WEST

Technical Documentation

POS-324-U-PFN

Two axes positioning and synchronization control module with integrated fieldbus interface SSI and analog sensor interface, selectable option for flexible function expansion (FlexiMOD)

Electronics
Hydraulics meets
meets Hydraulics
Electronics

CONTENTS

1 General Information

1.1 Order number

Two axes positioning controller with programmable output (±10 V differential voltage or 4… 20 mA), analog or SSI sensor interface and optional synchronous control. FlexiMOD.

POS-324-U-PFN	Control via Profinet - IO interface

1.2 Scope of supply

The scope of supply includes the module including the terminal blocks which are a part of the housing.
The Profibus plug, interface cables and further parts which may be required should be ordered separately.
This documentation can be downloaded as a PDF file from www.w-e-st.de.

1.3 Accessories

WPC-300	Start-Up-Tool (download: www.w-e-st.de/produkte/software)

Any standard cable with USB-A and USB-B connector can be used as the programming cable.

1.4 Symbols used

General information

Safety-related information

1.5 Legal notice

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Date: 15.01.2026

The data and characteristics described herein serve only to describe the product. The user is required to evaluate this data and to check suitability for the particular application. General suitability cannot be inferred from this document. We reserve the right to make technical modifications due to further development of the product described in this manual. The technical information and dimensions are non-binding. No claims may be made based on them.

1.6 Safety instructions

Please read this document and the safety instructions carefully. This document will help to define the product area of application and to put it into operation. Additional documents (WPC-300 for the start-up software) and knowledge of the application should be taken into account or be available.
General regulations and laws (depending on the country: e.g. accident prevention and environmental protection) must be complied with.

These modules are designed for hydraulic applications in open or closed-loop control circuits. Uncontrolled movements can be caused by device defects (in the hydraulic module or the components), application errors and electrical faults. Work on the drive or the electronics must only be carried out whilst the equipment is switched off and not under pressure.

This handbook describes the functions and the electrical connections for this electronic assembly. All technical documents which pertain to the system must be complied with when commissioning.

This device may only be connected and put into operation by trained specialist staff. The instruction manual must be read with care. The installation instructions and the commissioning instructions must be followed. Guarantee and liability claims are invalid if the instructions are not complied with and/or in case of incorrect installation or inappropriate use.

CAUTION!
All electronic modules are manufactured to a high quality. Malfunctions due to the failure of components cannot, however, be excluded. Despite extensive testing the same also applies for the software. If these devices are deployed in safety-relevant applications, suitable external measures must be taken to guarantee the necessary safety. The same applies for faults which affect safety. No liability can be assumed for possible damage.

Further instructions

- The module may only be operated in compliance with the national EMC regulations. It is the user's responsibility to adhere to these regulations.
- The device is only intended for use in the commercial sector.
- When not in use the module must be protected from the effects of the weather, contamination and mechanical damage.
- The module may not be used in an explosive environment.
- To ensure adequate cooling the ventilation slots must not be covered.
- The device must be disposed of in accordance with national statutory provisions.

2 Characteristics

This electronic module has been developed for controlling hydraulic positioning drives.

Both axes can be controlled independently or also be driven in synchronous mode via fieldbus.

The differential outputs are provided for the control of proportional valves with integrated or external electronics (with differential input). Alternatively the output can be parameterized to 4… 20 mA. This module is intended for the connection with analog position sensors 0...10V or 4...20mA (scalable) or digital SSI sensor interfaces.

The internal monitoring sends information about error and operating states via the fieldbus connection to the master controller. The operational readiness is reported via a digital output, too.

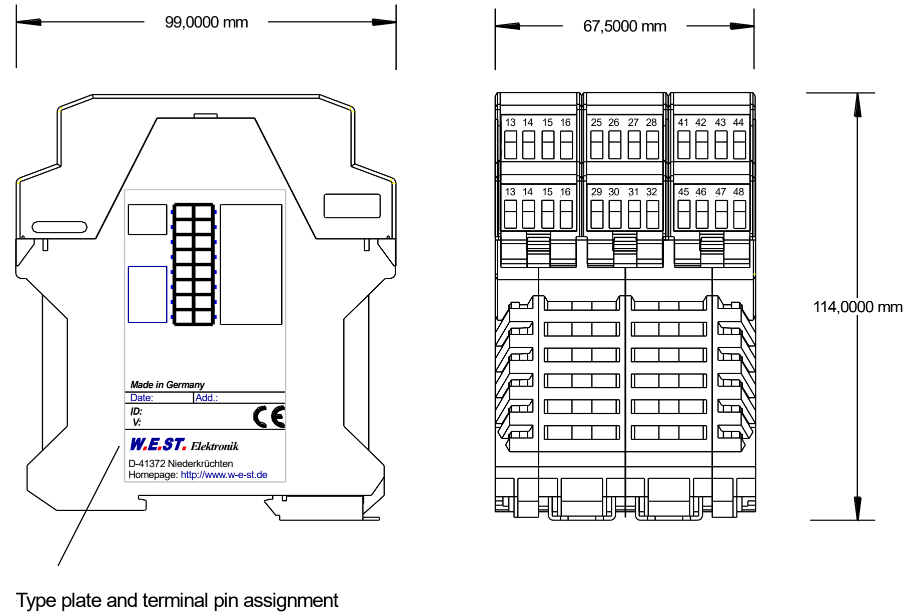
The integrated script language allows the device functions and bus communication of the signals to be adapted within wide limits. This even allows the device to be used with analog setpoint specification or internal generation of setpoint curves, for example.

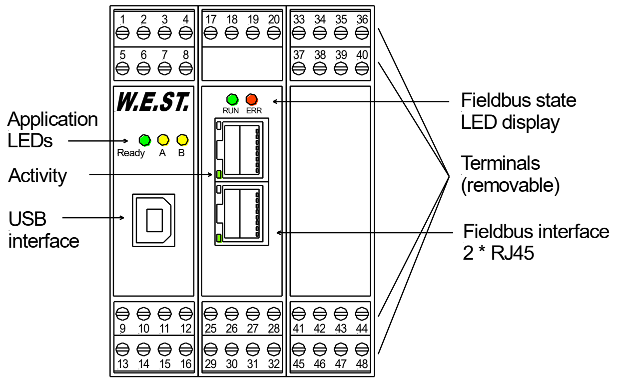
Typical applications: Positioning control or synchronization control with hydraulic axes.

Features

- **Two independent positioning axes**
- **Can be combined for synchronized control**
- **Command position value parameter, actual value response, control bytes and status bytes via integrated fieldbus interface**
- **SSI-Sensor interface or analog sensor interface (0….10V or 4…20mA)**
- **Simple and user-friendly sensor scaling**
- **Speed resolution of 0.005 mm/s**
- **Principle of stroke-dependent deceleration for the shortest positioning time or NC generator for defined motion profile**
- **Highly accurate positioning**
- **Advanced position control with PT_1 controller, Drift compensation and Fine positioning**
- **Superimposed synchronization controller with PT_1 (optimal for hydraulic applications)**
- **Optimal use with zero lapped control valves**
- **Synchronization control in Master / Slave or average value mode**
- **Synchronisation with linear interpolation / gear function selectable**
- **Fault diagnosis and extended function checking**
- **Simplified parameterization with WPC-300 software**

2.1 Device description





3 Use and application

3.1 Installation instructions

- This module is designed for installation in a shielded EMC housing (control cabinet). All cables which lead outside must be screened; complete screening is required. It is also a requirement that no strong electro-magnetic interference sources are installed nearby when using our control and regulation modules.

- **Typical installation location:** 24V control signal area (close to PLC)
  The devices must be arranged in the control cabinet so that the power section and the signal section are separate from each other.
  Experience shows that the installation space close to the PLC (24 V area) is most suitable. All digital and analog inputs and outputs are fitted with filters and surge protection in the device.

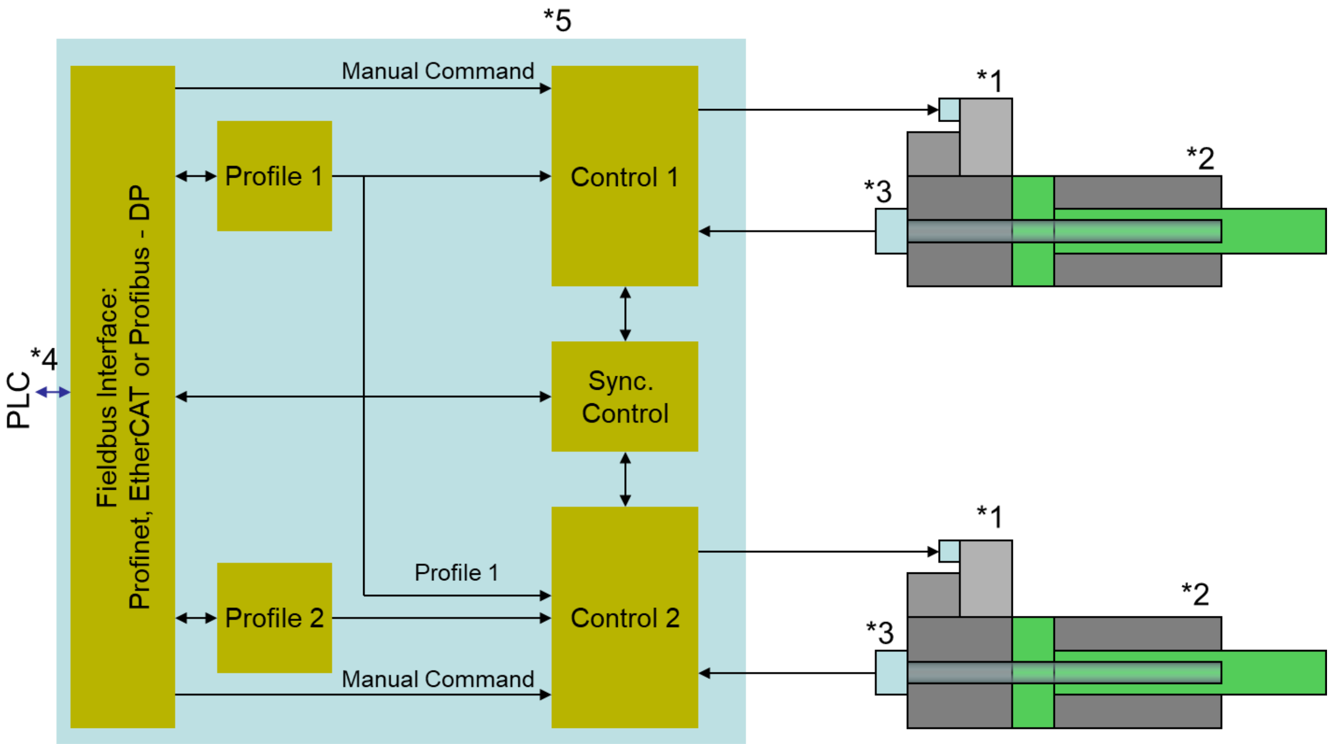
- The module should be installed and wired in accordance with the documentation bearing in mind EMC principles. If other consumers are operated with the same power supply, a star- connected ground wiring scheme is recommended. The following points must be observed when wiring:
    - The signal cables must be laid separately from power cables.
    - Analog signal cables **must be shielded.**
    - All other cables must be screened if there are powerful interference sources (frequency converters, power contactors) and cable lengths > 3m. Inexpensive SMD ferrites can be used with high-frequency radiation.
    - The screening should be connected to PE (PE terminal) as close to the module as possible. The local requirements for screening must be taken into account in all cases. The screening should be connected to at both ends. Equipotential bonding must be provided where there are differences between the connected electrical components.
    - With longer lengths of cable (>10 m) the diameters and screening measures should be checked by specialists (e.g. for possible interference, noise sources and voltage drop). Particular care is required with cables of over 40 m in length – the manufacturer should be consulted if necessary.

- A low-resistance connection between PE and the mounting rail should be provided. Transient interference is transmitted from the module directly to the mounting rail and from there to the local earth.
- Power should be supplied by a regulated power supply unit (typically a PELV system complying with IEC364-4-4, secure low voltage). The low internal resistance of regulated power supplies gives better interference voltage dissipation, which improves the signal quality of high-resolution sensors in particular. Switched inductances (relays and valve coils connected to the same power supply) must always be provided with appropriate overvoltage protection directly at the coil.

3.2 Typical system structure

This minimal system consists of the following components:

(*1) Proportional valve with OBE
(*2) Hydraulic cylinder
(*3) Position sensor
(*4) interface to PLC with analog and digital signals
(*5) POS-324-U control module



3.3 Method of operation

This control module supports simple point-to-point positioning with hydraulic drives. The system works based on the principle of stroke-dependent deceleration, i.e. the control gain (deceleration stroke) is set via parameters **D:A** and **D:B**. Alternatively it can be used in NC mode by setting the loop gain parameters and maximum speed. In this mode the drive will move with controlled velocity to the target position. The movement profile will be calculated by giving acceleration and speed demand.

The deceleration characteristics can be set linearly (**LIN**) or approximately quadratically (**SQRT1**) via the **CTRL** parameter. For normal proportional valves **SQRT1** is the input setting.

For control valves with a linear flow curve it depends on the application. If **LIN** is selected for these valves a significantly shorter deceleration distance can often be set (**D:A** and **D:B**).

Positioning sequence:

The positioning is controlled via Fieldbus. After switching on the ENABLE input, the command position (or target position) is set equal to the actual position of the sensor and the axis stays in closed loop position control mode. The READY output indicates that the system is generally ready for operation. After setting the START-signal, the preset command value will be taken over. The axis immediately will drive to this new command position and indicates reaching it by setting the InPos output.

The Poswin output stays active as long as the axis is within the preset Poswin window and the START input is active. The driving velocity is regulated by a signal received by the fieldbus interface. The axis moves with a limited speed according to this preset value.

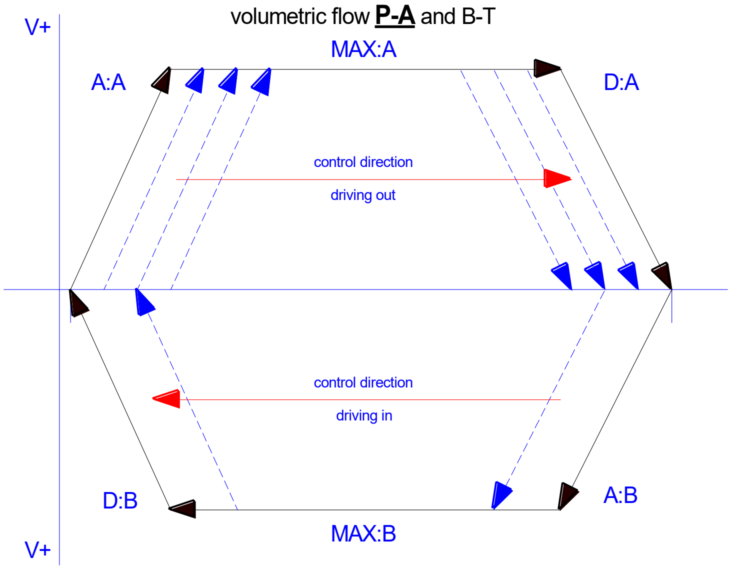
The axis can be driven in manual mode (START is off) using the control bits HAND+ or HAND-. The velocity is programmable. When the HAND signal is deactivated, the command position is set to the actual position and the system stays in closed loop position control mode.

Setting the synchronous bit (GL) will synchronize both axes and the synchronization controller is overriding the position controller of axes 2. Axes 2 is now following axes 1 according to the master-slave-principle.

In order to achieve a reliable synchronous control, the maximum speed should be limited to about 70… 80 % of the possible speed. For compensating for deviations the slave axis must have the ability to move faster than the master axis. This control margin is necessary and has to be considered during the system design.

Influences on positioning accuracy:

The positioning accuracy is determined by the hydraulic and mechanical conditions. The right choice of valve is therefore a decisive factor. In addition, two mutually contradictory requirements (short position time and high accuracy) must be taken into account when designing the system.
The electronic limitations lie mainly in the resolution of the analog signals, although with our modules a resolution of < 0.01% only needs to be considered with long positions. In addition, the linearity of the individual signal points (PLC, sensor and control module) must be considered. The worst-case scenario is that a system-specific absolute fault occurs.
The repeat accuracy is, however, not affected by this.

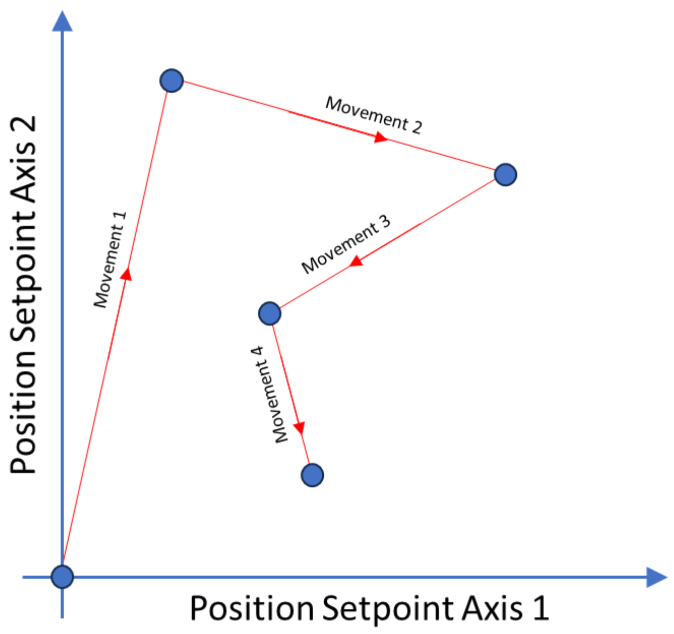


3.4 Synchronisation control with and without gear function / interpolation

This device supports various synchronisation concepts. In the simplest case, the two axes should always move to the same absolute position and move synchronously during the movement. These movements can be performed in NC or SDD mode. When synchronisation is activated, axis 2 is also controlled via the setpoint of axis 1. This synchronisation variant is activated via the SCS control bit. In principle, you can choose between master-slave and average value control. See section 5.6.1.

Alternatively, the gear function or linear motion interpolation can be used: Both axes move to their respective specified target positions. As with the other variant, this movement is triggered by the start bit of the first axis when the SCG control bit is set and both axes report ‘READY’. In gear synchronisation, the DIRECT control bit is ignored because the movement must be started in a coordinated manner. With the rising edge of the START_1 control bit, the controller first calculates the stroke times of the two axes, which are determined by the parameterisation via VMAX, ACCEL and the specified speed of both axes. To enable the slower of the two axes to follow, the algorithm selects the setpoint profile of the axis with the longer stroke time as the reference for the movement. With axes of equal speed and the same speed specification, this is usually the axis for which the greater travel distance is specified. The other axis follows this movement with a reduction ratio that results in the same stroke time, so that both axes reach the target point at the same time.

If the trajectories of the two axes are plotted in a two-dimensional coordinate system, they always follow a straight line, for example:



The specified setpoints can be used to determine whether the axis group behaves as if connected via a gear or in a linear interpolation: For the ‘gear’ variant, the setpoints are always specified in a fixed ratio to each other. If you do not want to calculate this in the PLC, you can also assign the second setpoint WA2 for the geared function very easily using a script function from the first setpoint WA1 in the device.

3.5 Commissioning

Step	Task
Installation	Install the device in accordance with the circuit diagram. Ensure it is wired correctly and that the signals are well shielded. The device must be installed in a protective housing (control cabinet or similar).
Switching on for the first time	Ensure that no unwanted movement is possible in the drive (e.g. switch off the hydraulics). Connect an ammeter and check the current consumed by the device. If it is higher than specified there is an error in the wiring. Switch the device off immediately and check the wiring.
Setting up communication	Once the power input is correct the PC (notebook) should be connected to the serial interface. Please see the WPC-300 program documentation for how to set up communication. Further commissioning and diagnosis are supported by the operating software.
Pre-parameterisation	Now set up the following parameters (with reference to the system design and circuit diagrams): SYSRANGE, SENSOR SETTINGS, POLARITY, ACCELERATION and DECELERATION. Pre-parameterisation is necessary to minimise the risk of uncontrolled movements. Parameterise specific settings for the control element (MIN for following error compensation and MAX for maximum velocity). Reduce the speed limitation to a value which is uncritical for the application.
Control signals	Check the control signal with a voltmeter. The control signals (PIN 15 to PIN16 and PIN19 to PIN20) lies in the range of ± 10V. In the current state it should show 0V. Alternatively, if current signals are used, approx. 0 mA should flow. **CAUTION!** This signal depends on the EOUT setting.
Fieldbus communication	Activate the fieldbus communication and check whether the right values and bits are send to the module.
Switching on the hydraulics	The hydraulics can now be switched on. The module is not yet generating a signal. Drives should be at a standstill or drift slightly (leave its position at a slow speed).
Activating ENABLE	**CAUTION!** Drives can now leave their position and move to an end position at full speed. Take safety measures to prevent personal injury and damage. Drives stay in the current position (with ENABLE the actual position is accepted as the required position). If the drive moves to an end position, the polarity is probably wrong.
Activating START	With the start signal the demand value on the analog demand value input is accepted and the axis moves to the predefined target position. If START is disabled the axis stops in the preset deceleration distance D:S.
Manual (HAND) operation	If START is disabled the axis can be moved manually with HAND+ or HAND- . After disabling the HAND signal, the axis stops in a controlled manner at the current position.
Optimize controller	Now optimize the controller parameters according to your application and your requirements.

4 Technical description

4.1 Input and output signals

Connection	Supply
PIN 3	Power supply control module (see technical data)
PIN 31	Power supply Profibus extension (see technical data)
PIN 35	Power supply SSI extension (see technical data)
PIN 4	0 V (GND) connection control module.
PIN 32	0 V (GND) connection Profibus extension.
PIN 36	0 V (GND) connection SSI extension.
Connection	**Analog signals**
PIN 6	Analog input, signal range 0… 10 V or 4… 20 mA, for free use in the script
PIN 9 (-) / /10 (+)	Differential input, signal range -10… 10 V or 4… 20 mA, for free use in the script
PIN 11	0 V (GND), potential for analog input signals, internally connected to PIN 4
PIN 12	0 V (GND), potential for analog output signals, internally connected to PIN 4
PIN 13	Analog position actual value (X1), signal range 0… 10V or 4… 20 mA, scalable
PIN 14	Analog position actual value (X2), signal range 0… 10V or 4… 20 mA, scalable
PIN 15 / 16 (V) PIN 15 / 12 (mA)	Valve control signal axis 1. Type of signal and polarity can be selected by the parameter SIGNAL:U1.
PIN 19 / 20 (V) PIN 19 / 18 (mA)	Valve control signal axis 2. Type of signal and polarity can be selected by the parameter SIGNAL:U2.
Connection	**SSI sensors**
PIN 33	Power supply for sensor 1
PIN 34	0 V (GND) for sensor 1
PIN 37	CLK +
PIN 38	CLK -
PIN 39	DATA +
PIN 40	DATA -
PIN 47	Power supply for sensor 2
PIN 48	0 V (GND) for sensor 2
PIN 41	CLK +
PIN 42	CLK -
PIN 43	DATA +
PIN 44	DATA -

4.2 LED definitions

Connection	Digital inputs and outputs
PIN 8	**Enable input:** This digital input signal initializes the application. In combination with the software enable the corresponding axis will be activated..
PIN 1	**READY output:** **ON:** The module is enabled; there are no discernible errors. **OFF:** Enable is deactivated or an error has been detected.
PIN 5, PIN 7	Digital inputs for free use in the script
PIN 2	Digital output for free use in the script

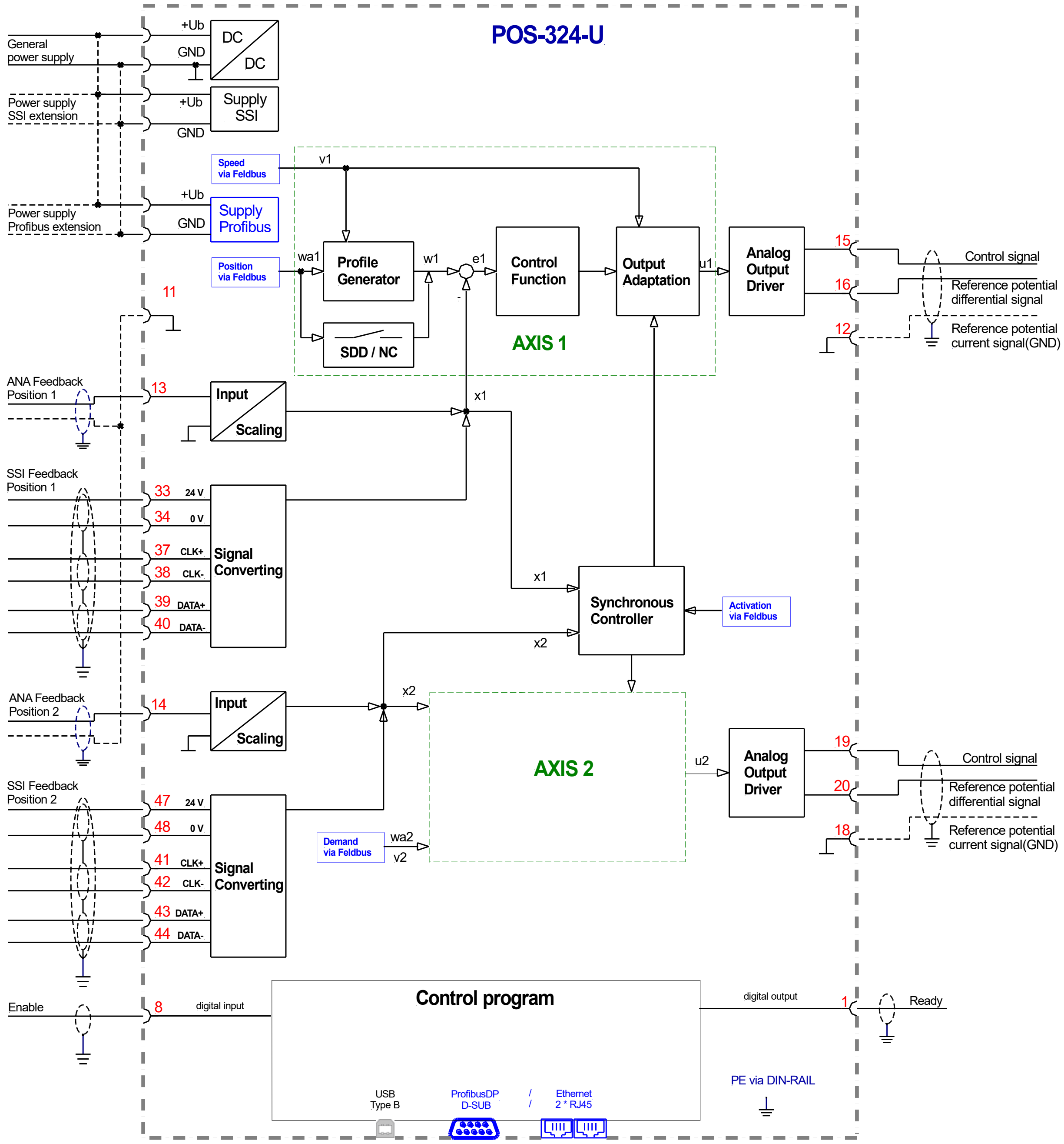
4.2.1 First section with USB

LEDs	Description of the LED function
GREEN	Identical to the READY output. OFF: No power supply or ENABLE is not activated ON: System is ready for peration Flashing: Error discovered Only active when SENS = ON
YELLOW A	STATUS output. OFF: The axis 1 is outside the INPOS window. ON: The axis 1 is within the INPOS window.
YELLOW B	STATUS output. OFF: The axis 2 is outside the INPOS window. ON: The axis 2 is within the INPOS window.
GREEN + YELLOW A+B	1. **Chasing light (over all LEDs):** The bootloader is active. No normal functions are possible. 2. **All LEDs flash shortly every 6 s:** An internal data error was detected and corrected automatically! The module still works regularly. To acknowledge the error the module has to be cycle powered.
YELLOW A + YELLOW B	**Both yellow LEDs flash oppositely every 1 s:** The nonvolatile stored parameters are inconsistent! To acknowledge the error, the data have to be saved with the SAVE command or the corresponding button in the WPC.

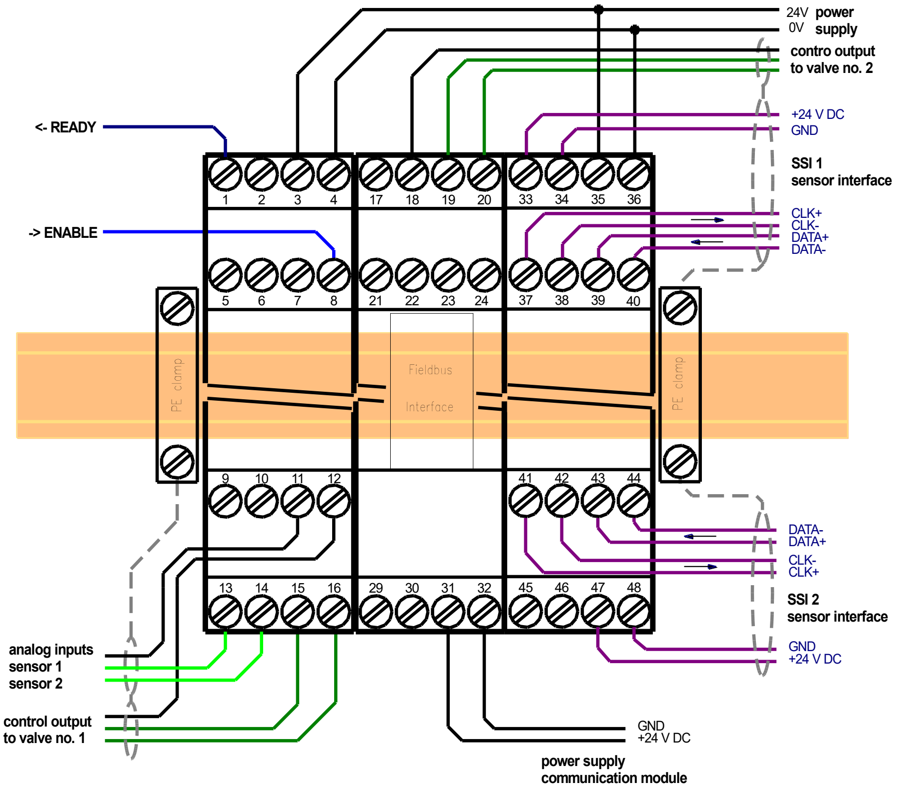
4.2.2 Second section with Fieldbus

LEDs Ethernet	Description of the LED function
GREEN at the ports	Green LEDs shows network traffic at the relating port. OFF: No connection available ON: Active network connected Flashing: PROFINET participant flash test
GREEN	The green RUN LED indicates the status of the central communication processor. OFF: Bus not started Flashing: Profinet: Initializing ON: Connected and active
RED	The red ERR LED indicates a faillure state OFF: No Error. Flashing: - ON: Profinet: Failure in the data communication

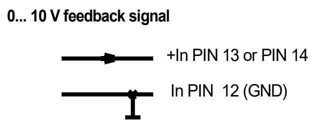
4.3 Block Diagram

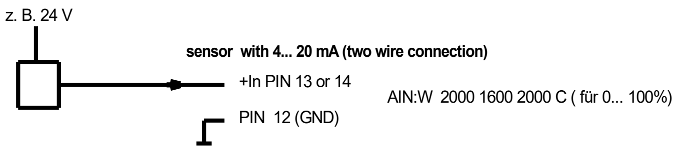


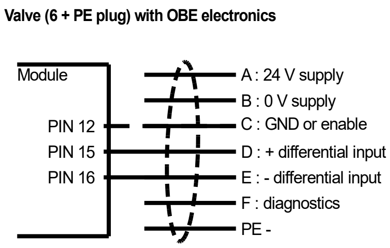
4.4 Typical wiring (without optional inputs)

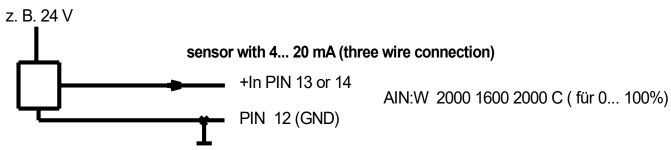


4.5 Connection examples









4.6 Technical data

4.6.1 Common

Supply voltage (Ub) Current requirement External protection	[VDC] [mA] [A]	24 (±10 %) 500 1 medium time lag
Digital inputs OFF ON Input resistance	 [V] [V] [kOhm]	 < 2 > 10 25
Digital outputs OFF ON Maximum current	 [V] [V] [mA]	 < 2 max. Ub 50
Analog inputs Voltage Input resistance Signal resolution Current Burden Signal resolution	 [V] [kOhm] [%] [mA] [Ohm] [%]	 0… 10 min. 25 0.003 incl. Oversampling 4… 20 240 0.006 incl. Oversampling
Analog outputs Voltage Maximum load Current Maximum load Signal resolution	 [V] [mA] [mA] [Ohm] [%]	 +/- 10 differential 10 4… 20 390 0.007
SSI interface Transmission rate	- [kBaud]	RS-422 Specification 120
Signal processing sample time	[ms]	1
Serial interface Transmission rate	- [kBaud]	USB - virtual COM Port 9.6… 115.2
Housing		Snap-on module to EN 50022 PA 6.6 polyamide Flammability class V0 (UL94)
Weight	[kg]	0.310
Protection class Temperature range Storage Temperature Humidity	 [°C] [°C] [%]	IP20 -20… 60 -20... 70 < 95 (non-condensing)
Connections		USB-B 4-pole terminal blocks PE: via the DIN mounting rail
EMC		EN 61000-6-2: 8/2005 EN 61000-6-4: 6/2007 + A1:2011

4.6.2 Fieldbus

Profinet IO		
Transmission rate	**[Mbit/s]**	100
Conformity	**-**	CC-B
Redundancy (optionally usable)	**-**	S2
Connections	**-**	2 * RJ45

5 Parameters

5.1 Parameter overview

The indices specified in this table can be used for parameterisation via Profinet or in the script command 'SPAR'. Please note: In older WPC versions, some numerical values are entered with a decimal point shift, e.g. 100.00% -> entry '10000'. This can be seen from the comment text displayed there, in this case, for example, [0.01%].

Group	Command	Default	Unit	Description	Index [hex.] / Factor [dez.]
Basic parameter					
	MODE	STD	-	Parameter view	
System settings					
	LG	EN	-	Changing language help texts	
	PASSFB	0	-	Password for fieldbus parameterizing	
	SENS	ON	-	Malfunction monitor	0x1500
Axis 1					
	SYS_RANGE_1	100	mm	Axis working stroke	0x1501
	HAND_1:A **HAND_1:B**	3330 -3330	0.01 % 0.01 %	Output signal in manual mode	0x1502 / 100 0x1503 / 100
	POSWIN_1:S **POSWIN_1:D**	200 5000	µm µm	Target window for position status messages	0x2001 0x2002
	EOUT_1	0	0.01 %	Output signal if not ready	0x1504 / 100
Axis 2					
	SYS_RANGE_2	100	mm	Axis working stroke	0x1511
	HAND_2:A **HAND_2:B**	3330 -3330	0.01 % 0.01 %	Output signal in manual mode	0x1512 / 100 0x1513 / 100
	POSWIN_2:S **POSWIN_2:D**	200 5000	µm µm	Target window for position status messages	0x2021 0x2022
	EOUT_2	0	0.01 %	Output signal if not ready	0x1514 / 100
Synchronisation monitoring					
	SYNCWIN	5000	µm	Synchronization error window	0x2041
Input signal adaption					
	SELECT:X	SSI	-	Selecting sensor signals	0x1520
	SHOW:X	SEL	-	Show all parameters or only selected	
	SSI:RES	0.1	µm	Sensor resolution	0x1521
	SSI:BITS	24	-	Number of transmitted bits	0x1522
	SSI:CODE	GRAY	-	Type of transmission code	0x1523
	SSI:ERRBIT	0	-	Position of the error bits	0x1524
Axis 1					
	SSI_1:POL	+	-	Sensor polarity	0x1531
	SIGNAL_1:X	U0-10	-	Type of analog input	0x1532
	N_RANGE_1:X	100	mm	Nominal range of the sensor	0x1533
	OFFSET_1:X	0	µm	Offset of the sensors	0x2017

Group	Command	Default	Unit	Description	Index [hex.] / Factor [dez.]
Axis 2					
	SSI_2:RES	0.1	µm	Sensor resolution	0x1525
	SSI_2:BITS	24	-	Number of transmitted bits	0x1526
	SSI_2:CODE	GRAY	-	Type of transmission code	0x1527
	SSI_2:ERRBIT	0	-	Position of the error bits	0x1528
	SSI_2:POL	+	-	Sensor polarity	0x1541
	SIGNAL_2:X	U0-10	-	Type of analog input	0x1542
	N_RANGE_2:X	100	mm	Nominal range of the sensor	0x1543
	OFFSET_2:X	0	µm	Offset of the sensors	0x2037
additional analog inputs (script)					
	SIGNAL:6	OFF	-	Type of analog input	0x1551
	SIGNAL:910	OFF	-	Type of analog input	0x1552
Positioning controller					
Axis 1					
	VMODE_1	SDD	-	Method of positioning	0x1560
	VRAMP_1	200	ms	Speed ramp time	0x2006
	PT1_1	1	ms	PT1-filter time constant	0x2011
	CTRL_1	SQRT1	-	Control characteristic	0x2012
	D_1:S	10	mm	STOP - Overtravel	0x1561
NC Mode					
	ACCEL_1	250	mm/s²	Acceleration	0x2003
	VMAX_1	50	mm/s	Maximum velocity	0x1562
	V0_1:A **V0_1:B** **V0_1:RES**	10 10 1	1/s 1/s -	Loop gain Loop gain resolution	0x2004 0x2005
SDD Mode					
	A_1:A **A_1:B**	100 100	ms ms	Acceleration time	0x2007 0x2008
	D_1:A **D_1:B**	25 25	mm mm	Deceleration stroke	0x2009 0x2010
Achse 2					
	VMODE_2	SDD	-	Method of positioning	
	VRAMP_2	200	ms	Speed ramp time	0x2026
	PT1_2	1	ms	PT1-filter time constant	0x2031
	CTRL_2	SQRT1	-	Control characteristic	0x2032
	D_2:S	10	mm	STOP - Overtravel	0x2030
NC Mode					
	ACCEL_2	250	mm/s²	Acceleration	0x2023
	VMAX_2	50	mm/s	Maximum velocity	0x1563

Group	Command	Default	Unit	Description	Index [hex.] / Factor [dez.]
	VO_2:A VO_2:B VO_2:RES	10 10 1	1/s 1/s -	Loop gain Loop gain resolution	0x2024 0x2025
SDD Mode					
	A_2:A A_2:B	100 100	ms ms	Acceleration	0x2027 0x2028
	D_2:A D_2:B	25 25	mm mm	Maximum velocity	0x2029 0x202A
Synchronous controller					
	SYNCWIN	5000	µm	Synchronization error window	0x2041
Output signal adaption					
Axis 1					
	MIN_1:A MIN_1:B	0.0 0.0	% %	Deadband compensation	0x2013 / 100 0x2014 / 100
	MAX_1:A MAX_1:B	100.0 100.0	% %	Output scaling	0x1580 / 100 0x1581 / 100
	TRIGGER_1	2.0	%	Deadband compensation trigger point	0x2015 / 100
	OFFSET_1	0.0	%	Offset value for the output	0x2016 / 100
	SIGNAL_1:U	U+-10	-	Type and polarity of output signal	0x1582
Axis 2					
	MIN_2:A MIN_2:B	0.0 0.0	% %	Deadband compensation	0x2033 / 100 0x2034 / 100
	MAX_2:A MAX_2:B	100.0 100.0	% %	Output scaling	0x1585 / 100 0x1586 / 100
	TRIGGER_2	2.0	%	Deadband compensation trigger point	0x2035 / 100
	OFFSET_2	0.0	%	Offset value for the output	0x2036 / 100
	SIGNAL_2:U	U+-10	-	Type and polarity of output signal	0x1587
Extended functions					
Fine positioning / drift compensation					
Axis 1					
	DC_1:AV DC_1:DV DC_1:CR DC_1:I	0.0 0.0 5.0 2000	% % % ms	Point of activation Point of deactivation Time constant of the integrator function Limit of the control range	0x1590 / 100 0x1591 / 100 0x1592 / 100 0x1593
Axis 2					
	DC_2:AV DC_2:DV DC_2:CR DC_2:I	0.0 0.0 5.0 2000	% % % ms	Point of activation Point of deactivation Time constant of the integrator function Limit of the control range	0x1595 / 100 0x1596 / 100 0x1597 / 100 0x1598

Additionally transmitted bus signals					
	SELPLUS:1 **SELPLUS:2**	– –	– –	Selection of additional signal 1 Selection of additional signal 2	0x2076 0x2077

Script parameters					
	PAR1 ... **PAR10**	–	–	Free parameters for use in the script	0x15A1 / 100 … 0x15AA
	MON:A… MON:D	–	–	Assignment of process value displays SC:A .. SC:D to the M lines	
	CCSET	X Y	– –	Free characteristic curve, X – coordinates (ascending), Y – coordinates	0x9040[1] - 0x9069 / 100
	PI:KP	1,0	–	Free controller: Proportional gain	0x1600 / 100
	PI:TN	1,0	s	Free controller: Integration time	0x1601 / 100
	PI:YR	100,0	–	Free controller: Feedback allowance	0x1602 / 100
Profinet					
	PNVOL	–	NORMAL	Volume of data exchange	
Special commands					
Terminal commands					
	NEGW	–	OFF	Release of negative position setpoints	
	ST	–	–	Display of the values received from the fieldbus	
	DIAG1/DIAG2	–	–	Query the last switch-off causes	
	SIM	–	OFF	Activating a simple internal simulation	
	DIAGTPS	–	–	Querying diagnostic info on Profinet	
	SETPFNAME	–	–	Setting the station name	

[1] The coordinates are indexed in the order X-10/Y-10...X10/Y10. X-10 and X10 cannot be changed.

5.2 System parameters

General note:

For selection parameters, a number is specified in brackets in the list of parameter values. This corresponds to the numerical value of the corresponding selection when the parameter is queried or set by Profinet or the script command 'SPAR'.

5.2.1 LG (Changing the language for the help texts)

Command	Parameters	Unit	Group
LG X	x= DE|EN	-	**SYSTEM**

Either German or English can be selected for the help texts.

5.2.2 PASSFB (Password fieldbus)

Command	Parameters	Unit	Group
PASSFB X	x= 0… 10000000	-	**SYSTEM**

The value inputted here serves as password for the parameterizing via fieldbus. For enabling parameterization, it has to be sent via fieldbus to the relating address. For a value of "0" the password protection is deactivated.

5.2.3 SENS (Malfunction monitoring)

Command	Parameters	Unit	Group
SENS X	x= ON(1)|OFF(2)|AUTO(3)	-	**SYSTEM**

This command is used to activate/deactivate the monitoring functions of the module.

ON: All monitoring functions are active. Detected failures can be reset by deactivating the ENABLE input.

OFF: No monitoring function is active.

AUTO: Auto reset mode. All monitoring functions are active. If the failure does not exist anymore, the module automatically resumes to work.

Normally the monitoring functions are always active because otherwise no errors are detectable via the READY output. Deactivating is possible mainly for troubleshooting.

5.2.4 SYS_RANGE (Working stroke)

Command		Parameters	Unit	Group
SYS_RANGE_1	X	x= 10… 10000	mm	**SYSTEM**
SYS_RANGE_2	X	x= 10… 10000	mm	

This command defines the full stroke, which corresponds to 100 % of the input signal. If the demand is set incorrectly, this leads to incorrect system settings, and the dependent parameters such as speed and gain cannot be calculated correctly.

5.2.5 HAND (Manual speed)

Command		Parameters	Unit	Group
HAND_1:i	X	i= A|B		**SYSTEM**
HAND_2:i	X	x= -100.0… 100.0	%	

The manual speeds are set with these parameters. The drive moves in a controlled manner in the defined direction when the manual signal is active. The direction is defined by the sign of the parameters. After the manual signal has been disabled, the drive remains under control in the current position.

In case of a fault (position sensor fault), the drive can still be moved with the manual function. The output will be switched off when hand signals are turned off.

The manual speed is also limited by the (internal or external) speed demand (MIN evaluation).

Caution! Do not use the manual mode in conjunction with the EOUT command. After the deactivation of the HAND input the output is set to the EOUT value.

5.2.6 POSWIN (In-position monitoring range)

Command		Parameter	Unit	Group
POSWIN_1:i	X	i= S|D		**SYSTEM**
POSWIN_2:i	X	x= 2… 200000	µm	

This parameter is entered in µm.
The POSWIN command defines a range for which the POSWIN message is generated. This function monitors the difference between the command and actual position. If the error is less than the programmed value an POSWIN message is generated. The positioning process is not influenced by this message. START must be acivated to generate the POSWIN messages.

POSWIN:S Static, for monitoring the target position in SDD mode.

POSWIN:D Dynamic, for monitoring the following error in NC Mode[2].

5.2.7 EOUT (Output signal: READY = OFF)

Command		Parameters	Unit	Group
EOUT_1	X	x= -100.0… 100.0	0.01 %	**SYSTEM**
EOUT_2	X			

Output value in case of a detected error or a deactive ENABLE input. A value (degree of valve opening) for use in the event of a sensor error (or the module is disabled) can be defined here. This function can be used if, for example, the drive is to move to one of the two end positions (at the specified speed) in case of a sensor error.

|EOUT| = 0 The output is switched off in the event of an error. This is normal behavior.

CAUTION! If the output signal is 4… 20 mA, the output is switched off when **|EOUT| = 0**. If a null value = 12 mA is to be output in the event of an error, EOUT must be set to 0.01[3].

The output value defined here is stored permanently (independently of the parameter set). The effects should be analyzed by the user for each application from the point of view of safety.

Do not use the manual mode in conjunction with the EOUT command. After the deactivation of the HAND input the output is set to the EOUT value.

5.2.8 SYNCWIN (synchronization monitoring range)

Command		Parameter	Unit	Group
SYNCWIN	x	x= 2… 200000	µm	**SYSTEM**

This parameter is entered in µm.
The SYNCWIN command defines a range for which the $\overline{GL - ERROR}$ message is generated. This function monitors the difference between the command and actual position. The controlling process is n ot influenced

[2] POSWIN:D should always be set greater than POSWIN:S . With POSWIN:D the increasing following error can be detected (e.g. through high external force). In SDD mode both signals are equal.

[3] This is necessary if using valves without error detection for signals lower than 4 mA. If the valve has an error detection, it moves into a defined position after switching off the output.

by this message and remains active.

Monitoring function in standard mode – synchronisation:

SYNCMODE AV	The average value of both axes is the demand value. Both axes are monitored.
SYNCMODE MS	The difference between both axes is monitored.

Monitoring function for gear–type synchronisation:

The deviation of the second axis from its calculated reference position is monitored. The transmission ratio of the current movement is taken into account by reducing the deviation in the event of unequal travel distances.

5.3 *Input signal adaption*

5.3.1 SELECT:X (Type of position sensors)

Command	Parameters	Unit	Group
SELECT X	x= SSI(0)|ANA(1)	-	**INPUT**

With this parameter, the appropriate sensor type can be activated.

ANA: The analog sensor interfaces are active.

SSI: The SSI sensor interfaces are active. The SSI sensors have to be adjusted via the SSI commands to the sensors. The relevant sensor data must be available.

The SSI interface is suitable for digital position sensor. The internally processed accuracy is 1 micron.

5.3.2 SHOW:X (Show all parameters or only selected)

Command	Parameters	Unit	Group
SHOW:X x	x= SEL(0)|ALL(1)	-	**INPUT**

This command selects the parameter view of the input signals and the internal dependencies of the associated parameters:

SEL: Only the parameters relevant to the selected sensor interface (according to SELECT:X) are displayed. For the SSI interface, only one configuration is possible for both axes (number of bits, resolution, etc.). The additional input signals that can be used in the script cannot be parameterised.

ALL: All parameters are displayed, even those that are not used. The two SSI sensors can be set differently. The analog inputs on PIN9/10 and PIN6 can also be parameterised.

5.3.3 SSI:RES (Signal resolution)

Command	Parameters	Unit	Group
SSI(_2):RES X	x= 0.01…	µm	**INPUT**

This command defines the signal resolution[4] of the sensor. Data entry has a resolution of 10 nm (nanometer). Take the data from the sensor's data sheet.

[4] The signal resolution is 1µm. Sensors with a higher resolution should not be used without asking the manufacturer.

5.3.4 SSI:BITS (Number of bits)

Command	Parameters	Unit	Group
SSI:BITS X	x= 8… 31	-	**INPUT**

With this command the number of data bits can be set. Take the data from the sensor's data sheet.

5.3.5 SSI:CODE (Signal coding)

Command	Parameters	Unit	Group
SSI:CODE X	x= GRAY(1)|BIN(0)	-	**INPUT**

With this command the signal coding can be chosen. Take the data from the sensor's data sheet.

5.3.6 SSI:ERRBIT (Position of the "out of range" bit)

Command	Parameter	Unit	Group
SSI:ERRBIT X	x= 0… 31	-	**INPUT**

The position of the error bit will be defined by this parameter.
The appropriate data can be found in the sensor's data sheet. In case of no described error bit, the default value is 0 (deactivation of the monitoring).

5.3.7 SSI:POL (Direction of the sensor signal)

Command	Parameters	Unit	Group
HUBLÄNGESSI_1:POL1 X SSI_2:POL2 X	x= +(0)|-(1)	-	**INPUT**

To reverse the working direction of the sensor, with this command the polarity can be changed.
Attention: Unlike the POS124, you have to raise the parameters OFFSET_1/_2:X , in case of negative polarity, according to the stroke length, so the position measurement value stays positive.

5.3.8 SIGNAL (Type of input)

Command	Parameter	Unit	Group
SIGNAL_1:X X SIGNAL_2:X X	x= OFF(1)|U0-10(2)| I4-20(3)|U10-0(4)| I20-4(5)	-	**INPUT**

This command can be used to change the type of input signal (voltages or current) and to define the direction of the signal. This command is available for the analog feedback inputs.

OFF= Deactivation of the input.

5.3.9 N_RANGE (Nominal range of the sensor)

Command	Parameter	Unit	Group
N_RANGE_1:X X N_RANGE_2:X X	x= 10… 10000	mm	**INPUT**

N_RANGE (nominal range or nominal stroke) is used to define the length of the sensor. This value should be always higher or equal in comparison with SYS_RANGE. The control parameter cannot be calculated correctly in case of wrong values.

5.3.10 OFFSET (Sensor zero correction)

Command	Parameter	Unit	Group
OFFSET_1:X X OFFSET_2:X X	x= -100000… 100000	µm	**INPUT**

By these commands the zero-point of the axes can be adjusted.
The offset value is added to the control element signal at the output and limited to SYS_RANGE.

5.4 Positioning controller

5.4.1 VMODE (Selecting the control mode)

Command	Parameters	Unit	Group
VMODE_1 X VMODE_2 X	x= SDD(1)|NC(0)	-	**CONTROL**

The fundamental control structure can be changed with this parameter.

SDD: **S**troke-**D**ependent **D**eceleration. In this mode, stroke-dependent deceleration is activated. This mode is the default mode and is suitable for most applications. With stroke-dependent deceleration the drive comes to a controlled stop at the target position. From the set deceleration point the drive then switches to control mode and moves accurately to the desired position. This control structure is very robust and reacts insensitively to external influences such as fluctuating pressures. One disadvantage is that the speed varies with the fluctuating pressure as the system runs under open-loop control.

NC: **N**umerically **C**ontrolled. In this mode a position profile is generated internally. The system always works under control and uses the following error to follow the position profile. The magnitude of the following error is determined by the dynamics and the set control gain. The advantage is that the speed is constant (regardless of external influences) due to the profile demand. Because of continuous control, it is necessary not to run at 100% speed, as otherwise the errors cannot be corrected. 80% of the maximum speed is typical although especially the system behaviour and the load pressure should be taken into account when specifying the speed.

5.4.2 VRAMP (Ramp time for external speed demand)

Command	Parameters	Unit	Group
VRAMP_1 X VRAMP_2 X	x= 1… 2000	ms	**CONTROL**

The rate of change of the external speed demand can be limited by this ramp time. In NC mode, this value should be set to 10ms.

5.4.3 ACCEL (Acceleration in NC mode)

Command	Parameters	Unit	Group
ACCEL_1 X ACCEL_2 X	x= 1… 20000	mm/s	**CONTROL**

This command is used to define the acceleration in NC mode. The command is only active if the VMODE has been parameterized to NC. For stable operation it must be set to a value which is a little smaller than the technically possible acceleration. Experience shows that a factor of 3…5 should be considered.

5.4.4 VMAX (Maximum speed in NC Mode)

Command	Parameters	Unit	Group
VMAX_1 X VMAX_2 X	x= 1… 5000	mm/s	**CONTROL**

Specification of the maximum speed in NC Mode. This value is defined by the drive system and should be specified as precisely as possible (not too high under any circumstances). The maximum speed is scaled with the external speed demand. The command is only active if the VMODE has been parameterized to NC.

If the speed differs between the two directions of movement the lower value should be entered.

5.4.5 V_0 (Loop gain setting)

Command	Parameters	Unit	Group
V0_1:I X V0_2:I X	i= A|B|RES x= 1… 200 RES: x= 1(1)|100(0)	s^{-1}	**CONTROL**

This parameter is specified in s^{-1} (1/s).
In NC Mode the loop gain is normally specified rather than the deceleration distance[5].

The internal gain is calculated from this gain value together with the VMAX and SYS_RANGE parameters.

$$D_i = \frac{v_{max}}{V_0}$$

$$G_{Intern} = \frac{SYS\_RANGE}{D_i}$$

Calculation of the internal control gain

In NC Mode the following error at maximum speed is calculated using the loop gain. This following error corresponds to the deceleration distance with stroke-dependent deceleration. The conversion and therefore also the calculation of the correct parameter value can be easily performed using this relationship.

With **V0:RES** the resolution can be changed in order to put in significant smaller values.

[5] The loop gain is alternatively defined as a KV factor with the unit (m/min)/mm or as Vo in 1/s. The conversion is KV = Vo/16.67.

5.4.6 A (Acceleration ramp time)

Command	Parameters	Unit	Group
A_1:i X A_2:i X	i= A|B x= 1… 5000	ms	**CONTROL**

Ramp function for the 1st and 3rd quadrants in SDD mode.

The acceleration time for positioning is depending on the direction. 'A' corresponds to connection 15 and 'B' corresponds to connection 16 (if POL = +). Normally A = flow P-A, B-T and B = flow P-B, A-T.

For quadrants 2 and 4, parameters D:A and D:B are used as the deceleration distance demand.

5.4.7 D (Deceleration / braking distance)

Command	Parameters	Unit	Group
D_1:i X D_2:i X	i= A|B x= 1… 10000	mm	**CONTROL**

This parameter is specified in mm[6].
The deceleration distance is set for each direction of movement (A or B). The control gain is calculated internally depending on the deceleration distance. The shorter the deceleration distance, the higher the loop gain. A longer deceleration distance should be specified in the event of instability.

$$G_{Intern} = \frac{SYS\_RANGE}{D_i}$$ Calculation of control gain

5.4.8 D_1:S / D_2:S (Stop - Overtravel)

Command	Parameters	Unit	Group
D_1:S X D_2:S X	x= 1… 10000	mm	**CONTROL**

If the ENABLE signal is switched off, the output signal is always abruptly removed. If only the START bit is switched off before a movement is completed, the controller brakes the axis with a defined deceleration. This is set by the parameters D_1:S and D_2:S as the overtravel. After deactivating START, a new target position in relation to the speed (current position plus D:S) is calculated and specified as the setpoint. Higher values lead to smoother braking.

If the NC mode is selected, braking is compatible with previous versions for input values <= 10 mm. In this case, the lag distance serves as overtravel, i.e. the axis decelerates by immediately stopping the profile generator. This is usually a relatively hard reaction, which can be made softer by entering larger values.

[6] **CAUTION!** With older modules this parameter was specified in % of the maximum path. Since data specification for this module has now been converted to mm the relationship between the path (PATH command) and these parameters must be taken into account.

5.4.9 PT1 (Time response of the controller)

Command	Parameter	Unit	Group
PT_1 X PT_2 X	x= 0… 300	ms	**CONTROL**

The time response of the controller can be influenced via this parameter.
Hydraulic drives are often critical to control especially in case of high speeds and very fast valves. The PT1 filter can be used to improve the damping rate and allows therefore higher loop gains.

Requirements for the use are: The natural frequency of the valve should be equal or higher than the natural frequency of the drive.

5.4.10 CTRL (Deceleration characteristics)

Command	Parameters	Unit	Group
CTRL_1 X CTRL_2 X	x= LIN(1)|SQRT1(2)|SQRT2(3)	-	**CONTROL**

The deceleration characteristic is set with this parameter. In case of overlapped proportional valves the SQRT function should be used. The non-linear flow function of these valves is linearized by the SQRT[7] function.

In case of zero lapped valves (control valves and servo valves) the LIN or SQRT1 function should be used regardless of the application. The progressive characteristic of the SQRT1 function has better positioning accuracy but can also lead to longer positioning times in individual cases.

LIN: Linear deceleration characteristic (gain factor is 1).

SQRT1: Root function for braking curve calculation. The gain is increased by a factor of 3 (in the target position). This is the default setting.

SQRT2: Root function for braking curve calculation. The gain is increased by a factor of 5 (in the target position). This setting should only be used with a significantly progressive flow through the valve.

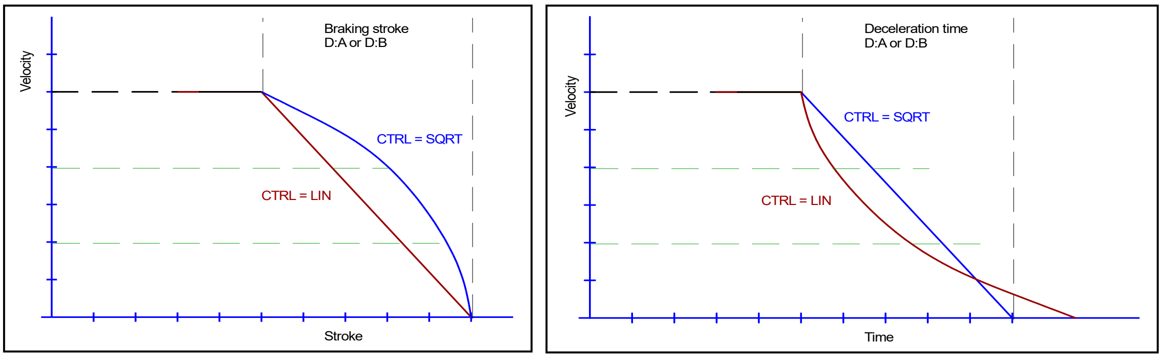


Figure 2 (Braking function with respect to stroke and time)

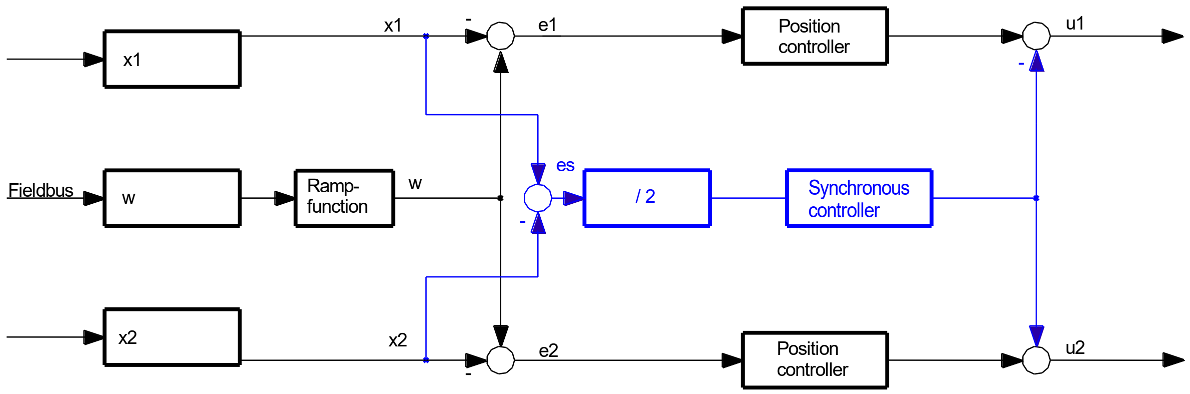
[7] The SQRT function generates constant deceleration and thus reaches the target position faster. This is achieved by increasing the gain during the deceleration process.

5.5 *Synchronous controller*

5.5.1 SYNCMODE (Operation mode synchronous run)

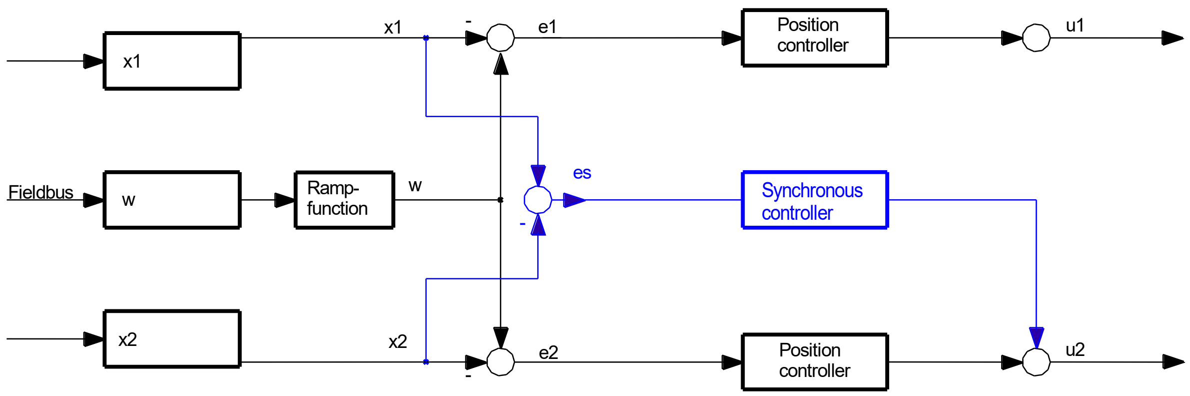
Command	Parameters	Unit	Group
SYNCMODE X	x= MS|AV	-	**SYNC_CTRL**

With this command the behavior of synchronization controller be selected
MS: Master Slave Control. Axis 2 is always the Slave
AV: Average value control



Picture 1: Control structure of the average value controller

Both actual positions are checked. The calculated average value serves as command value for the synchronous controller, which has an effect on both axes while trying to synchronize them. The lagging one will be accelerated and the advanced one decelerated.



Picture 2: Control structure of the master / slave principle

The actual position of the master axis serves as command position for the synchronous controller. It exerts influence on the slave axis and tries to synchronize it to the master axis. Here, the parameterization should be adapted in a way that the master axis is speed – limited. Otherwise a lagging slave axis may not be able to compensate the synchronous error.

5.5.2 SYNC (Control parameters)

Commands		Parameter	Units	Group
SYNC:P	X	x= 1… 10000	mm	**SYNC_CTRL**
SYNC:V0	X	x= 1… 400	s^{-1}	
SYNC:T1	X	x= 1… 300	ms	

These parameters are used to optimize the synchronization controller. The SYNC-controller works as a PT1 or PI compensator for optimized controlling of hydraulic drives. The parameter T1 effects a delayed action of the SYNC Controller. The stability of the compensator could be increased in critical cases with the up streamed T1 Filter.

In **SDD-mode** is specified with SYNC:P, the braking distance in mm. The gain will depend on the stopping distance is calculated internally. In short braking distance, the high gain is calculated. In the case of instability should be given a longer stopping distance.

In the **NC-mode** parameters of the SYNC: V0 is in s-1 (1 / s) specified. In this mode, the loop gain is entered.

The parameter SYNC: T1 causes a delayed action of the synchronized controller. The stability of the controller can be increased by the upstream T1-filter in critical cases.

Synchronisation control in gear mode:

In this operating mode, the synchronisation controller behaves in a similar way. However, instead of adjusting the absolute position of the axes, a reference position is determined for each axis, which relates the relative travel of the other axis to its own path. This can mean that, if the travel distances are very different, the deviations of the axis with the shorter distance have a very large effect on the axis with the longer distance to travel. This is taken into account internally with a correction factor that reduces the gain of the synchronisation controller.

5.6 Output signal adaption

5.6.1 MIN (Deadband compensation)

5.6.2 MAX (Output scaling)

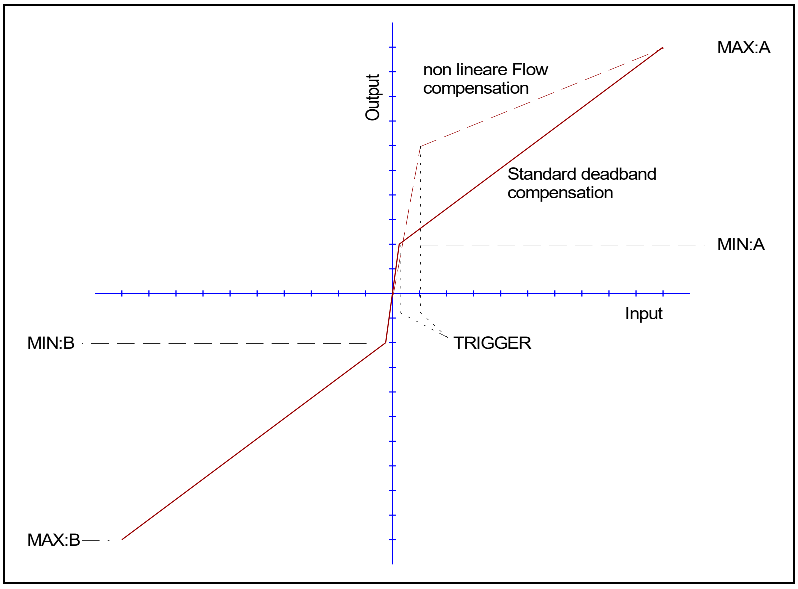
5.6.3 TRIGGER (Response threshold for the MIN parameter)

Command	Parameters	Unit	Group
	i= A|B	-	**OUTPUT**
MIN_1:i X	x= 0.0… 60.0	%	
MAX_1:i X	x= 30.0… 100.0	%	
TRIGGER_1 X	x= 0.0.… 40.0	%	
MIN_2:i X	x= 0.0… 60.0	%	
MAX_2:i X	x= 30.0… 100.0	%	
TRIGGER_2 X	x= 0.0… 40.0	%	

The output signal to the valve is adjusted by means of these commands. A kinked volume flow characteristic is used instead of the typical overlap step for the position controls. The advantage is a better and more stable positioning behavior. At the same time, a kinked volume flow characteristic of the valve can also be equalised with this compensation[8].

CAUTION: If there should also be adjustment options for deadband compensation on the valve or valve amplifier, it must be ensured that the adjustment is performed either at the power amplifier or in the module.

If the MIN value is set too high, this has an effect on the minimum speed, which can then no longer be adjusted. In extreme cases this leads to oscillation around the controlled position.



[8] Various manufacturers have valves with a defined nonlinear curve: e.g. a kink at 40 or 60 % (corresponding to 10 % input signal) of the nominal volume flow. In this case the TRIGGER value should be set to 10.0 and the MIN value to 40.0 (60.0).

If zero lapped or slightly underlapped valves are used, the volume flow gain in the zero range (within the underlap) is twice as high as in the normal working range. This can lead to vibrations and jittery behavior. To compensate this, the TRIGGER value should be set to approximately 2.0 and the MIN value to 1.0. The gain in the zero point is thus halved and an overall higher gain can often be set.

5.6.4 OFFSET (Zero correction)

Command	Parameters	Unit	Group
`OFFSET_1 X` `OFFSET_2 X`	`x= -40.0… 40.0`	`%`	**OUTPUT**

The offset value is added to the output value. Valve zero offsets can be compensated with this parameter.

5.6.5 SIGNAL:U (Type and polarity of the output signal)

Command	Parameter	Unit	Group

`SIGNAL_1:U X`
`SIGNAL_2:U X`
	`x= U+-10(1)|`
	`I4-12-20(2)|`
	`U-+10(3)|`
	`I20-12-4(4)`
		-	**OUTPUT**

This command is used to define the output signal (voltage or current) and to change the polarity.

Differential output ± 100 % corresponds with ± 10 V (0… 10 V at PIN 15 and PIN 16 or PIN 19 and PIN 20). Current output ± 100 % corresponds with 4… 20 mA (PIN 15 to PIN 12 or PIN 19 to PIN 18). 12 mA (0 %) = center point of the valve.

An output current of << 4 mA indicates an error and the module is disabled. The current input of the proportional valves should be monitored by the valve. The valve has to be deactivated in case of < 4 mA input signal. Otherwise the EOUT command can be used to get a defined output signal.

5.7 Drift compensation / high accurate positioning

The high accurate positioning or the drift compensation can be used if external influences limit the positioning accuracy. These function can be critical because limit cycling[9] could be caused by wrong parameterization.

Which positioning errors can be compensated[10]?

1. Zero point adjustment of the valve. By this kind of error a constant offset between command and feedback signal remains. This error is more or less constant.
2. Zero point deviation depending on the temperature. The same behavior as point 1, but the effect is increasing slowly (over the temperature).
3. Position error caused by an external force. All control and servo valves have a typical pressure gain characteristic. In case of external forces an output signal of 2…3 % has to be generated for the compensation of this force. And this signal is proportional to the positioning error. In opposite to point one and two the positioning error generated by forces can vary from cycle to cycle.

How does the drift compensation / high accurate positioning work?

The position errors should be compensated when the axis is near by the target position. The drift compensator generates a slowly changing output signal (integrating behavior) by which the a.m. errors can be eliminated.

To prevent instabilities, the integrator value will be frozen when the output value is lower than the deactivation limit (DC:DV).

Drift compensation (zero point adjustment)

By this function position errors described below point one and two are eliminated.

High accurate positioning (external force compensation)

To compensate positions errors as described below point three.

Control bits via fieldbus:

Through the fieldbus it is possible to activate drift compensation as well as high accurate positioning.

This can be accomplished by using the following control bits:

DC_ACTIVE: General activation of the drift compensation and high accurate positioning[11].

DC_FEEZE: Freezing of the static drift compensation value.

DC_F_POS: Activation of the high accurate positioning (dynamic drift compensation).

[9] The „limit cycling“ is a small and permanent oscillation around the target position. The main reason are static frictions and the hysteresis of the valve. By proper parameter setting, this can be avoided under the boundary condition that the desired accuracy is not achieved. In this case, the hydraulic system is the limiting factor in the accuracy.

[10] This is relevant for zero lapped control valves and servo valves.

[11] The static drift compensation to adjust the zero point and the freezing of this value should always be carried out at first. Only by this it is possible to avoid or minimise overshooting of the target position.

Typical setup

Valve pressure gain: 2,5 %; the activation point has to be set to 3… 5 % (DC:AV).
Valve hysteresis: 0,5 %; the deactivation point has to be set to 0,7… 1,0 % (DC:DV). The lower the value the better the accuracy.

DC:CR should be equal to DC:AV. Limiting the control range of the integrator is necessary to avoid long settlement durations.

The optimum integrator time has to be determined experimentally. Starting with higher values is recommended.

The integration time usually has to be determined by experiments. For this it is recommended to start with a long time (1500 ms) and to reduce it gradually. If overshooting or limit cycling occurs, the time setting has become too small.

5.7.1 DC:AV (Activation value)

5.7.2 DC:DV (Deactivation value)

5.7.3 DC:CR (Integrator limitation)

5.7.4 DC:I (Integration time)

Command		Parameter	Unit	Group
DC_1:AV	X	x= 0… 20.0	%	**EXTENDED**
DC_1:DV	X	x= 0… 10.0	%	
DC_1:CR	X	x= 0… 5.0	%	
DC_1:I	X	x= 0… 2000	ms	
DC_2:AV	X	x= 0… 20.0	%	
DC_2:DV	X	x= 0… 10.0	%	
DC_2:CR	X	x= 0… 5.0	%	
DC_2:I	X	x= 0… 2000	ms	

DC:AV This parameter is used to define the activation point (activation value). The DC function is completely deactivated in case of DC:AV = 0.

DC:DV This parameter is used to define the deactivation point (DV = deactivation value) Within the deactivation window no compensation value will be calculated (frozen state).
DC:AV = 0 should be used for best positioning, but „limit cycling“ can occur. This value should be set to 50 % of an acceptable error.

DC:CR The output range of the DC function will be limited (CR = control range) by this parameter.

DC:I This parameter is used to define the integrator time. The lower this value the faster the compensation. Low values will result in „limit cycling“.

5.8 SELPLUS (additionally transmitted bus signals)

Command	Parameters	Unit	Group

`SELPLUS:I X`	`I= 1|2`
	`x= -(1)|E1(2)|U1(3)|`
	`ES(4)|E2(3)|U2(4)`
		-	**EXTENDED**

Bytes 20 - 23 of the output signals to the fieldbus can be freely connected to two of the internal process variables. These parameters are used to determine the assignment.

The following table gives an overview of the adjustable signals, their value ranges and scaling:

Signal	Description	Range	Unit
E1	Control deviation axis 1	+/- 30000	0.01 mm
U1	Control signal axis 1	+/- 10000	0.01 %
ES	Synchronisation error	+/- 30000	0.01 mm
E2	Control deviation axis 2	+/- 30000	0.01 mm
U2	Control signal axis 2	+/- 10000	0.01 %

5.9 PAR (free parameters)

Command	Parameters	Unit	Group
`PAR:i x`	`i= 1... 10`	-	**EXTENDED**

The parameters entered here are available for free use in the script. The setting can be made both by the WPC and the West Script software.

In older WPC versions, the entry is made with a decimal point shift in the unit 0.01.

5.10 MON (definition of the monitor signals)

Command	Parameters	Unit	Group
`MON:i x`	`i= A, B, C, D` `x= 0... 60`	-	**EXTENDED**

These parameters do not influence the function of the module, but merely select which M signals of the script can be observed in the monitor and oscilloscope of the WPC.

The value "0" as the default setting does not correspond to any selection, as the M numbers start with "1". The corresponding SC value in the WPC monitor is then permanently displayed as "999.99".

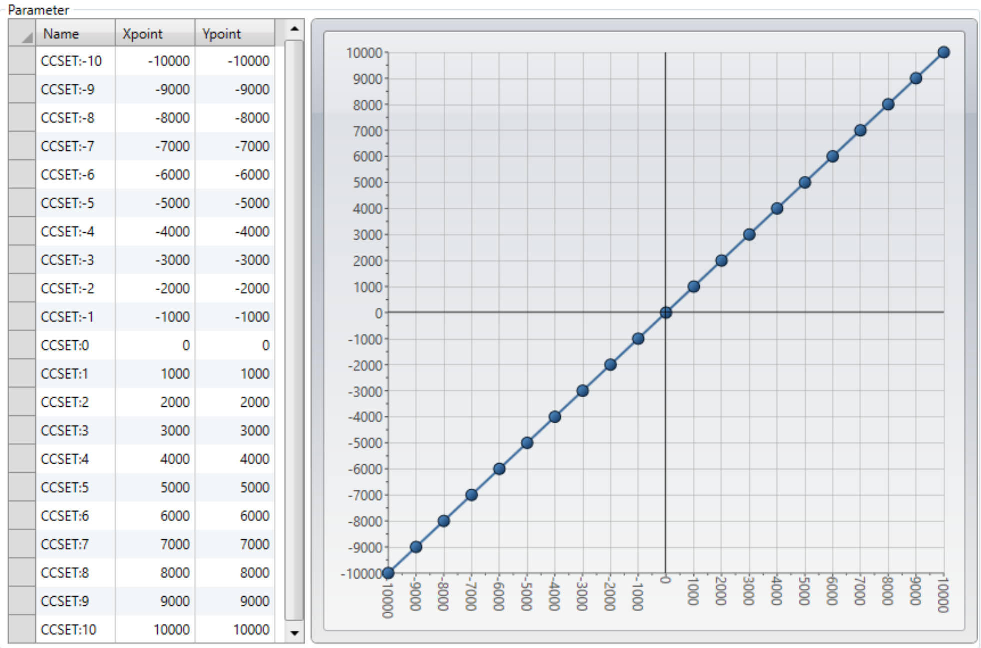
5.11 CCSET (free linearisation for the script)

Command	Parameters	Unit	Group
`CCSET:I X Y`	i= -10... 10 x= -10000... 10000 y= -10000... 10000	- 0,01 % 0,01 %	**EXTENDED**

At this point, a characteristic curve can be defined based on 21 pairs of values.
This can be used in the script via the "CC" function.
The X-axis corresponds to the input signal, the Y-axis to the output signal.
Restrictions when entering values:

- The X coordinates must increase monotonically
- The X coordinate of the first interpolation point is -10000, corresponding to -100.0 [%]
- The X coordinate of the last interpolation point is 10000, corresponding to 100.0 [%]

The default setting provides for a completely linear assignment with equidistant interpolation points:



Name	Xpoint	Ypoint
CCSET:-10	-10000	-10000
CCSET:-9	-9000	-9000
CCSET:-8	-8000	-8000
CCSET:-7	-7000	-7000
CCSET:-6	-6000	-6000
CCSET:-5	-5000	-5000
CCSET:-4	-4000	-4000
CCSET:-3	-3000	-3000
CCSET:-2	-2000	-2000
CCSET:-1	-1000	-1000
CCSET:0	0	0
CCSET:1	1000	1000
CCSET:2	2000	2000
CCSET:3	3000	3000
CCSET:4	4000	4000
CCSET:5	5000	5000
CCSET:6	6000	6000
CCSET:7	7000	7000
CCSET:8	8000	8000
CCSET:9	9000	9000
CCSET:10	10000	10000

The output of the curve encoder is calculated using linear interpolation:
y=(x-x1)*(y1-y0)/(x1-x0)+y1.
The input signal of the function is set internally to the range of
-100.0 [%] ... 100.0 [%], so that no extrapolation takes place.
The effects of linearisation can be assessed via the process data in the monitor or oscilloscope.

5.12 Free PI controller

Command	Parameter	Unit	Group
PI:KP x PI:TN x PI:YR x	x= +/- 1000,0 x= 0... 1000,0 x >= 0	- s -	**EXTENDED**

These parameters can be used to parameterise a universal, widely adjustable PI controller with optional external feedback.
external feedback can be parameterised. This controller can be configured in the script programme for various

TN = 0 switches off the I component.

YR is used to determine what is known as a feedback margin: The output signal of the controller and the integrator it contains are limited so that they lie within a band +/- YR around the feedback value.

In older WPC versions, the entry is made with a decimal point shift in the units 0.01 or 0.01s.

If the feedback value is fixed at 50% and YR is set to "50.0", this results in a limitation of the output signal to 0...100%.

If the feedback value is set to 0% and YR is set to "100.0", this results in the output signal being limited to +/- 100%.

If the signal continues to influence the output or external limitations, the correspondingly adjusted signal should be fed back.

5.13 PNVOL (Volume of data exchange)

Command	Parameter	Unit	Group
PNVOL X	x= NORMAL|EXTEND	-	**EXTENDED**

This parameter allows the transmitted fieldbus values to be configured to 64 bytes (bidirectional).

This corresponds to the EXTEND setting. Values exceeding 32 bytes can be used in script programming.

Please note that the PLC must also be configured accordingly (see Chapters 7.5 and 11).

5.14 Special commands

5.14.1 NEGW (Release of negative position setpoints)

Command	Parameter	Unit	Group
NEGW X	x= ON|OFF	-	**TERMINAL**

The specification of negative position setpoints can be useful if you have set a negative sensor offset so that the actual position of the axis can actually fall below the zero point. In this way it is possible, for example, to move to the actual end stop via the profile generator and then readjust the offset.

5.14.2 ST (Status of the fieldbus signals)

Command	Parameter	Unit	Group
ST X	-	-	**TERMINAL**

This command allows you to query all input signals from the field bus interface in the terminal window. The communication status is also displayed. PN AR is output for Profinet devices and means 'address relation', i.e. the existing connection to a master. In the redundant case (S2), 1 / 1 is output if both masters have access. In normal operation with one master, the display is 1 / 0. The remaining outputs are self-explanatory and commented on in the claret.

5.14.3 DIAG (Query of the switch-off causes)

Command	Parameters	Unit	Group
DIAG DIAG2	-	-	**Terminal**

If you enter this command in the terminal window, a list of the last 10 shutdowns (no Ready if Enable is present) is displayed. However, the causes of the shutdown are not saved when the supply voltage is switched off. The last cause is displayed in the bottom line of the list. Entries "---" indicate unused memory cells.

5.14.4 DIAGTPS (Profinet - Diagnostic information)

Command	Parameters	Unit	Group
DIAGTPS	-	-	**Terminal**

This command provides information about the status of the Profinet interface. It is used for expert analysis and can facilitate diagnosis in the event of a fault. In addition, the set Profinet device name is displayed.

5.14.5 SETPFNAME (Set the station name)

Command	Parameters	Unit	Group
SETPFNAME	x x x x	-	**Terminal**

This command can be used to set the Profinet device name. See also Section 8.3.
The name can be specified as a parameter. If the name is longer than 18 characters, it must be divided into blocks of a maximum of 18 characters each, which are entered separated by spaces (the 'x' in the table above should illustrate this)
Please note that WPC always displays lowercase letters entered in the terminal as uppercase letters. Since the device name, according to convention, must not contain uppercase letters, these are converted back into lowercase letters when received by the module. It therefore does not matter whether you use lower or uppercase letters when entering the name.
The command SETPFNAME -RESET resets the device to factory settings, i.e. a set name is deleted again.

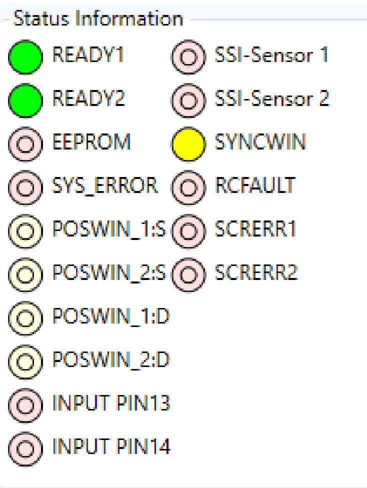
5.15 PROCESS DATA (Monitoring)

Command	Parameters	Unit
WA1	External command position axis 1	mm
W1	Actual command position after ramp function axis 1	mm
X1	Feedback positon axis 1	mm
E1	Control deviation axis 1	mm
V1	Speed set point axis 1	%
U1	Control signal axis 1	%
ES	Synchronisation error	mm
WA2	External command position axis 2	mm
W2	Actual command position after ramp function axis 2	mm
X2	Feedback positon axis 2	mm
E2	Control error axis 2	mm
V2	Speed set point axis 2	%
U2	Control signal axis 2	%
DT	Execution time control task	µs
SC:A … SC:D	User-defined M signals (by MON:A … MON:D)	-

The process data are the variables which can be continuously observed on the monitor or on the oscilloscope.
The 'DT' signal indicates, for information purposes only, the current processing time of the control program. The unit indicates the speed at which this is happening. The numerical value may vary slightly and also depends on the number and type of commands in the script table. Since a new call is made every 1000 µs = 1 ms, the processing time should be less than 500 µs, which is completely uncritical due to the highly efficient processing.

5.16 Status information

Each W.E.St. device with serial interface provides system and application oriented status information. If using the WPC those can be found realized as virtual LEDs in the monitor view. Green coloured are messages about the common readiness, yellow marked are defined states including being within the monitoring windows and the red ones are error messages. Moving the mouse marker on one of these LEDs a relating help text will be displayed.



6 Common device functions

6.1 Failure monitoring

Following possible error sources are monitored continuously when SENS = ON/AUTO:

Source	Fault	Characteristic
Feedback signal PIN 13 4... 20 mA	Out of range or broken wire.	The output will be switched off.
Feedback signal PIN 14 4… 20 mA	Out of range or broken wire.	The output will be switched off.
SSI-sensor 1	Out of range or broken wire.	The output will be switched off.
SSI-sensor 1	Out of range or broken wire.	The output will be switched off.
EEPROM (at switching on)	Data error	The output is deactivated. The module can be activated by saving new parameters (pressing of the SAVE Button).
RC - Mode	The WPC connection (since WPC-V4.0) is disconnected during RC operation, e.g. by exiting the program or pulling the USB plug.	The output will be switched off.
SCERR1 / 2	Errors generated in the script: The user can program his own monitoring functions in the script, which become effective via these predefined error messages.	The output will be switched off.

CAUTION: Take care of the EOUT command. Changes will influence the behaviour.

6.2 Troubleshooting

It is assumed that the device is in an operable state and there is communication between the module and the WPC-300. Furthermore, the valve control parameterization has been set with the assistance of the valve data sheets.

The monitor view in WPC can be used to analyse faults.

Attention: When using RC mode safety issues have to be considered. In this mode the module is directly controlled and the superimposed control of the system has no influence on it.

FAULT	CAUSE / SOLUTION
ENABLE is active, the module does not respond, and the READY LED is off.	There is presumably no power supply or the ENABLE signal is not present. If there is no power supply there is also no communication via our operating program. If a connection has been made to the WPC-300, then a power supply is also available If the power supply exists, an attempt should be made to see whether the system can be moved by means of the HAND+ and HAND- signals (measuring the output signal to the valve helps).
ENABLE is active, the READY LED is flashing.	The flashing READY LED signals that a fault is been detected by the module. The fault could be: • A broken cable or no signal at the input (PIN 14 or 13), if 4… 20 mA signals are parameterized. • Internal data error: press the command/SAVE button to delete the data error. The system reloads the DEFAULT data. With the WPC-300 operating program the fault can be localised directly via the monitor.
ENABLE is active; the READY LED is on, the system moves to an end position.	The control circuit polarity is incorrect. The polarity can be changed with the SIGNAL:U command or by reversing the connections to PIN 15 and PIN 16 or PIN 19 and PIN 20.
ENABLE is active, the READY LED is on, the STATUS LED is not flashing, the system moves to the target position but doesn't reach it (positioning error).	Serious positioning errors can result from incorrect parameterization or incorrect system design. • Is the cylinder position specified correctly? • Are the deceleration distances correct (to start the system the deceleration distances should be set to approx. 20… 25 % of the cylinder position[12])? • Is the valve a zero lapped control valve or a standard proportional valve? In the case of a proportional valve, the valve overlap which may be present should be compensated for with the MIN parameters. Typical values are to be found in the valve data sheet.
ENABLE is active, the READY LED is on, and the system oscillates on the spot.	The system is working and also actuating the valve. Various potential problems could be: • The parametrisation is not yet adjusted to the system (gain too high). • There is severe interference on the power supply. • Very long sensor cables (> 40 m) and sensor signal interference. • The MIN setting to compensate the valve overlap is too high. As a basic principle, the parametrisation of the sensor data and the controller settings must be carried out first (before switching on). An incorrect demand is equivalent to incorrect system design which then leads to incorrect operation. If the system oscillates, the gain should first be reduced (longer deceleration distances for D:A and D:B) and in the case of overlapped valves the MIN parameter should also be reduced.

[12] The stability criterion of the hydraulic axes must be taken into account.

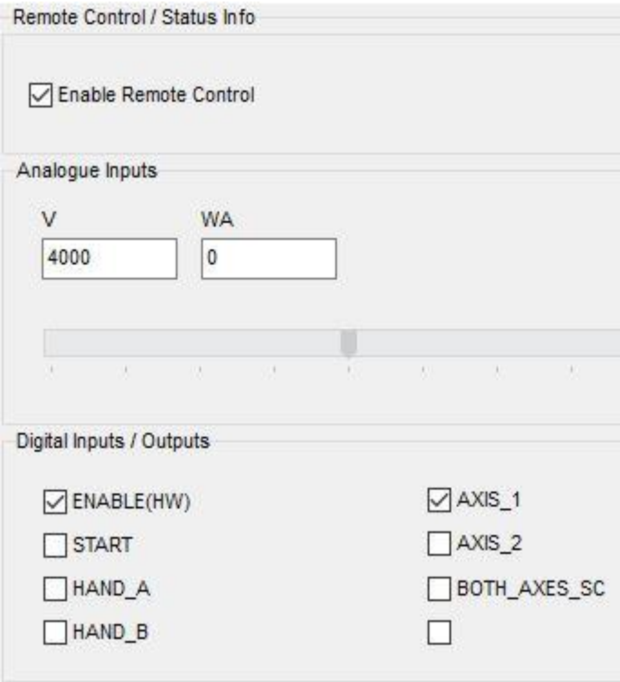
Speed too low	The drive may be able to move to position but the speed is too low.
	• Check the control signal to the valve.
	  • Via the integrated oscilloscope (U variable).
	  • Measure the signal to the valve with an external oscilloscope / voltmeter.
	• If the control is within the range of ± 100% (± 10V), the fault must be sought in the hydraulics.
	• If the control signal is relatively low, the following points should be checked:
	  • Is the internal/external speed signal limiting the speed?
	  • Which setting has been specified for the deceleration distance in relation to the POSITION?

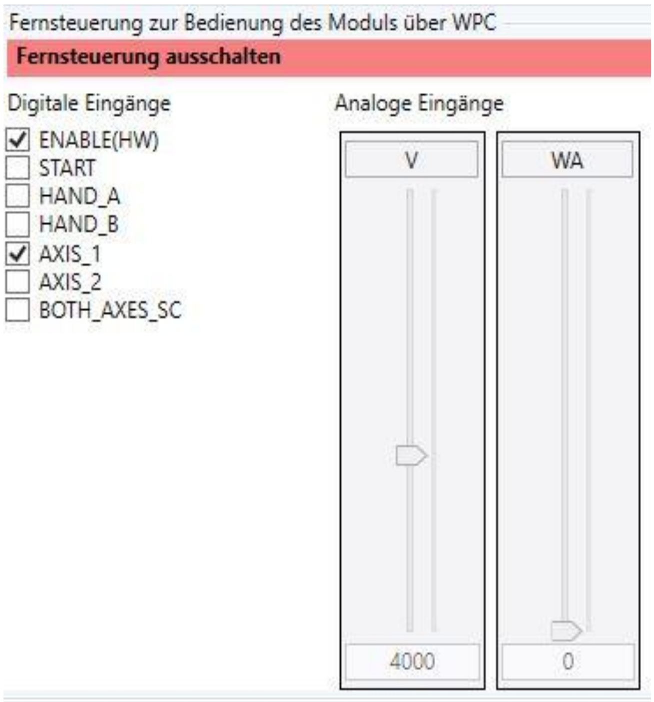
Speed too high	The drive should move to position. The drive moves in and out too fast leading to uncontrolled behaviour. Reducing the speed (VMAX parameter) has very little or no effect. The hydraulic system is over-sized. The entire parameterization of the movement cycle cannot be reproduced (overlap and deceleration distance settings)

6.3 Remote control mode

This function allows the user controlling the device via the USB interface. When active the module is independent from the external demands. So we offer the possibility to put an axis into operation and test it without having the fieldbus available. Further this mode helps also when trouble shooting is necessary, because the plc or similar has not to be changed for trials. The WPC program therefor offers a simple user interface for giving those demands. Following pictures show examples of both versions of the software with this view. In version 3 a double click on the value to change is necessary before the slider can be moved or a value can be typed in. In version 4 the slider can be moved directly by holding the mouse button. Special feature at this device is the control of two axes in one device. Therefor at first the axis to control has to be selected. It is also possible to move both axes in synchronous run. This option corresponds to the activation of the SC bit via the fieldbus, means the once set demands are valid for both axes.

If the connection breaks down during the RC mode is active, the controller will be deactivated. An error message (RC fault) is generated and displayed even after re-establishing the connection. It can be quit like a standard error with the enable signal.





7 Profinet IO RT interface

7.1 Profinet IO function

PROFINET is the standard for industrial ethernet based on IEEE 802.xx. PROFINET is based on the 100 Mb/s-version of full-duplex and switched Ethernet. PROFINET IO is designed for the fast data exchange between Ethernet-based controllers (master functionality) and field devices (slave functionality) with cycle times up to 4 ms.

7.2 Profinet Installation guideline

The Profinet IO field devices are connected exclusively via switches as network components. A Profinet IO network can be set up in star, tree, line or ring topology. Profinet IO is based on the Fast Ethernet standard transmission with 100 Mbit / s. The transmission media are copper cables CAT5.

For the IP20 environment in the control cabinet, the RJ45 connector CAT5 according to EN 50173 or ISO / IEC 11801 is used. The pin assignment is compatible with the Ethernet standard (ISO / IEC 8802-3).

The connection between Profinet participants is called Profinet channel. In most cases, Profinet channels are built with copper cables to IEC 61784-5-3 and IEC 24702. The maximum length of a Profinet channel, which is constructed with copper cables is 100 m.

7.3 Profinet name assignment

All Profinet devices must be given a unique IP address and a name to enable communication. The IP address is automatically assigned to the device by the Profinet IO controller (PLC); it does not need to be set on the device or actively assigned to the device by the user.

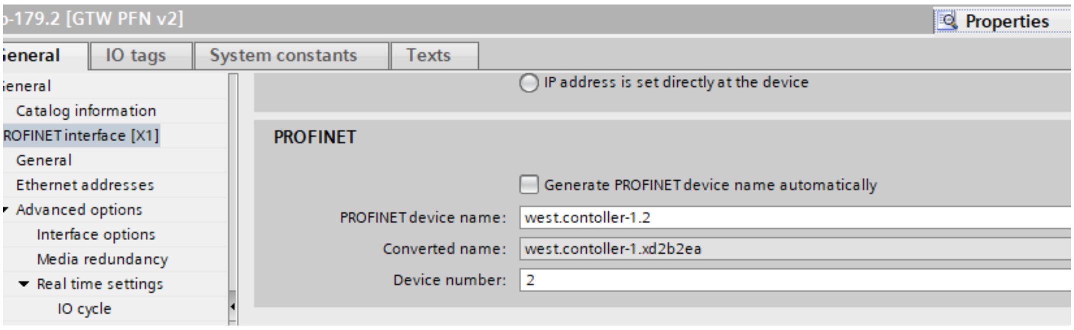
The name of the PROFINET IO device is stored in the permanent memory of the device. It can be modified by an IO supervisor. This is usually the engineering system of the PLC used.

Alternatively, it is possible to assign a name to the device using the terminal command SETPFNAME. See section 5.9.6.

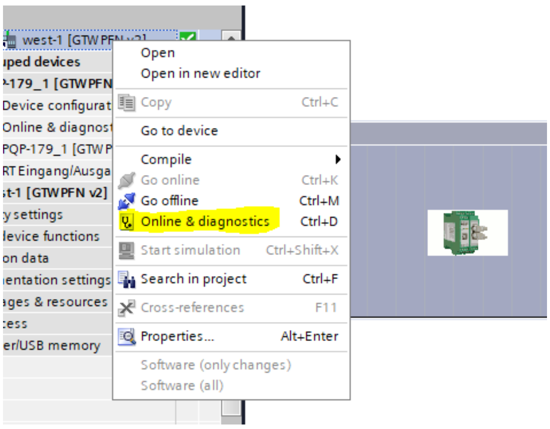
There are some conditions for the device names:

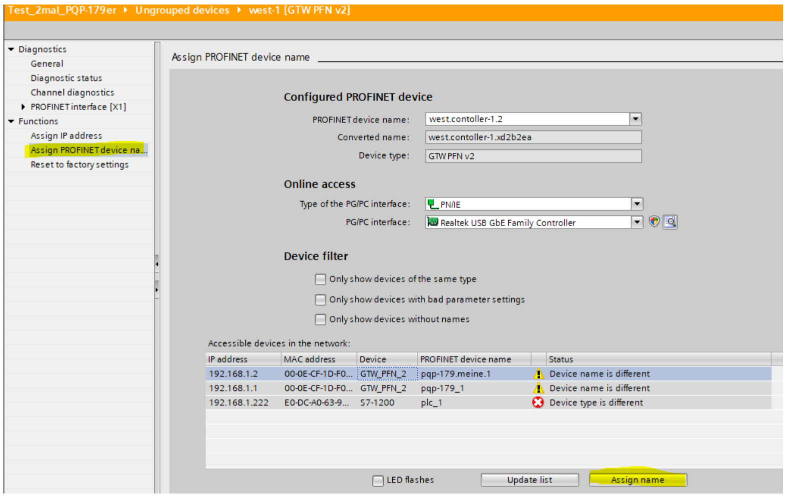
- The name consists of one or more name components that can be separated by a period (.).
- Restriction to 240 characters in total (lower case letters, numbers, hyphen or period)
  If the name is to be assigned using WPC, a maximum of 72 characters is possible.
- A name component within the device name, i.e. a character string between two points, can be a maximum of 63 characters long.
- A name component consists of the characters [a-z, 0-9].
- The device name must not begin or end with the character ‘-’.
- The device name must not begin with numbers.
- The device name must not have the form n.n.n.n (n = 0, ... 999).
- The device name must not begin with the character sequence ‘port-xyz’ or ‘port-xyz-abcde’ (a, b, c, d, e, x, y, z = 0, ... 9).

Please note that some master systems, such as TIA Portal, do not assign the device name given there directly to the device, but work with a so-called converted name. This conversion does not follow obvious rules.
However, the converted names are also displayed there:



The preferred way of assigning names is to use the corresponding function of the engineering system. In the TIA Portal, this is done as follows:





7.4 *Device data file (GSDML)*

The characteristics of an IO device are described by the device manufacturer in a general station description (GSD) file. The language used for this purpose is the GSDML (GSD Markup Language) - an XML based language. For I/O data, the GSDML file describes the structure of the cyclic input and output data transferred between the programmable controller and the PROFINET IO device. Any mismatch between the size or structure of the input and output data and the actual internal device structure generates an alarm to the controller.

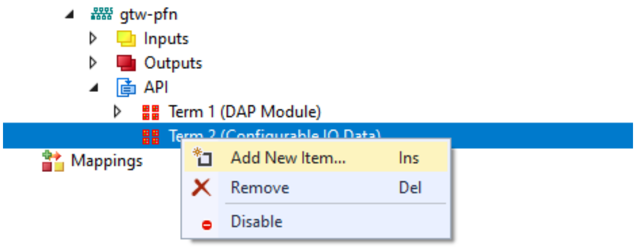
This device requires the GSDML file GSDML-V2.43-W.E.St-GTW_PFN_v6-20240116.xml

7.5 Integration into the PLC

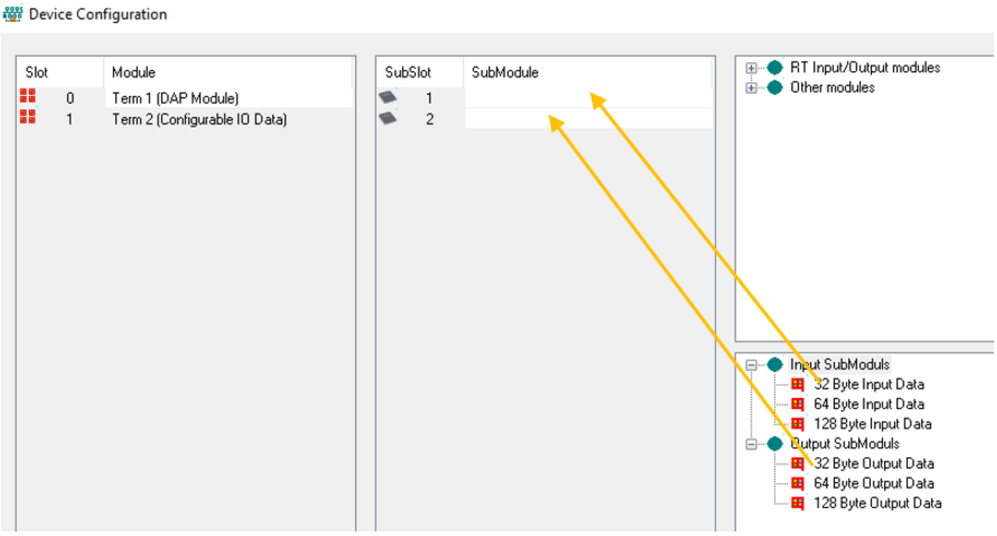
This module requires 32 bytes for input data and 32 bytes for output data as standard and must therefore be preset. When using the extended scope PNVOL = EXTEND, this is 64 bytes in each direction. Integration into the engineering system is achieved by installing submodules, as shown for Simatic controllers in Chapter 11, here using the TwinCAT program as an example.

For other master systems, installation is similar.

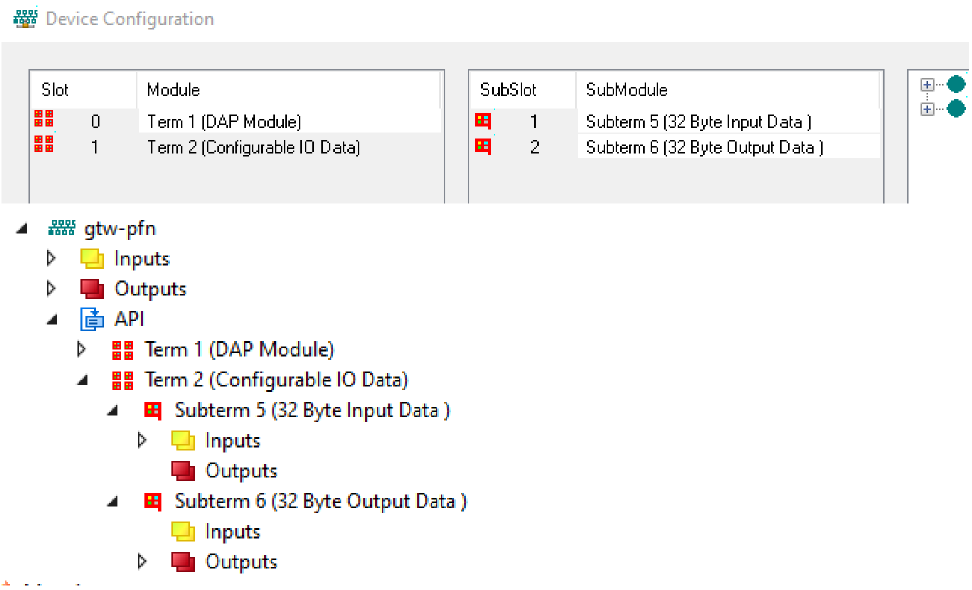
Device, inserted as a Profinet device in the project tree:



Insert input and output areas, 2 x 32 bytes for PNVOL = NORMAL and 2 x 64 bytes for EXTEND:



This yields:



8 Process data

The following description of data exchange applies if no changes have been made to it in the script program.

8.1 Data sent to the device

The demand PDO consists of the following 32 byte data frame:

Nr.	Byte	Function	Type	Range	Unit
1	0	Control_1	UINT8		
2	1	Control_2	UINT8		
3	2	Control_3	UINT8		
4	3	Control_4	UINT8		
5	4	Position_1 High (MSB)	UINT32	0… 10000000	0,001 mm
6	5	- - -			
7	6	- - -			
8	7	Position_1 Low (LSB)			
9	8	Velocity_1 High	UINT16	0… 0x3fff (0… 100 %)	-
10	9	Velocity_1 Low			
11	10	Position_2 High (MSB)	UINT32	0… 10000000	0,001 mm
12	11	- - -			
13	12	- - -			
14	13	Position_2 Low (LSB)			
15	14	Velocity_2 High	UINT16	0… 0x3fff (0… 100 %)	-
16	15	Velocity_2 Low			
17	16	Spare RI1_W16	INT16		Spare RI1_DW32 INT32[13]
18	17				
19	18	Spare RI2_W16	INT16		
20	19				
21	20	Spare RI3_W16	INT16		Spare RI2_DW32 INT32[13]
22	21				
23	22	Spare RI4_W16	INT16		
24	23				
25	24	Spare RI5_W16	INT16		
26	25				
27	26	Parameter value High (MSB)	UINT32	value of a parameter to be changed via the bus	depending on the parameter
28	27	- - -			
29	28	- - -			
30	29	Parameter value Low (LSB)			
31	30	Parameter address High	UINT16		hex
32	31	Parameter address Low			

[13] Double assignment to the 16-bit values. Only one of the two data types can be used at a time.

8.1.1 Description of the bus signals

The module is controlled with two **control words** consisting of following bits:

Bit name	Description of the bit
ENABLE	General activation of the axis. Error messages are deleted and the output signal gets activated (in combination with the hardware enable). The actual position is taken over as command position for actively staying in position.
START	Start signal for positioning. The actual transmitted command value is taken over into the positioning controller and the output signal will be generated relating to the parameterization.
HAND:A	Manual mode. The axis is driven with the preset speed (parameter with the same name). This mode can only be used when ENABLE is available (even no READY is reported) and the START comand is not set.
HAND:B	Manual mode, see HAND:A. Two parameters and control bits are available for this mode for example in order to preparameterize different speed values for both directions.
DC_F-POS	Activation of fine positioning function (Extended functionality, please look at the chapter for this function).
DC_ACTIVE	General activation of the drift compensation / high accurate positioning function.
DC_FREEZE	Freezing of the static drift compensation value (Extended functionality, please look at the chapter for this function).
SCS	Activating the standard synchronisation function. In synchronous run the preset values for axis 2 are not active. The system is driven by the demand values of axis 1. Control bits, command position and speed as well as control mode are synchronized. Only enable has to be set for both axes separately.
SCG	Activating the geared synchronisation function. Setpoints and speeds are specified individually, start bit from axis 1. This function is only available in NC mode. The two synchronisation variants are interlocked; if both bits are set, neither function is active.
DIRECT	In direct mode new command positions are taken over directly from the controller while START signal is available. In normal mode the START signal has to be reset and set again for getting a new command position into the controller. Speed values are always updated directly.
LIVEBIT	The fieldbus communication can be monitored with the Livebit functionality. The status of the bit is continuously reported back via LIVEBIT OUT. This also enables the higher-level control system to monitor the communication. If communication fails, the activation should also be withdrawn there so that unwanted movements cannot occur when com-munication is restored.
PARA READ	Reading out the selected (parameter) address when activated. The value of the selecte parameter is returned in PARA VALUE of the status. If the address is not valid the function will return „0xffffffff".
PARA VALID	Transmitting new parameter settings when activated.
PARA MODE	Enables parameterizing via fieldbus (Procedure is described in the following chapter)

Setting the bit (signal 1) activates the relating function.

Further demands like **command position, speed a**nd p**arameterizing**.

Byte notation	Description of the byte
(COMMAND) POSITION	With the resolution of 1 µm the position which will be driven to after setting START is preset.
(COMMAND) VELOCITY	Sets the maximum possible speed of the axis in SDD mode. 3FFF allows 100%, if the parameterization allows it. This limitation is also responcible for the manual mode. If the demand here is lower, the parameterized hand value will not be reached. In NC mode the value which is preset here is the speed demand for the profle generator.
(PARAMETER) VALUE	New value for a parameter which should be changed via the fieldbus. Resolution and value range depend on the relating parameter.
(PARAMETER) ADDRESS	Here the address of the parameter to change is transmitted. Available parameters and their addresses can be found in the table of the following chapter with the functional description.

Positioning resolution of 1 µm (independent from the real sensor resolution), max. 0x989680 (10.000.000) is used. The command position is limited by the parameter SYSRANGE.

The command speed is interpreted in percentage of the programmed speed or of the output signal. The value of 0x3fff corresponds with 100 % speed.

8.1.2 Coding of the control bits

Description of control 1 (axis 1)

Nr.	Bit	Name	Description	Type	Default
1	0	-	-	BOOL	0
2	1	DC_FREEZE_1	Storing of the drift compensation offset axis 1	BOOL	0
3	2	DC_ACTIVE_1	General activation of the extended functionality axis 1	BOOL	0
4	3	DC_F-POS_1	Fine positioning function axis1	BOOL	0
5	4	HAND_B_1	Manual mode value B axis 1	BOOL	0
6	5	HAND_A_1	Manual mode value A axis 1	BOOL	0
7	6	START_1	Start signal for positioning axis 1	BOOL	0
8	7	ENABLE_1	General activation of the axis 1	BOOL	0

Description of the Control_2 (axis 2)

Nr.	Bit	Name	Description	Type	Default
1	0	-	-	BOOL	0
2	1	DC_FREEZE_2	Storing of the drift compensation offset axis 2	BOOL	0
3	2	DC_ACTIVE_2	General activation of the extended functionality axis 2	BOOL	0
4	3	DC_F-POS_2	Fine positioning function axis2	BOOL	0
5	4	HAND_B_2	Manual mode value B axis 2	BOOL	0
6	5	HAND_A_2	Manual mode value A axis 2	BOOL	0
7	6	START_2	Start signal for positioning axis 2	BOOL	0
8	7	ENABLE_2	General activation of the axis 2	BOOL	0

Setting the bit (signal 1) activates the relating function.

Description of the Control_3 (device)

Nr.	Bit	Name	Description	Type	Default
1	0	LIVEBIT	Communication monitoring	BOOL	0
2	1	-	-	BOOL	0
3	2	-	-	BOOL	0
4	3	-	-	BOOL	0
5	4	-	-	BOOL	0
6	5	SCG	Synchronisation with geared function, setpoints and speeds are individual, start bit from axis 1	BOOL	0
7	6	SCS	Synchronous control	BOOL	0
8	7	DIRECT	Direct mode for new command positions	BOOL	0

Description of the Control_4 (parameterizing)

Nr.	Bit	Name	Description	Type	Default
1	0	-	-	BOOL	0
2	1	-	-	BOOL	0
3	2	-	-	BOOL	0
4	3	-	-	BOOL	0
5	4	-	-	BOOL	0
6	5	PARAREAD	Reading out the selected address	BOOL	0
7	6	PARAVALID	Transmitting a new parameter setting	BOOL	0
8	7	PARAMODE	Enables parameterizing via fieldbus	BOOL	0

Setting the bit (signal 1) activates the relating function.

8.2 Data sent to Fieldbus

The status PDO consists of the following 32 byte data frame:

Nr.	Byte	Function	Type	Range	Unit
1	0	Status_1	UINT8		
2	1	Status_2	UINT8		
3	2	Status_3	UINT8		
4	3	Status_4	UINT8		
5	4	Actual_Position_1 High (MSB)	UINT32	0… 10000000	0,001 mm
6	5	- - -			
7	6	- - -			
8	7	Actual_Position_1 Low (LSB)			
9	8	Internal command position 1 High (MSB)	UINT32	0… 10000000	0,001 mm
10	9	- - -			
11	10	- - -			
12	11	Internal command position 1 Low (LSB)			
13	12	Actual_Position_2 High (MSB)	UINT32	0… 10000000	0,001 mm
14	13	- - -			
15	14	- - -			
16	15	Actual_Position_2 Low (LSB)			
17	16	Internal command position 2 High (MSB)	UINT32	0… 10000000	0,001 mm
18	17	- - -			
19	18	- - -			
20	19	Internal command position 2 Low (LSB)			
21	20	Additional output value 1 (MSB)	INT16	See Command Table in 5.9.1	
22	21	Additional output value 1 (LSB)			
23	22	Additional output value 2 (MSB)	INT16	See Command Table in 5.9.1	
24	23	Additional output value 2 (LSB)			
25	24	Spare RO1_W16	INT16		Spare RO1_DW32[14]
26	25				
27	26	Spare RO2_W16	INT16		
28	27				
29	28	Parameter value High (MSB)	UINT32	Value range of respective parameter	Parameter dependent
30	29	- - -			
31	30	- - -			
32	31	Parameter value Low (LSB)			

[14] Double assignment to the 16-bit values. Only one of the two data types can be used at a time.

8.2.1 Description of the bus signals

Report from the controller via the fieldbus happens by two **status words** with the following bits:

Bit name	Description of the bit
READY	General operational readiness of the axis. ENABLE signals are available and no error was detected. The module is active.
POSWIN:S	Static position monitoring. Message for reaching the target position within the preset tolerance.
POSWIN:D	Dynamic position monitoring. Message for being within the preset window for the following error, relevant in NC mode.
SYNCWIN	Synchronous run monitoring. Message for being within the preset window for the synchronous error. Only active when synchronous controller is active.
$\overline{\text{D-ERROR}}$	Internal data error. Try to save the parameterset to reactivate the module.
$\overline{\text{SENS-ERROR}}$	Sensor error. SSI or 4… 20mA input signals can be monitores.
PARA ACTIVE	Parameterization via fieldbus is active (feedback PARA MODE).
PARA READY	Confirmation for transferring new parameter value to the module successfully (validation of the PARA VALID command).
LIVEBIT OUT	Reporting the demand for the monitoring function (see description control livebit)

A set bit (signal 1) signalizes the relative message.

Attention: Error signals are inverted, an error exists if the bit is **not** set.

Further status signals like **internal command position, actual position** and **parameter values.**

Byte notation	Description of the byte
(ACTUAL) POSITION	Monitoring of the actual position of the axis, reported in µm units.
(INTERNAL) COMMAND POSITION	The internal command position can be evaluated here, means the actual relevant value for the controller which can vary depending on adaptions and profile generator.
(PARAMETER) VALUE	The actual existent value of the relating parameter is displayed here when the PARA READ function was activated.

8.2.2 Coding of the status bits

Description of the status byte 1 (axis 1)

Nr.	Bit	Name	Description	Type	Default
1	0	$\overline{\text{SENSERROR\_1}}$	Sensor error axis 1	BOOL	0
2	1	-	-	BOOL	0
3	2	-	-	BOOL	0
4	3	-	-	BOOL	0
5	4	SYNCWIN	Synchronous error within the window	BOOL	0
6	5	POSWIN_1:D	Following error within the window axis 1	BOOL	0
7	6	POSWIN_1:S	Reaching target position with set accuracy axis 1	BOOL	0
8	7	READY_1	General operational readiness of axis 1	BOOL	0

Description of the status byte 2 (axis 2)

Nr.	Bit	Name	Description	Type	Default
1	0	$\overline{\text{SENSERROR\_2}}$	Sensor error axis 2	BOOL	0
2	1	-	-	BOOL	0
3	2	-	-	BOOL	0
4	3	-	-	BOOL	0
5	4	-	-	BOOL	0
6	5	POSWIN_2:D	Following error within the window axis 2	BOOL	0
7	6	POSWIN_2:S	Reaching target position with set accuracy axis 2	BOOL	0
8	7	READY_2	General operational readiness of axis 2	BOOL	0

A set bit (signal 1) signalizes the relative message.

Attention: Error signals are inverted, an error exists if the bit is **not** set.

Description of the status byte 3 (error messages)

Nr.	Bit	Name	Description	Type	Default
1	0	-	-	BOOL	0
2	1	-	-	BOOL	0
3	2	-	-	BOOL	0
4	3	-	-	BOOL	0
5	4	-	-	BOOL	0
6	5	-	-	BOOL	0
7	6	$\overline{\text{CHK\_ERROR}}$	Error in the checksum of the **EtherCAT** or **Profinet** gateway error.	BOOL	0
8	7	$\overline{\text{D\_ERROR}}$	Internal data error.	BOOL	0

Description of the status byte 4 (parameterizing)

Nr.	Bit	Name	Description	Type	Default
1	0	LIVEBIT_OUT	Feedback (= LIFEBIT), monitoring of communication	BOOL	0
2	1	-		BOOL	0
3	2	-		BOOL	0
4	3	-		BOOL	0
5	4	-		BOOL	0
6	5	-		BOOL	0
7	6	PARA_READY	Parameter has been taken over	BOOL	0
8	7	PARA_ACTIVE	Bus parameterization	BOOL	0

A set bit (signal 1) signalizes the relative message.

Attention: Error signals are inverted, an error exists if the bit is **not** set.

9 Parameterizing via Fieldbus

9.1 Procedure

Preparation:

- Power supply of the different sections has to be available.
- For safety issues the system should not be active.
  If active, the ENABLE bit in the control word has to be reset.
  Attention: Parameterization via fieldbus can also be done having an active system. In this case it should be done very carefully because changes are directly operative.

Parameterization:

- At first the **PARA MODE** bit has to be set to enable parameterizing via Profinet.
  This will be reported via the **PARA ACTIVE** bit.
- Pretend **address** and new **value** of the parameter which should be changed.
- Setting the **PARA VALID** bit to high will transmit the data.
  The **PARA READY** bit will report a successful parameterization.
  Attention: A missing **para ready** bit means parameterization was not done.

Storing:

- Same procedure as parameterizing standard parameters.
- Selecting **2100** as **address**, written **value** does not matter (below 60000).

Password protection:

- If a password was set this has to be entered first for enabling parameterization. Procedure is the same as when parameterizing standard parameters.
- Select **2200** as **address** and send the password (PASSFB) as **value**.
- After **PARA READY** reports success, subsequently parameterizing can be done as long as **PARA MODE** stays active. After resetting it password has to be renewed when it gets activated again.
  Attention: Even with active **PARA MODE** mode the device stays ready for operation.

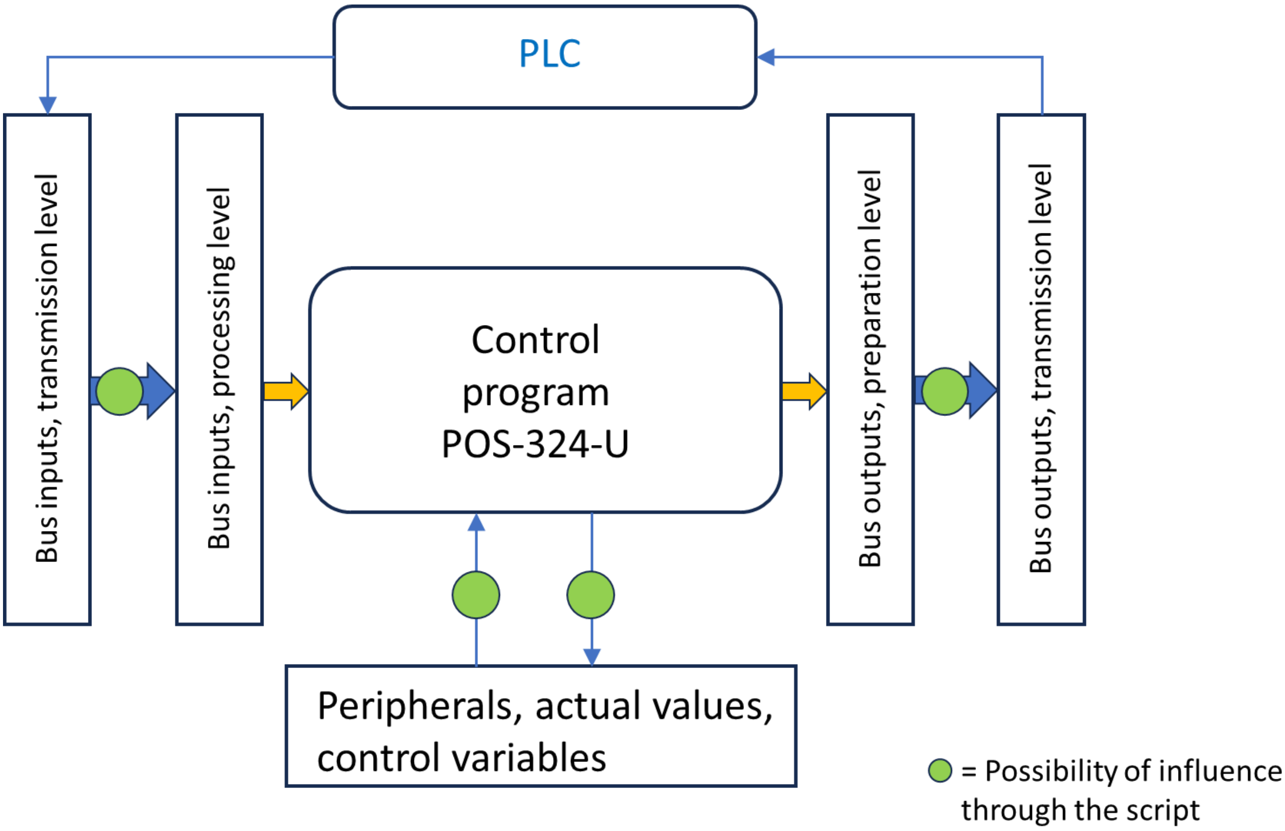
➡ If the password was transferred incorrect three times, the parameterization mode gets locked (reported by deactivated **PARA ACTIVE** bit). Only restarting the device enables three new attempts for enabling.

➡ Please note that a storage of the parameterization via the Profinet is limited in the number of writing cycles. Means it should be done only when necessary.

10 FlexiMod

10.1 Use Cases

If the function of the device needs to be adjusted beyond what is possible through simple parameterisation, script programming is used.



This diagram shows the possible influences. This means that both the fieldbus coupling signals and the process-related signals can be modified within very wide limits. Intermediate levels are used for bus coupling. The assignments described in the previous sections refer to an intermediate level, which is referred to as the processing level on the input side and the preparation level on the output side. By default, these levels are transferred unchanged from the transmission level (inputs) or transferred to this level (outputs). Script programming now makes it possible to influence this and change the transmission as desired. In extreme cases, the bus inputs can be completely replaced by physical inputs and the device can be operated without a field bus. The signals exchanged with the physical peripherals can also be used elsewhere and linked differently. Finally, the parameters of the control program can also be read and written from the script.

10.2 Scripting Language

10.2.1 Basic concept

A script consists of a list in which predefined memory cells are listed. For each of these cells, one can specify a function with which the content of the memory cell is calculated.

During runtime, these functions are called cyclically and the cell content is recalculated.

There are two types of cells, namely freely usable (M1 ... Mxx) and cells permanently connected to outputs. The content of the latter is either passed directly to physical outputs of the unit or serves as an input signal into a fixed defined internal function, for example as the setpoint of a controller.

The naming and function of the cells depends on the device, M... cells always exist.

The called functions can have up to three parameters, which are themselves memory cells or physical input signals.

An example:

Consider the following script:

```
M1          = GT    PIN14   PAR1
M2          = LT    PIN14   PAR2
...
LED_YR      = RS    M1      M2
```

The first line (M1) checks whether the input signal at PIN14 is greater than a parameterisable fixed value (PAR1).

The second line (M1) checks whether the input signal at PIN14 is lower than a second parameter.

The output signal, with which the right yellow LED of the unit is controlled, is the switching state of an RS - flipflop, which is connected to the results of these comparisons.

As can be seen, the memory cells can have the meaning of an analog value as well as a boolean variable. The script interpreter evaluates a content >= 1.0 as logically "TRUE" and functions that provide a logical output value set the corresponding memory cell to 0 or 1.0.

Analog input and output signals are always scaled in the range 0 ... 100%.

So, in the above example, if you set the parameter PAR1 to the value 50.0 and PAR2 to 40.0, you get a comparator with hysteresis. A voltage > 5 V at PIN 14 will switch on the right yellow LED. The LED lights up until the voltage has dropped below 4 V again.

10.2.2 Command overview

Command:	Meaning:	Operand 1:	Operand 2:	Operand 3:
Mathematics				
DIR	direct assignment	Source	-	-
ADD	Addition	Summand 1	Summand 2	Summand 3 (optional)
SUB	Subtraction	Minuend	Subtrahend	-
MUL	Multiplication	Factor 1	Factor 2	Factor 3 (optional)
DMUL	Multiplication + Division	Factor 1	Factor 2	Divisor
LIM	Limitation	Input value	Lower limit	Upper limit
SQRT	Square root function	Input value	-	-
SIN	Sine function	Input value	-	-

Com-mand:	Meaning:	Operand 1:	Operand 2:	Operand 3:
COS	Cosine function	Input value	-	-
ATAN2	Extended arctangent	x-coordinate	y-coordinate	-
ABS	Absolute value	Input value	-	-
NORM(L)	Normalisation to a range	Input value	Supporting point X1	Supporting point X2
UNORM	Scaling	Normalised value (u)	Supp. point Y1 (u=0)	Supp. point Y2 (u=1)
INTEG	Integrator	Input value	Reset	Reset value (optional)
PT1	1st order low pass	Input value	Time constant	Reset
MIN	Minimum value selection	Value 1	Value 2	Value 3 (optional)
MAX	Maximum value selection	Value 1	Value 2	Value 3 (optional)
Logic				
SEL	Signal selector	Switching input (OP1)	Value at OP1 < 1	Value with OP1 >=1
GT	Comparison: OP1 > OP2	Value 1 (OP1)	Value 2 (OP2)	-
LT	Comparison: OP1 < OP2	Value 1	Value 2	-
GE	Comparison: OP1 >= OP2	Value 1	Value 2	-
LE	Comparison: OP1 <= OP2	Value 1	Value 2	-
AND	logical "and"	Value 1	Value 2	Value 3 (optional)
OR	logical "or"	Value 1	Value 2	Value 3 (optional)
NOT	logical negation	Input value	-	-
RS	RS-Flipflop	Set input	Reset input	-
Time functions				
RAMP	1 - Quadrant ramp	Input value	Ramp time	Reset
TE	Switch-on delay	Input value	Time	-
TA	Switch-off delay	Input value	Time	Reset
FP	Edge detection (rising)	Input value	-	-
FN	Edge detection (falling)	Input value	-	-
FUR	Square wave generator	Frequency	Amplitude	Reset
FUS	Sine wave generator	Frequency	Amplitude	Reset
FUT	Triangular wave generator	Frequency	Amplitude	Reset
Miscellaneous / Complex functions				
PI	Universal controller	Control deviation	Feedback Value	Tracking
CC	Linearisation curve	Input value	-	-
BUSRD	Read bus data	Byte number	Data type	Bit number or scaling
FUN2	Secondary function value	-	-	-
SPAR	Read / write parameters	Trigger function	Index	Write value (- for read)
PRGI	Initialise profile generator	Initial position	Perform initialisation	Start signal
PRGR	Create profile	Target Position	Speed	Acceleration
MAP – Commands (Bus data)				
MAPC	Copy control bits	Target byte/bit	Source byte/bit	

Com-mand:	Meaning:	Operand 1:	Operand 2:	Operand 3:
MAPS	Copy status bits	Target byte/bit	Source byte/bit	
MAPMC	Write M-value to control bit	Target byte/bit	M-Line (source)	
MAPMS	Write M- value to status bit	Target byte/bit	M-Line (source)	
RNGC	Copy receive data area	Target start/end	Source start/end	
RNGS	Copy transmit data area	Target start/end	Source start/end	
VALM16	M-Value in transmit data (int)	Target byte (start)	M-Line (source)	
VALM32	M-Value in transmit data (long)	Target byte (start)	M-Line (source)	
VALMR	M-Value in transmit data (real)	Target byte (start)	M-Line (source)	

The MAP commands can only be processed in separate lines at the end of the script table (MAP1…60). In the standard case, the areas are copied completely 1:1: RNGC 0/31 0/31 and RNGS 0/31 0/31.

A detailed description of the functions can be found in the online help for script programming in WPC.

10.3 Interface between script and firmware

As you can see in the block diagram, the script is a frame around the control application.

There are signals...

1.) ...which come from the hardware (inputs) and which are passed on to the script.
2.) ...those that come from the standard firmware (e.g. operating status 'READY')
3.) ...those that are transferred from the script to the positioning firmware (e.g. setpoints)
4.) ...that go from the script to the hardware outputs

From the script's point of view, 1) and 2) are input signals and 3) and 4) are output signals.

With this device, individual bits are transferred to the firmware by overwriting the fieldbus specification. If, for example, the ENABLE signals of the axes are not to come from the bus but from the script program, these bits are written to the processing area of the bus input signals using the corresponding MAP command (MAPMC).

An exception to this is the possible generation of error states in the script, in which case the results of lines SCERR1 and SCERR2 are taken over by the error processing in the module firmware.

Analog variables, i.e. the position and speed setpoints, are taken from the script lines provided for this purpose, if something is entered there. If the corresponding lines are empty, normal processing is carried out.

The same applies to the hardware outputs and LEDs; without an entry in the corresponding script line, they have the default function.

Input signal script	Meaning	Value range
PIN6	Analog input at PIN 6, 0...10V or 0...20 mA	0.0 ... 100.0 %
PIN910	Analog differential input at PIN 9/10, -10...0...10V or 0...20 mA	-100.0 ...0.0 ... 100.0 %
PIN13	Analog input at PIN 13, 0...10V or 4...20 mA	0… 100 %
PIN14	Analog input at PIN 14, 0...10V or 4...20 mA	0… 100 %
PIN7	Switching input at PIN 7	0.0 or 1.0
PIN8	Switching input at PIN 8	0.0 or 1.0
PIN5	Switching input at PIN 5	0.0 or 1.0
SSI1	Input value of SSI sensor 1	mm, scaled w/o offset
SSI2	Input value of SSI sensor 2	mm, scaled w/o offset
READY1 / 2	Operational readiness (output error processing)	0.0 or 1.0
U1 / 2	Control signals	+/- 100.0 %
XSC1 / 2	Scaled actual values	mm

If additional process variables are required, these can be read from the preparation level of the fieldbus data using the BUSRD function. If necessary, the additional output signals can be used for this purpose, to which process variables can be assigned with 'SELPLUS'.

Output signal script	Meaning	Value range or unit
WA1 / 2	Position setpoints	mm
VA1 / 2	Speed setpoint specification	%
X1 / 2	Current actual value	mm
PIN15	Analog output at PIN 15, 0...10V or 4...20 mA	0.0 ... 100.0
PIN16	Analog output at PIN 16, 0...10V or 4...20 mA	0.0 ... 100.0
PIN19	Analog output at PIN 19, 0...10V or 4...20 mA	0.0 ... 100.0
PIN20	Analog output at PIN 20, 0...10V or 4...20 mA	0.0 ... 100.0
PIN1	Switching output at PIN 1	On: Value >= 1.0
PIN2	Switching output at PIN 2	On: Value >= 1.0
LED_GN	Green LED on the front of the module	On: Value >= 1.0
LED_YM	Central yellow LED on the front of the module	On: Value >= 1.0
LED_YR	Right yellow LED on the front of the module	On: Value >= 1.0
SCERR1 / 2	Error shutdowns from the script	Error: Value >= 1.0
SNAP	Snapshot of the script variables on rising edge	On: Value >= 1.0

Generation of an error shutdown from the script program:

If you want to generate a shutdown of the module from the script program, which is to be processed like one of the other monitored error sources, the signal2 "SCERR(1/2)" can be used for this. If the content of this line yields a value >= 1.0, the SCERR error is generated, which leads to the READY message disappearing and generally also to the outputs being switched off. The error status is reset via the error processing function, as set via the SENS parameter. This means that the error status is retained even if the SCERR line is reset.

Special handling: If you want to reset the error status of this individual error directly from the script, this can be done with a value of < -1.0. In this way, the error bit disappears regardless of a rising edge at ENABLE.

Sequence of processing:

To ensure delay-free signal processing, it is recommended that the parts of the script that serve as input variables for the position controller are evaluated before it is processed and the output variables are evaluated afterwards. Therefore, the lines above the dividing line are processed in a first run (incl. the M lines 51-60), the rest afterwards. All manipulations of the actual values should always take place in this area. The setpoint specification and other functions (logic, etc.) are less critical and can be split up as required.

10.4 Standard script

In the delivery state, or if the module is reset to this state via ‘DEFAULT’ or ‘SC:CLEAR’, the script is reset to the standard function of the POS-324-U. This means that all lines are empty except for the complete copy of the transfer area of the bus inputs to the processing area and from the preparation area to the transfer area of the bus outputs:

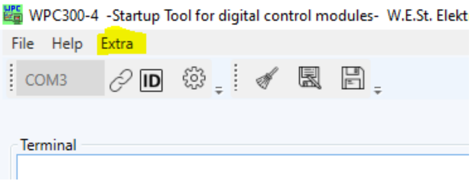
```
MAP1    RNGC    0/31          0/31
MAP2    RNGS    0/31          0/31
```

10.5 Programming software

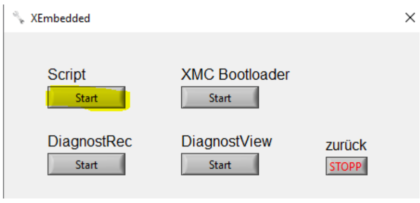
The programming environment for script editing is included in the WPC software package (from version 4.1.2.5). With this software you can load and save the script, display it clearly and edit it comfortably. At this point, only the basic information on operation is to be given. Further information can be found in the programme documentation, see below.

10.5.1 Connect and read out data

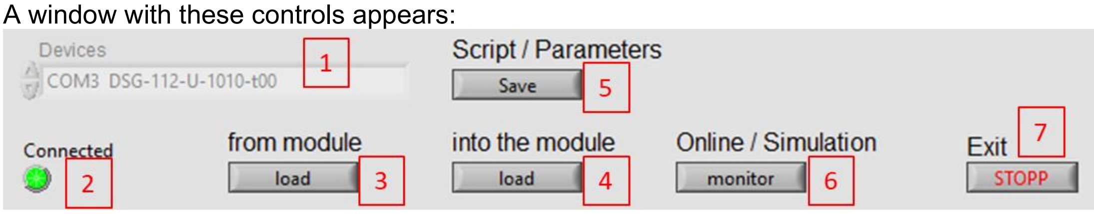
Connect the module in the WPC and then select the menu item "Extras":



A submenu opens from which you can start the environment:

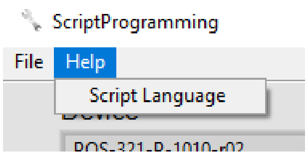


A window with these controls appears:



1. Display of the active connection with the module identification.
2. The green indicator confirms the successfully established connection.
3. This button reloads the current script program on the module to the editor.
4. Transfer of the script from the editor to the module. Attention: The change is effective immediately.
5. This button causes both the script and the currently set parameters to be permanently stored in the EEPROM of the unit. It corresponds to the homonymous button in the WPC-main window.
6. Activation of the observation mode (see below)
7. The sub-programme should only be terminated via this button. You return to the WPC main window and the module is automatically re-identified. This may take a short moment.

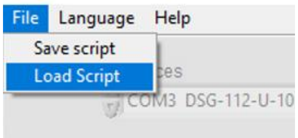
In the menu line you can also call up a comprehensive description of the script language:



10.5.2 Load script created offline or enter script with connected module

If you want to transfer a script file from your computer to the unit, this is done in several steps:

1. Load the script from the file into the editor:



Save: Saves the displayed script table to a file

Load: Loads the script from a file into the table

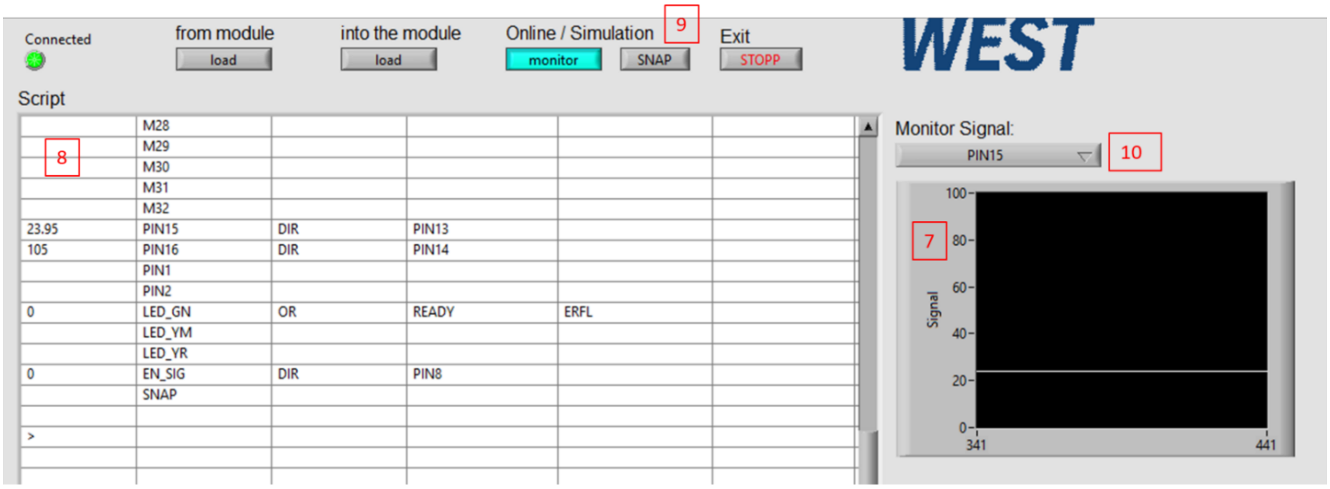
2. Use button 4 (see above) to transfer the contents of the table to the unit.
   If there are faulty commands, the transmission stops at this point.

3. After successful transfer, the changed script is immediately active. You can now make further settings (e.g. parameters) and test the function. However, do not forget to permanently save the data in the non-volatile memory of the unit to complete the activities via the Save button in this software (5) or WPC.

Direct editing of a script in online mode:
After connecting a module, the data of the module definition is automatically read from the unit. As described in chapter 5, one can change the script directly in the displayed table. The context menus can also be activated accordingly via a right click. However, this is only enabled if no observation mode has been activated (see the following section). After changing, the script is loaded into the module by clicking on button 4.

10.5.3 Observation mode

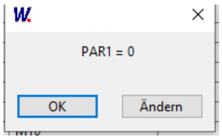
The observation mode is used for commissioning and checking the script function. If one activates this mode via button 6, the current values for each line are displayed in the "Online" column of the script table (8):



Pressing button 6 again deactivates the observation mode.

Special function possible in observation mode:

- **Parameter display and change**
  When (left)-clicking on a free parameter "PAR..." in the table, a dialogue window appears in which the current value is displayed and the possibility to change it is offered:

- **Signal recorder**
  In the observation mode, a strip chart (7) is visible in which the temporal course of one of the signals can be displayed. To do this, select a signal of interest via the pull-down menu 10. The scaling of the Y-axis can be changed by right-clicking on its scale: Deactivate autoscaling, then it is possible to change the lower and upper limit in the diagram by clicking directly on the value and entering a number there. The signal recorder at this point is intended as a tool for quick assessment of individual signals. If you want to record several signals, save the result, etc., the oscilloscope function in WPC is a much more comprehensive and convenient tool.

- **Snapshot**
  If you want to reconstruct the situation in case of sporadic events, it is helpful if you can create a copy of the online values at the time in question. There is a special memory cell "SNAP" for this purpose. If the value of this variable rises >= 1.0, a snapshot of the online values is saved at that time. This snapshot can be viewed by pressing the "SNAP" button (9). The snapshot is overwritten with every rising edge of the variable "SNAP" in the table. If you want to save only one state, you can enter e.g. the function RS and connect only the set input. If you select the snapshot view and find only zeros in the online column (including the SNAP line), this means that no recording has been triggered after the unit was started.

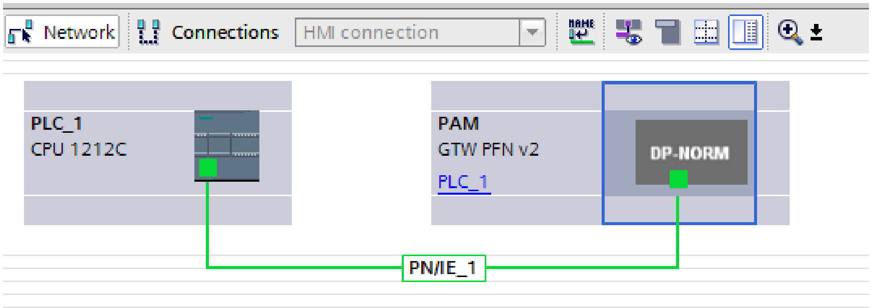
11 Profinet – Driver Blocks for Simatic – Controllers

For use within the „TIA Portal“ software we provide two driver blocks that enable a convenient access out of the application program:

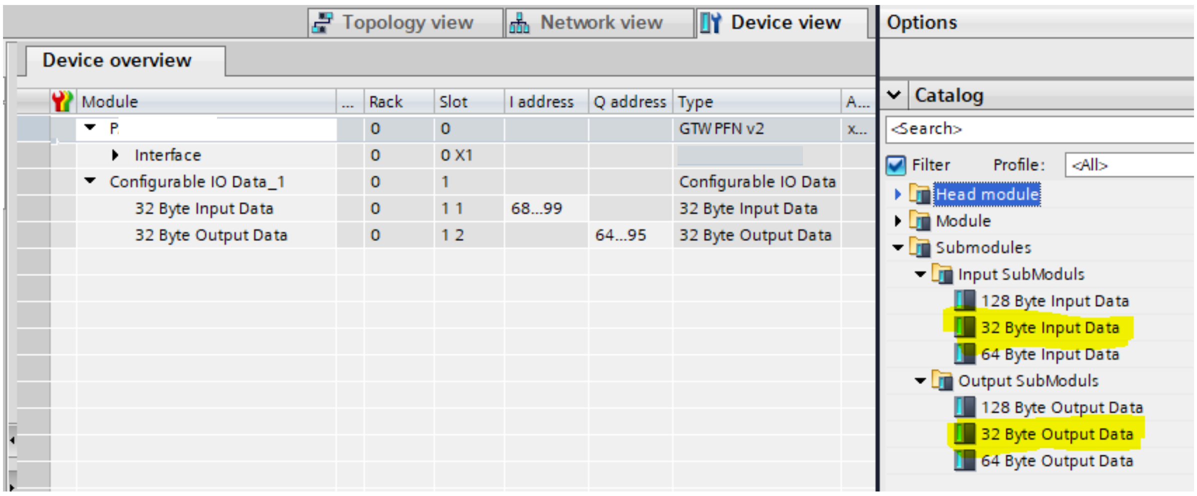
a) The source WEST_POS124U_PFN.scl for controllers of the S7-1200 and -1500 series
b) The source WEST_POS124U_PFN_TIA_KLASSIK.scl for controllers of the S7-300 and -400 series

Below their integration in the TIA project and the interconnections are explained.

1. Import the GSDML- file
2. Project the connection between PLC and controller card via Profinet:



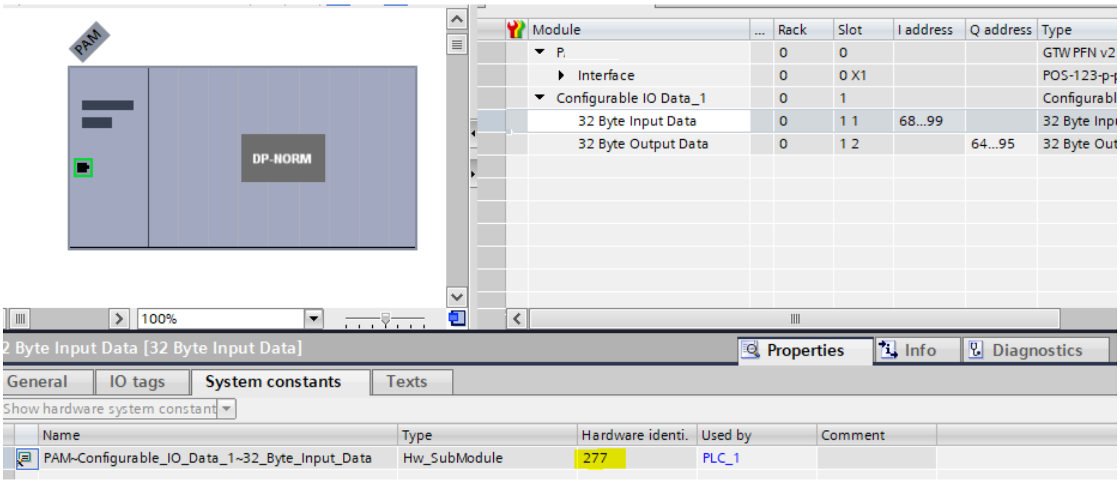
3. Install two submodules in the device:
   32 byte output data
   32 byte input data



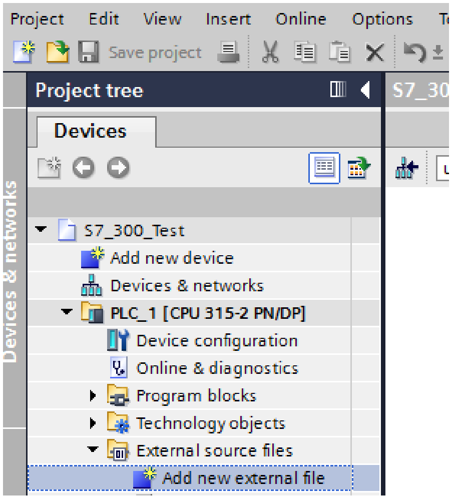
The addresses are assigned automatically. The automatically assigned hardware identifiers are also important for connecting the program module when using the S7-1200 / -1500. These can be determined by right-clicking on the two modules in the device overview and selecting the context menu item "Properties". The HW-identifier will be shown under the tab “System constants”:

These numbers are different and must be noted separately for the input and output data.

If an S7-300 / -400 is used, the input and output addresses of the IN/OUT module are required.



4. The driver block is supplied as SCL-source. In order to assemble it into the project, the file has to be added to the TIA-Portal as “new external file”:

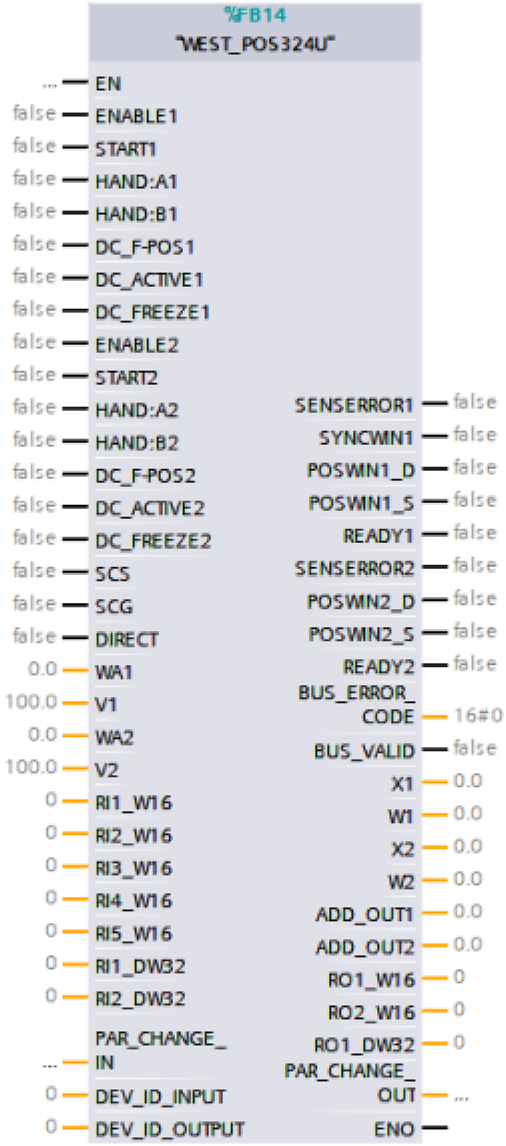


5. Subsequently click on the imported file and chose “generate blocks from source”. After this step the driver block can be found in the “blocks” folder.

This FB can now be called out of the application program. This must happen in a cyclic interrupt with an execution time >= 4 ms.

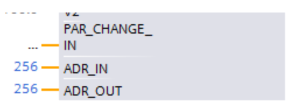
If the block is called faster or in the free cycle (OB1), the time-dependent live bit monitoring does not function reliably and an error may be erroneously output.

View of the block in FUP w/o interconnection:



The error bits are negated in the driver before the output, i.e. for the output parameters of the block, the set status corresponds to an active error. Here you can see below the specification of the previously read HW identifiers. These must be adjusted accordingly.

Address designation for S7-300 / -400 (example):



The start addresses of the input and output data are specified here, not the hardware identifiers.

The connectors of the driver block correspond as far as possible to the description in the previous chapter. The following differences have to be considered:

- Transduction of setpoint positions in the number format “real” and unit [mm]
- Transduction of the speed setpoint in the number format “real” and [%] related to the parameterized value.
- The signals allowing to change parameters are bundled in structures (usage is optional).
- As parameter „DEV_ID“ the hardware identifier of the IO Module has to be entered (TIA)
- As parameters ADR_IN / ADR_OUT the starting addresses (see HW config.) have to be entered (Step 7 classic).
- The values „SENSEERROR1/2“ are not inverted, which mean “TRUE” indicates the presence of an error.
- The bit “BUS_VALID” signals the operation of the bus data transfer.
- Feedback of the actual positions and internal setpoints in the number format “real” and unit [mm]

BUS_ERROR_CODE:

This output parameter contains various error bits of the fieldbus communication and the device in bit-coded form. In the good state, the number is "0". The meaning is as follows:

	Bit - Number	Valence (decimal)	Valence (hex.)
Data Error (DERROR)	0	1	0x01
Bus Error	2	4	0x04
Driver error when receiving data	3	8	0x08
Driver error when sending data	4	16	0x10
Livebit Error	5	32	0x20

If several errors occur at the same time, several bits are set and the number output is the sum of these.

If the bus data exchange is faulty, the feed back values are not reliable. In most cases they will be frozen in that case. If the output values are processed and used to control further functions, the valid bit has also to be considered. In case of a bus failure adequate fall-back values have to be used so that the complete system is kept in a safe state.

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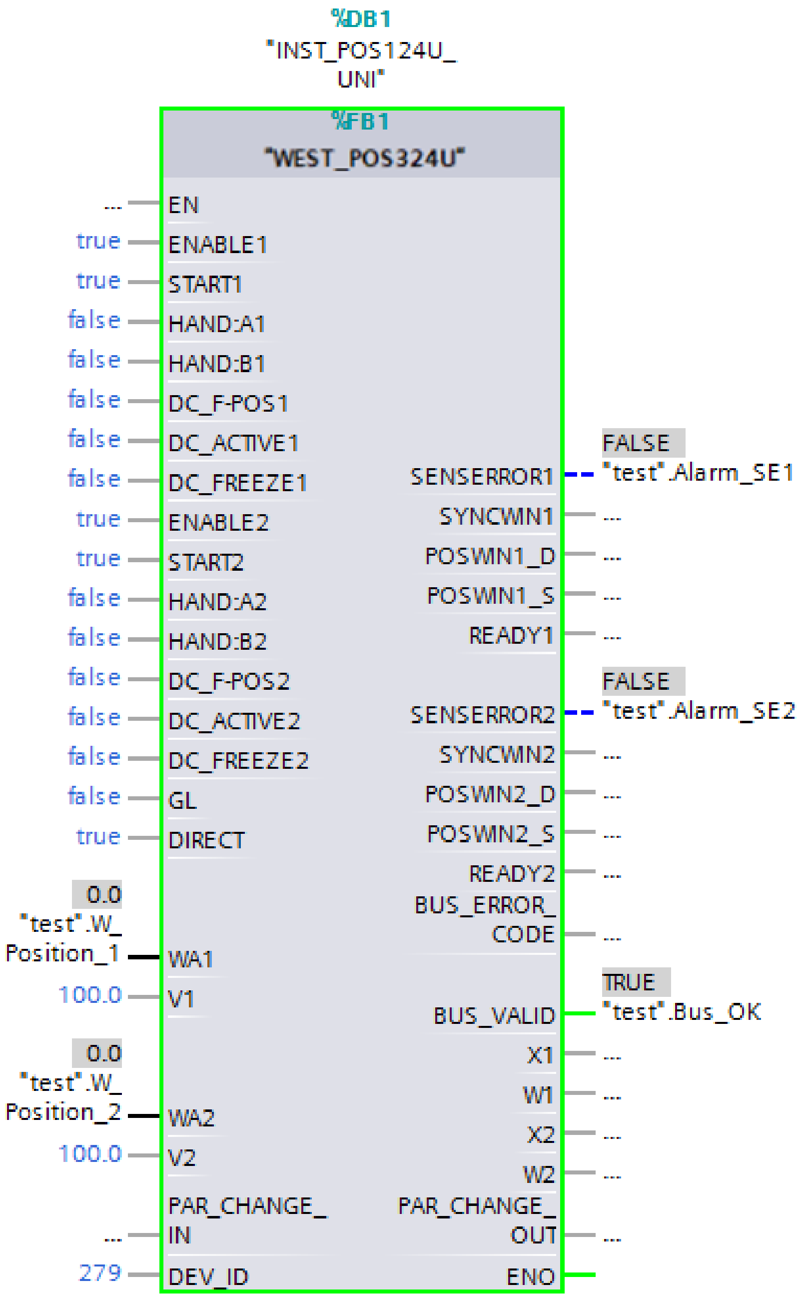
These input and output values can be used if additional signals are to be transmitted via the script.

The corresponding addresses for the script program can be found in the bus list for the input and output data (sections 8.1 / 8.2).

Double assignment: To enable numbers to be transferred in either ‘Dint’ (32 bytes) or ‘Int’ (16 bytes) format, the driver module has connections for both data types. Only the values used should be connected to the input parameters and the others should be left at ‘0’. The module then only transmits the connected values. On the output side, all values are output, but values that are not written in the corresponding format by the script are meaningless.

Application example:

Here an example with minimum usage of the signals is shown, basis is a positioning of two independent axes. No manual commands are used and the control should be permanently active. Drift compensation and fine positioning are no used in this case.



12 Notes