1261	COM_DP_NSOLL_B	DWORD	NSOLL_B	32 Bit speed set point B, (100% = 0x40000000 of rated speed), Range: -200% ... 200%
1280	COM_DP_Contr olword2	WORD	STW2	PROFIdrive control word 2
1263	COM_DP_G1_STW	WORD	G1_STW	Encoder 1 / Sensor 1 control word

Drive Para.-Nr.	Drive Parameter Name	Drive Data Type	Telegram PCD / PZD	Object Description
<b>PNU 916 - Drive Output</b>				
968	COM_DP_Statu sword	WORD	ZSW1	PROFIdrive status word 1
1262	COM_DP_NIST_B	DWORD	NIST_B	32 Bit actual speed
1281	COM_DP_Statu sword	WORD	ZSW2	PROFIdrive status word 2
1264	COM_DP_G1_Z SW	WORD	G1_ZSW	Encoder 1 status word
1265	COM_DP_G1_XI ST1	DWORD	G1_XIST1	Cyclic position (Incremental Encoder) / Actual position value
1266	COM_DP_G1_XI ST2	DWORD	G1_XIST2	Absolute position (Absolute Encoder) / Additional actual position value

Automatic mapping for standard telegram 5 with DSC:

Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
<b>PNU 915 - Drive Input</b>				
967	COM_DP_Contr olword	WORD	STW1	PROFIdrive control word 1
1261	COM_DP_NSOLL_B	DWORD	NSOLL_B	32 Bit speed set point B, (100% = 0x40000000 of rated speed), Range: -200% ... 200%
1280	COM_DP_Contr olword2	WORD	STW2	PROFIdrive control word 2
1263	COM_DP_G1_S TW	WORD	G1_STW	Encoder 1 / Sensor 1 control word



Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
1259	COM_DP_XERR	DINT	XERR	Position error command
1260	COM_DP_KPC	DINT	KPC	Position controller gain factor
<b>PNU 916 - Drive Output</b>				
968	COM_DP_Statusword	WORD	ZSW1	PROFIdrive status word 1
1262	COM_DP_NIST_B	DWORD	NIST_B	32 Bit actual speed
1281	COM_DP_Statusword	WORD	ZSW2	PROFIdrive status word 2
1264	COM_DP_G1_ZSW	WORD	G1_ZSW	Encoder 1 status word
1265	COM_DP_G1_XIST1	DWORD	G1_XIST1	Cyclic position (Incremental Encoder) / Actual position value
1266	COM_DP_G1_XIST2	DWORD	G1_XIST2	Absolute position (Absolute Encoder) / Additional actual position value

User mapping for telegram 102:

Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
<b>PNU 915 - Drive Input</b>				
967	COM_DP_Controlword	WORD	STW1	PROFIdrive control word 1
1261	COM_DP_NSOLL_B	DWORD	NSOLL_B	32 Bit speed set point B, (100% = 0x40000000 of rated speed), Range: -200% ... 200%

Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
1280	COM_DP_Contr olword2	WORD	STW2	PROFIdrive control word 2
1251	COM_DP_MOM RED	UINT	MOMRED	Torque Sacling (100% = 0x4000, reference = nominal motor torque)
1263	COM_DP_G1_S TW	WORD	G1_STW	Encoder 1 / Sensor 1 control word
<b>PNU 916 - Drive Output</b>				
968	COM_DP_Statu sword	WORD	ZSW1	PROFIdrive status word 1
1262	COM_DP_NIST _B	DWORD	NIST_B	32 Bit actual speed
1281	COM_DP_Statu sword	WORD	ZSW2	PROFIdrive status word 2
1252	COM_DP_MEL DW	UINT	MELDW	Extended status word (currently no function in the drive)
1264	COM_DP_G1_Z SW	WORD	G1_ZSW	Encoder 1 status word
1265	COM_DP_G1_XI ST1	DWORD	G1_XIST1	Cyclic position (Incremental Encoder) / Actual position value
1266	COM_DP_G1_XI ST2	DWORD	G1_XIST2	Absolute position (Absolute Encoder) / Additional actual position value

= 12 Byte In / 20 Byte Out

*User mapping for telegram 105 with DSC:*

Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
<b>PNU 915 - Drive Input</b>				
967	COM_DP_Contr olword	WORD	STW1	PROFIdrive control word 1
1261	COM_DP_NSOLL_B	DWORD	NSOLL_B	32 Bit speed set point B, (100% = 0x40000000 of rated speed), Range: -200% ... 200%
1280	COM_DP_Contr olword2	WORD	STW2	PROFIdrive control word 2
1251	COM_DP_MOM RED	UINT	MOMRED	Torque Sacling (100% = 0x4000, reference = nominal motor torque)
1263	COM_DP_G1_S TW	WORD	G1_STW	Encoder 1 / Sensor 1 control word
1259	COM_DP_XERR	DINT	XERR	Position error command
1260	COM_DP_KPC	DINT	KPC	Position controller gain factor
<b>PNU 916 - Drive Output</b>				
968	COM_DP_Statu sword	WORD	ZSW1	PROFIdrive status word 1
1262	COM_DP_NIST _B	DWORD	NIST_B	32 Bit actual speed
1281	COM_DP_Statu sword	WORD	ZSW2	PROFIdrive status word 2
1252	COM_DP_MEL DW	UINT	MELDW	Extended status word (currently no function in the drive)
1264	COM_DP_G1_Z SW	WORD	G1_ZSW	Encoder 1 status word

Drive Para.-Nr.	Drive Parameter Name	Drive Datatype	Telegram PCD / PZD	Object Description
1265	COM_DP_G1_XI ST1	DWORD	G1_XIST1	Cyclic position (Incremental Encoder) / Actual position value
1266	COM_DP_G1_XI ST2	DWORD	G1_XIST2	Absolute position (Absolute Encoder) / Additional actual position value

= 20 Byte In / 20 Byte Out

## 4.5 Using Torque reduction

For a torque reduction/scaling, at least a telegram with included MOMRED must be used. Then, different ways are possible:

1. The TO is linked with telegram 102/105, so the torque can be scaled directly online via TO (*MOMRED*) by using the function block *MC\_TorqueLimiting*.
2. Using a free mappable telegram without PKW channel, which contains the same data like telegram 3 or 5 and add also parameter 332[0] *TMaxScale* (0 ... 100% of the nominal torque) or P1286 / P1287 / P1288 (1/1000 of the nominal torque) to the mapping for a cyclic transmission:

1286 0	COM_DP_TMaxScale	1000	1/1000	Motor torque scaling (online factor)	uint16
1287 0	COM_DP_TMaxPos	1000	1/1000	Motor torque scaling pos. direction	uint16
1288 0	COM_DP_TMaxNeg	1000	1/1000	Motor torque scaling neg. direction	uint16

3. Using a TO with standard telegram 3 or 5, then you can scale the torque via DP-V1 acyclic service via parameter 332[0] *TMaxScale* (0 ... 100% of the nominal torque)

**Note:** The SIEMENS function block *MC\_TorqueLimiting* was introduced by SIEMENS since TO V3.0, which requires a CPU firmware  $\geq 2.0$  and at least TIA V14. Before TO V3.0, there is no torque scaling via TO possible.

The actual torque value can be taken from the TO axis structure, e.g. "*PositioningAxis1*".*StatusTorqueData.ActualTorque* (*LREAL*) or from the KeStudio DriveManager.

## 4.6 Using Dynamic Servo Control

Beside the PLC, **Dynamic Servo Control** must be supported by the drive itself also. With DSC, the control structure will be improved by taking also the position controller in the drive into account (*distributed position control loop in drive and PLC*). The PLC position control loop calculates the raw values, the drive control loop handles the position difference.

Advantages:

- Faster compensation of disturbances
- Elimination of system dead times
- High position control gain and dynamic stiffness

Disadvantages:

- Both sides (PLC and drive) doesn't know the actual following error any more (Calculated substitute values in the PLC)

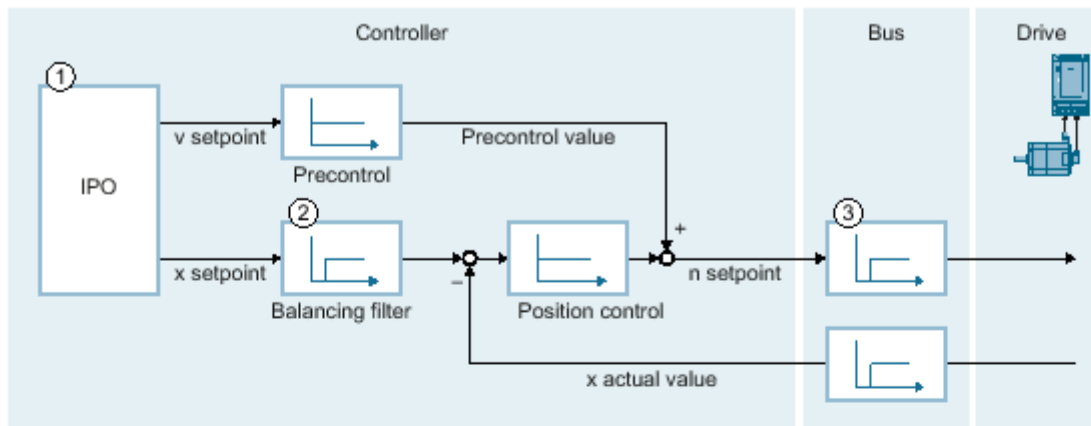
With ServoOne, you have to use standard telegram 5 or 105 for DSC (Application Class 4). Then, the values ***XERR*** = Position error from PLC (*P1259*) and ***KPC*** = Position gain from PLC (*P1260*) are involved.

PZD number	1	2	3	4	5	6	7	8	9
Setpoint	STW1	NSOLL_B		STW2	G1_STW	<b>XERR</b>		<b>KPC</b>	

PZD number	1	2	3	4	5	6	7	8	9
Actual value	ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2	

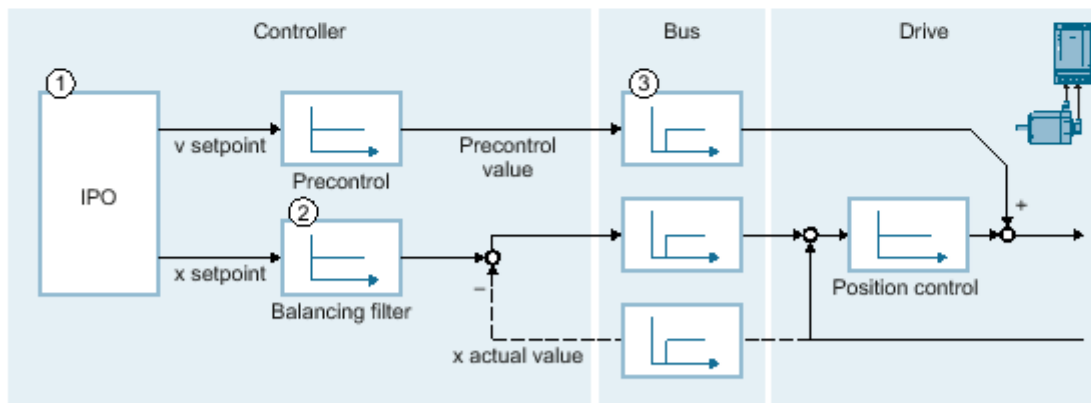
- ***XERR*** = Position Error Command from PLC, the ***XERR*** does not correspond to the immediate / expected following error. It also contains a speed-proportional dead time component, corresponding to the transmission dead times.
- ***KPC*** = Position Controller Gain, constant value, Kv PLC value \* 1000 = value in the drive, directly given to the drive control loop, original value will be restore in manual mode
  - The position control loop is closed in the drive
  - The KPC is calculated with the position error of the PLC on the position setpoint
  - The speed setpoint is used as speed pre-control value
  - When selecting telegram 5, the drive sets automatically its internal selectors (not at telegram 105)
  - The drive is working in *PCON* Position Control with DSC (will be forced when power stage is enabled with telegram 5), has to be set manually with telegram 105

The following figure shows the effective closed loop control structure **without DSC**:



- ① Interpolator with motion control
- ② Internal consideration of the signal propagation times and the speed-control loop substitute time
- ③ Communication between controller and drive

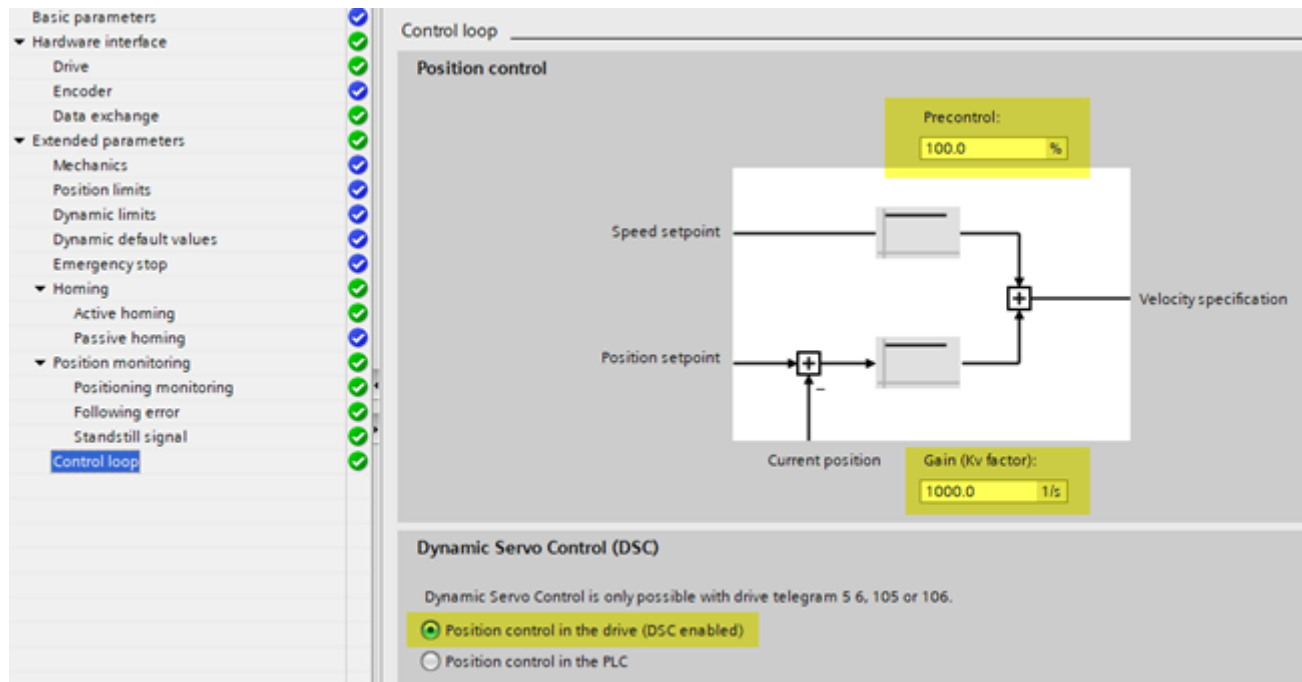
The following figure shows the effective closed loop control structure **with DSC**:



- ① Interpolator with motion control
- ② Internal consideration of speed control loop substitute time
- ③ Communication between controller and drive

**TIA Portal:** If the data exchange with the selected axis takes place via PROFIdrive telegram 5 in TIA Portal, the DSC (Dynamic Servo Control) function for relocating the position control to the drive is automatically activated when the positioning axis technology object is created.

If DSC is not to be used, this function must be explicitly changed in the technology object under *Control loop* from "Position control in the drive (DSC enabled)" to "Position control in the PLC". The position control of the axis is then taken over again by the technology object alone.



The values for *Gain* and *Precontrol* must be determined empirically - it is also depending on the load. Start with a small values, otherwise the gain is too high and the control loop / motor is instable. The effective values for *KPC* and *XERR* you can see in the KeStudio DriveManager parameters / PNUs:

1259 0	COM_DP_XERR	13392
1260 0	COM_DP_KPC	1000000

#### FAQs to DSC:

- Is active feedforward control always required for DSC or must it be deactivated? → No: The *NSOLL\_B* value is responsible for feedforward control
- How is the torque pre-control calculated with Profinet (telegram 5 with DSC)? → No: The torque pre-control is not calculated
- Is the PCON gain in the drive overwritten by the TIA-DSC values (*XERR*, *KPC*) or is it somehow additively influenced? → The *KPC* overwrites the Position Control Loop Gain value if it is not equal to 0. The old value is stored temporarily. The *KPC* is then used 1 to 1 in the calculation. The *XERR* is added to the position setpoint with a delay.
- SIEMENS requires that when *KPC*=0 will be transmit, only speed controller is active with speed feed forward control - is supported by ServoOne? → Set Feed Forward Mode for *SCON* to *External*

			Feed forward control		Configuration of feed forward control
372	0	CON_IP_SFFTF	0.5	ms	Speed feedforward filter time constant (PCON mode)
374	0	CON_IP_EpsDly	0	ms	Delay pos. reference by integer no. of cycles CON_PConTS
375	0	CON_IP_SFFScale	100	%	Scaling of speed feedforward
376		CON_IP_TFFScale			Scaling of torque feedforward
377		CON_IP_EnableFF			Enable feedforward
378	0	CON_IP_ACCFFTF	0	ms	Acceleration feedforward filter time constant (PCON, SCON mode)
379		CON_IP_FFMode			Feedforward calculation mode
379	0	PosHighRes	Standard		Position high resolution
379	1	Speed	External		Speed
379	2	Torque	Internal		Torque
386		CON_SCON_TFric			Dry friction comp., normalized to motor rated torque
387		CON_SCON_TFricSp...			Friction compensation: Speed limits
388	0	CON_SCON_TConst	0	%	Constant torque comp., normalized to motor rated torque
1516	0	SCD_Jsum	0	kg m²m	Total inertia of motor and plant
Advanced Scope sign...					
Basic Scope signals					
276	0	MPRO_FG_UsrActPos	0	POS	actual position in user units
277	0	MPRO_FG_UsrRefPos	0	POS	reference position in user units
279	0	MPRO_FG_UsrPosDiff	0	POS	position tracking error in user units
305	0	CON_PConTS	0.125	ms	Position control sampling time
360	0	CON_PCON_Kp	4000	1/min	Position control gain

### 4.7 General IRT / TO configurations with ServoOne

For IRT, nothing must be set in the drive itself. At SIEMENS PLC side:

- 1. The hardware configuration must be done with a valid IRT telegram.
- 2. Add a TO
- 3. Check, if IRT mode for the slave device is enabled
- 4. Link with generated MC-Servo OB
- 5. IRT cycle time (IO cycle): default = 1 ms

D3\_OnlyCopy ▸ Ungrouped devices ▸ DRIVE [ServoOne]

DRIVE [ServoOne]

DRIVE

Topology view

Network view

Device view

Device overview

Module	Rack	Slot	I address	Q address	T...
DRIVE	0	0			S...
▸ Interface	0	0 X1			D...
▾ Profile Standard telegram 3, 10 bytes out 18 bytes in_1	0	1			...
Parameter Access Point	0	1 1			P...
Profile Standard telegram 3, 10 bytes out 18 bytes in	0	1 2	42...59	42...51	...

Technology objects

Add new object

Emergency stop

Limits

Add new object

Name:

Motion Control

Name	Version
▾ Motion Control	V4.0
TO_SpeedAxis	V4.0
TO_PositioningAxis	V4.0
TO_SynchronousAxis	V4.0

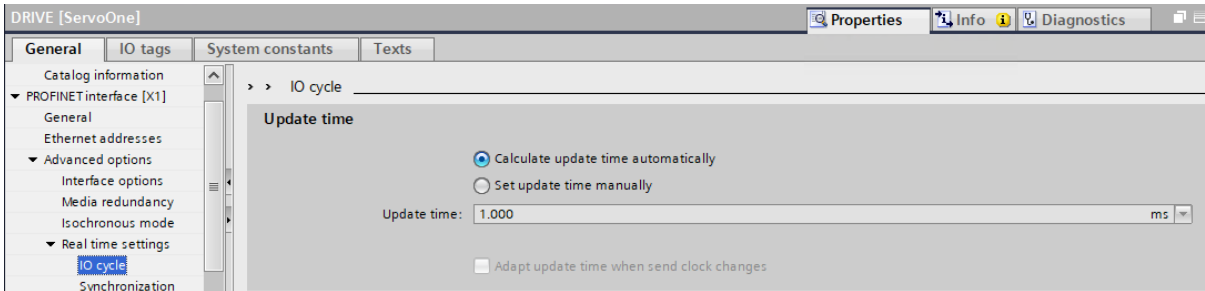
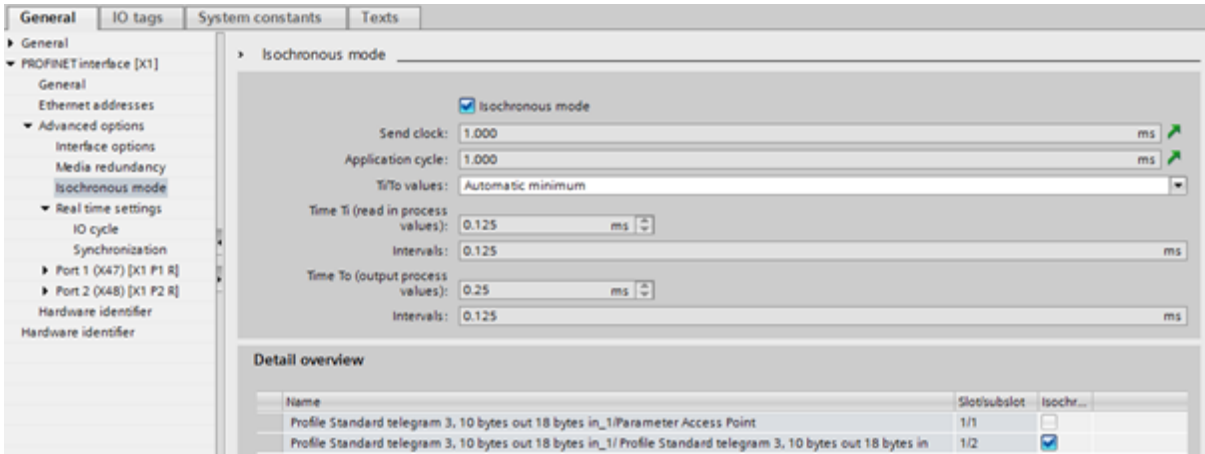
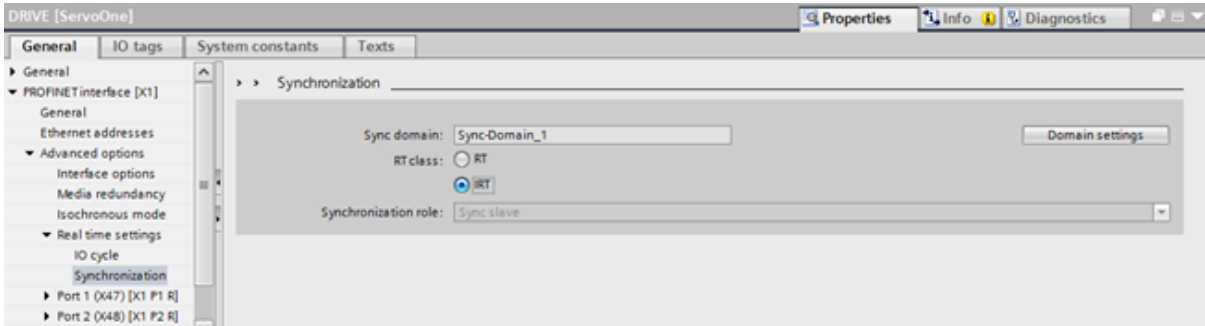
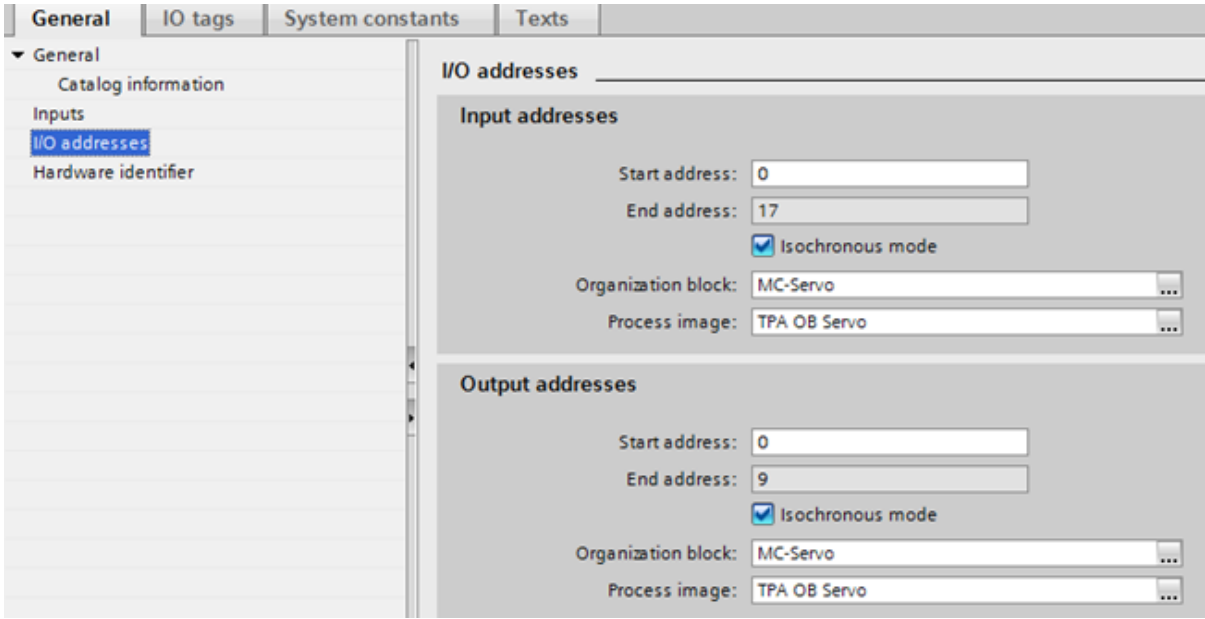
Type:

Number:

Manual

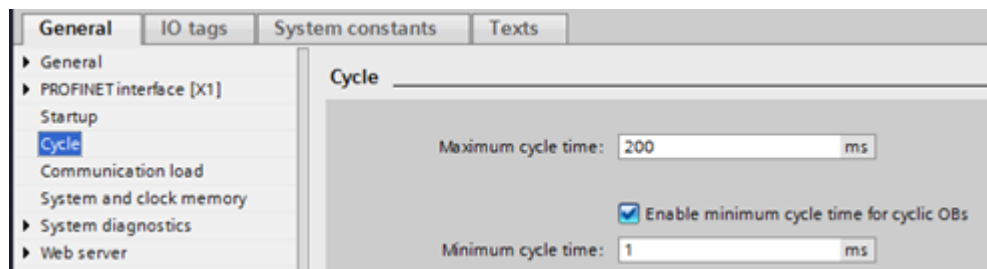
Automatic



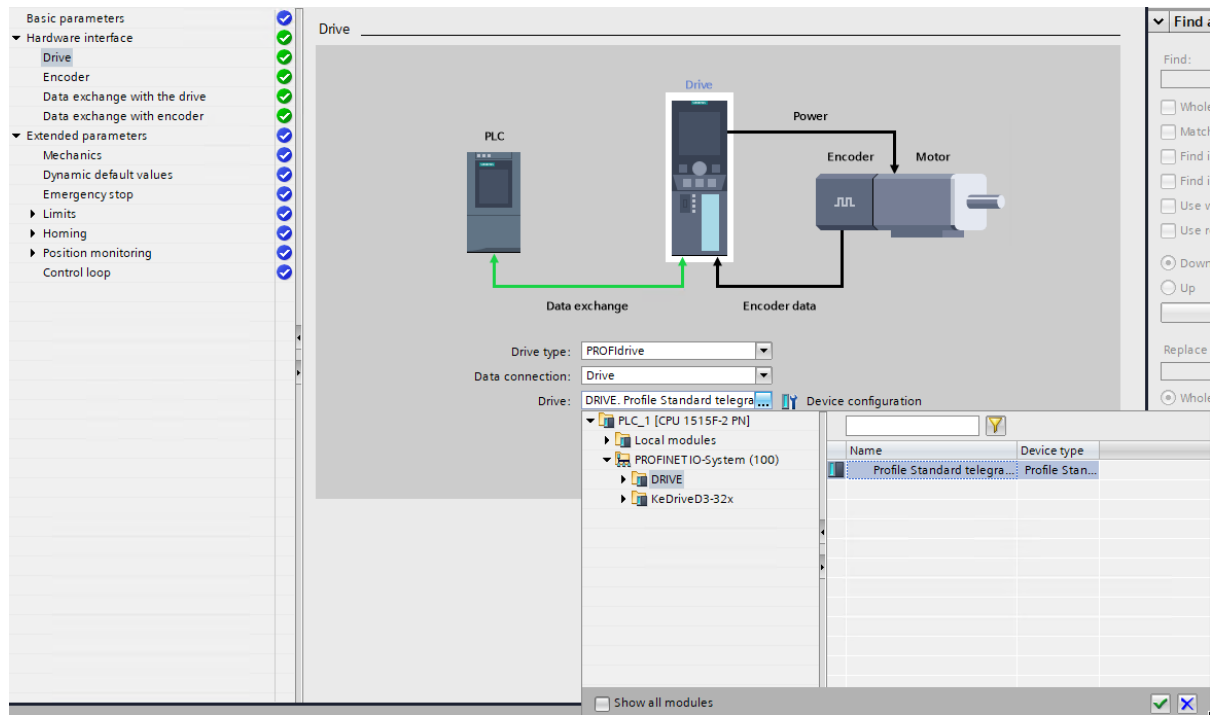




It may be possible to change / deactivate the cycle time watchdog and the cycle factor in your PLC settings.

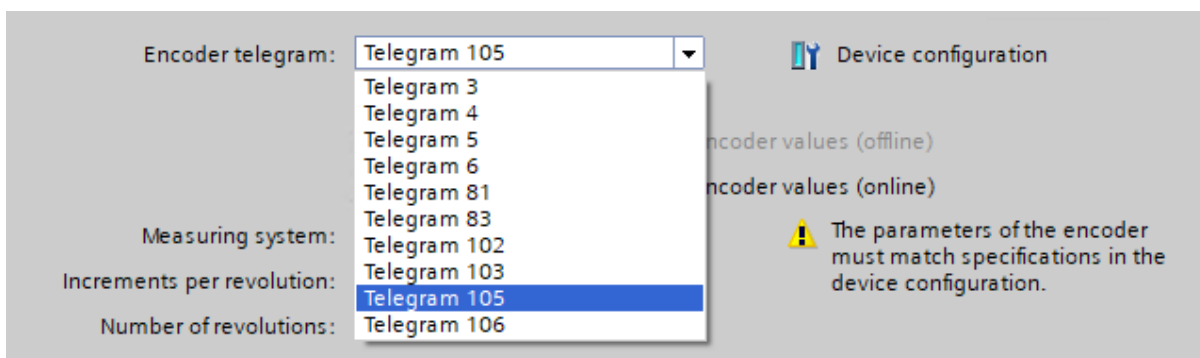
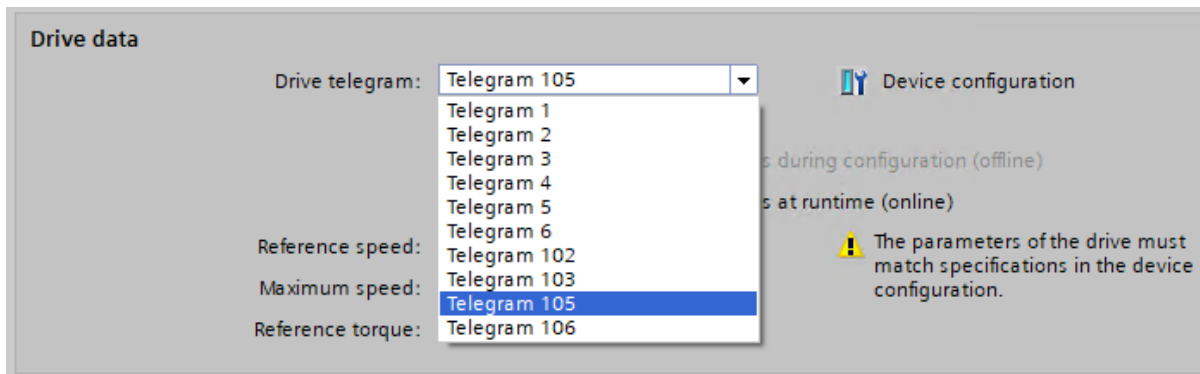
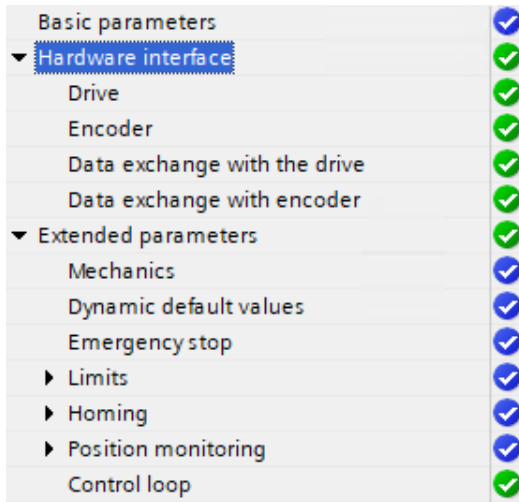


At TO side, you must now link the axis with the matching telegram (Data exchange for drive and encoder). With standard telegram, the order of the several configuration points doesn't matter. Most settings will be recognized then automatically:



When using a user specific telegram, the order of the several configuration points are important, example for telegram 105:

1. *Data exchange with the drive* → Set *Encoder telegram* = 105
2. *Data exchange with encoder* → Set *Encoder telegram* = 105
3. *Drive* → force a linking with user specific IRT telegram (by showing all modules)
4. *Encoder* → force a linking with user specific IRT telegram (by showing all modules)

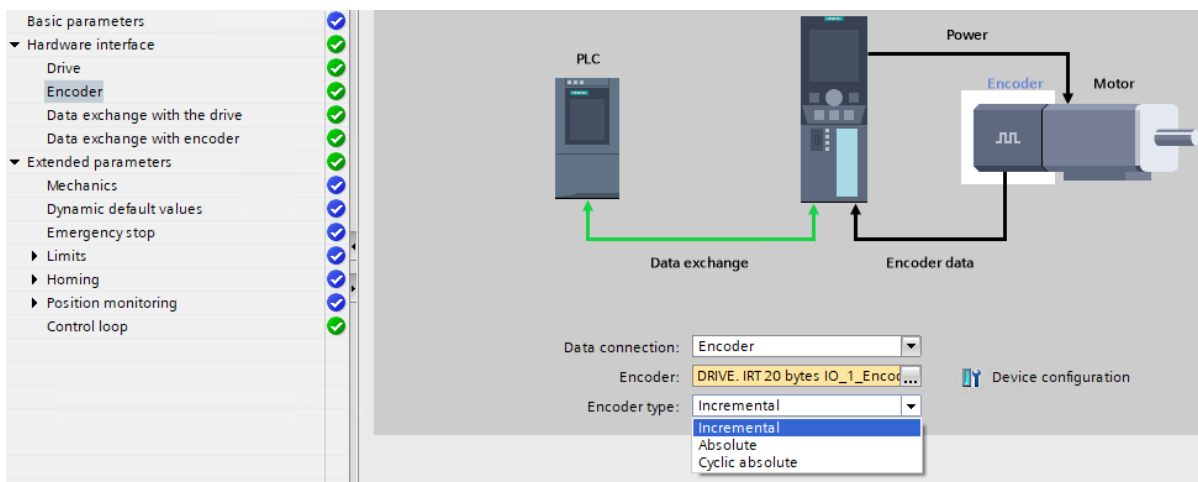


With it, the main IRT configuration is done. Go one with further TO configuration ...

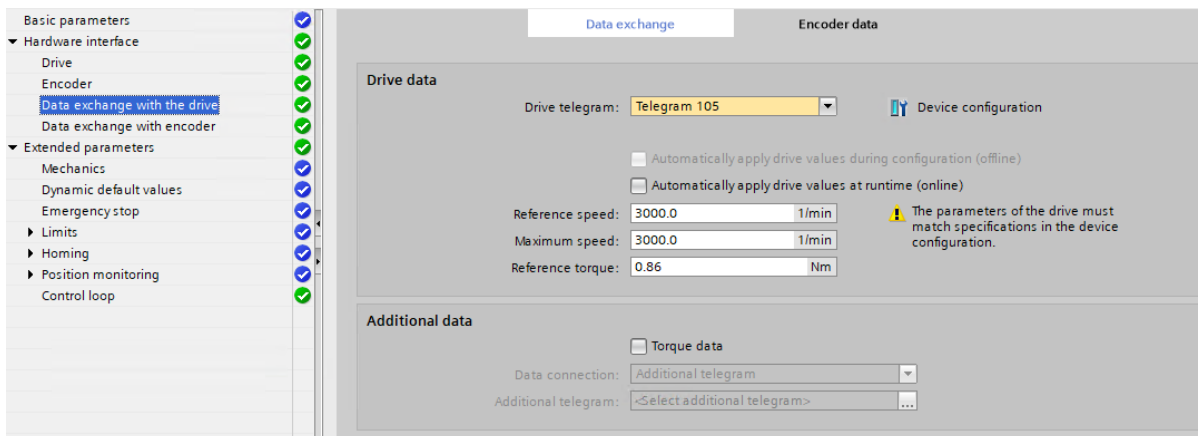
## 4.8 TO settings for Speed Axis and Positioning Axis

- Set Measuring System (*Rotary / Linear*)
- Set Encoder type according to the used encoder ...

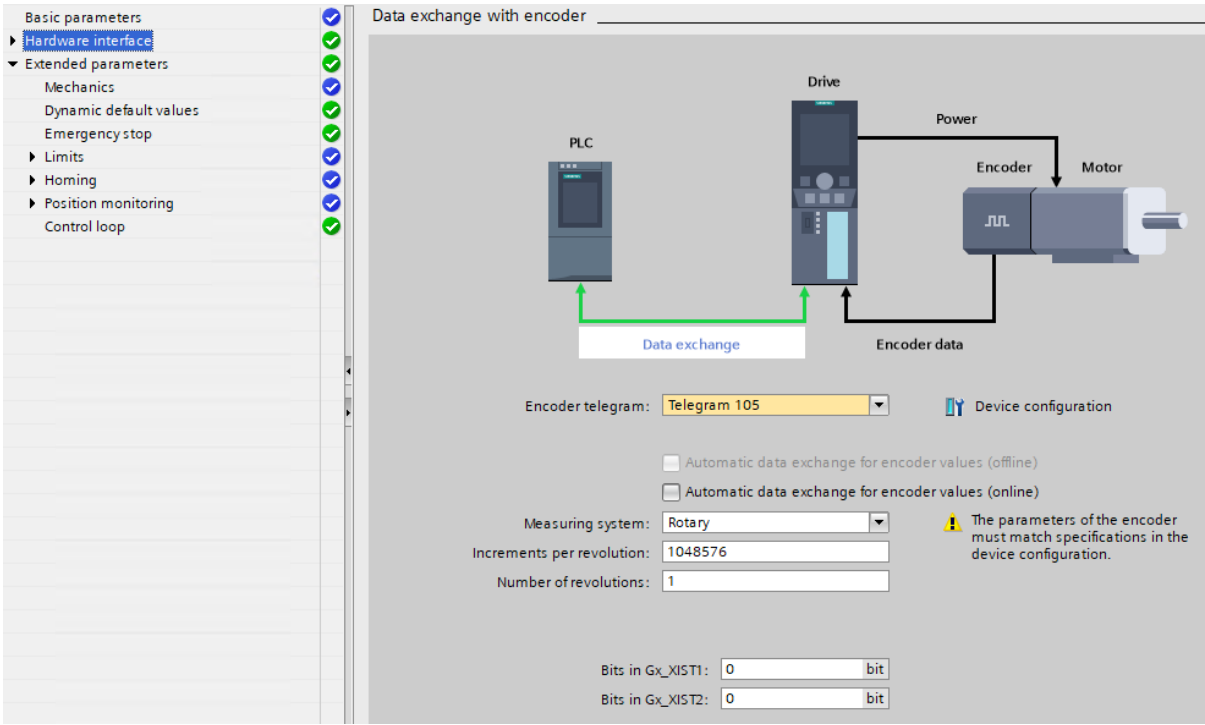
- **Incremental** = Counting increments per revolution, after every restart: homing needed, no absolute position available
- **Absolute** (measuring range > traversing range, Example: SinCos) = The axis position results directly from the current actual encoder value. The traversing range must be within an encoder measuring range. This means that the zero passage of the encoder must not be located in the traversing range. When the controller is switched on, the axis position is determined from the absolute actual encoder value.
- **Cyclic Absolute** (measuring range < traversing range) = The encoder supplies an absolute value within its measuring range. The controller includes the traversed measuring ranges and thus determines the correct axis position beyond the measuring range. When the controller is switched off, the traversed measuring ranges are saved in the retentive memory area of the controller. At the next power-on, the saved traversed measuring ranges are taken into account in the calculation of the actual position value.



- Set correct reference and maximum speed values. This must match with the configured motor data set in the drive.



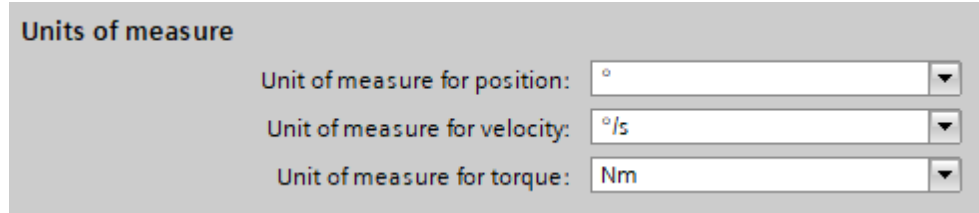
- Set increments per revolution + fine resolution, here  $2^{20}$  Bits + 0 Bit, the fine resolution is already included in the standard position feedback value



## 4.9 Normalization Settings

For the PLCopen function blocks, you have to set the target values for Position, Velocity, Acceleration, Deceleration and Jerk in the configured TO user units.

Example: Units for TO Positioning Axis, *Pos.* = [deg], *Acc.* = *Dec.* = [deg/s<sup>2</sup>], *Jerk* = [deg/s<sup>3</sup>]



The TO will convert the target values into linearised speed information (-200% ... 200% of nominal motor speed, data type *N2* and *N4* according to PROFIdrive). Due to that, the units in the KeStudio DriveManager doesn't really matter for the main PLC control but it is recommended to keep the units consistent between TIA TO and DriveManager for monitoring / debug pupose.

More important values, which have to be consistent between TO and DriveManager:

- Moving direction (CW, CCW)
- Feed contant (in TIA only, when linear axis)
- Position encoder resolution (in TIA only, when positioning axis)

When using a motor gear box:

- the gear ratio must only inserted into the TO configuration

Example here:

Standardisation assistant - start

Standardisation profile:

☒ Standard/DS402

☐ Sercos

☐ User

Continue >>

Close

Help

Standardisation assistant - DS402 (1)

CANopen

Units:

Position:

(0) =

x

deg(2) = Degree

=>

degree

Speed:

(0) =

x

deg/s(3) = Degrees per second

=>

degree/s

Acceleration:

(0) =

x

deg/s/s

=>

degree/s/s

<< Back

Continue >>

Close

Help

Standardisation assistant - DS402 (2)

CANopen

**Polarity of command values:**

Position control modes:

☒ clockwise

☐ anti-clockwise

Speed control modes:

☒ clockwise

☐ anti-clockwise

<< Back

Continue >>

Close

Help

Standardisation assistant DS402 (3) X

**CANopen**

**Feed constant:**

deg

---

rev of driven shaft

**Gear ratio (if available):**

Input revolutions (motor shaft)  rev

Output revolutions (driving shaft)  rev

**Position encoder resolution:**

incr = 2  (power of two)

---

rev (motor)

**Processing format:**

☒ absolute

☐ modulo (rotary table)

**Outcoming multiturn resolution**

The actual setting of position controller resolution and position standardisation leads to a maximum range from:

rev

deg

to:

rev

deg

☐ Consider multi-turn overflow

Target value calculation example:

Target speed for *MC\_MoveVelocity.Velocity* = **1500 deg/s** → Resulting speed in the drive = 1500 deg/s / 360 deg feed constant \* 60 s = **250 rpm**

**Note:** At TO, the naming “*Velocity*” means always the value in the parametrized TO units, “*Speed*” means the same value in *rpm* (monitoring values).

## 4.10 Using PLCopen Function Blocks

The [PLCopen](#) is an organization for developing standards for efficient motion control libraries. These libraries are implemented by many manufacturers and lead to a standard with defined behavior. Also SIEMENS offers this libraries to handle the TO axis. This Function Blocks are linked by giving the name of the TO axis.

See also the description in the TIA help and/or the web for *PLCopen* function blocks.

Tested Function Blocks with ServoOne:

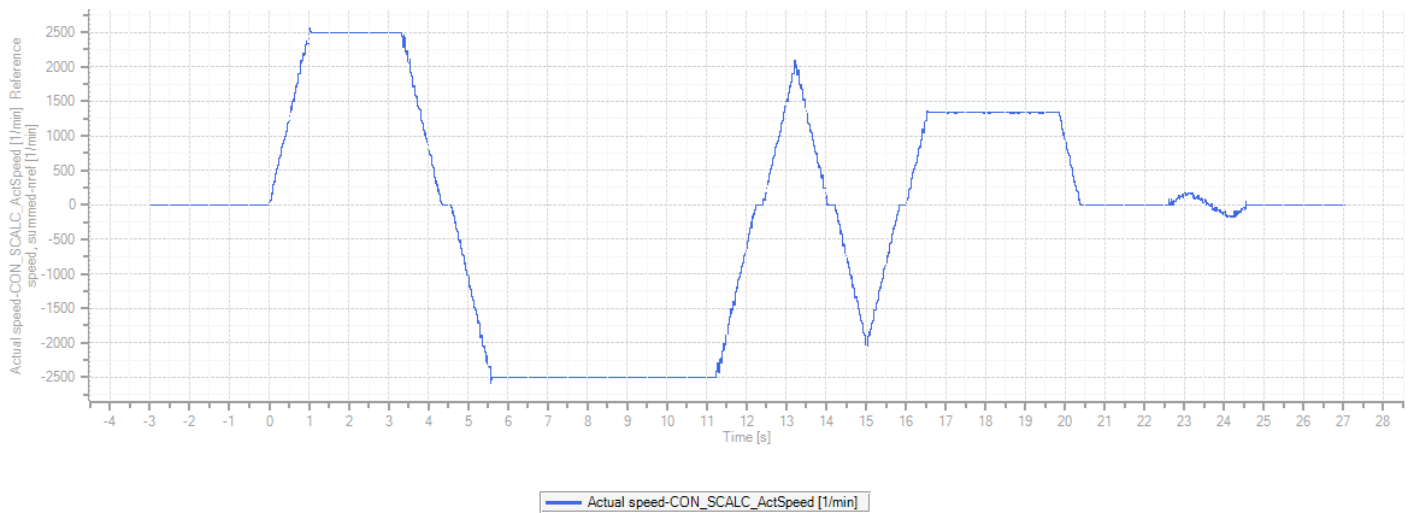
- MC\_Reset
- MC\_Power
- MC\_Home



- MC\_MoveAbsolute
- MC\_MoveRelative
- MC\_MoveVelocity
- MC\_Halt
- MC\_MoveJog

### Resulting Scope Plots with PLCopen Function Blocks (normalized speed in rpm)\*

#### KeStudio DriveManager Scope



Sampling Time = 0.0146875 s

## Resulting Scope Plots with PLCopen Function Blocks (normalized speed in rpm)\*

### SIEMENS TIA Trace



Sampling Time = 1 PLC cycle, interpolated

\* no time line relation due to different trigger events

## 4.11 Homing

- Drive integrated Homing Methods can't be use by Technology Object
- A homing is a prerequisite for absolute positioning movement.
- Initially, the positions of the drive and the TO are not consistent. Both value are related to each other because of the SIEMENS value normalization (data types *N2* and *N4* according to PROFIdrive).
- In general, you can use the PLCopen homing function block *MC\_Home* of the TIA for setting a reference position of the **TO axis** but with it, you can't use directly the delivered homing modes of the drive itself.
- SIEMENS defines different PLC forced homing modes, an active and a passive homing. The mode must be configured in *MC\_Home*. The homing procedure will be then handled internally via G1\_STW and G1\_ZSW (handshake).

### Active Homing with *MC\_Home*

For active homing, the mode 3 or 5 can be used. Please check this in the TIA help for *MC\_Home*. In combination with an active homing you have to use a digital input for Touch Probe at ServoOne (junior) = *ISD05* / ServoOne Functional Safety (FS) = *ISD05*. The Touch Probe event (reference switch) indicates the reference position. The device will latch the current position (edge detection) and copy it to the G1 position in the standard telegram to complete the PROFINET master information (homing handshake).

Passive and active homing ("Mode" = 2, 3, 5, 8, 10) are not possible for an absolute value encoder.

The necessary parameters have to be configured for homing in the DriveManager:

*Example settings:*

- In general, with this parameters in P1255 the device will automatically set the Touch Probe parameters and input selectors internally.
- for **ServoOne-FS**: P1255[0] = 2: Use TouchProbe on **ISD05 (TP1)**, P1255[4] = 0: Digital input works with rising edge / 1 = negative edge ...

Digital Input Selector: **ISD05** PROBE(15) = Touch probe (only ISD04/05)

	1255	COM_PN_Reference...		Reference mark configuration for sensor interface	Sub paramete...
	1255 0	Source 1	2	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 1	Source 2	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 2	Source 3	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 3	Source 4	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 4	Edge 1	0	0=POS, 1=NEG	uint16
	1255 5	Edge 2	0	0=POS, 1=NEG	uint16
	1255 6	Edge 3	0	0=POS, 1=NEG	uint16
	1255 7	Edge 4	0	0=POS, 1=NEG	uint16

- for **ServoOne-Junior**: P1255[0] = 1: Use TouchProbe on **ISD05 (TP0)**, P1255[4] = 1: Digital input works with falling edge ...

Digital Input Selector: **ISD05** PROBE(15) = Touch probe (only ISD05/06)

	1255	COM_PN_Reference...		Reference mark configuration for sensor interface	Sub paramete...
	1255 0	Source 1	1	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 1	Source 2	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 2	Source 3	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 3	Source 4	0	0=OFF, 1=TP0, 2=TP1, 3=ZM	uint16
	1255 4	Edge 1	1	0=POS, 1=NEG	uint16
	1255 5	Edge 2	0	0=POS, 1=NEG	uint16
	1255 6	Edge 3	0	0=POS, 1=NEG	uint16
	1255 7	Edge 4	0	0=POS, 1=NEG	uint16

Also the Zero Mark / Zero Pulse (ZM) from an encoder can be used instead of Touch Probe inputs. Then, the value 3 has to be used in P1255[0...3]. Then the position will be latched by Touch Probe function (will be automatically activated). A new latched position values can be seen according to the selected source channel:

	Id	Sub id	Name	Value	Unit	Introduction
	240		MPRO_TP_Ctrl			Touchprobe: Control value
	240 0		MPRO_TP_Ctrl	NONE		Touchprobe: Control value
	240 1		MPRO_TP_Ctrl	NONE		Touchprobe: Control value
	240 2		MPRO_TP_Ctrl	NONE		Touchprobe: Control value
	241		MPRO_TP_Position			Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	241 0		MPRO_TP_Position	0	POS	Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	241 1		MPRO_TP_Position	0	POS	Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	241 2		MPRO_TP_Position	0	POS	Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	241 3		MPRO_TP_Position	0	POS	Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	241 4		MPRO_TP_Position	0	POS	Probe: Pos. high/low edge of TP0/1, encoder zero pulse
	1400 0		MPRO_TP_Config	TP_TP		Touchprobe: Configuration

The latched position will be passed to the PROFIdrive telegram to the TO.

Additionally, when running active Homing with *MC\_Home*, you have to set the dynamics and direction in the TO homing configuration mask for searching the reference mark according to your application → “*Use Zero mark of the PROFdrive telegram*” for internal Touch Probe function. Then, you can set an additional homing position or offset for the current TO position with *MC\_Home.Position (3)* or *TO Mask (%9)*, but not for the drive itself.

Basic parameters

- Hardware interface
  - Drive
  - Encoder
  - Data exchange with the drive
  - Data exchange with encoder
- Extended parameters
  - Mechanics
  - Dynamic default values
  - Emergency stop
  - Limits
  - Homing
    - Active homing
    - Passive homing
  - Position monitoring
  - Control loop

Active homing

Select the homing mode

- ☒ Use zero mark via PROFdrive telegram
- ☐ Use reference cam and zero mark via PROFdrive telegram
- ☐ Use homing mark via digital input

Digital input homing mark/cam: <Select tag>

Level selection: High level

☐ Enable direction reversal at HW limit switch

Homing direction

- ☒ Positive
- ☐ Negative

Velocity

Position

Approach velocity: 3600.0 °/s

Homing velocity: 900.0 °/s

Home position offset: 0.0

Home position: 0.0

### Passive Homing with MC\_Home

Passive homing methods in TIA means that only the reference indicator will be set at current position when *MC\_Home* was executed (with the depending mode). You are able to handle your reference search movement by your own. For example, you can use *MC\_Jog* function block and act on a digital input from any input module. Then, you can set the reference on the current position, optionally with any offset value.