INSTALLATION AND START-UP MANUAL - PQDXXA-PROFINET-Z10 ELECTRONIC MODULE FOR P/Q CONTROL OF PVPLUS WITH PROFINET INTERFACE

Firmware: PQDXXA-PROFINET-Z10-r06 and higher

Effective: November, 2025
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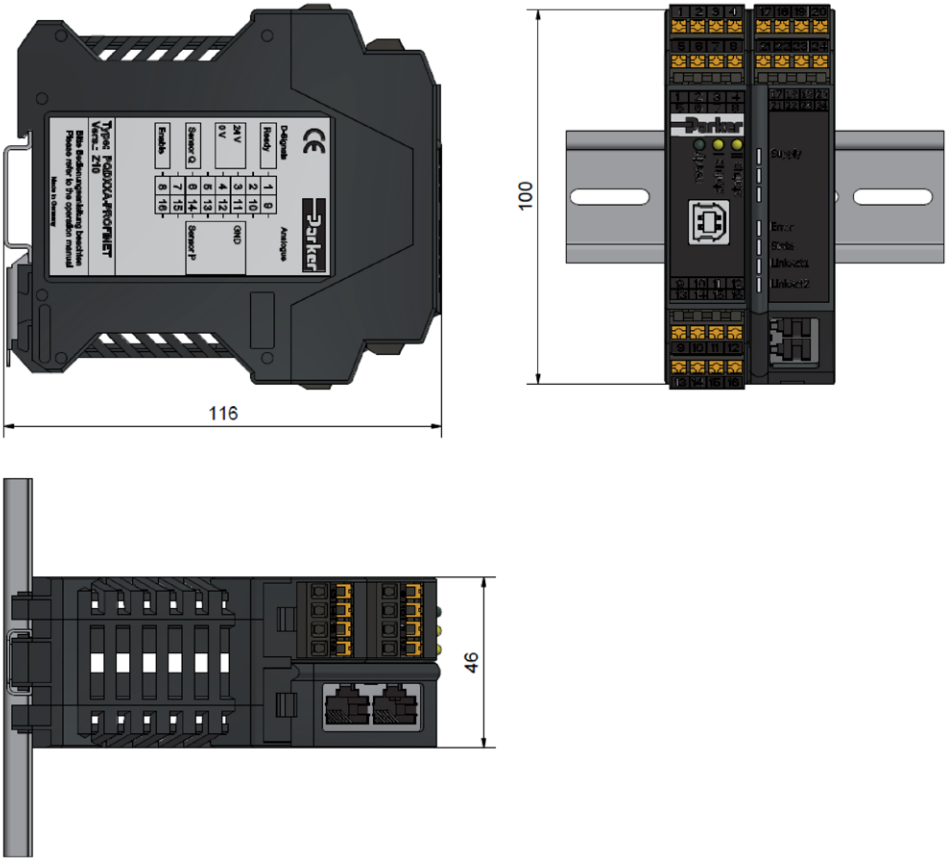
1 INTRODUCTION

Parker digital control module series **PQDXXA-PROFINET-Z10** for snap track mounting is compact, quickly installed and easy to connect with push-in PIN blocks. The digital concept offers perfect reproducibility and optimized adaption to all PVplus pump displacements and all possible functions from a simple displacement control to a closed loop pressure control with horse power limitation through an easy to use setup software. The fieldbus interface enables full integration of process data handling, condition monitoring of electrical signals and parametrization into the overlaying machine. Remote access and therewith remote diagnosis down to the component layer are a main benefit for the first stage of any field service.

1.1 Dimensions

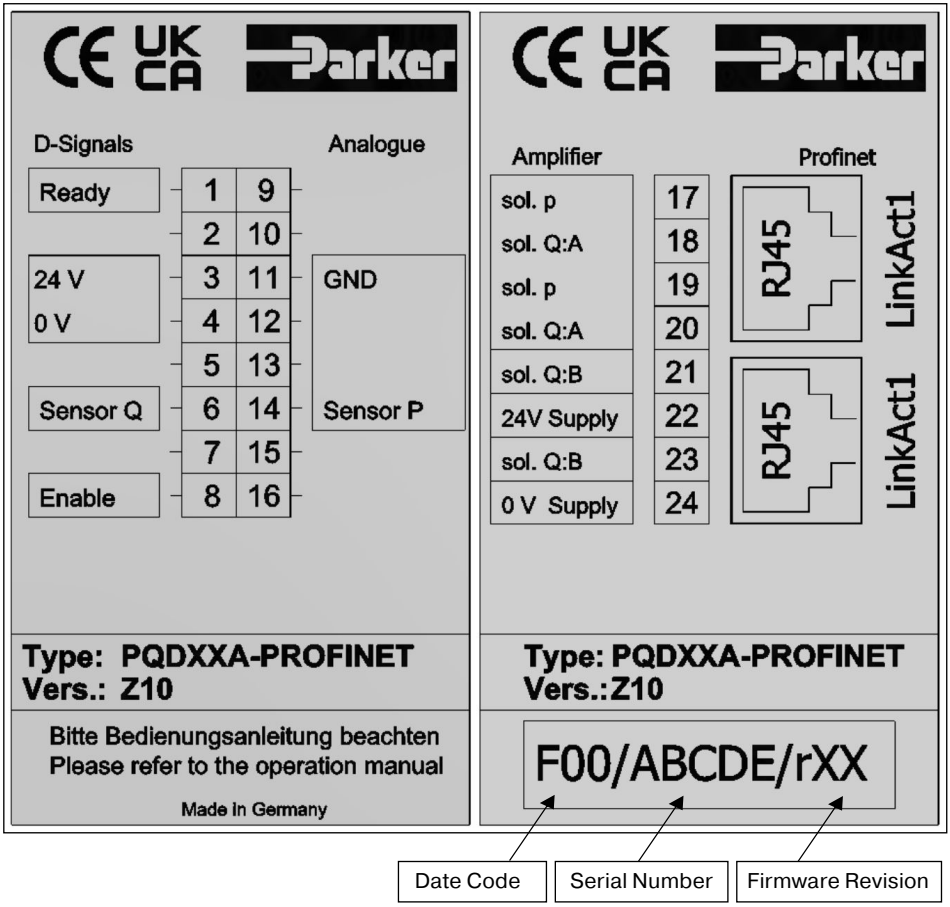


1.2 Ordering Codes

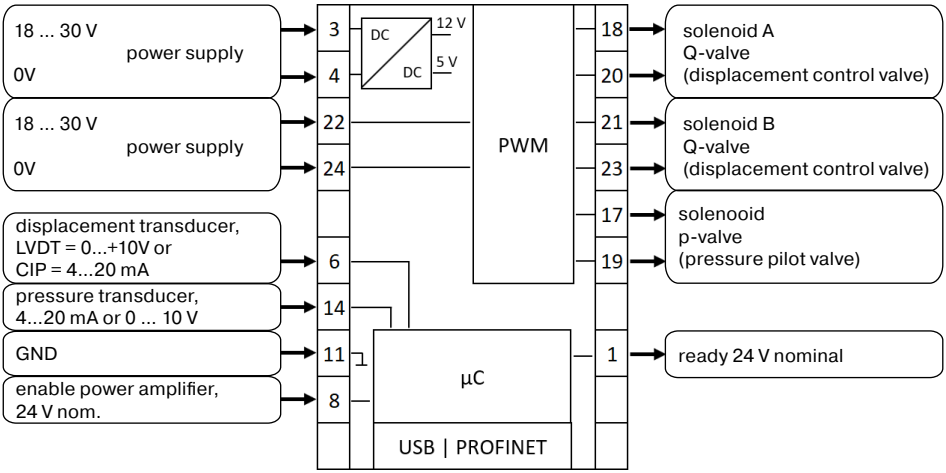
PQDXXA-PROFINET-Z10
Digital Control module for PVplus pumps with two RJ45 ports for Profinet communication and USB-B Port for Connection with ProPVplus.

PQDXXA-ZXX-KABEL
Programming cable to connect the control module PQDXXA-PROFINET-Z10 to a Computer via USB Interface (USB-A @ computer / USB-B @module)

1.3 Nameplates and tags



1.4 Block diagram



1.5 Features – Overview

- Profinet interface enabling process data interaction, condition monitoring and parametrization
- Digital and adjustable control circuits for pump displacement and pressure
- Individual adjustable ramp function for displacement and pressure
- Enable input for solenoid power amplifier stage
- Status monitor
- Parameter setting via USB Interface
- Easy to use PC based setup software
- Electrical connection via push-in PIN blocks
- Compatible to the relevant European EMC specifications
- Covers all pump displacements from 16 to 360 cm³/rev
- Covers all functions: displacement control, displacement control with open loop pressure control and displacement control with closed loop pressure control. Horse power (-torque) control.

1.6 Functional principle

The PQDXXA-PROFINET-Z10 is used for displacement, pressure and power (torque-) control of PVplus axial piston pumps.

The Control structure is designed for an independent actuation of the displacement control valve (4/3 or 4/2 prop. directional valve) and the pressure valve (prop. pressure relief valve). The power amplifiers are integrated in the module. Several parameters enabling an optimal system control.

The process data (command and actual values), condition monitoring of electrical signals and parametrization are handled via the Profinet interface. The current towards the actuators is controlled and therewith independent from supply and the coils resistance. The amplifier is monitoring excess current and cable break. The amplifier shuts down in case of an error detection.

The displacement control is basically comparable with the positioning of a hydraulic cylinder.

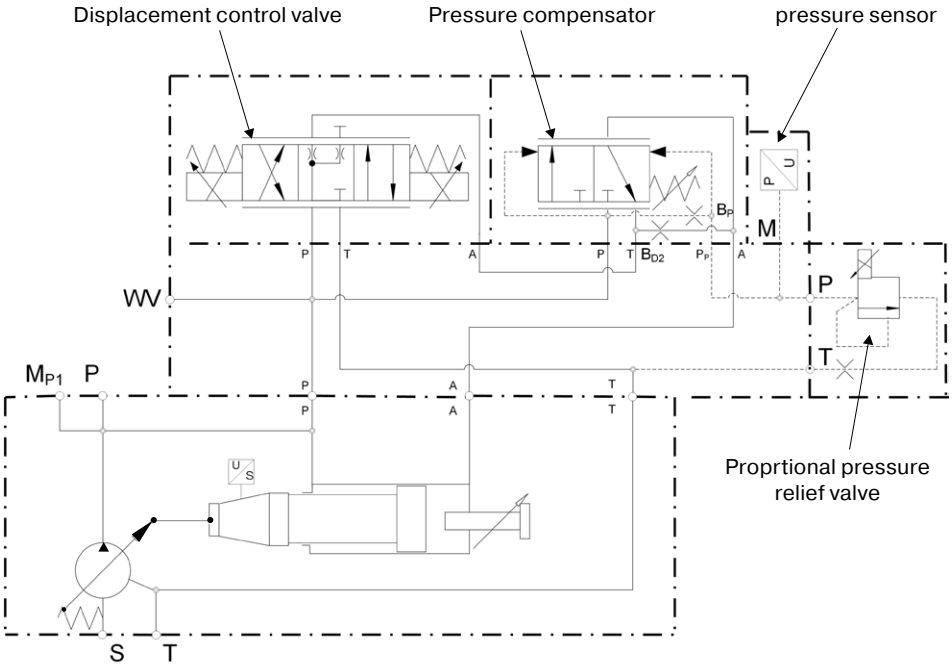
The cylinder position equals the pumps displacement. By actuating the displacement valve the pumps displacement is increased (A-coil) or decreased (B-coil) respectively.

The pressure control is realized with the prop. pressure relief valve. In case the system pressure exceeds the command pressure the pilot control opens and forces therewith the pressure compensators to decrease pumps displacement.

NOTICE

If the hydraulic system is not able to maintain a pump outlet pressure of 20 bar at pump dead head, a pre-load valve must be installed at the pumps outlet to maintain controllability of the pump displacement.

To enable the pump to control pressures up to 350 bar the displacement command must be at least 15 %



1.7 Technical Data

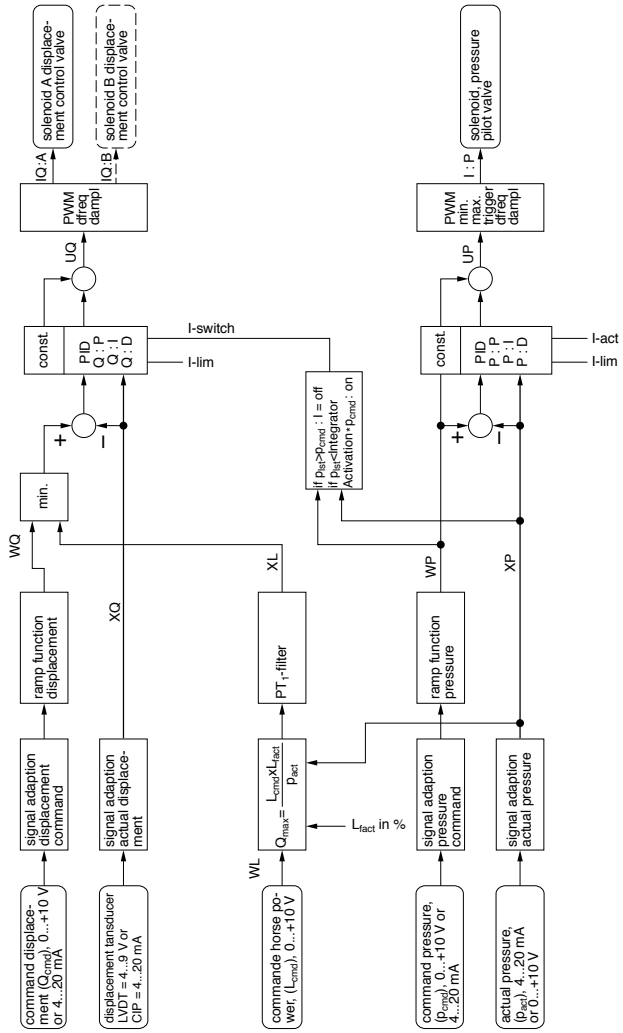
General	Unit	Description
Mounting		Snap-On Module according EN 50022
Housing material		Polyamid PA6.6
Inflammation class		V0 according UL 94
Mounting position		any
Environmental temperature range	°C	-20...+55
Storage temperature	°C	-20...+70
Protection class		IP 20 according DIN 40050
Mass	g	260
General	**Unit**	**Description**
Duty cycle ED	%	100
Supply voltage Us	V	18...30, ripple < 5 % eff., surge free
Rush in current peak, typ.	A	22 für 0,2 ms
Current consumption, max.	A	< 2,0 for displacement control < 4,0 for p/Q-control
Supply line fuse	A	5,0 A medium slow-blow
Input signal options	Uc V Ic mA	0...+10, ripple < 0,01 % eff., surge free, Ri =25 kΩ +4...+20, ripple < 0,01 % eff., surge free, Ri = 250 Ω
Resolution of input command	%	<0.025 (Please review section 7.5, page 38 for details)
Digital Input (Enable)	V	Logic 0: <2 Logic1: >10 (and <30) Input resistance Ri = 25 kΩ
Digital Output (Ready)	V	Logic 0: <2 Logic 1: >12 (50 mA) Max. load current: 30 mA
Serial Interface		USB-B as RS232C, 9600...57600 Baud, 1 stop bit, no parity check, echo mode
Connectors		6x4 pol. Terminal blocks, push-in type 0.2 mm² (24 AWG)... 2.5 mm² (14 AWG) USB-B for Remote Connection to Computer RJ45 for Connection to Profinet, PE: via DIN rail
Fieldbus Interface		Profinet IO RT per IEEE802.xx (100Mb/s) Conformance class B Netload class II
EMC		EN61000-6-2: 2005 (Immunity) EN61000-6-3: 2007 +A1: 2010 (Emission)
Harnesses	mm² mm²	1.5 (AWG16) overall braid shield, for supply and solenoid cables 0.5 (AWG 20) overall braid shield, for sensors and digital signals
Maximum cable length	m	50
Reliability	a	MTTF = 228 MTTFd = 457

1.8 Control quality

	Displacement control	Open loop pressure control	Closed loop pressure control
Linearity	< 1.5 %	< 4 %	< 2 %
Hysteresis	< 1.5 %	< 6 %	< 2 %
Repeatability	< 0.3 %	< 0,8 %	< 0.3 %

The shown values are valid for components out of the delivery content and calibrated sensors.

1.9 Signal flow chart



2 SECURITY ADVICE

Please read and follow this installation and setup manual before installation, setup, start up, service, repair and storage! Failure to follow the instructions herein can cause severe damage to the electronic or to the connected system.

2.1 Name plates, markings

Information direct attached to the module like connecting diagrams and name plates are to be kept in readable condition.

2.2 Work with electronics

Working in installation and commissioning of the electronics should only be done by qualified personnel. This means persons which have, because of education, experience and instruction, sufficient knowledge on relevant directives and approved technical rules.

3 IMPORTANT NOTES

3.1 Intended usage

This operation manual is valid for module electronics PQDXXA-PROFINET-Z10 series. Any different or usage beyond it is deemed to be as not intended. The manufacturer is not liable for warranty claims resulting from this.

3.2 General instructions

We reserve the right for technical modifications of the described product. Illustrations and drawings within this manual are simplified representations. Due to further development, improvement and modification of the product the illustrations might not match precisely with the described unit. The technical specifications and dimensions are not binding. No claim may result out of it. Copyrights are reserved.

3.3 Liability

The manufacturer does not assume liability for damage due to the following failures:
- incorrect mounting / installation
- improper handling and operation
- lack of maintenance
- operation outside the specifications

3.4 Storage

In case of temporary storage, the electronic must be protected against contamination, atmospheric exposure and mechanical damages.

4 MOUNTING / INSTALLATION

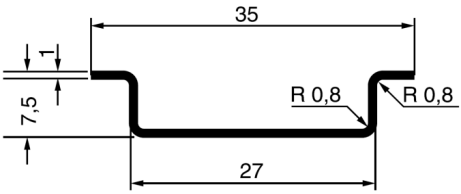
4.1 Scope of Supply

Please check at receiving the shipment for damages due to shipping. Report damages immediately to the carrier, the insurance company and the supplier!
The programming cable (only for setup needed) is not part of the module shipment and must be ordered separately (please refer to section 1.2, page 5).

4.2 Mounting

- compare electronic module type (see ordering code on name plate) with the parts list respectively the circuit diagram.
- the module may be mounted in any orientation
- for mounting an assembly rail according to EN 50022 is required

Mounting rail dimensions:



4.3 Installation and removal of module from the rail

Mounting:
- bring the module in contact with the upper edge of the rail.
- flip the module downward until it snaps into/on the rail.

Removing:
- use a screw driver (approx. 4 x 1 mm blade) to lift metal socket.
- flip the module upwards and remove it from rail.

4.4 Operating limits

The electronic module may be operated within the specified limits only. Please refer to the section „technical data " (page 8).
Follow the environmental conditions! Extreme temperatures, shock load, moisture, radiation, illegal electromagnetic emissions may result in malfunction and other operating issues. Follow the limitations listed in the „specifications" table.

4.5 Electrical Interface

4.5.1 Electrical Connection

The module is connected to power supply, machine control and to pump/valves with plug-in PIN push-in blocks. This easy-to-install connection allows a fast module replacement. The connecting wires need to match the specification below:

Wire Type:	strand or solid
Cross sections:	
supply, solenoids:	min. AWG 16 / 1.5 mm²
Sensors, digitals:	min. AWG 20 / 0.5 mm²
Wire length:	max. 50 m

NOTICE

for wire length > 50 m please consult the factory.

4.5.2 Wire stripping

The push-in terminals are designed to connect to all kinds of copper wires without the need for specific preparation.

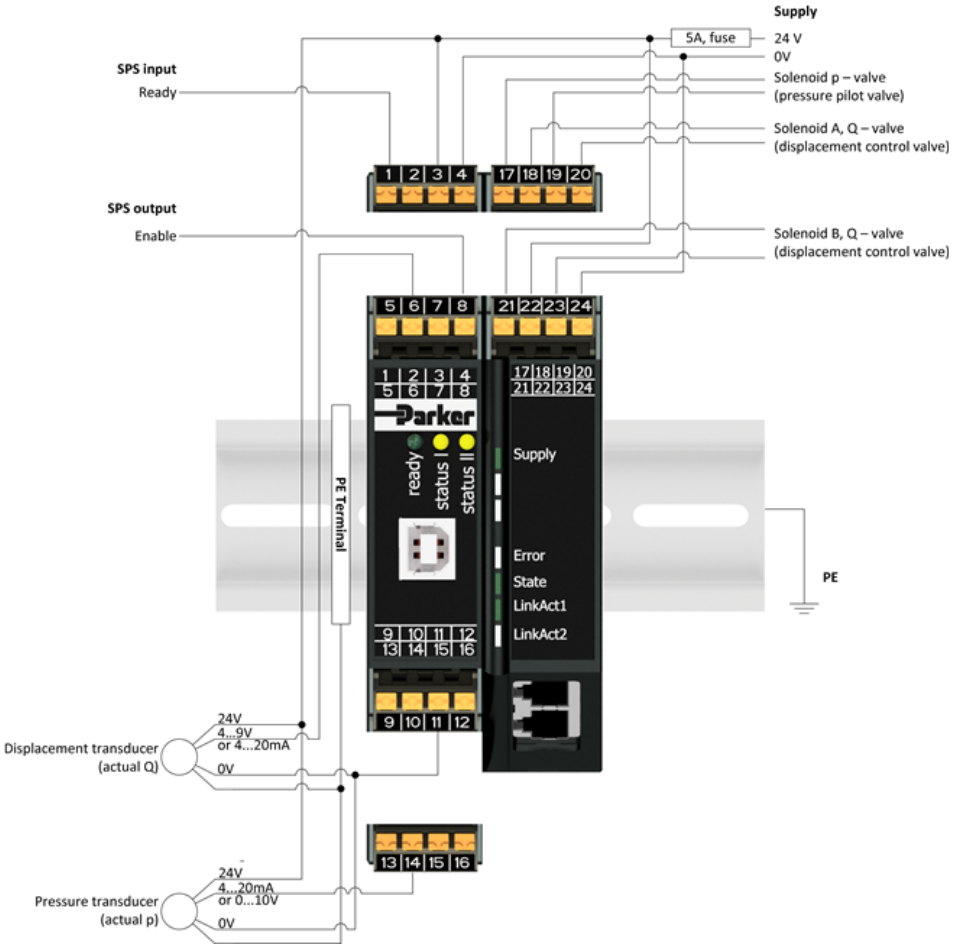
To protect stripped wires the use of end sleeves is recommended. Soldering of the connecting wires is not permitted. To ensure EMC compatibility, the connections partly must be shielded. See details in the „Electrical Interfacing“ section. The installation must be performed by qualified personnel only. An electrical short between individual connectors, loose wires as well as improper shielding can result in malfunction of electronic or pump and in irreparable destruction of control module. The pump must have a direct connection to an earth grounded machine frame. An earth ground connection of the mounting rail and the cable shields must be connected to the control unit earth ground terminal. Machine frame and control unit must be connected with a low resistance connection to avoid ground loops.

4.5.3 Supply Voltage

- The supply voltage must be connected to PINs 3 and 4 and to PINs 22 and 24. The supply voltage must be higher than 18 V to avoid sensor malfunction and lower than 30 V to avoid overheating and destruction of the module. The residual ripple may not exceed 5 %.
- The power supply must comply with the relevant standards (e.g. DIN EN 61 558) and must carry a CE mark. The supply voltage must be free of inductive surges.

- Please consider the high inrush current when selecting the power supply (see specification). Power supplies with current limiting features may cause problems during energizing the unit.
- The function of the module is blocked, when supply voltage polarity is wrong. Each module requires a preliminary fuse of 5 A, medium slow-blow. Without a fuse, irreparable damage to the module or the pump control is possible.

4.5.4 Wiring Diagram



4.5.5 Digital Input – Enable

A positive voltage higher than 10 V (and < 30 V) at PIN 8 enables the solenoid current driver circuit of the module. The operation of the module requires a permanent signal on PIN 8 (e.g. supply voltage). Disconnecting the enable signal or a signal level below 2.5 V will immediately switch off the solenoid current. Ramp settings will not apply.

NOTICE

The enable function is not a safety function to avoid unwanted operation of the machine in terms of machine safety regulations. The Enable on digital input works in conjunction (logic AND) with the Enable on Profinet. The amplifier is active If both are true.

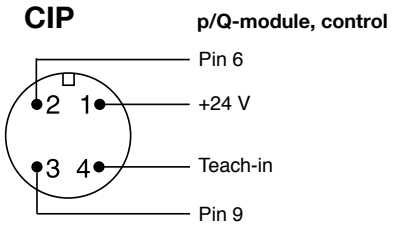
4.5.6 Sensor signals

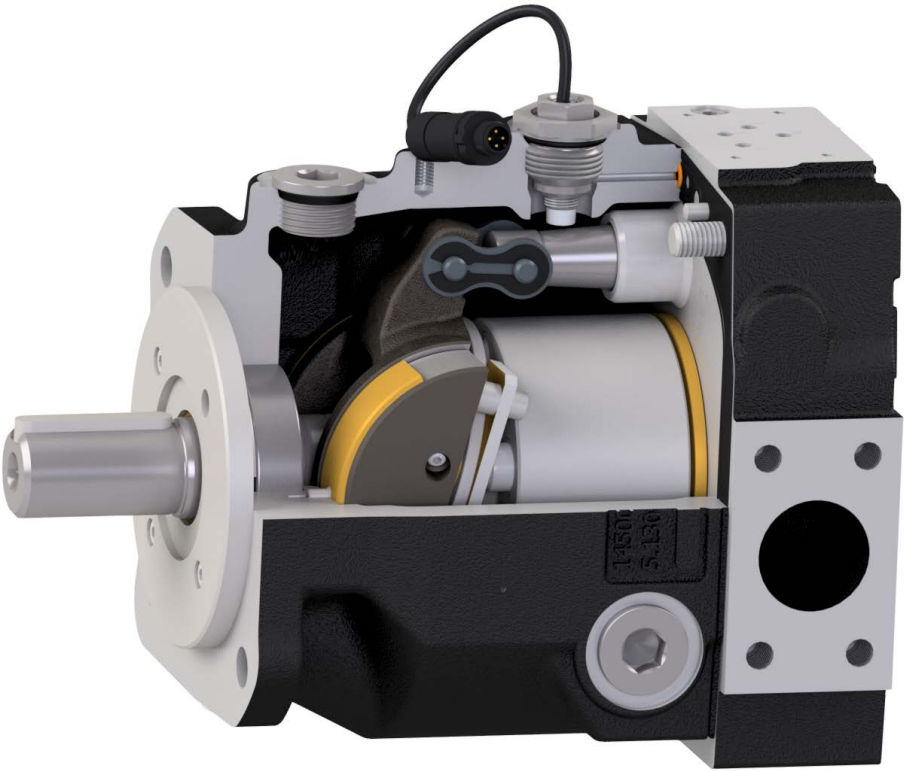
Displacement Transducer – CIP

The displacement transducer (CIP) must be connected to the power supply (CIP connector PIN 1 to +24 V), to the displacement signal input (CIP connector PIN 2 to module PIN 6) and to the module 0 V CIP connector PIN 3 to module PIN 9 / 11).
The displacement transducer signal is 4 mA when the pump is at dead head and 20 mA at full stroke. The connection to the displacement transducer is checked by the modules cable break monitoring

cable 1:	4 x 0.5 mm², shielded
connector:	round plug connector type M12 x 1; 4-PIN version

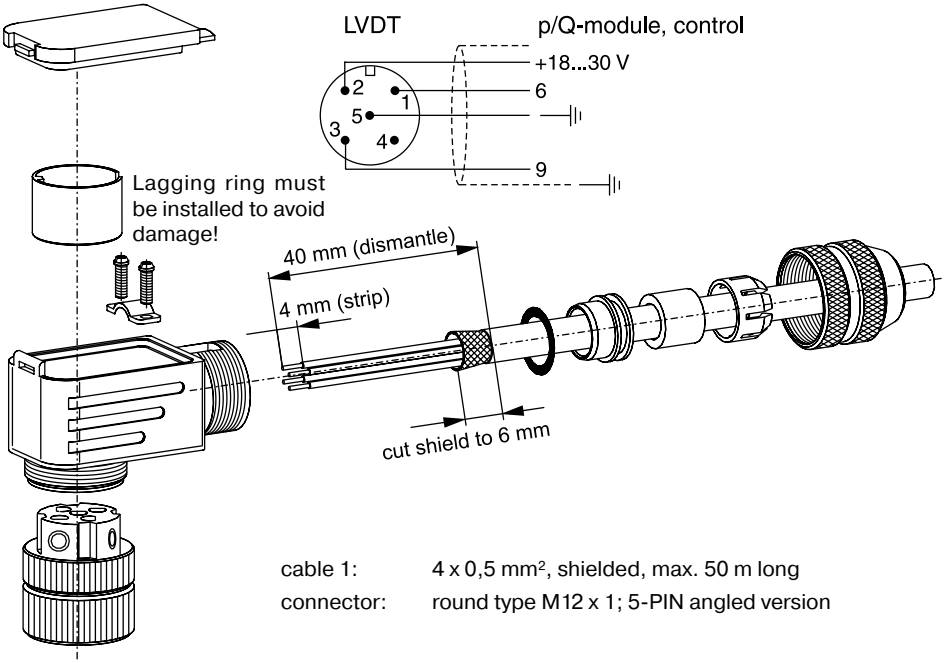
☞ Some electronics supply companies offer prefabricated cables with the M12x1 connector molded to the cable. These cables avoid the risk of mis-assembly, offer a higher protection against ingression of moisture or oil and are available in many different length options.





Displacement Transducer (cable 1)

The displacement transducer (LVDT) must be connected to the power supply (LVDT connector PIN 2 to +24 V [allowed range: +18...+30 V]), to the displacement signal input (LVDT connector PIN 1 to module PIN 6) and to the module 0 V (LVDT connector PIN 3 to module PIN 11). The displacement transducer signal is 9 V (7.5 V at frame size 1 and 2), when the pump is at dead head and between 7.5 and 4 V (depending on frame size and nominal displacement) at full stroke. Please review section 6.6 page 32 for more detailed information per frame size. The connection to the displacement transducer is checked by the modules cable break monitoring. A deviation higher than ±0,5 V of sensor signal and set calibration (MIN:XQ, MAX:XQ) activates the error detection and shuts off the power amplifier stage. The pump strokes to zero displacement in this case.



cable 1: 4 x 0,5 mm², shielded, max. 50 m long

connector: round type M12 x 1; 5-PIN angled version

NOTICE

The LVDT connector must be assembled carefully to avoid the danger of a short circuit in the connector (i.e. the exact position of the lagging ring is to be checked). An electrical short in the connector can cause irreparable damage to the electronic module.

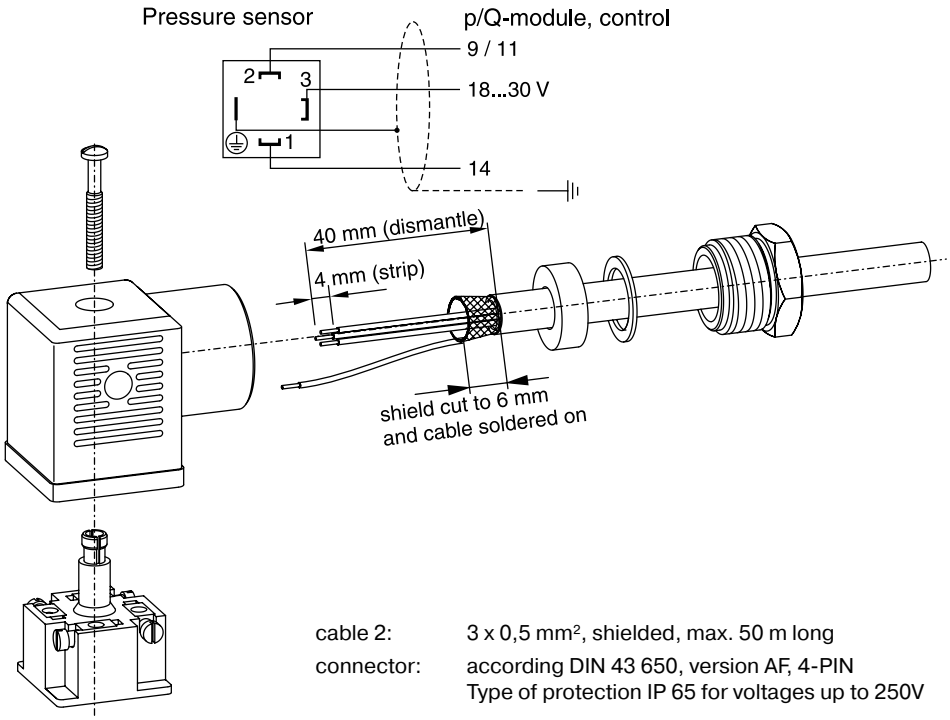
Some electronics supply companies offer prefabricated cables with the M12x1 connector molded to the cable. These cables avoid the risk of misassembly, offer a higher protection against ingression of moisture or oil and are available in many different length options.

Please note that the displacement signal is a voltage signal and the voltage drop is proportional to the cable length. The length (max. 50 m) of the cable should only be as long as necessary.

Pressure Transducer (cable 2)

A pressure transducer is needed, when the module is set to closed loop pressure control (TYPE = Q) or if the circuit requires an internal or external horse power control. The pressure transducer must be connected to the power supply (connector PIN 3 to +24 V), to the pressure transducer signal input (connector PIN 1 to module PIN 14) and to the module 0 V level (connector PIN 2 to module PIN 11).

The pressure transducer signal is between 4 mA (current signal) at 0 bar and 20 mA at the transducers nominal pressure of 600 bar. The normal working range in case of a PV series pump is 4...13.33 mA (0...350 bar). The connection to the pressure transducer is checked by the modules cable break monitoring. A current below 3 mA will lead to a shut off the power amplifier stages and will force the pump to dead head.



cable 2:	3 x 0,5 mm², shielded, max. 50 m long
connector:	according DIN 43 650, version AF, 4-PIN Type of protection IP 65 for voltages up to 250V

4.5.7 Current Outputs

Displacement control valve solenoid (cable 3a/3b)
The displacement control valve (Q-valve) solenoid – A must be connected to PIN 18 (connector PIN 1) and PIN 20 (connector PIN 2) of the control module. The displacement control valve (Q-valve) solenoid – B must be connected to PIN 21 (connector PIN 1) and PIN 23 (connector PIN 2) of the control module.

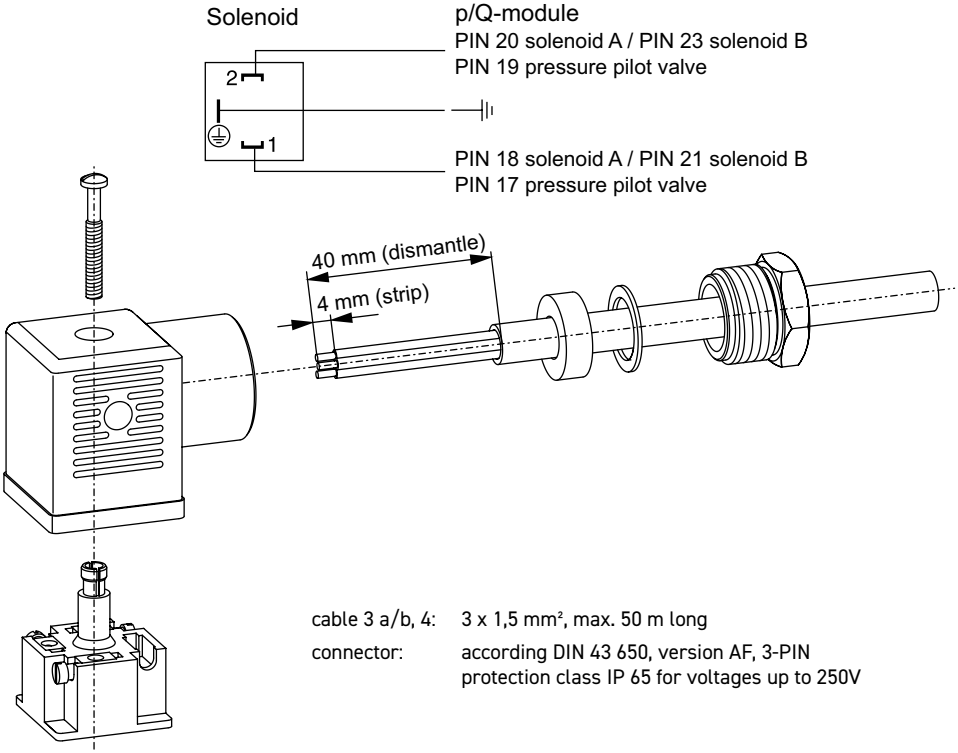
The current to the solenoid is between 0 and 2,7 A for the usage of a **PVCMD1FB***.**.

The current to the solenoid is between 0 and 1,3 A for the usage of a **PVCM*PV**.** The nominal current in a constant displacement control situation is with this type of valve (4/2) in the range of 720 mA to 750 mA, to operate at approximately half of the solenoids nominal force.

Pressure pilot valve solenoid (cable 4)
The pressure pilot valve (p-valve) solenoid must be connected to PIN 17 (connector PIN 1) and PIN 19 (connector PIN 2) of the control module. The module supplies a current between CP: MINV and CP:MAXV to the solenoid.

4.6 Digital output – Ready

The Ready output (PIN 1) gives information on the module being ready to operate. A signal higher than +10 V signals a logic 1, a signal lower than +2 V signals a logic 0. PIN 1 has a logic 1 signal, when all necessary sensors are attached and intact and the Enable signal is set (logic 1 at PIN 5). The control loop is closed under these conditions. The Ready LED (green) is lighted. When a sensor fault occurs (cable broken, no sensor connected, signal out of range, or wrong pump size selected) a logic 0 is sent. The Ready LED starts flashing.



cable 3 a/b, 4:	3 x 1,5 mm², max. 50 m long
connector:	according DIN 43 650, version AF, 3-PIN protection class IP 65 for voltages up to 250V

4.7 LED Display

4.7.1 Controller unit

LEDs	LED-function of the application
GREEN	Identical function as the digital output READY: **OFF:** no supply or ENABLE is not active. **ON:** System is operational. **FLASHING:** Error.
STATUS I	Depending on operational mode: **ON:** Power (torque-) limitation active **FLASHING:** Error Category according to table in section 4.7.2 (only with SENS = ON & AUTO)..
STATUS II	Depending on the operational mode: **ON:** Power (torque-) limitation active. **FLASHING:** Error Description according to table shown in section 4.7.2 (SENS = ON & AUTO)..
LEDs	**LED-function of the system**
GREEN + YELLOW	Chaser light (over all LEDs): Bootloader is active! Module functions are off. LEDs are flashing every 6 s shortly 3 times: Internal data error diagnosed and repaired automatically. Disconnect supply to reset the error message.
GREEN + YELLOW	Both yellow LED are flashing alternately every second. The nonvolatile saved data set is inconsistent. Perform the save command in ProPVplus to reset the error.

4.7.2 Error Codes on STATUS LEDs

Below shown table describes the flash sequences of both STATUS LEDs. STATUS I flashes first, describing the error category. STATUS II follows after a short pause with the error description. In case SENS = AUTO, the sequences are interrupted by the internal try to reset the error. Set SENS = TRUE for detailed root cause analysis or alternatively use the error detection on the field bus or the error detection within ProPVplus.

Error Category	EPROM	Sensor	Sensor	Solenoid	Solenoid	Solenoid
Error Description	Memory Error	Pressure Sensor	Displacement Sensor	Pressure Valve	Displacement Valve (Solenoid A)	Displacement Valve (Solenoid B)
STATUS I	1	3	3	4	4	4
STATUS II	1	1	2	1	2	3

4.7.3 PROFINET Section

LEDs	LED-Function of the system
GRÜN	Supply: **OFF**: No power supply on the field bus note. **ON:** 3,3 V system supply.
LEDs	**LED-Function of the field bus**
ROT	Error: **OFF:** No field bus error. **ON:** Error on field bus communication. **FLASHING:** Field device flash test on PROFINET.
GRÜN	State: **OFF:** Bus not started. **ON:** Connection. **FLASHING 2Hz:** Configuration mode (Bus started, waiting for connection). **FLASHING 10Hz:** Error condition.
GRÜN	LinkAct1: **OFF:** No Connection on port 1 available. **ON (pulsing):** Working network connected to port 1. **FLICKERING:** Data transfer with the network on port 1.
GRÜN	LinkAct2: **OFF:** No Connection on port 2 available. **ON (pulsing):** Working network connected to port 2. **FLICKERING:** Data transfer with the network on port 2.

4.8 Error Monitoring / Error Behavior:

In Case of an error detected by the module the amplifier gets shut down .

Following error root causes are monitored continuously with SENS = ON / AUTO

Source	Error	Behavior
Actual value PIN 6	Outside specified range or cable break	Amplifier will be deactivated
Actual value PIN 14, 4... 20 mA	Outside specified range or cable break	Amplifier will be deactivated
Solenoid PIN 17/19	Break e.g.: cable break	Amplifier will be deactivated
Solenoid PIN 18/20	Break e.g.: cable break	Amplifier will be deactivated
Solenoid PIN 21/23 (optional)	Break e.g.: cable break	Amplifier will be deactivated
Profinet (optional)	Break	Amplifier will be deactivated
EEPROM (while run up)	Data error	Amplifier will be deactivated. The amplifier is going to be activated again with saving the parameter set again!

[1] Wherever possible. In case the amplifier itself is defect, it is not possible to it shut down. The correlating setting is visible on READY.

5 MONITORING AND PARAMETER SETTING WITH PROPVPLUS

The Programming of the p/Q-module can be done in a straightforward way. Both programming via Profinet interface (section 8.2, page 58) or USB interface (described below) is possible. For programming the module must be connected with the PC via a programming cable (Ordering number **PQDXXA-ZXX-cable)**. The **ProPVplus** Software need to be installed and started on the connected computer to get the module parameterized. The program runs under all conventional Microsoft operating systems.

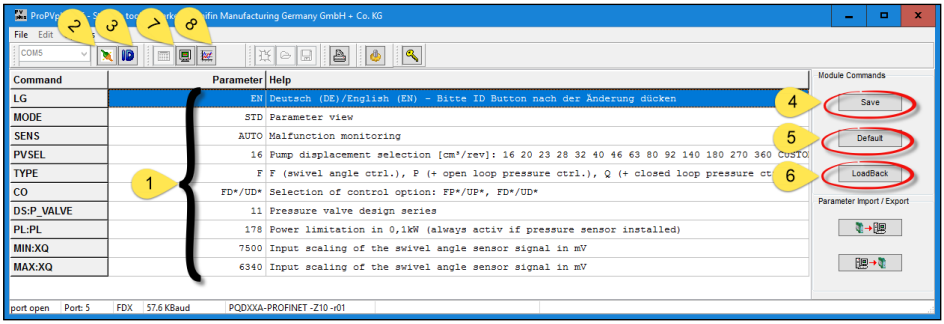
The latest ProPVplus version is available at:

www.parker.com/pmde → Support → Software downloads → Software programs

The **PQDXXA-PROFINET-Z10** module is compatible to ProPVplus 3.6.4 and upwards.

The software offers the following features:

The **PARAMETER LIST (1)** displays all available and editable parameters after **CONNECTING (2) & IDENTIFIYING (3)**. Three different security/input levels are available (MODE = STD or EXP or EXP & password). An input dialog opens after double clicking on the parameter. Limits of the input are shown; faulty or wrong inputs are identified. All parameters are directly sent to the module, if it is in active mode. The command: **SAVE (4)**, saves the parameter settings to the modules memory. **DEFAULT (5),** resets the module to factory settings. **LOAD BACK (6),** resets the module to the last saved parameter settings. Parameter sets can also be edited offline without any connection to the module. The parameter dependency is not active in offline mode. The **MONITOR (7)** window allows the numerically display of various process data. The **OSCILLOSCOPE (8)** displays various process data as graphs. Furthermore, the oscilloscope offers an option to record (Start-Stop) and export the process data as well as an option to store the data in form of a text file (.txt). The cursor function in the right mouse button menu provides the option for amplitude and time measurements. Screenshots can also be captured with the right mouse button dialog. Please see the documentation in the software ProPVplus under Menu Help for further information about the handling of ProPVplus.



Oscilloscope and monitor view:

Process data are variables, which can be tracked in the monitor and oscilloscope view as well as.
Please refer to section 1.9, page 9

Parameter	Beschreibung	Einheit
	Displacement control loop	
WQ	Displacement command (after ramp function implementation)	%
XQ	Displacement actual value	%
XQ_R	Displacement sensor value	V / (mA)
EQ	Control error displacement control	%
UQ	Correcting variable displacement valve	%
Q:P/I/D	Control output for P, I or D respectively	%
	(where $Q:P_{Displacement} = CQ:FF + Q:P_{action}$)	
	Pressure control loop	
WP	Pressure command (after ramp function implementation)	bar
XP	Pressure actual value	bar
XP_R	Pressure sensor value	mA / (V)
EP	Control error pressure control	bar
UP	Correcting variable – pressure valve	%
P:P/I/D	Control outputs for P, I or D respectively	%
	Power (Torque-) Limitation	
WL	Power (Torque-) command	%
XL	Output signal	%
	Current outputs	
IQ:A	Solenoid A, Q-Valve	mA
IQ:B	Solenoid B, Q-Valve	mA
IP	Solenoid, pressure valve	mA

6 OPERATING PARAMETERS

Latest parameter sets are pre-installed on the module.
Below shown parameter are available with the graphical user interface ProPVplus. Parameter available on the Profinet interface are named in section 7.7.2 page 42.

The shown parameter varies with the chosen control type [TYPE] and the chosen Parameter View [MODE].

6.1 Parameter overview

Group	Command	Factory Setting	Unit	Description
Base parameter				
	LG	EN	-	Help text / tool tip language
	MODE	STD	-	Parameter view
	SENS	AUTO	-	Status monitoring
System configuration				
	PVSEL	16		Pump displacement
	DS:P_VALVE	12		Design series pressure valve
	SOLENOIDS	2S		Number of coils on displacement valve
	TYPE	F		Control type selection
	CO	FD*/UD*		Control option (pump configuration)
	CCMODE	OFF		Linearization of pressure valve characteristic
	TS	10	0,1 ms	Control loop sample time
Input signal parameter				
Pressure				
	P_SENSOR P_NOMINAL P_CORR	600 350 15	bar bar bar	Operating range pressure sensor Nominal pressure of prop. pressure R/V Differential pressure setting
	AP:UP AP:DOWN	50 50	ms ms	Ramp settings pressure command WP
	AIN:XP	C	-	Signal type pressure sensor XP
Displacement				
	Q:CORR	0	0,01 %	Compensation of pumps volumetric efficiency
	AQ:UP AQ:DOWN	33 41	ms ms	Ramp settings displacement command WQ
	MINC:XQ MAXC:XQ AIN:XQ	4 20 C	mA mA -	Scaling displacement sensor signal XQ
Control loop parametrization				
Pressure				
	CP:FF CP:P CP:I CP:I_LIM CP:IC CP:D CP:T1	8000 50 3000 2500 500 10 10	0,01 % 0,01 0,1 ms 0,01 % 0,01 % 0,1 ms 0,1 ms	PID control loop for pressure control
Displacement				

Group	Comman	Factory Setting	Unit	Description
	CQ:FF CQ:P CQ:I CQ:I_LIM CQ:IC CQ:D CQ:T1	0 200 1800 2500 700 200 10	0,01 % 0,01 0,1 ms 0,01 % 0,01 % 0,1 ms 0,1 ms	PID control loop for displacement control
	Power (Torque)			
	PL:RPM PL:EFF PL:PL PL:T1	1500 7850 178 500	1/min 0,01 % 0,1 kW 0,1 ms	Parametrization of power limitation (torque limitation)
Output signal parameter				
	Pressure			
	CC	X Y	-	Definable linearization function
	TRIGGER:P	0	0,01 %	Trigger point pressure valve
	CP:MINV CP:MAXV	280 1320	mA mA	Valve adjustments
	Displacement			
	TRIGGER:Q	0	0,01 %	Trigger point displacement valve
	OFFSET:Q	750	0,01 %	Neutral point adjustment
	CQ:MINVA CQ:MINVB CQ:MAXVA CQ:MAXVB	0 405 2700 2700	mA mA mA mA	Valve adjustment
Power amplifier parameter				
	Pressure			
	DFREQ:P	120	Hz	Dither frequency
	DAMPL:P	200	0,01 %	Dither amplitude relative to nominal current
	PWM:P	2941	Hz	PWM frequency
	PPWM:P IPWM:P	7 40	-	Current control loop settings
	Displacement			
	DFREQ:Q	120	Hz	Dither frequency
	DAMPL:Q	400	0,01 %	Dither amplitude relative to nominal current
	PWM:Q	2941	Hz	PWM frequency
	PPWM:Q IPWM:Q	3 40	- -	Current control loop settings

6.2 MODE – Standard (STD)

LG (help text / parameter description language)

DE German, Display of help texts and parameter descriptions in German.

EN English, Display of help texts and parameter descriptions in English.

MODE (Parameter view):

STD Standard, all parameters for quick start up are shown.

EXP Expert, Further parameter for advanced settings and control performance optimization are shown additionally to the standard parameter. The EXP parameters influence to the system behavior is significant and should be handled with care.

CO (control option [pump configuration])

FD* / UD* prop. directional valve PVCMD1FB***
FP* / UP* prop. directional valve PVCM*PV**

This Parameter is referring to the control option named in the pumps product code.

PVSEL (pump displacement):

PVSEL 016, 020, 023, 028, 032, 040, 046, 063, 080, 092, 140, 180, 270, 360, CUSTOM (additional parameterizable data set).

NOTICE

PVSEL, TYPE, CO and DS:p_valve need to be adjusted first before further changes and adjustments in the data set since those are driving underneath laying parameter. Otherwise other parameter changes might have no effect.

TYPE (Selection of control type):

F Displacement control

P Displacement control with open loop pressure control

Q Displacement control with closed loop pressure control

S Open loop control for the displacement function with digital character.

If WQ > 60 %, the pump strokes up, Max current to solenoid A.

If WQ < 40 %, the pump strokes down, Max current to solenoid B.

DS:P_VALVE
(design series – pressure valve)

Selection of the pressure valves design series. The parameter defines the presetting of CP:MAXV. The parameter is to be set according to the valve type plate!

NOTICE

Please verify the conformity of valves nameplate with the modules parameter settings. Nonconformance (e.g.: DS:P_Valve = 12 and mounted valve = DS 11) can lead to dangerous overpressure!

PL:PL (horse power control setting):

PL:PL Selection of horse power control in 0,1 kW. The parameter is freely selectable, where the upper limit equals the pumps maximum input power (corner power), which is calculated internally. The lower limit equals 10 % of the pumps maximum input power. The rotational speed of the drive is used for the calculation of the pumps maximum input power. Please mind the correct adjustment. The standard adjustment of the parameter PL:RPM is set to 1500 rpm. Please refer to Parameter PL:EFF section 6.4, page 29.

SENS (Setting of the Sensor monitoring):

ON Sensor monitoring is activated. The reset must be done manually. The error will be shown at the module and in the monitor view until the reset.

OFF Sensor monitoring is deactivated.

AUTO Sensor monitoring is activated. The module gets automatically reset after the failure or the defect is corrected. A manual reset is not necessary.

NOTICE

The manual reset is done by switching the **ENABLE** signal at PIN 8.
The module monitors signals from the displacement sensor as well as from the pressure sensor according to a specified range and the electric circuit to the valve solenoids. Signals out of the specified range (pressure sensor < 3 mA, displacement ±0,5 V out of the scaled range) or an opened electric circuit (broken cable detection) are detected as failure. The module

will force the pump to minimum displacement. The green **READY** LED is flashing. The error codes are shown via the status LEDs (please refer to chapter 4.7.2, page 18) as well as on the Profinet interface (Please refer to chapter 7.6.2, page 41).
The voltage signals at pressure sensor input are not monitored. The pressure sensor signal is also monitored at TYPE F and P. Switch the sensor signal type (AIN:XP) to a voltage signal to disable the monitoring for that input if needed.

Displacement sensor adjustment:

ATTENTION!
In **PQDXXA-Z10-r08** current signal is defined as standard signal.

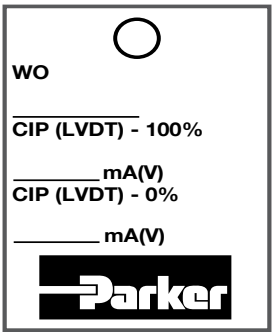
CIP setting

MINC:XQ	Displacement sensor feedback at dead head (CIP-0 %) in mA.
MAXC:XQ	Displacement sensor feedback at full stroke (CIP-100 %) in mA.

LVDT setting
MODE „EXP" → AIN:XQ = „V"

MIN:XQ	Displacement sensor feedback at dead head (LVDT-0 %) in V.
MAX:XQ	Displacement sensor feedback at full stroke (LVDT-100 %) in V.

NOTICE
Both parameters are shown at the pump enclosed tag.



Pumps are tested at a fluid temperature of (50±2) °C. Small deviation of the CIP/LVDT parameters are possible if the hydraulic system temperature where the pump is used is significantly different. In this case, the values need to be re-measured with a convenient voltmeter and redefined in the software.

6.3 MODE – EXPERT (EXP)

CC / CCMODE (Linearization of the pressure valve):

CCMODE	Activation of the pressure valve linearization function.
CC	Adjustment of the pressure valve Linearization.

The Linearization is only active at TYPE P. Due to pressure valves hysteresis only ascending or descending pressure functions can be optimized.

P_SENSOR
(Pressure sensor end range):
Setting of pressure sensor end range in bar. This parameter is base for the scaling of the sensor with the parameter P_NOMINAL.

NOTICE
P_SENSOR is by default set to 600 bar.
For the control options UDM, UDF, UDQ (old: UPM, UPF, UPQ) the 600 bar sensor (**PVACMS**, SCP01-600-24-06) is used as standard.

P_NOMINAL (Pressure sensor scaling):
Setting of pressure sensor scaling in bar. This parameter determines the upper limit for the pressure sensor signal.

NOTICE
Changing this parameter may cause negative effects to your system. A new adjustment of the pressure valve solenoid limitation (Parameter CP:MINV and CP:MAXV) might be necessary!

In case of running the pump with a PVACRE***K42 as pilot pressure valve, this parameter must be set to 420 bar. A new adjustment of the pressure valve solenoid limitation (Parameter CP:MINV and CP:MAXV) might be necessary!

The parameter P:NOMINAL shall match the pressure pilots end range.

P_CORR (differential pressure setting, compensator):
Setting of the differential pressure in bar.

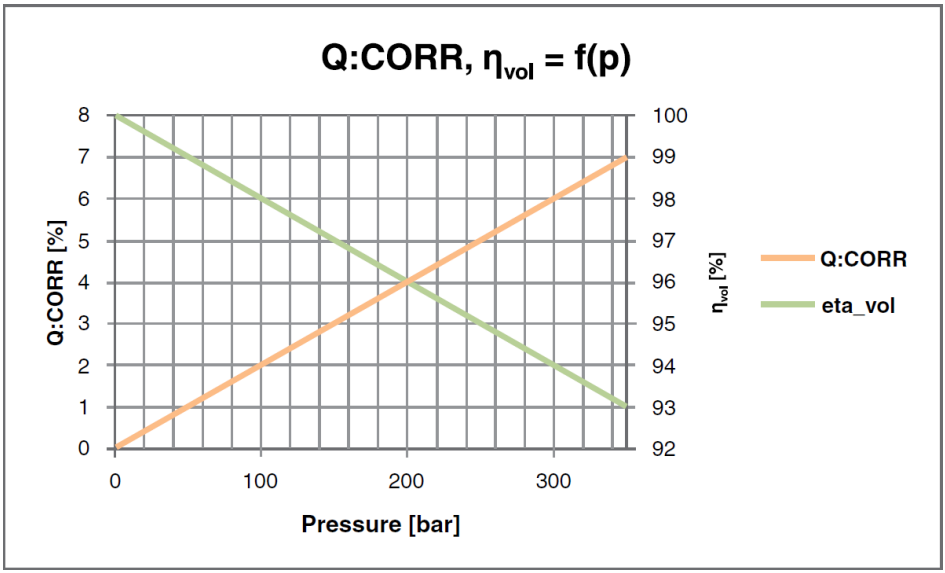
NOTICE
The factory standard setting of the compensator differential pressure is 15 bar.
P_CORR needs to be adjusted to 0 bar in case of installing the pressure transducer in the pumps outlet.
The differential pressure is a numerical constant, which is added to the sensor pressure signal all time. If the pump acts in displacement control, the constant is added as well. The system pressure equals in this case actual pressure (XP) minus P_CORR.

PL:RPM (Rotational speed setting):
Setting of the pumps or drive motors rotational speed respectively. The parameter is used for the calculation of the maximum input power.

PL:T1 (Setting of the horse power controls delay element):
Setting the horse power controls delay element. The time between signal input and signal processing of the horse power controlled subsystem can be modified with that parameter.

NOTICE
This parameter should be changed only if the controlled system tends to have instabilities due to high dynamic challenges.
When the module is operated in horse power control mode under certain conditions and at fast pressure rise rates the power limiter may act too slowly, and the horse power requirements exceed the limits briefly.

Q:CORR (Compensation of pumps volumetric efficiency):
This parameter describes the compensation of the pumps volumetric efficiency and builds a linear correction function vs. pressure which output is added to the Q-command signal. The Q-controls maximum command is thereby still 100 %.



The usage of ramp functions (Parameter AQ:UP, AQ:DOWN) is recommended.

Recommended values for Q:CORR:

Frame size	Pump displacement [cm³/U]	System pressure [bar]	Q:CORR [0,01%]
1	16	350	1223
1	20		933
1	23		770
1	28		710
2	32		877
2	40		610
2	46		593
3	63		887
3	80		733
3	92		453
4	140		693
4	180		530
5	270		350
6	360		303

AQ:UP / AQ:DOWN (Ramp times - displacement control):

AQ:UP Ramp time settings for rising displacement commands in ms.

AQ:DOWN Ramp time settings for dropping displacement commands in ms.

Default ramp times – recommended ramp times for displacement control:

Frame size	Pump displacement [cm³/U]	System pressure [bar]	Ramp time [ms]			
			Rising comman values		Falling command values	
			FD* / UD*	FP* / UP*	FD* / UD*	FP* / UP*
1	16	350	33	50	41	50
1	20		37	55	46	50
1	23		40	60	51	50
1	28		44	65	57	50
2	32		47	80	62	65
2	40		51	80	67	65
2	46		54	80	72	65
3	63		58	120	78	110
3	80		61	120	83	110
3	92		65	120	88	110
4	140		87	135	112	165
4	180		110	180	136	175
5	270		132	195	159	185
6	360		154	225	183	245

AP:UP / AP:DOWN (Setting of ramp times – pressure control):

AP:UP Ramp time setting for rising pressure command signals in ms.

AP:DOWN Ramp time setting for dropping pressure command signals in ms.

NOTICE

It is recommended to activate ramps to achieve sustainable system stability. Ramps can be activated with ENABLE RAMP on the PROFINET Bus (section 7.4.1, page 36). Ramp times in the software refer to a command step of 100 % and define the ramp gradient. Ramp times are proportional to the percentage of the command steps. The optimal ramp time setting is for pressure control depending on the system, it is especially depending on the hydraulic capacities and the different operating points. The set-up at the specific system may help to optimize the pressure control.

AIN:XQ (Sensor signal type – displacement sensor):

The displacement sensors signal can either be a voltage signal [V, scalable via MIN:XQ and MAX:XQ] or a current signal [C, fix range 4 – 20 mA].

NOTICE

If a voltage signal has been chosen and is 0.5 V lower than MAX:XQ (at machines off-state) the module switches to error mode. This function is to see if the sensor scaling is done and if the right displacement has been chosen in the parameter list.

AIN:XP (Sensor signal type – pressure sensor):

The pressure sensor signal can either be a current signal [C] or a voltage signal [V]. Voltage signals at PIN 14 are not enclosed in the error detection (SENS). The current signals default range is 4 mA to 20 mA. The voltage signals default range is 0 V to 10 V. Further pressure related settings are done with the parameter P_SENSOR, P_NOMINAL and P_CORR.

CQ:FF (Offset – Displacement Control Valve)

Offset parameter (in 0.01 %) to adjust the displacements control valve neutral point. The Offset parameter is only needed for 4/2 directional valves (CO = FP*/UP*) with one solenoid. The parameter needs to be set to 0 in case of using a 4/3 directional valve with two solenoids. In a control situation, the solenoid should draw approx. 60 % of its nominal current (nominal current 1.3 A; current in control situation 780 mA). Under these conditions the solenoid provides approx. 50 % of its nominal force. That leads to a similar response for on- and off stroking.

CQ:P / CQ:I /CQ:I_LIM/ CQ:D (PID parameter – displacement control):

CQ:P P gain setting in 0.01 units. P gain is deactivated with input 0.

CQ:I I gain setting in 0.1 ms. I gain is deactivated with input 0.

CQ:I_LIM Integrator limitation of the closed loop displacement control in 0.01 %. The integrator compensates the systems nonlinearities. Therefore, this parameter should be chosen as small as possible. Typical value = 2500 (25 %).

CQ:D D gain setting (time factor for differential) in 0.1 ms. D gain is deactivated with input 0.

CQ:T1 Filter of D gain in 0.1 ms. D gain filter is deactivated with input 0.

CP:FF (Offset Pressure Control Valve)

Offset parameter (in 0,01 % of CP:MAXV) to bypass a constant portion to the pressure valve actuation. This control type increases stability in a closed loop pressure control (TYPE = C). This Typical value = 8000...9000.

CP:P / CP:I / CP:D (PID parameter – pressure control):

CP:P P gain setting in 0.01 units. P gain is deactivated with input 0.

CP:I I gain setting in 0.1 ms. I gain is deactivated with input 0.

CP:I_LIM Integrator limitation of the closed loop pressure control in 0.01 %. The integrator compensates the systems nonlinearities. Therefore, this parameter should be chosen as small as possible. Typical value = 2500 (25 %). Depending on systems linearity this value can also be higher.

CP:IC Integrator activation of the closed loop pressure control in 0.01 %. The Integrator gets activated within these limits (in % of full scale). This reduces the overshoot while starting the closed loop control. Typical value = 500...5000. This function shuts down with CP:IC = 0. In this case, the integrator is active all time.

CP:D D gain setting (time factor for differential) in 0.1 ms. D gain is deactivated with input 0.

CP:T1 Filter of D gain in 0.1 ms. D gain filter is deactivated with input 0.

NOTICE
The PID parameter tuning will help to optimize the hydraulic system interaction.

CQ:MINVA / CQ:MINVB (Dead band compensation – displacement control valve):

CQ:MINVA Dead band compensation solenoid A in mA.

CQ:MINVB Dead band compensation solenoid B in mA.

The dead band compensation is only reasonable for 4/3 directional valves (CO = FD* / UD*) with 2 solenoids. The valves offset, parameter CQ:FF needs to be set to zero "0" when using a 4/3 directional valve. The dead band compensation needs to be aligned to the parameter OFFSETQ.

CQ:MAX:VA / CQ:MAXVB (Nominal current – displacement control valve):

CQ:MAXVA Nominal current to solenoid A in mA.

CQ:MAXVB Nominal current to solenoid B in mA.

TRIGGER Q (Threshold for displacement function):
Threshold for the displacement controllers correcting variable (UQ) in 0.01 %. The displacement valves coil is not activated within the specified threshold. This function works in positive as well as in negative direction of UQ. CQ:MINV* superimposes the threshold function.

OFFSETQ (Adjustment of Q-valves hydraulic neutral point)
Adjustment of the Q-valves hydraulic neutral point in % of CQ:MAXVA for positive values or in % of CQ:MAXVB for negative values. A positive input acts to solenoid A, negative acts to solenoid B.

CP:MINV (Trigger threshold – pressure control valve):
Trigger threshold of pressure control valve in mA.

CP:MAXV (Nominal current – pressure control valve):
Nominal current of the pressure control valve in mA. It might be necessary to fine tune the trigger threshold CP:MINV and the nominal current CP:MAXV to get optimal results in open loop pressure control.

TRIGGER P (Threshold for pressure function)
Threshold for pressure controllers correcting variable (UP) in 0.01 %. The pressure valves coil is not activated within the specified threshold. The valve activation reaches CP:MINV after UP passes the set threshold.

6.4 MODE – Offline or expert and password (EXP & Password)

TS (Sample Time)
The sample time (in 100 µs) describes how often I/Os and signals is processed internally. The parameter TS represents the controls cycle time and therewith controls dynamic.

NOTICE
Changes should be performed only if enough knowledge about the dynamic system behavior is available. Changing TS requires that all time depended parameters need to be checked and possibly readjusted. The Sample time does not have any impact to the field bus communication.

SOLENOIDS (Number of solenoids – Displacement control valve):
Selection of the number of solenoids at the displacement control valve (4/2 = 1, 4/3 = 2). With the change of parameter SOLENOID, the parameter CQ:MINVA, CQ:MINVB, CQ:MAXVA, CQ:MAXVB and CQ:FF need to be adjusted as well. The parameter gets automatically set with CO.

PL:EFF (Mechanical Pump Efficiency)
Mechanical pump efficiency in 0.01 % (of 100 %). PL:EFF is used for the calculation of the pumps corner power and therewith the maximum of parameter PL:PL.

$$PL : PL_{MAX} = \frac{(PVSEL) \bullet (PL : RPM) \bullet (P\_NOMINAL)}{(PL : EFF) \bullet 6}$$

CQ:IC (Integrator Activation)
Integrator activation of the closed loop displacement control in 0.01 % (of the pressure error [%]). This parameter works as threshold for the integrator activation (Q-PID controller). If the actual pressure value is higher than the command value, the integrator freezes. If the actual pressure value falls below the programmed threshold between command and actual value, the integrator is enabled again. This function is disabled with CQ:IC = 0. In this case, the integrator is always active.

DFREQ:Q (Dither Frequency)
Dither frequency of the displacement control valve in Hz.

DAMPL:Q (Dither Amplitude)
Dither amplitude of the displacement control valve in 0.01 % of CQ:MAXV. The Dither can be set with Dither amplitude and Dither frequency. The below mentioned value for Dither amplitude and frequency should not be changed when using a PVCMD1FB*** or a PVCM*PV**!

DFREQ:Q = 120

DAMPL:Q = 400

PWM:Q (PWM Frequency)
PWM frequency of the displacement control valve in Hz. The frequency can be defined in predefined steps (Table below). The optimal frequency depends on the valve.

PPWM:Q (P gain)
P gain of the solenoids control (displacement control valve).

IPWM:Q (I gain)
I gain of the solenoids control (displacement control valve).

DFREQ:P (Dither Frequency)
Dither frequency of the pressure control valve in Hz.

DAMPL:P (Dither Amplitude)
Dither amplitude of the pressure control valve in 0,01 % of the current.
The Dither can be set with Dither amplitude and Dither frequency.
The below mentioned value for Dither amplitude and frequency should not be changed when using a PVACRE*K**!**

DFREQ:P = 60

DAMPL:P = 400

PWM:P (PWM Frequency)
PWM frequency of the pressure valve solenoid in Hz. The frequency can be defined in predefined steps (Table below). The optimal frequency depends on the valve.

PPWM:P (P gain)
P gain of the solenoids control (pressure control valve).

IPWM:P (I gain)
I gain of the solenoids control (pressure control valve).

NOTICE
PPWM and IPWM parameter are influencing the Dither settings. This parameter should not be changed after the Dither optimization. The solenoid control parameters are optimized for the usage of PVACRE*K** as pressure valves and PVCMD1FB*** respectively PVCM*PV** as displacement valve. This parameter should not be changed if using these valves!**

Paramter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PWM:P [Hz]	60	70	80	90	100	110	120	130	150	199	230	280	336	405	511	1069	1470	1960	2252	2941
PWM:Q [Hz]																				

⚠ **ATTENTION!** At low PWM frequencies, the parameters PPWM and IPWM should be adapted, as the longer dead times reduce the stability of the control loop.

6.5 PID Parameter Setting

Displacement and pressure control have separate control loops, whose parameters need to be set separately. The pressure control should stay in focus, since the system behavior is depending on hydraulic capacities, the way of piping to the hydraulic load and the varying hydraulic working points. The displacement control should only be tuned again in case of system instabilities.
The parameter of proportional-, integral and differential action should be adjusted in the ranges shown below. The setting for the pressure control can also be beyond these points depending on the system.

Control Loop	Action	Typical Ranges		Tendency
		Min. Value FD*/UD* (FP*/UP*)	MAx. Value FD*/UD* (FP*/UP*)	
Pressure	P	10	200	**Depending on hydraulic system!!**
	I	150	-	
	D	0	200	
Displacement	P	50 (80)	3000 (800)	Proportional to pump displacement
	I	V_g < 92 cc/rev. → 200 (1500) $V_g \geq 92$ cm³/U → 80 (300)	V_g < 32 cm³/U → - $V_g \geq 32$ cm³/U → -	Linearity errors of the displacement valve are compensated. Bigger pump displacements can be parametrized with smaller I-Gain without disadvantages.
	D	0	1200 (600)	

Recommendation for the PID parameter setting:

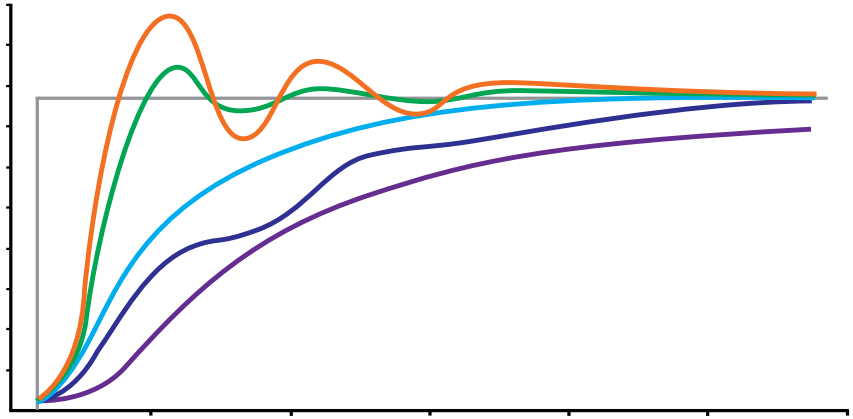
Preparations:

- Set P gain to small value.
- Set I gain to very high value.
- Set D gain to zero.

PID Setting:

- Increase P gain until an acceptable command response is achieved.
- Decrease I gain until an acceptable dynamic reducing the error between command and actual value is achieved. P might be lowered again (iteratively process).
- Increase D gain to compensate I actions phase shift and to increase dynamic as well as to reduce noise on response signal

Typical system responses



Selected Step Responses:

Actual value nears only slow to the command value:

- Increase P gain, if this improves, decrease I gain, iterate possibly.

Actual value nears only slow and with small oscillations to the command value:

- Increase P gain, if this improves, decrease D gain, iterate possibly.

Actual value nears only without overshoot to the actual value:

- Increase P gain to get a faster response in the actual value.

Actual value nears with small overshoots to the command value:

- Optimal system behavior
  If no overshoots are not allowed, reduce P gain

Actual value nears with fast to the command value, but overshoots are to big

- Decrease P gain, if this improves, increase I gain, iterate possibly.

6.6 Important settings and diagnosis values

Settings- and diagnosis values for CIP

Size/Code	Diagnosis signal $V_{G\ max}$ [Volt $_{-0,5}$]	CIP signal A_{max} [mA$^{+0,4}$]	Diagnosis signal V_{Gmin} [Volt]	CIP signal A_{max} [mA $_{\pm 0,25}$]
PVXXX	10	20	0.15	4

Settings- and diagnosis values for LVTD

Displacement/ Code	Max. Displacement [cc/rev.]	Max. Displacement	Min. Displacement
		Sensor signal $V_{G\ max}$ [$V_{+0,25}$]	Sensor signal $V_{G\ max}$ [$V_{\pm 0,25}$]
PV016	16	6.34	7.5
PV020	20	6.06	7.5
PV023	23	5.87	7.5
PV028	28	5.50	7.5
PV032	32	6.40	7.5
PV040	40	5.70	7.5
PV046	46	5.43	7.5
PV063	63	7.12	9.0
PV080	80	6.48	9.0
PV092	92	6.10	9.0
PV140	140	5.24	9.0
PV180	180	3.83	9.0
PV270	270	4.06	9.0
PV360	360	4.06	9.0

7 PROFINET IO RT INTERFACE

Following graphical descriptions are made with SIEMENS TIA Portal V 14. Details may differ with different versions of SIEMENS TIA Portal or even Step 7. All program examples are shown in the following sections are in FBD (Function Block Diagram) language.

7.1 Profinet functions

PROFINET is a standard of industrial ethernet per IEEE 802.xx., based on the 100 Mb/s version of full-duplex and switched ethernet. PROFINET IO is for the fast data transfer between ethernet based controls (masters) and field devices (slaves) with a cycle time up to 10 ms.

7.2 Profinet access management

All PROFINET-IO slaves must get a unique IP address and a PROFINET device name, to ensure a proper communication.

The slaves IP-address is set by the PROFINET-IO-controller (PLC). This IP-address is saved in the device non-volatile memory. The IPs modification is possible with IO-controller.

NOTICE

Do not assign IPs redundant.

Standard address:

IP Address:	0.0.0.0
Subnet-Mask:	0.0.0.0
IP Address Gateway:	0.0.0.0

Example address:

IP Address:	192.168.1.111
Subnet-Mask:	255.255.255.0
IP Address Gateway:	192.168.1.111

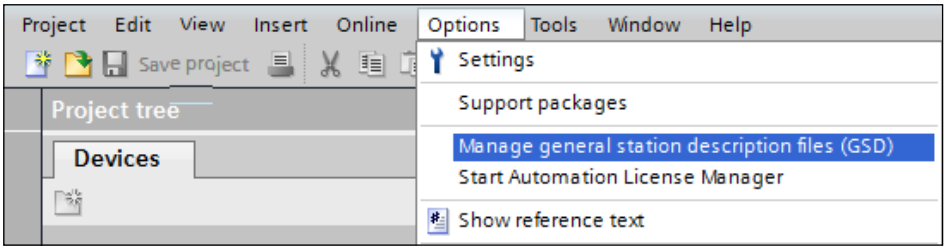
7.3 Device Data File (GSDML)

The General Station Description (GSD) File describes the IO device properties. The GSDML File (GSD Markup Language) is written in XML based language. It describes for the IO data, structure of cyclic data transfer between PLC and slave. Each nonconformance in size and structure of IO data gives a prompt to the PLC. This PQDXXA-PROFINET-Z10 demands a

32-byte input and a 32-byte output protocol. The latest PQDXXA-Z10-PROFINET GSDML file is distributed by Parker and is available online at parker.com/MSGE.

7.3.1 GSDML installation – TIA Portal

Navigate to the GSDML Manager.

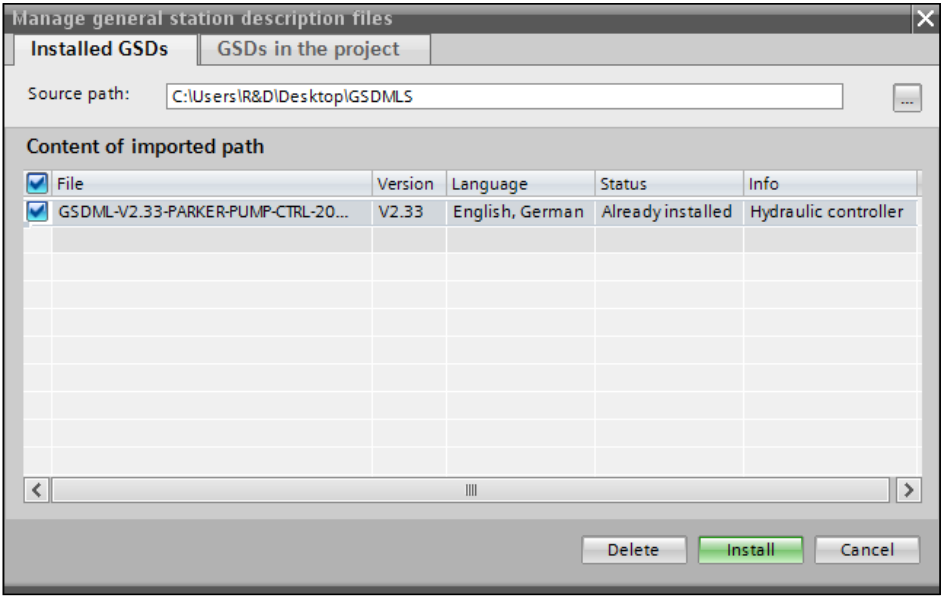


Point to source path of the just downloaded GSDML file, select the file in the content list and press install.

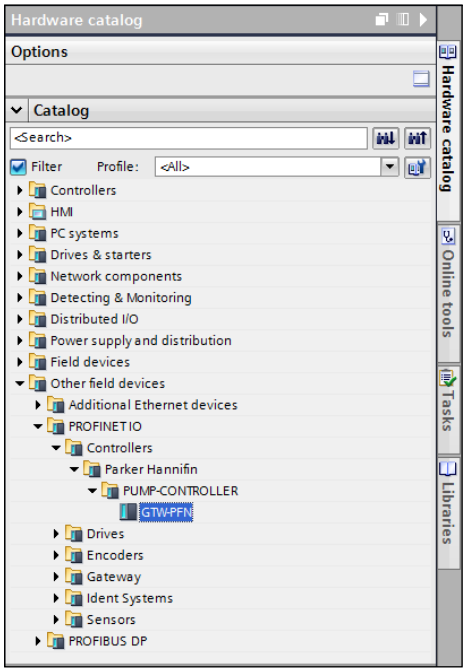
GSDML V2.33 → Revision 01 – 05

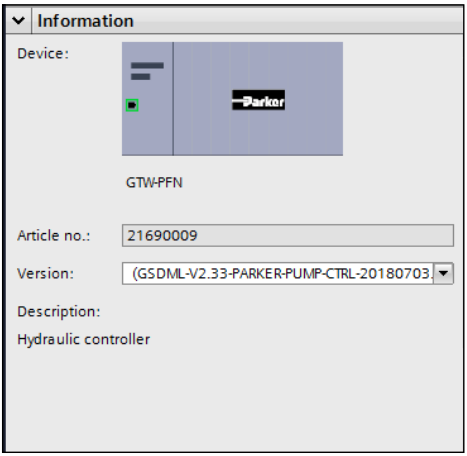
GSDML V2.43 → Revision 06 and higher

Picture below is a reference for showcasing the import dialogue.



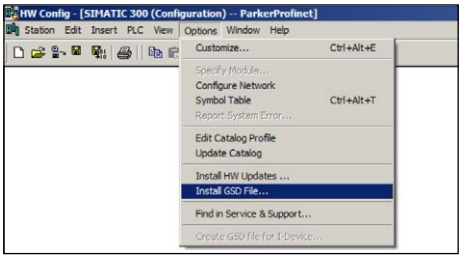
The PQDXXA-Z10-PROFINET appears in the hardware catalogue accordingly for implementation in the network under:
Other field devices\PROFINET IO\Controllers\
Parker Hannifin\PUMP-CONTROLLER\
GTW-PFN v2.

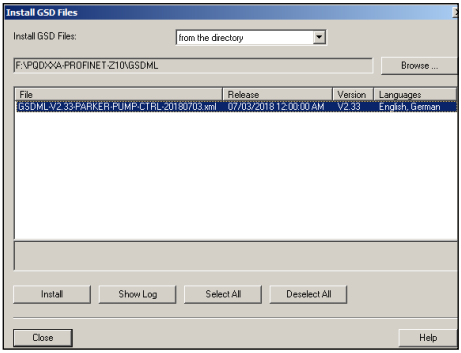




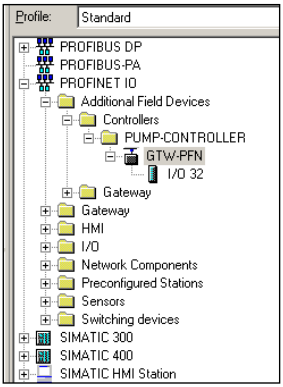
7.3.2 GSDML installation – STEP 7

Navigate to the GSDML Manager and point to source path of the just downloaded GSDML file, select the file in the content list and press install





The PQDXXA-Z10-PROFINET appears in the hardware catalogue accordingly for implementation in the network under:
PROFINET IO\Additional Field Devices\
Controllers\PUMP-CONTROLLER\GTW-PFN v2.



7.4 Description Profinet interface

The pressure command is limited by parameter P_NOMINAL.
All relative commands value range is up to 0x3fff for 100 %.
Pressure signals have a resolution of 0,1 bar for commands and actuals.
A “1” at control and status bits mean an activation or an active message.
Error bits are prompted differently, a “0” reflects an active error.

7.4.1 Command to module – control word

ENABLE general system activation
ENABLE P activation pressure control function.

NOTICE
“1” [true] allows the module to perform the displacement control of the pump only. The p-valve solenoid current is set to maximum. The amplifier for the pressure valve is deactivated at TYPE F (no function with mounted p-Q block).

ENABLE RAMP activation ramp function

ENABLE PL activation horse power limitation (horse power command necessary)

READLLIM readout command of chosen parameters lower limit at READOUT PARA while performing a PARAREAD

READULIM readout command of chosen parameter upper limit at READOUT PARA while performing a PARAREAD

PARAREAD reads the current parameter value at the PARAINDEX pointed parameter address and turns value back at READOUT PARA. An invalid parameter address turns back with “0xFFFFFFFF”. The corresponding lower or upper limit gets submitted instead when performing READLLIM / READULIM.

PARAMODE activates the parametrization via Bus. The deactivation of ENABLE is necessary.

NOTICE
Do not parametrize your control in an unsafe state of your machine or application.

PARAVALID Transfer of the chosen parameter.

LIVEBIT IN Monitoring of the field bus communication: The internal monitoring gets activated with this bit. Once activated, the function checks if at least one incoming value is changing per second. This change can be caused by the live bit itself. The READY – status gets reset after expiration of the mentioned time without data change. The bit condition gets continuously reported back by the LIVEBIT OUT.

7.4.2 Commands and data words to the module:

Enable and control of the module functions is done with a command word.

DISPLACMENT COMMAND
Displacement command in %

PRESSURE COMMAND
Pressure command in 0,1 bar resolution.

HORSE POWER COMMAND
Horse power command in % of PL:PL
(necessary if ENABLE PL is active)

PARAVALUE Parameter value, which gets submitted

PARAADRESS Parameters address, which gets read or write

7.4.3 Modules response – status word:

The response to the control is done with a status word.

READY general systems operating status

POWER LIM horse power limitation actively decreasing the displacement

P ACTIVE pressure control active (displacement control overwritten)

XQ ERROR error displacement sensor

XP ERROR error pressure sensor

IP ERROR	error pressure valve
IQA ERROR	error displacement valve (coil A)
IQB ERROR	error displacement valve (coil B)
DERROR	internal data error
CHKERROR	check sum error in the field bus communication
BUFFEROV	error while processing the field bus communication (overflow)
PARA ACTIVE	parametrization mode active
PARA READY	parameter value has been taken over correctly. This bit gets reset with the reset of PARAVALID.
LIVEBIT OUT	Monitoring of the field bus communication: Feedback on LIVEBIT IN. The master slave communication is also monitorable at the machine control side with this frequent bit transfer.

7.4.4 Actual values and other outputs toward the fieldbus:

STATUS WORD	operating status and other conditions
XQ FEEDBACK	actual value displacement
XP FEEDBACK	actual value pressure
XL FEEDBACK	actual value horse power limitation
READOUT PARA	read parameter value

7.5 Commands from PLC (Master control)

7.5.1 Command values – overview

Nr.	Byte	Function	Type	Range	Unit
1	0	Control word Hi	int		
2	1	Control word Lo			
3	2	Reserve			
4	3				
5	4	Displacement command Hi	int	0... 0x3FFF	0... 100 %
6	5	Displacement command Lo			
7	6	Pressure command Hi	int	0... 10000	0,1 bar
8	7	Pressure command Lo			
9	8	Horse power lim. command Hi	int	0... 0x3FFF	0... 100 %
10	9	Horse power lim. command Lo			
11	10	---			
12	11	---			
13	12	---			
14	13	---			
15	14	---			
16	15	---			
17	16	---			
18	17	---			
19	18	---			
20	19	---			
21	20	---			
22	21	---			
23	22	---			
24	23	---			
25	24	---			
26	25	---			
27	26	Parameter value (MSB)	long		
28	27				
29	28				
30	29	Parameter value (LSB)			
31	30	Parameter index (address) Hi	int		
32	31	Parameter index (address) Lo			

7.5.2 Control word definition

Byte 0 – Control Word Hi			
Nr.	**Byte**	**Function**	
1	0	---	
2	1	---	
3	2	---	
4	3	---	
5	4	ENABLE PL	Activation horse power control
6	5	ENABLE RAMP	Activation ramps
7	6	ENABLE P	Activation pressure control loop
8	7	ENABLE	System activation

Byte 1 – Control Word Lo			
Nr.	**Byte**	**Function**	
1	0	LIVEBIT IN	(Start of) field bus monitoring
2	1	---	
3	2	---	
4	3	READLLIM	Readout of chosen parameters lower limit at READOUT PARA in conjunction with PARAREAD command
5	4	READLLIM	Readout of chosen parameters upper limit at READOUT PARA in conjunction with PARAREAD command
6	5	PARAREAD	Readout of the chosen parameter
7	6	PARAVALID	Transfers the chosen parameter
8	7	PARAMODE	Activates the parametrization mode

7.6 Feedback from PQDXXA Modul (Slave)

7.6.1 Actual values – overview

Nr.	Byte	Function	Type	Range	Unit
1	0	Status word Hi Status word Lo	int		
2	1				
3	2	Reserve (Status word)			
4	3				
5	4	Displacement command Hi Displacement command Lo	int	0... 0x3FFF	0... 100 %
6	5				
7	6	Displacement actual value Hi Displacement actual value Lo	int	0... 0x3FFF	0... 100 %
8	7				
9	8	Control error displacement control Hi Control error displacement control Lo	int	0... 0x3FFF	0... 100 %
10	9				
11	10	Correcting variable displacement control Hi Correcting variable displacement control Lo	int	0... 0xC001 0... 0x3FFF	+/- 100 %
12	11				
13	12	Pressure command Hi Pressure command Lo	int	0... 0x1770	0,1 bar
14	13				
15	14	Pressure actual value Hi Pressure actual value Lo	int	0... 0x1770	0,1 bar
16	15				
17	16	Control error pressure control Hi Control error pressure control Lo	int	0... 0x1770	0,1 bar
18	17				
19	18	Correcting variable pressure control Hi Correcting variable pressure control Lo	int	0... 0x3FFF	0... 100 %
20	19				
21	20	Displacement limit horse power lim. Hi Displacement limit horse power lim. Lo	int	0... 0x3FFF	0... 100 %
22	21				
23	22	Displacement sensor signal Hi Displacement sensor signal Lo	int	0... 1000	0,01 V
24	23				
25	24	Current to displacement valve Hi Current to displacement valve Lo	int	-2720... 0...2720	mA
26	25				
27	26	Current to pressure valve Hi Current to pressure valve Lo	int	0...2720	mA
28	27				
29	28	Read parameter value Hi ... ... Read parameter value Lo	long		Depending on chosen parameter
30	29				
31	30				
32	31				

7.6.2 Definition Status word

Byte 0 – Status word Hi			
Nr.	**Byte**	**Function**	
1	0	$\overline{\text{DERROR}}$	Internal data error
2	1	$\overline{\text{CHKERROR}}$	Check sum error in the field bus communication
3	2	$\overline{\text{BUFFEROV}}$	Overflow in the fieldbus communication
4	3	HW ENABLE	Feedback PIN 8 (Hardware ENABLE)
5	4	$\overline{\text{ERROR}}$	Cumulative error
6	5	P ACTIVE	Pressure control loop active and overwriting displacement control
7	6	POWER LIM P	Horse power control active
8	7	READY	General operating status

Byte 1 – Status word Lo			
Nr.	**Byte**	**Function**	
1	0	LIVEBIT OUT	Feedback on fieldbus monitoring
2	1	$\overline{\text{IQA ERROR}}$	Error displacement valve – coil A
3	2	$\overline{\text{IQB ERROR}}$	Error displacement valve – coil B
4	3	$\overline{\text{IP ERROR}}$	Error pressure valve
5	4	$\overline{\text{XQ ERROR}}$	Error displacement sensor
6	5	$\overline{\text{XP ERROR}}$	Error pressure sensor
7	6	PARA READY	Parameter has been taken over correctly
8	7	PARA ACTIVE	Parametrization mode active

7.7 Parametrization on field bus

7.7.1 Procedure

Preparations:
- Both the control stage and amplifier stage need to be on power supply
- Ensure a safe state and position of your machine or application.

Parametrization:
- The PARAMODE (0) bit need to be activated, to enable the parametrization mode. The corresponding slave feedback is the PARA ACTIV (7.6.2) bit.
- Select the address of the parameter which need to be changed at Parameter index (7.5.1) and the according value at Parameter value (7.5.1).
- The selected data will be send with the PARAVALID (0) bit. The corresponding slave feedback about the successful parametrization is the PARA READY (7.6.2) bit.
- Text parameter need to be selected with a corresponding number shown in the parameter list (7.7.2).

NOTICE
Parameter outside the valid parameter limitations (READLLIM / READULIM, 0) are not accepted from the controller and will not return a PARAREADY. Sending parameter with wrong value can lead to unwanted and serious consequences.

7.7.2 Parameter list

Nr.	Index [HEX]	Index [DEC]	Parameter	Range		Comment
1	0x2001	8193	PVSEL	0x1...	0xF	0x1="16cc"... xF="CUSTOM"
2	0x2002	8194	TYPE	0x1...	0x4	0x1="F"... 0x4="S"
3	0x2003	8195	CO	0x1...	0x2	0x1="FP/UP", 0x2="FD/UD"
4	0x2004	8196	DS:P_VALVE	0x1...	0x2	0x1="11", 0x2="12"
5	0x2011	8209	P:SENSOR	0xA...	0x258	
6	0x2012	8210	P:NOMINAL	0xA...	0x258	
7	0x2013	8211	P:CORR	0x0...	0x28	
8	0x2014	8212	PL:RPM	0x12C...	0xBB8	
9	0x2015	8213	PL:PL	0x1...	0x1388	
10	0x2016	8214	Q:CORR	0x0...	0x3E8	
11	0x2021	8225	AQ:UP	0x1...	0x927C0	
12	0x2022	8226	AQ:DOWN	0x1...	0x927C0	
13	0x2023	8227	AP:UP	0x1...	0x927C0	
14	0x2024	8228	AP:DOWN	0x1...	0x927C0	
15	0x2025	8229	MIN:XQ	0x0...	0x2710	
16	0x2026	8230	MAX:XQ	0x0...	0x2710	
17	0x2027	8231	AIN:XQ	0x1...	0x2	0x1="V", 0x2="C"
18	0x2028	8232	AIN:XP	0x1...	0x2	0x1="V", 0x2="C"
19	0x2031	8241	CQ:FF	0x0...	0x2710	
20	0x2032	8242	CQ:P	0x0...	0x2710	
21	0x2033	8243	CQ:I	0x0...	0x7530	
22	0x2034	8244	CQ:I_LIM	0x0...	0x2710	
23	0x2039	8249	CQ:IC	0x0...	0x3E8	
24	0x2036	8246	CQ:D	0x0...	0x4B0	
25	0x2037	8247	CQ:T1	0xA...	0x64	
26	0x2041	8257	CP:FF	0x0...	0x2710	
27	0x2042	8258	CP:P	0x0...	0x2710	
28	0x2043	8259	CP:I	0x0...	0x7530	
29	0x2044	8260	CP:I_LIM	0x0...	0x2710	
30	0x2045	8261	CP:IC	0x0...	0x2710	
31	0x2046	8262	CP:D	0x0...	0x4B0	
32	0x2047	8263	CP:T1	0xA...	0x64	
33	0x2051	8273	CQ:MINVA	0x0...	0x3E8	
34	0x2052	8274	CQ:MINVB	0x0...	0x3E8	
35	0x2053	8275	CQ:MAXVA	0x12C...	0xAA0	
36	0x2054	8276	CQ:MAXVB	0x12C...	0xAA0	
37	0x2055	8277	TRIGGER:Q	0x0...	0xBB8	
38	0x2056	8278	OFFSET:Q	0xEC78	0x1388	

Nr.	Index [HEX]	Index [DEC]	Parameter	Range		Comment
39	0x2061	8289	CP:MINV	0x0...	0x3E8	
40	0x2062	8290	CP:MAXV	0x12C...	0xAA0	
41	0x2063	8291	TRIGGER:P	0x0...	0xBB8	
42	0x2071	8305	DFREQ:Q	0x2C...	0x199	
43	0x2072	8306	DAMPL:Q	0x0...	0xBB8	
44	0x2073	8307	PWM:Q	0x1...	0x14	0x1=100...0x11=2604
45	0x2074	8308	PPWM:Q	0x0...	0x1E	
46	0x2075	8308	IPWM:Q	0x1...	0x64	
47	0x2081	8309	DFREQ:P	0x2C...	0x199	
48	0x2082	8321	DAMPL:P	0x0...	0xBB8	
49	0x2083	8322	PWM:P	0x1...	0x14	0x1=100...0x11=2604
50	0x2084	8324	PPWM:P	0x0...	0x1E	
51	0x2085	8325	IPWM:P	0x1...	0x64	
52	0x2222	8738	BUS_STORE	12345		“SAVE” Command
53	0x2233	8755	BUS_DEFAULT	12345		“DEFAULT” Command
54	0x2244	8772	BUS_LOADBACK	12345		“LOADBACK” Command

8 FUNCTION BLOCKS FOR SIMATIC CONTROLS

NOTICE
Function blocks described below are deployable at SIEMENS programmable logic controllers (PLCs). The software “Totally integrated Automation Portal” (TIA – PORTAL, min. V 13) or Step 7 (min. V 5.4.) are necessary. The mentioned software need different file types which lead to multiple source files.
Two function blocks are available for the comfortable integration and direct modules use out of the PLC user program. Following sections showing installation into the PLC user program and necessary configurations.

Software	TIA-Portal (*.scl file format)		Step 7 (*.awl file format)
PLC type	S7 – 1200/S7 – 1500	S7 – 300/S7 – 400	
- Driver - Introducing I/Os and according scaling	PQDXXA_PFN.scl	PQDXXA_PFN_TIA_KLASSIK.scl	PQDXXA_PFN.awl
- Parametrization - Introducing a comfortable way of parametrization.	PQDXXA_PARA.scl		PQDXXA_PARA.awl

The latest versions are available in the download section of the product website.
If revisions are attached to the file name, upward compatibility is generally guaranteed.

8.1 Function Block – Driver

8.1.1 Common Properties

The driver function block I/Os are generally corresponding to the descriptions in section 7.4, page 36.

Attention should be paid to:

- Command values for displacement and power limitation in format “real” and unit [%]
- Command value for pressure in format “real” and unit [bar]
- Signals to change parameter are summarized in the structure PAR_CHANGE_IN (usage optional)
- Input DEV_ID requires the hardware identification of the I/O module (TIA Portal)
- The inputs ADR_IN / ADR_OUT require the start addresses from the hardware identification (Step 7 classic))
- The error bits are not inverted, a “TRUE” signalizes an error at the according port.
- A collective bit, signalizing the BUS communication (BUS_VALID)
- A detailed information about the communication error can be retrieved from the output BUS_ERROR_CODE

BUS ERROR CODE		
Nr.	**Bit**	**Function**
1	0	Internal data error (DERROR)
2	1	Error in Checksum PROFINET (CHKERROR)
3	2	Data overflow PROFINET (BUFFEROV)
4	3	Error incoming Messages (access to input address, module SPS)
5	4	Error outgoing Messages (access to output address, SPS module)
6	5	No Data transfer (WATCHDOG)
7	6	
8	7	

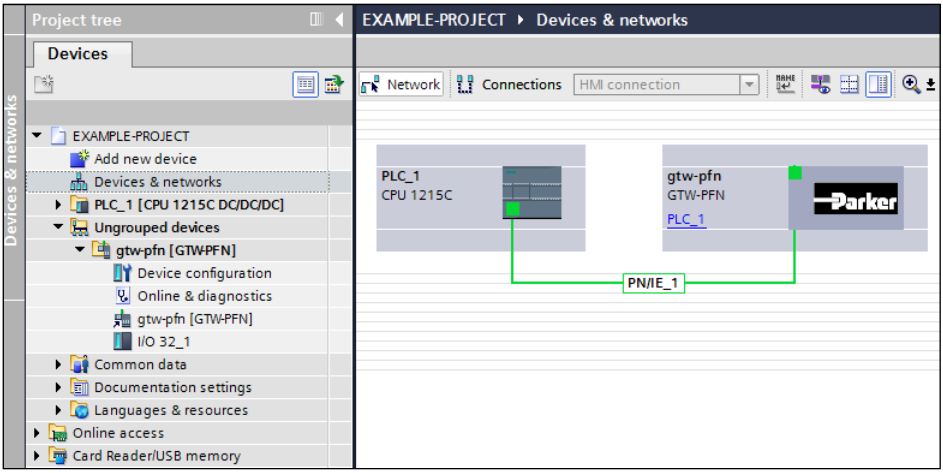
- Actual values as well as the feedback on the command values are in format „real“ and the unit [%]

NOTICE

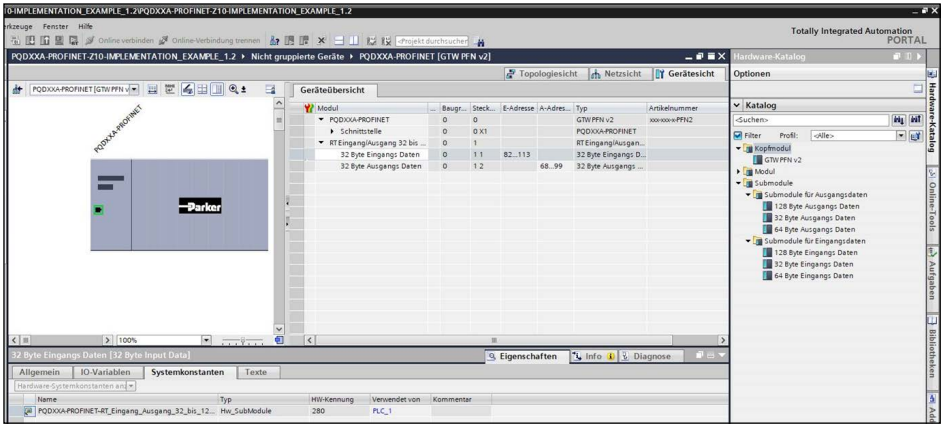
In case the BUS communication is failing or interrupts, the modules feedback is not reliable. In most cases the feedback gets frozen. If those feedback values control further process related functions, the Bit “BUS_VALID” should be evaluated and maneuver the entire system to a safe state with alternative values.

8.1.2 Implementation with TIA Portal

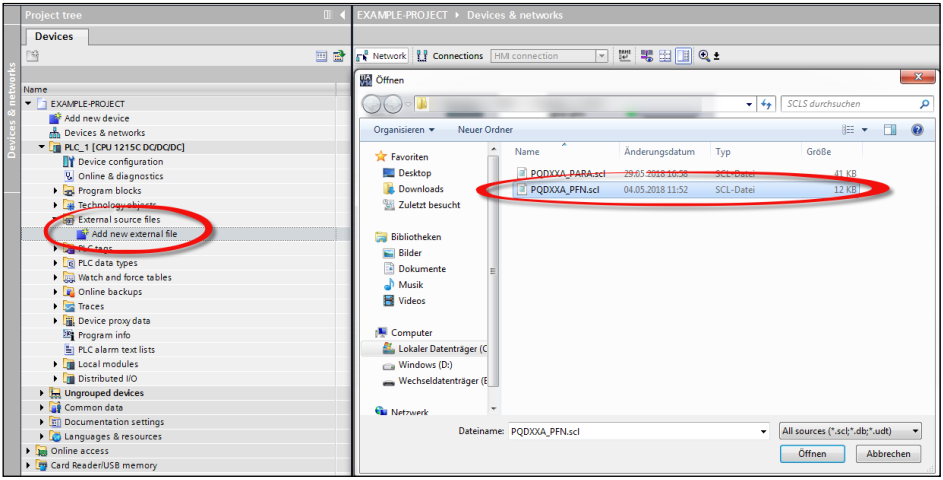
- Import the GSDML file as described in section 7.3.1, page 34.
- Import as many as needed pump modules in the “Devices & networks” (in network view) by drag & drop.
- Install the PROFINET Communication between PLC (Master) and PQDXXA-PROFINET-Z10 (Slave).



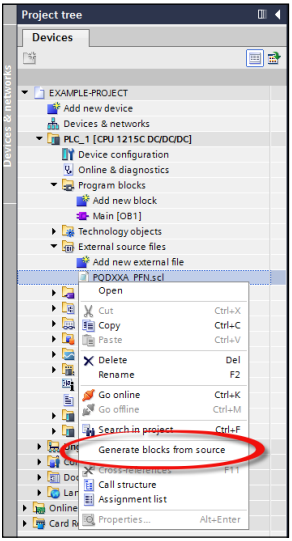
- Add the communication interface under “Devices & Networks”. In the device view, assign one 32-byte input and one 32-byte output. The I/O modules are located under Submodules and can be added via drag-and-drop. The hardware ID (HW ID), separately for input and output, under System Constants will be required again when parameterizing the parameterization block.



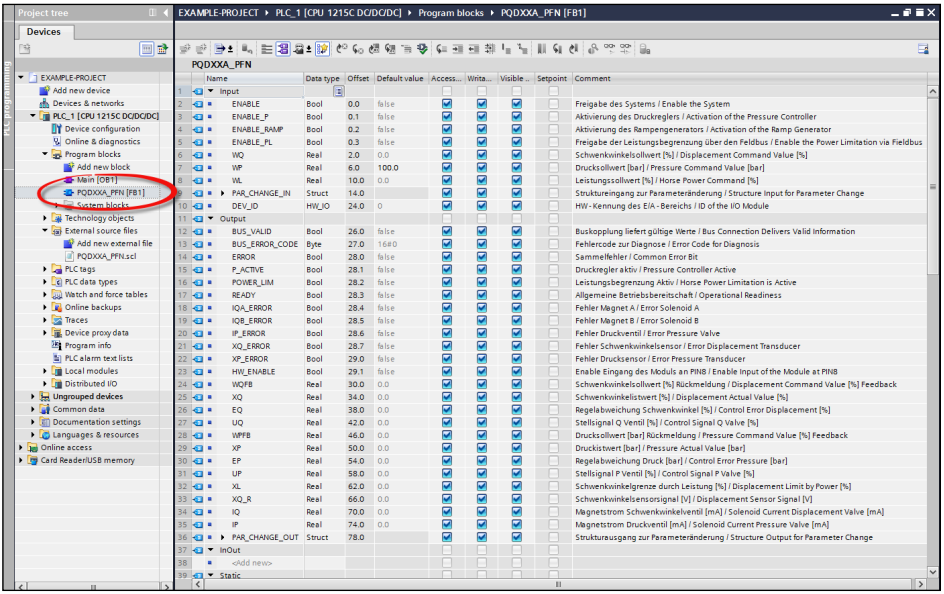
- The driver function block is delivered in SCL format (File: PQDXXA_PFN.scl) and need to be installed in TIA Portal as external source file.



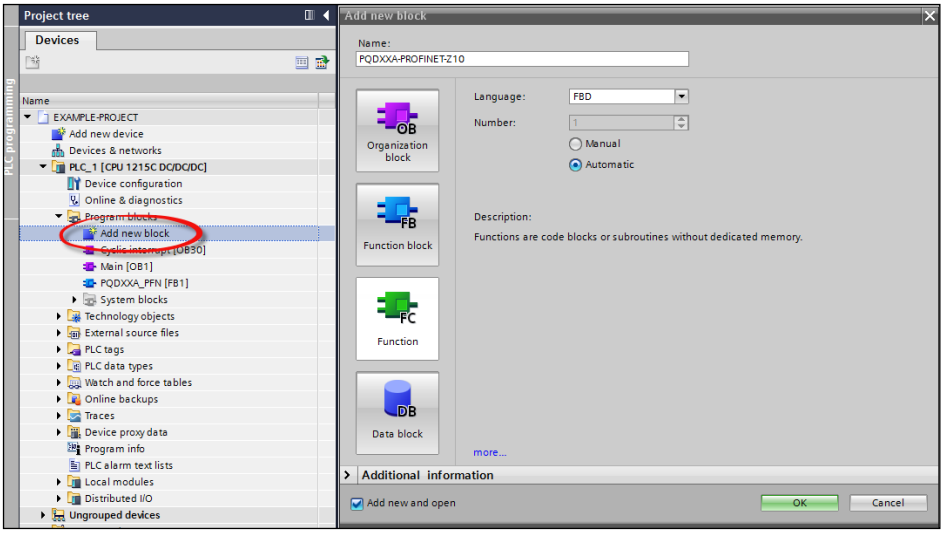
- Generate the function block from just imported external file with the right mouse button dialog.



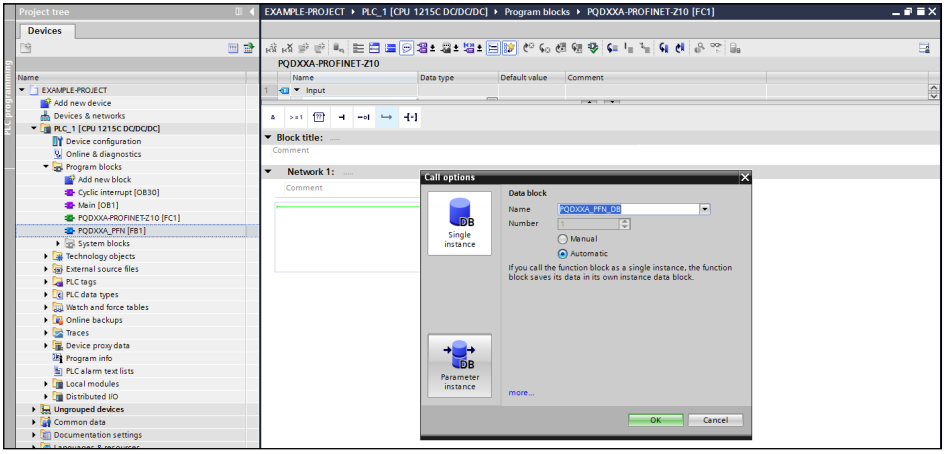
- The function block is ready to use in the “Program blocks” folder after translation. The functions block number may differ. The parameter descriptions are implemented in the comment column.



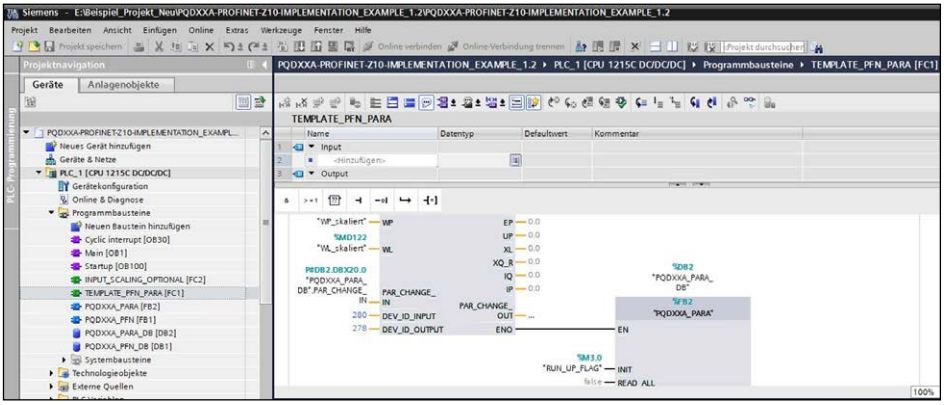
- The Function block is now ready to use in the PLC user program (function). If the function block is used in a separate function it need to be created as shown below. The functions name is freely selectable.



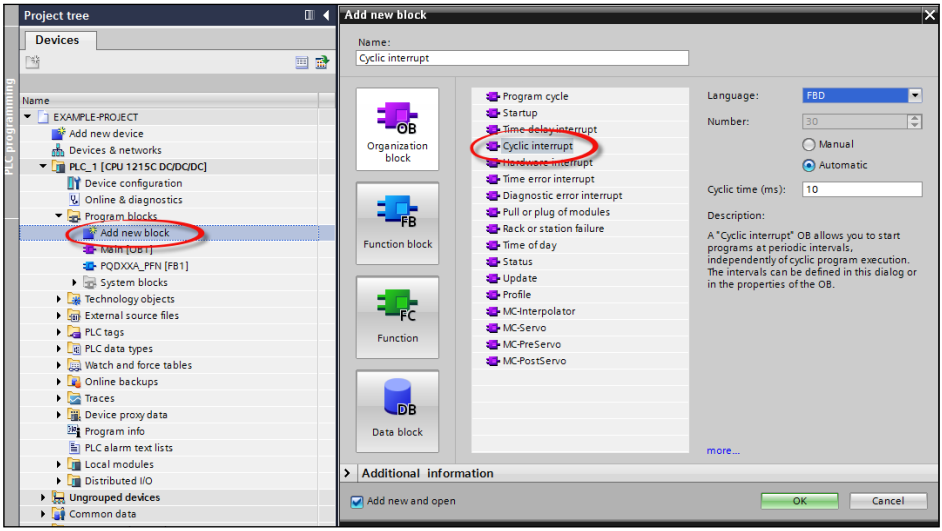
- While installing the function block by drag and drop in the just created function / network a new instance data block gets created where the function block saves its data to.



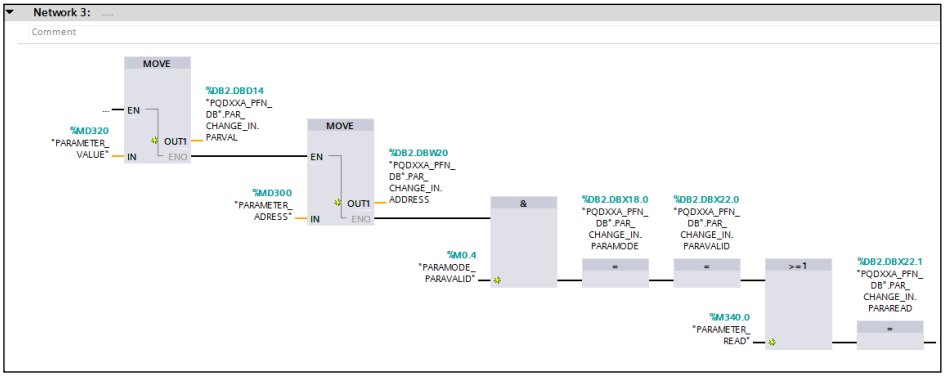
- The created block appears unconnected. The Hardware identifier needs to be entered at DEV_ID_INPUT & DEV_ID_OUTPUT.



- The function (here: PQDXXA-PROFINET-Z10 [FC1]) should be called in a “Organization block” of type “Cyclic Interrupt” with a cycle time › 10 ms. A cycle time of max. 50 ms is recommended to have a quick process of the asynchronously working communication especially when using the function block for parametrization. The function cannot be used directly in the Main program block OB1.

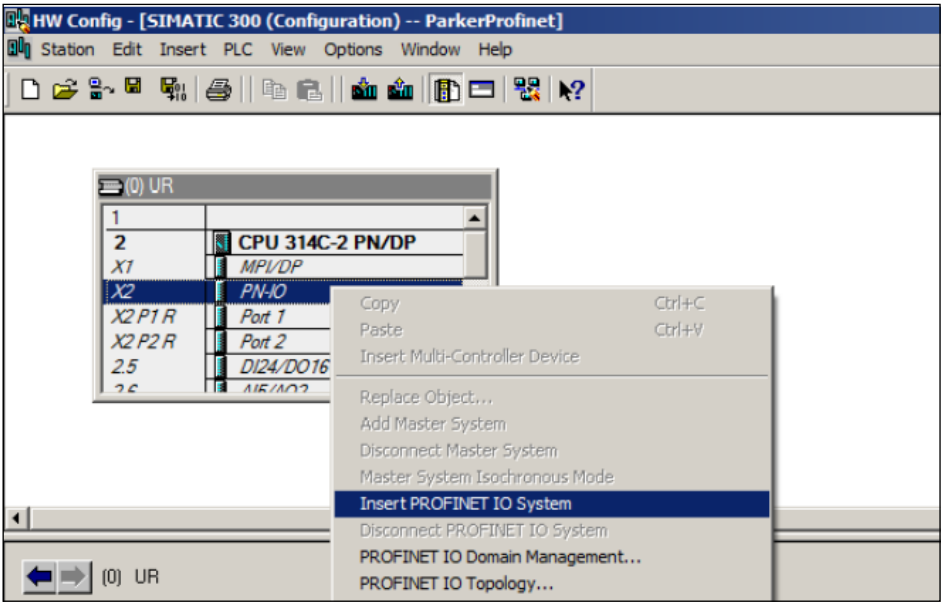


- If the function block for parametrization (section 8.2.3, page 58) is not used below shown network example can be used as simplified substitute. “Parameter Address” can be translated on HMI with the provided text list included in the implementation package.

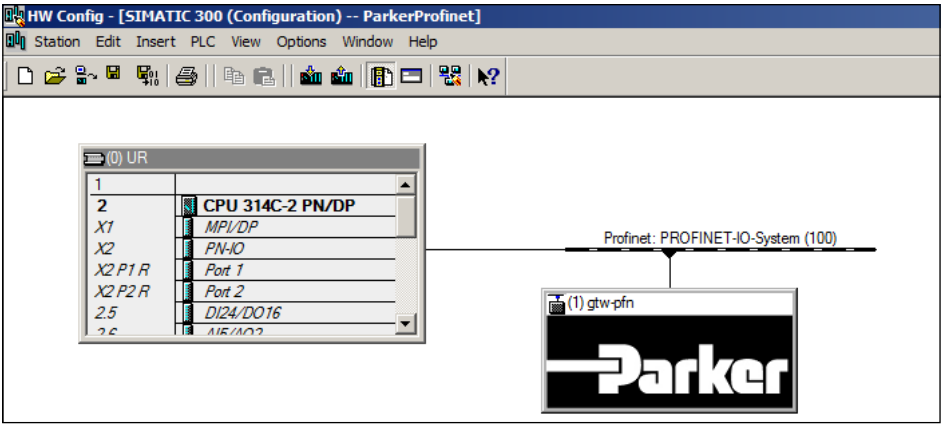


8.1.3 Implementation with Step 7 Classic

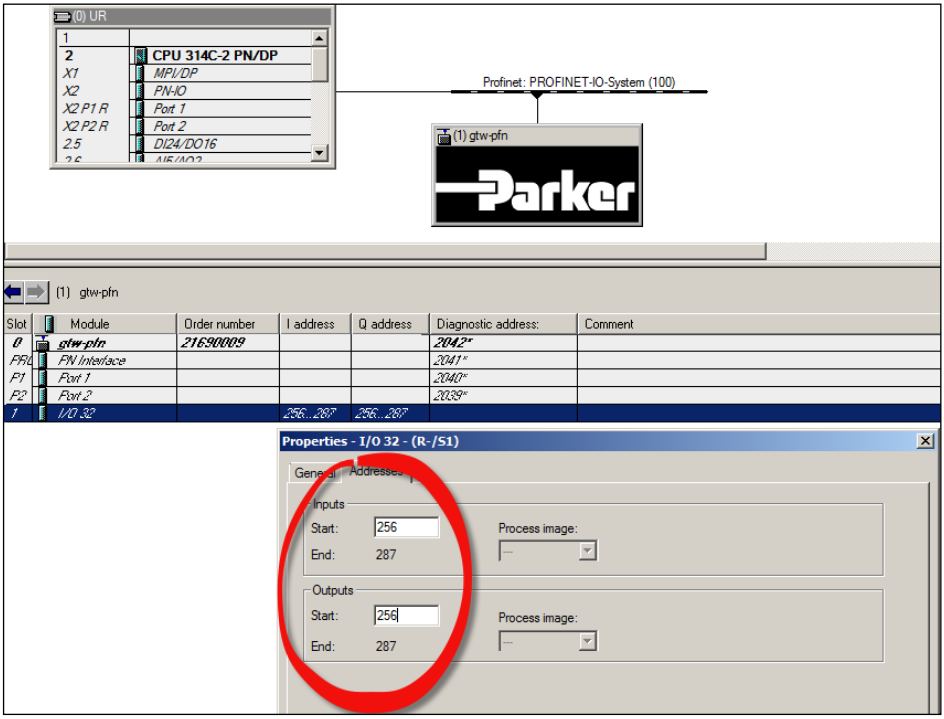
- Import the GSDML file as described in section 7.3.2, page 35.
- Insert a PROFINET IO System:



- Import as many as needed pump modules in the “Devices & networks” environment/view by drag & drop:[Devices & networks]” mittels “drag & drop”.

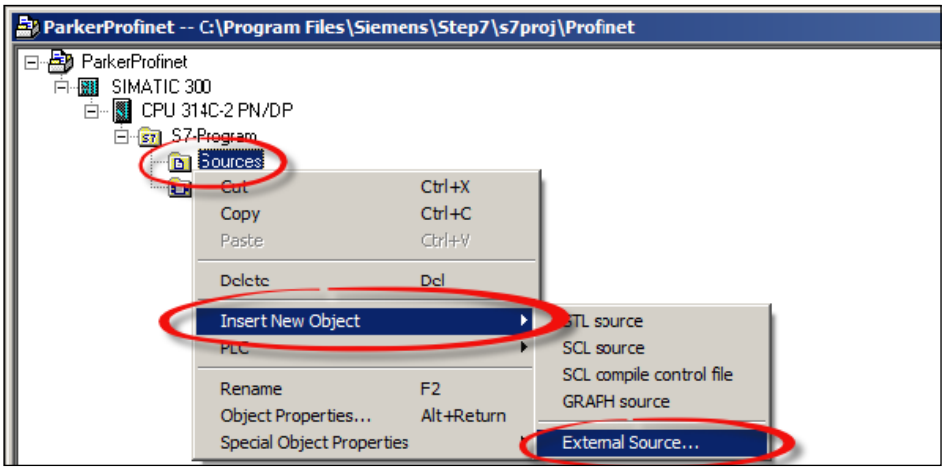


- Check if the 32 byte I/O has been installed correctly under “Devices & network” (component level). Addresses are assigned automatically. Ranges are displayed after double – clicking on the belonging entry:

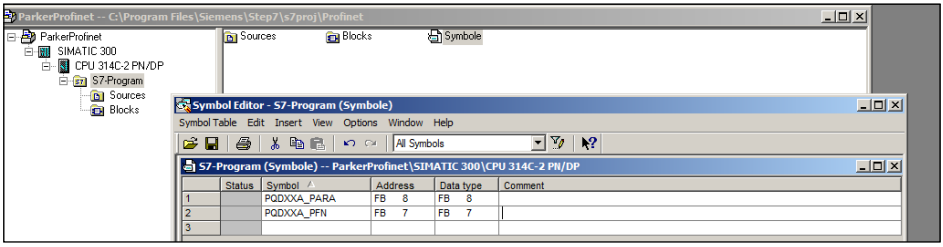


The start addresses need to be entered at the driver function block later.

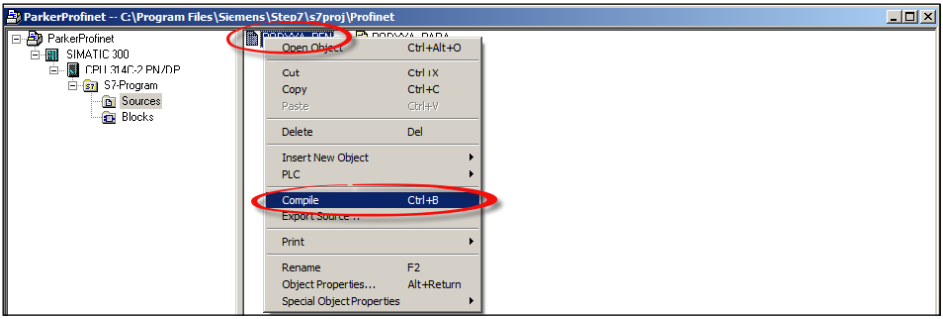
- The driver function block is delivered in AWL (STL) format (File: PQDXXA_PFN.awl) and needs to be installed in Step7 as external source file.



- Edit the symbol table of the program folder and add free FB numbers for the driver and eventually for the parametrization block. The Symbolic names need to match the names in the sources:

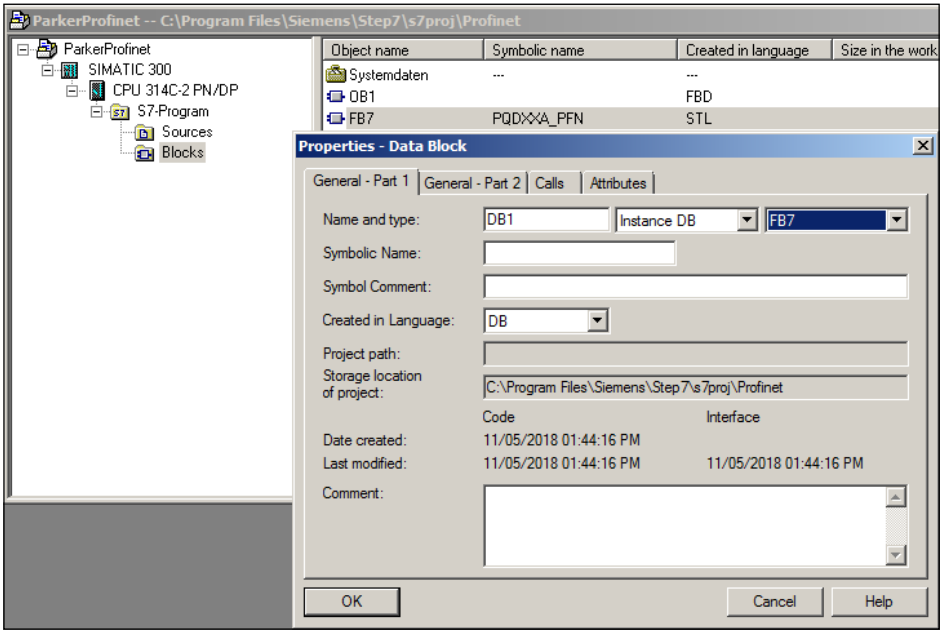


- Translate the source by right – click and “Compile” before using the function block in the PLC user program (function):



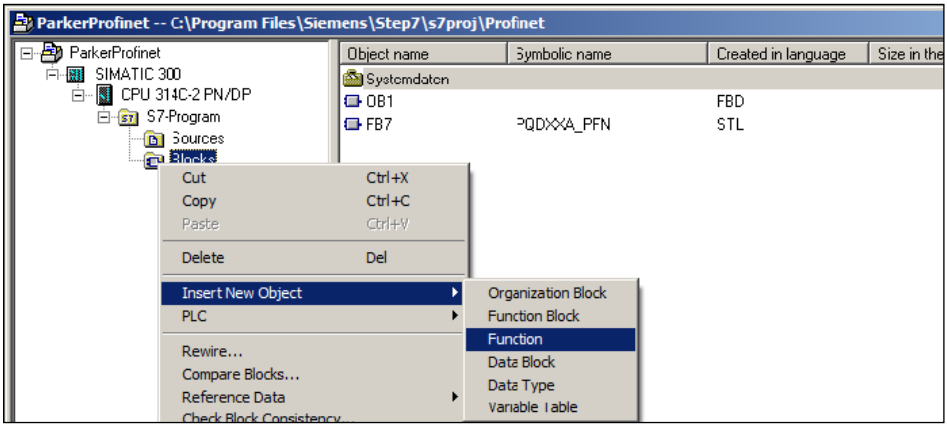
- The next steps show the usage of the block in the LAD/STL/FBD editor. If you use CFC, the driver can be directly drawn in a plan.

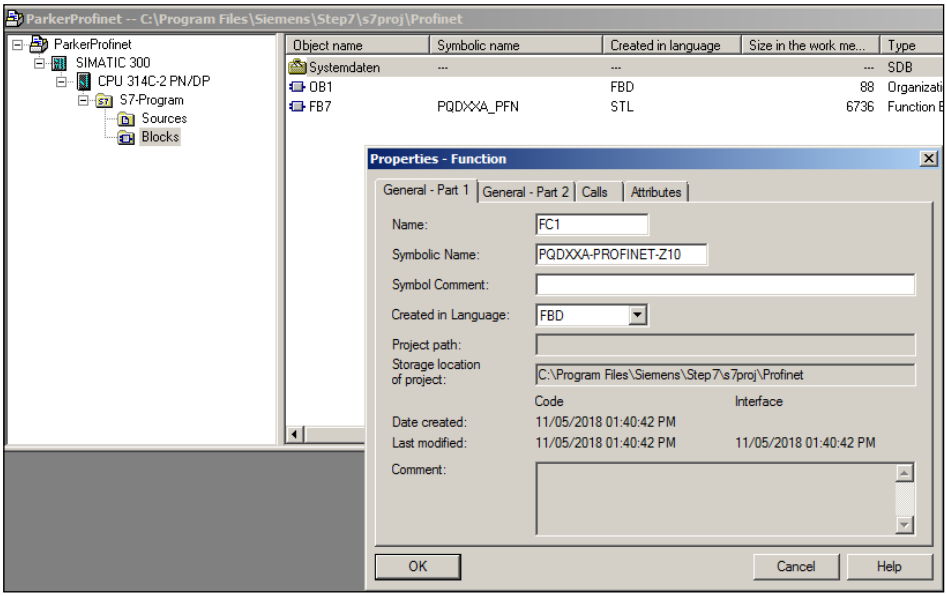
  Generate an instance – DB for the driver:



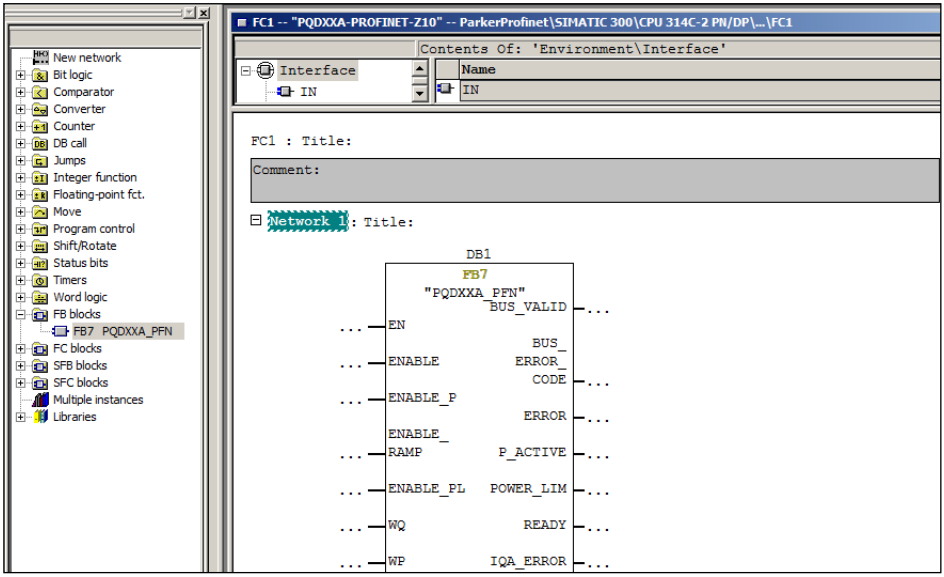
NOTICE
It is advisable to assign a symbolic name, e.g. “PQDXXA_PFN_DB”.

- If the function block is used in a separate function it need to be created as shown below. The function's number and symbolic name is freely selectable.

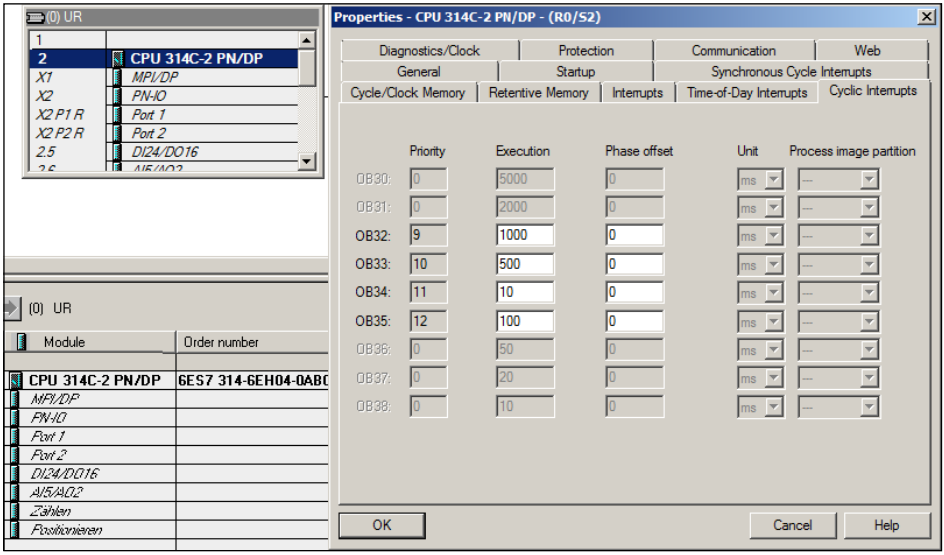




- Open the new empty function and insert a call of the driver block with the associated instance DB. The start addresses from the hardware overview need to be entered at ADR_IN and ADR_OUT:



- The function (here: PQDXXA-PROFINET-Z10 [FC1]) should be called in an organization block of type “Cyclic Interrupt” with a cycle time ⩾ 10ms. Here an OB34 is used. The cycle time is set in the property dialog of the PLC in the HW Config program.

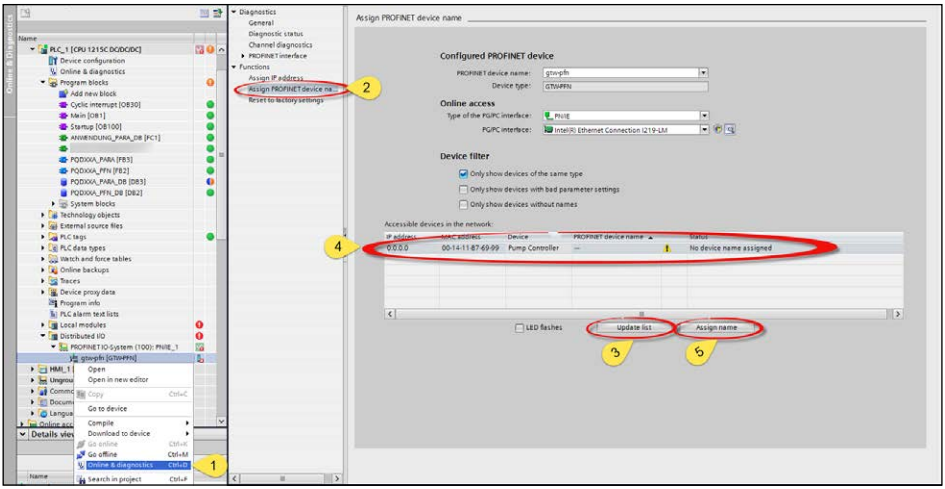


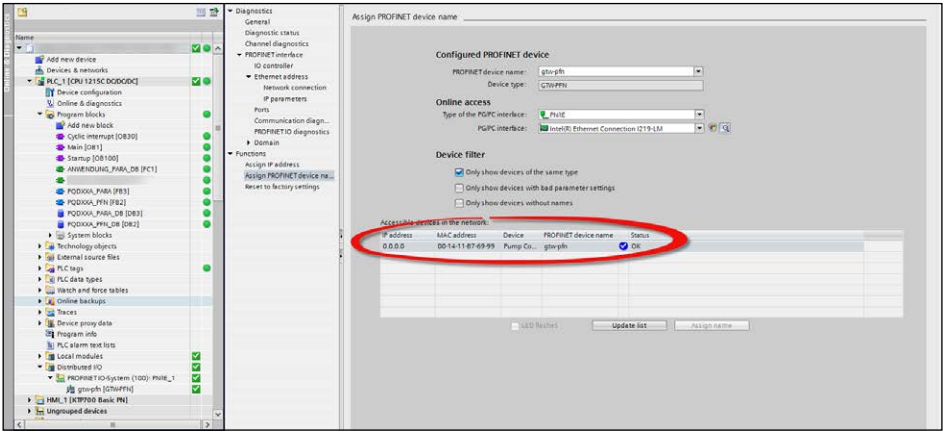
8.1.4 Practical module start-up

After implementing the module GSDML and implementing the hardware topology the module can be started up in the BUS environment.

ASSIGN PROFINET device name – TIA Portal

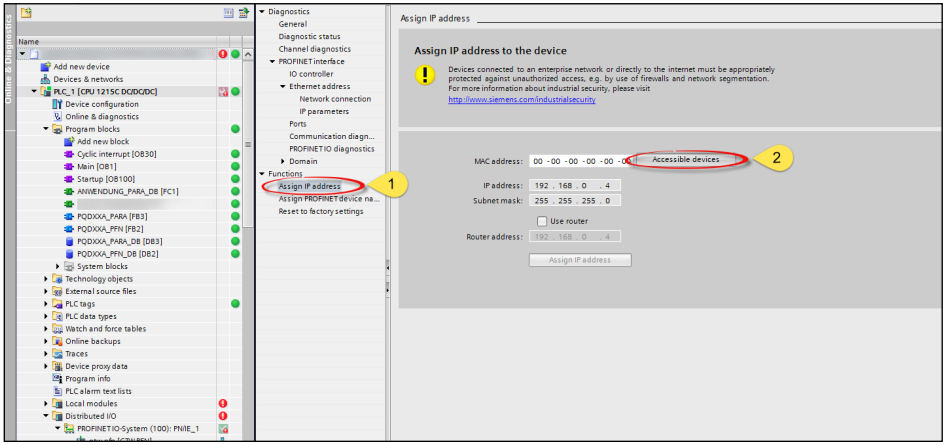
- The module will not be recognized correct by the MASTER since the PROFINET device name is not assigned by factory. Therefore, select the “Online & diagnostics” function, direct to “Assign PROFINET device name” and update the list of devices which same type as the pump controller module. Assign the name after the module has been shown up. This is “GTW-PFN” by default or another name you have assigned in the offline project.
- The LED flash option is visible at the ERROR light.

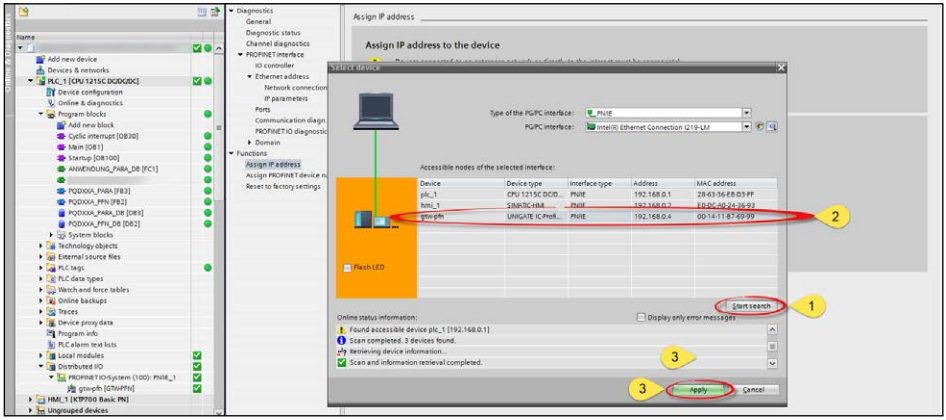


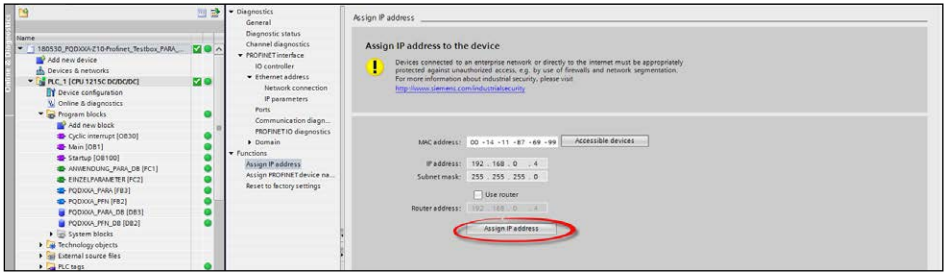


ASSIGN IP address – TIA Portal

- The module will also start up with unassigned IP. The IP assignment is done in the same “Online & diagnostics” function. Below shown picture describing the procedure to assign the IP properly. Sometimes a restart of PLCs run mode ensures that the initial communication is build up.



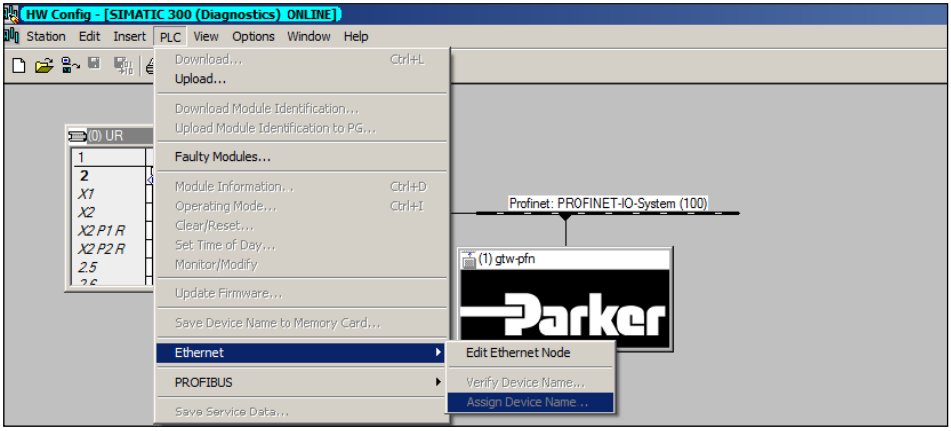




ASSIGN PROFINET device name – STEP 7

- Switch to ONLINE mode in the HW Config and choose “Ethernet / Assign Device Name”. A list of all found devices will open. The name of the pump controller need to be entered there. This is “GTW-PFN” by default or another name you have assigned in the offline project.

An explicit designation of the PROFINET device's IP address is not necessary, the controller will dynamically assign it during run-up.



8.2 Function Block – Parametrization

8.2.1 Prerequisites

Prerequisite for the usage is the implementation of the general “driver function block” mentioned in section 8.1.2 or 8.1.3.

8.2.2 Common Properties

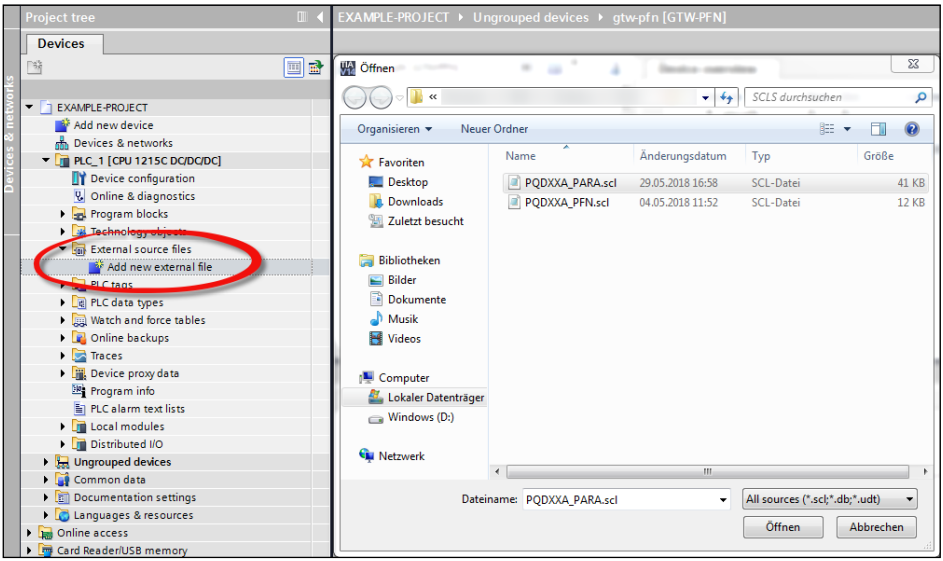
Supplemental TIA Portal / Step7 function block to the “Driver” function block of the pump control module.

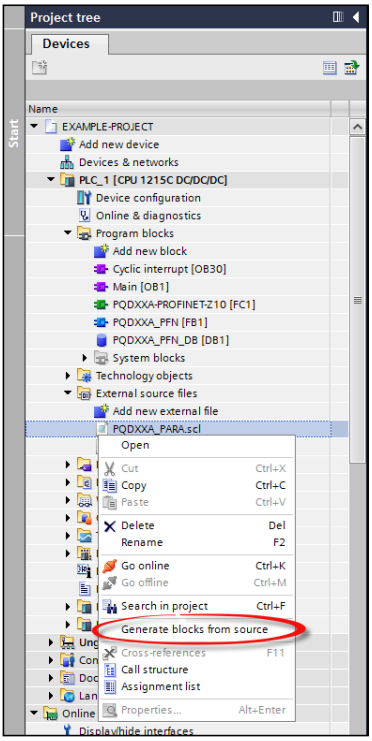
Summarized Content:

- Function to read and write complete data sets (prerequisite: ENABLE = FALSE)
- Function to write selected parameter which drive parameter setting underneath (prerequisite: ENABLE = FALSE)
- Function to modify single Parameter within a running machine process (possible both with ENABLE = TRUE or FALSE)
- Data set commandos – Save, Load back and Default

8.2.3 Implementation with TIA Portal

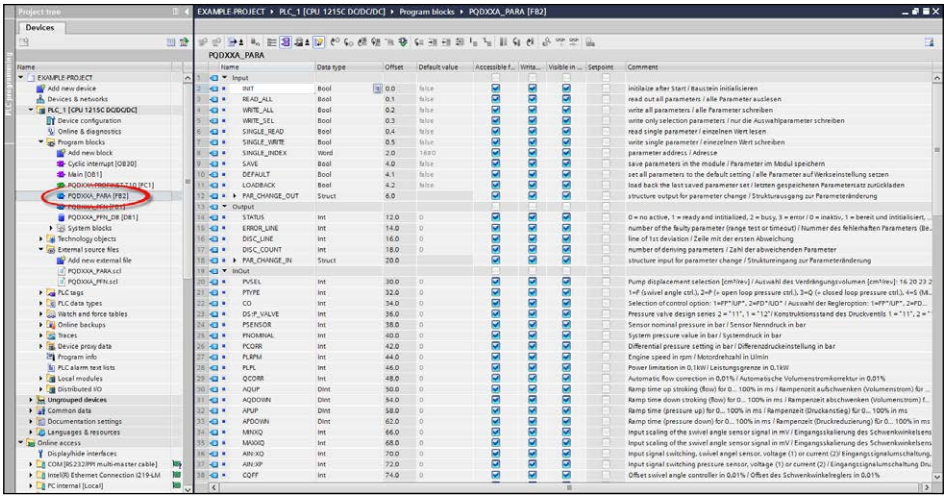
- The function block is delivered in SCL format as well and need to be installed in TIA Portal as external source file.





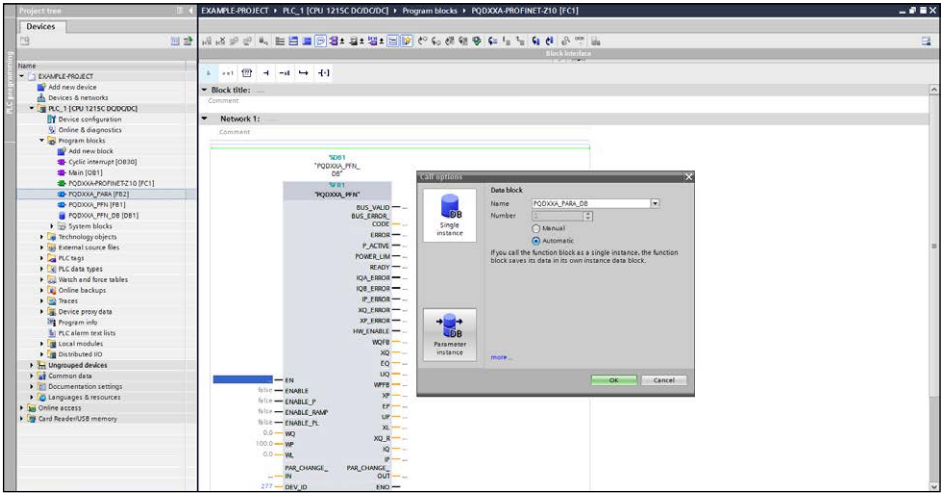
- Generate the function block from just imported external file with the right mouse button dialog.

- The function block is ready to use in the “Program blocks” folder after compilation. The function blocks number may differ. The parameter descriptions are implemented in the comment column.



- The Function block is now ready to be used in the functions / networks. A new instance data block gets created where the PQDXXA_PARA function block saves its data to while installing the FB by drag and drop. The usage/installation in the “Main” organization block is not possible.

A quick cycle time, not higher than 50 ms is recommended. The asynchronous communication, running multiple cycles would take too long for quick start up and parametrization. The usage of PQDXXA_PARA in the same network as PQDXXA_PFN is advisable.

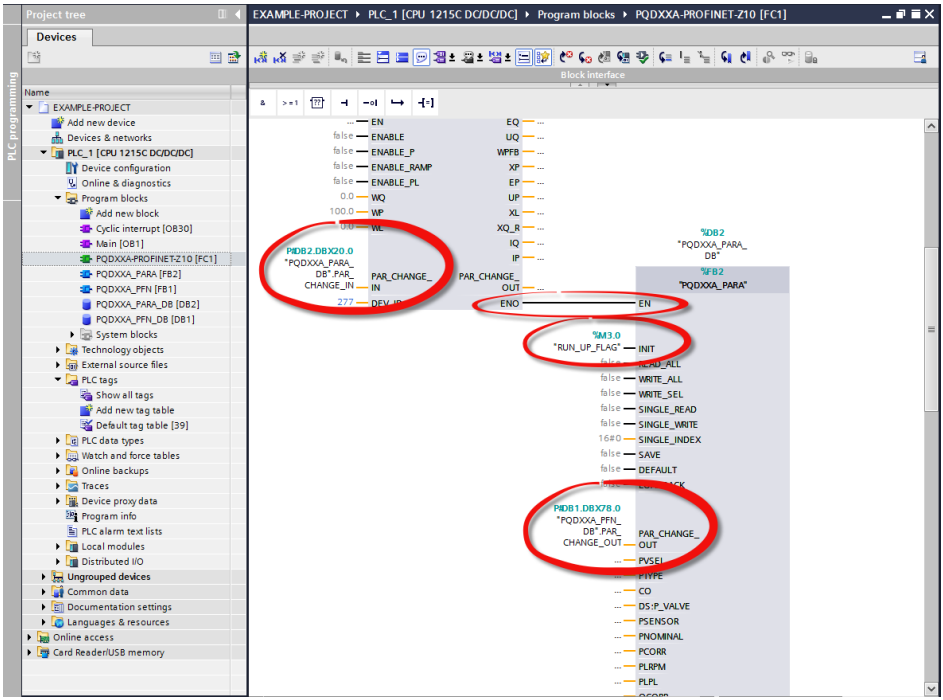


- Connect

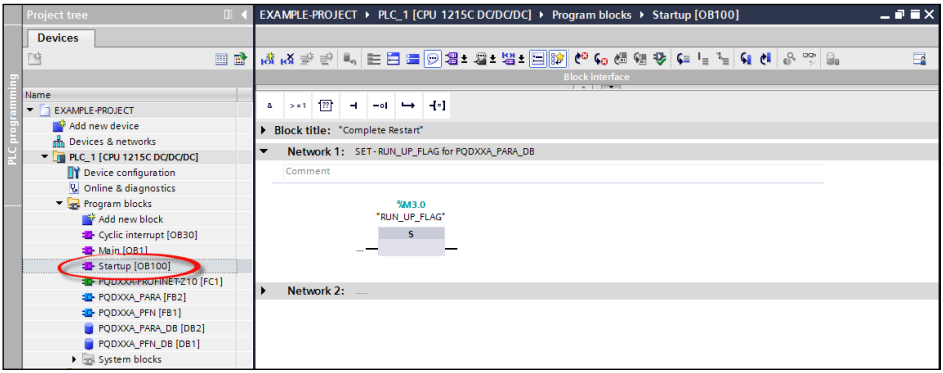
  The PQDXXA_PFN output (ENO) with the Input (EN) of the PQDXXA_PARA.

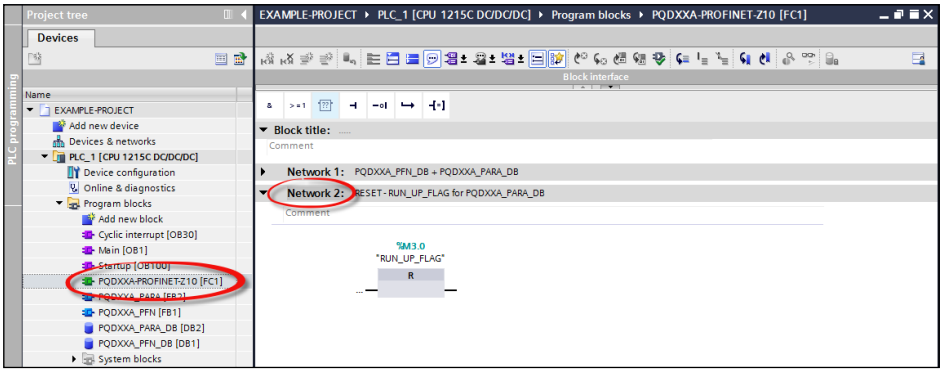
  Furthermore, connect the structure variable PQDXXA_PARA_DB.PAR_CHANGE_IN to the input “PAR_CHANGE_IN” of the driver function block “PQDXXA_PFN”

  as well as the structure variable PQDXXA_PFN_DB.PAR_CHANGE_OUT to the input “PAR_CHANGE_OUT” of the parametrization FB



- The entire block needs to be initialized with a “run up flag” (connected to INIT) at least for one cycle after the PLC has been started up. One possible implementation is the installation of a flag OB100 (start-up) and a corresponding flag reset after the network has been processed once.





Due to the internal handling of the instance data block as image of the set values it is not recommended to use the data block in form of a multi instance.

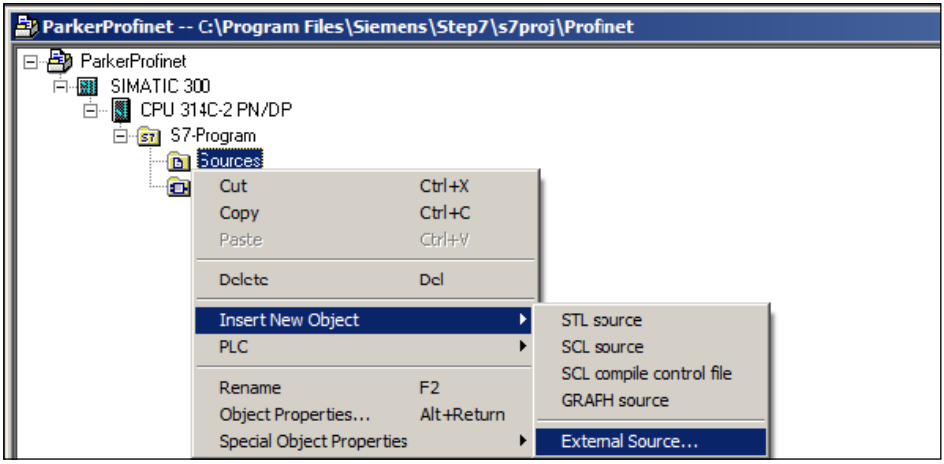
The pump controller's parameter are designed as In- and output parameter in the instance data block.

There are two alternative usage possibilities:

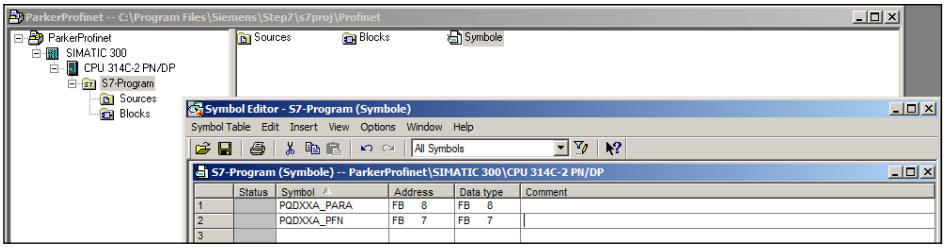
- Set and monitor the parameter values with the online view of the instance data block in TIA Portal.
- Link the parameter to according in- and output fields of WinCC, WinCC flexible or different HMI application.

8.2.4 Implementation with Step 7 Classic

- The function block is delivered in AWL (STL) format (File: PQDXXA_PARA.awl) and needs to be installed in Step7 as external source file:



- Edit the symbol table of the program folder and add free a FB number for the parametrization block, if this has not been accomplished yet during the setup of the driver. The symbolic name needs to match the name in the source:

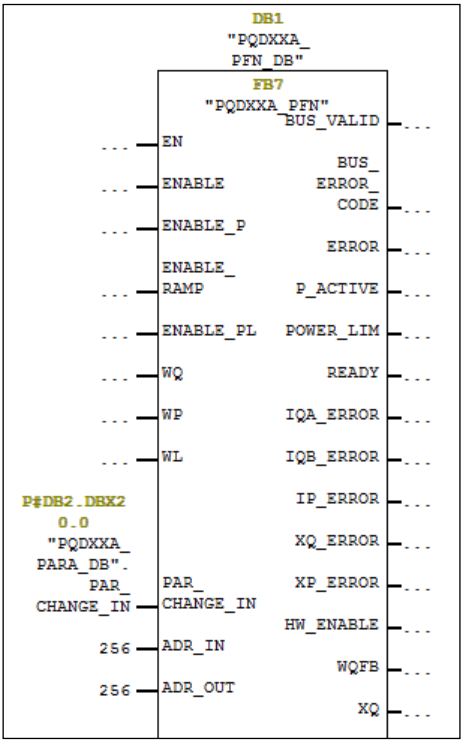


- Translate the source by right – click and "Compile". Warnings occurring during the translation can be ignored. The Function block is now ready to use in the PLC user program (function).
- If you use the LAD/STL/FBD editor, create an instance DB for the parametrization FB where the PQDXXA_PARA function block will save its data to. It makes sense to assign a symbolic name for this data block as well as for the instance data – block of the driver, e.g. "PQDXXA_PARA_DB" and "PQDXXA_PFN_DB". By this the symbolic access to their entries from the STL – editor is facilitated.
- The usage/installation of the parametrization block in OB1 (free cycle) is not possible. A quick cycle time, not higher than 50 ms is recommended. The asynchronous communication, running multiple cycles would take too long for quick start up and parametrization. The usage of PQDXXA_PARA in the same network as PQDXXA_PFN is advisable.

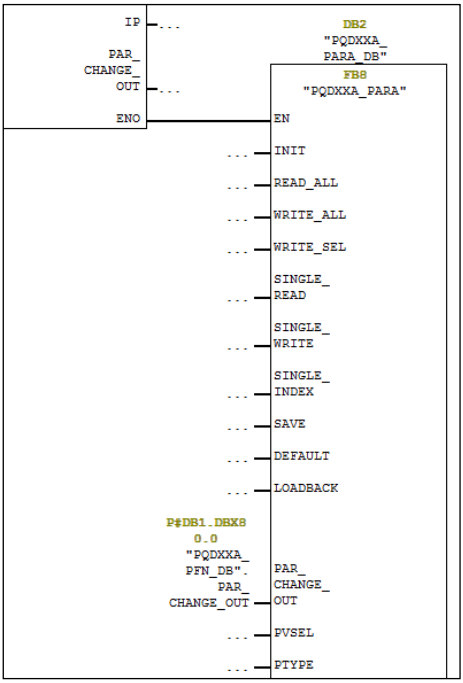
- Connect

  PQDXXA_PFN output (ENO) with the Input (EN) of the PQDXXA_PARA.

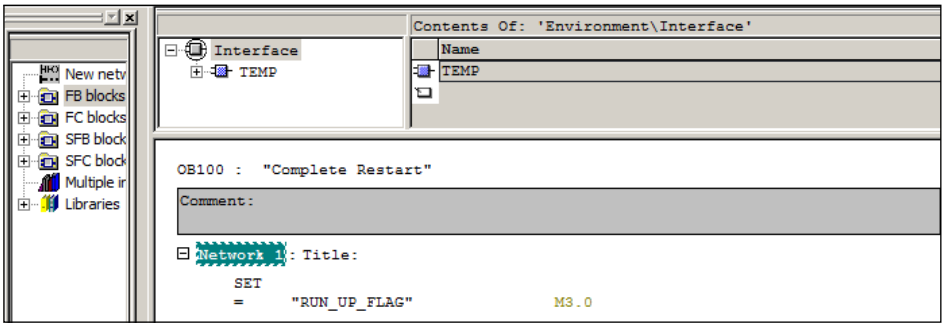
  Furthermore, connect the structure variable PQDXXA_PARA_DB.PAR_CHANGE_IN to the input “PAR_CHANGE_IN” of the driver function block “PQDXXA_PFN”:

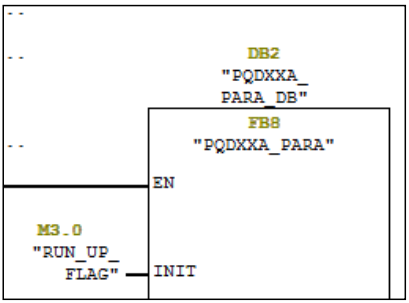


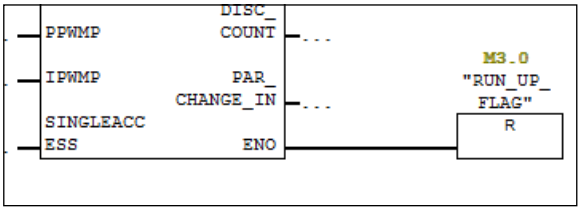
As well as the structure variable PQDXXA_PFN_DB.PAR_CHANGE_OUT to the input “PAR_CHANGE_OUT” of the parametrization FB:



- The entire block needs to be initialized with a “run up flag” at least for one cycle after the PLC has been started up. One possible implementation is the installation of a flag in OB100 (start – up) and a corresponding flag reset after the network has been processed once.







8.2.5 Function of Parametrization function block PQDXXA_PARA

Below mentioned In- and Output parameter are controlling the function of PQDXXA_PARA.

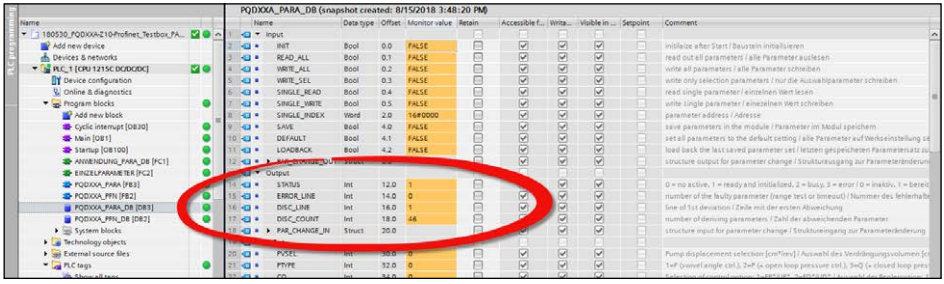
Function and Control of PQDXXA_PARA		
Input / Output	**Name**	**Function**
I	INIT	Block Initialization Current set parameter and the corresponding limits are read from the pump controller and stored inside an internal memory of the instance data block.
	READ_ALL	Modules current parameter are read out and stored in the IO array with a positive flank at this input (please see below for the IO array description).
	WRITE_SEL	Selected parameter such as PVSEL, (P)TYPE, CO, and DS:P_VALVE (driving underneath laying parameters) are written into the module with a positive flank at this input. All further parameters are read as a sequential process step and stored in the IO array.
	WRITE_ALL	The parameter at the IO array get written into the module with a positive flank at this input (please see below for the IO array description).
	SINGLE_READ	The parameter pointed to with “SINGLE INDEX” (please review the parameter list at section 7.7.2, page 42) gets read out with a positive flank at this input. The parameter value is shown at output “SINGLEACCESS” (please see below).
	SINGLE_WRITE	The parameter pointed to with “SINGLE INDEX” (please review the parameter list at section 7.7.2, page 42) gets written into the module with a positive flank at this input. The parameter value is taken from input “SINGLEACCESS” (please see below).
	SAVE	The parameters get saved into the non-volatile memory with a positive flank at this input. ⚠ **NOTICE** Do not automatically actuate this input since the amount of save commands might be too high for the EEPROM capability.
	DEFAULT	Modules parameter are set back to factory settings.
	LOAD BACK	Modules parameter are set back to current EEPROM content (last saved parameter set).
	SINGLE_INDEX	Index for the single parameter access (read / write).

Function and Control of PQDXXA_PARA		
Input / Output	**Name**	**Function**
I/O	"parameter name"	Image of modules parameter or parameter to written in the PLC. Comments displayed in the data block provide detailed information about the values need to put in. **NOTICE** Due to restrictions in programming the PQDXXA_PARA parameter names slightly differ from the parameter names displayed with the GUI ProPVplus. **NOTICE** State parameter are displayed as numerical value, PVSEL expects the displacement in cc. **NOTICE** The selection of a faulty value leads to an error displayed under "STATUS" while processing a write command.
	SINGLEACCESS	Parameter value which is read or written while processing a SINGLE_READ or SINGLE_WRITE command.
A	STATUS	Display of blocks status: 0 = inactive, 1 = ready and initialized, 2 = busy, 3 = error. The block displays several cycles 2 = busy while processing the block e.g. with READ_ALL or with INIT respectively. After successful operation/processing status turns back to 1 = ready and initialized. In case an error occurs while processing the PQDXXA_PARA block or the access is limited due to current settings (ENABLE in conjunction with WRITE_SEL or WRITE _ALL command) a 3 = error is displayed and static until the next command is being set.
	ERROR_LINE	Displays parameter number or line (please see the column "No." at section 7.7.2 Parameter list, page 42) if the parameter value is outside the limits or the process gets a timeout while processing write command.
	DISC_LINE	Displayed parameter number or line (please see the column "No." at section 7.7.2 Parameter list, page 42) where discontinuities/differences between module parameter and IO array are detected. This function allows small deviations due to rounding errors sometimes occurring saving parameter toward the module. This function is "-1" if the detection is not active. (e.g.: bus inactive, READ_ALL, INIT, etc.).
	DISC_COUNT	Number of detected discontinuities/differences. This function is "-1" if the detection is disabled (e.g.: Bus inactive)

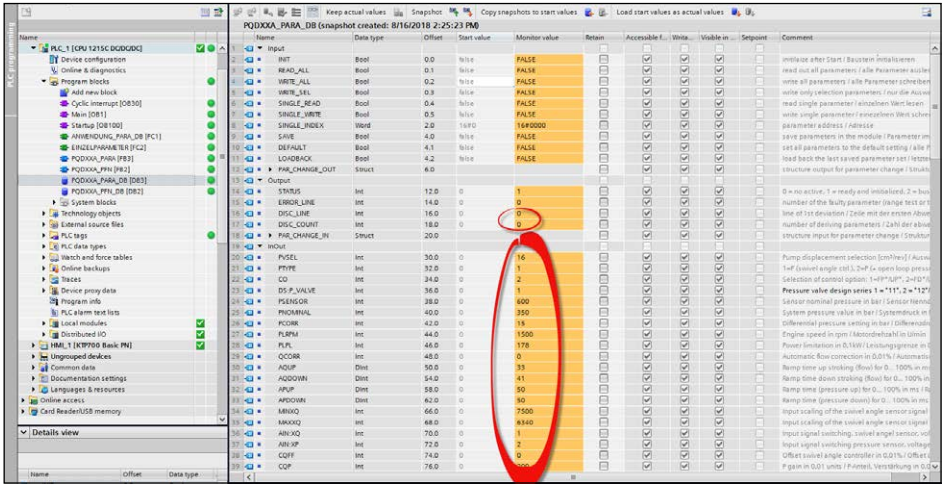
8.2.6 Practical handling of PQDXXA_PARA

NOTICE
Documentation below shows the TIA Portal Software only. The handling in Step7 is basically the same.

Parametrization via PLC – Option 1
After connecting the module to supply and establishing the PROFINET communication, the block starts to initialize (STATUS: 0 [not active] → 2 [busy]). The module parameter and the corresponding limits are stored into the data blocks internal memory. After the initialization is complete, STATUS turns back from 2 (busy) → 1 (ready and initialized). At this point no senseful parameter are at the IO-array, therefore all read parameter from initialization are shown as discontinuities.

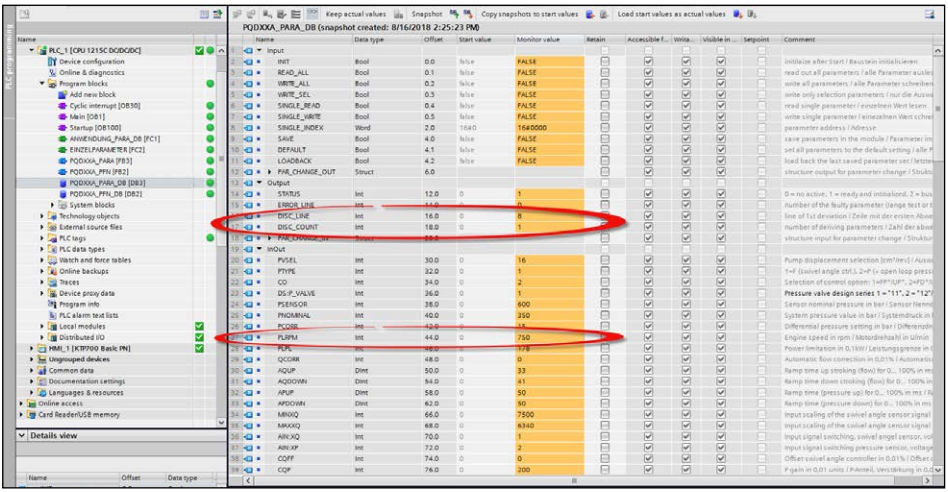


A “READ_ALL” (STATUS: 1 [ready and initialized] → 2 [busy]) command should follow to gather the default parameter. After some cycles waiting time (depending on tuned cycle time in OB – cyclic interrupt) the values are adjusted to the defaults and get displayed (STATUS: 2 [busy] → 1 [ready and initialized]). The discontinuities are swapped back to “0” as well.



Next step is the setting of parameter PVSEL, (P) TYPE, CO and DS:P_VALVE which are driving underneath laying parameter and functions. The “WRITE_SEL” command writes the mentioned parameters into the module and reads all remaining parameters a sequential process step. The IO array is now filled up with defaults suitable to the built up hydraulic application.

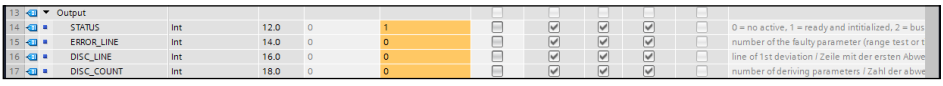
Further parameter adjustments are possible either directly in the data block instance or with In and output fields in an HMI either connected directly with symbolic access to the data block instance address or connected to a separate flag in between.
Following example shows the manipulation of parameter PLRPM from value 1500 to 750. The discontinuity between module parameter and PLC parameter are directly after change visible with DISC_COUNT=1 (Only one parameter has been changed) and DISC_LINE=8 (PLRM is the eighth parameter in parameter list, compare section 7.7.2, page 42).



Not every discontinuity is solved with a WRITE_ALL command since some parameters are depending on each other.

13	Output										
14	STATUS	Int	12.0	0	1						0 = no active, 1 = ready and intitialized, 2 = bus
15	ERROR_LINE	Int	14.0	0	0						number of the faulty parameter (range test or t
16	DISC_LINE	Int	16.0	0	9						line of 1st deviation / Zeile mit der ersten Abwe
17	DISC_COUNT	Int	18.0	0	2						number of deriving parameters / Zahl der abwe

The example shows that PLRPM (Line/No. 8) influences also the parameter PLPL (Line/No. 9). The maximum power has been recalculated in the module by changing the rotational speed and differs from the PLC values. An additional READ_ALL command solves the discontinuity.



13	Output										
14	STATUS	Int	12.0	0	1						0 = no active, 1 = ready and intitialized, 2 = bus
15	ERROR_LINE	Int	14.0	0	0						number of the faulty parameter (range test or t
16	DISC_LINE	Int	16.0	0	0						line of 1st deviation / Zeile mit der ersten Abwe
17	DISC_COUNT	Int	18.0	0	0						number of deriving parameters / Zahl der abwe

Parameter change with WRITE_ALL command is possible as often as desired.

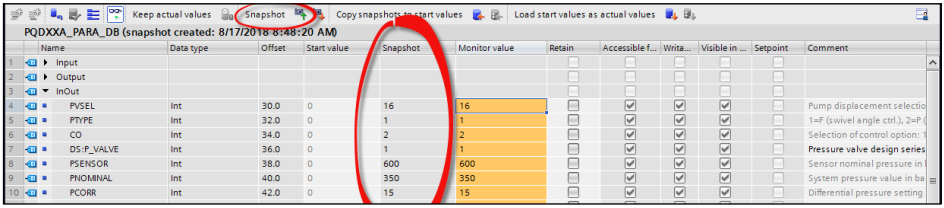
NOTICE
The function to change single parameters with SINGLE_WRITE is not recommended at this point, since this function does not compare discontinuities between module parameter and PLC parameter. This function is designed and valuable for “in – process” parameter changes such as PID gain manipulation or ramp time manipulations and many more in accordance with process demands and according programmed PLC logic. Basic parametrization requires WRITE_SEL / WRITE_ALL / READ_ALL.

Below shown table summarized the main differences between “SINGLE_*” and “*_ALL” commands.

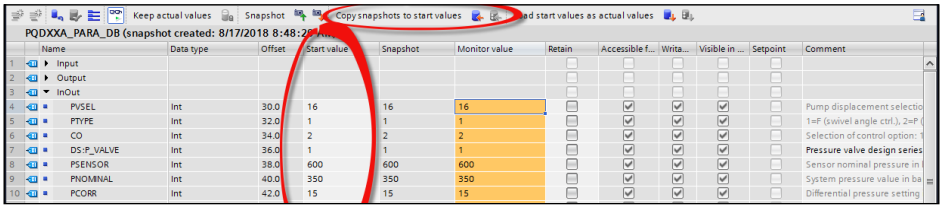
Command	ENABLE	Hardware ENABLE PIN 8	Comment
SINGLE_*	TRUE or FALSE	TRUE od. FALSE	In-process parameter changes / manipulations
WRITE_SEL	FALSE	TRUE od. FALSE	Selected parameter PVSEL, (P)TYPE, CO, and DS:P_VALVE are written.
WRITE_ALL	FALSE	TRUE od. FALSE	Write the entire parameter set
READ_ALL	TRUE or FALSE	TRUE od. FALSE	Read the entire parameter set

Save offline parameter – TIA Portal

Once parameter set to user's satisfaction the parameter settings can be kept with snapshot function inside the TIA projects online view.



A new column gets created with a copy of the just snapped parameter values. The function “Copy snapshot to start values” transfers these values to the start value column.

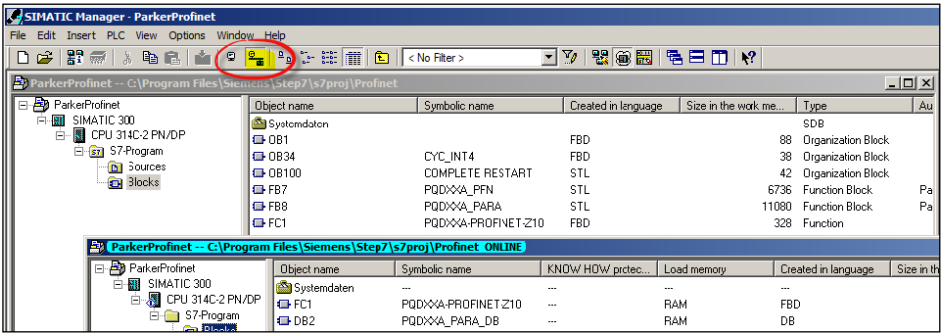


Saving the project and an additional download to the device keeps this data set offline in the project as well as on the control.

Regardless of the parameter storage at PLC and project side the data need to be written in the modules EEPROM with a SAVE command to keep the data while shutting down supply.

Save offline parameter – Step7

To save the parameter settings in the offline Step7 project and in the non-volatile memory of the PLC proceed as follows:
Open Online View of the block folder:



Copy the instance DB of the PARA block by drag & drop from the online to the offline folder. A message will pop up which can be acknowledged (Yes).

The DB in the offline folder now contains the set parameters as actual values:

DB2 -- ParkerProfinet\SIMATIC 300\CPU 314C-2 PN/DP

	Address	Declaration	Name	Type	Initial value	Actual value	Comment
25	28.2	out	PAR_CHA...	BOOL	FALSE	FALSE	
26	28.3	out	PAR_CHA...	BOOL	FALSE	FALSE	
27	30.0	in_out	PVSEL	INT	0	16	Pump displacement selection [cm³/rev] / Auswahl des
28	32.0	in_out	PTYPE	INT	0	1	1=F (swivel angle ctrl.), 2=P (+ open loop pressure ct
29	34.0	in_out	CO	INT	0	2	Selection of control option: 1=FP*/UP*, 2=FD*/UD* / Au
30	36.0	in_out	DSP_VALVE	INT	0	1	Pressure valve design series 2 = "11", 1 = "12"/ Kons
31	38.0	in_out	PSENSOR	INT	0	600	Sensor nominal pressure in bar / Sensor Nenndruck i
32	40.0	in_out	PNOMINAL	INT	0	350	System pressure value in bar / Systemdruck in bar

Finally download the DB from the offline folder to the PLC to ensure that the values are permanently stored. This step can be omitted if you use a PLC which supports the retention property of the DB, e.g. CPU 317.

Parametrization via ProPVplus – Option 2

The modules parametrization is also possible with the graphical user interface (GUI) ProPVplus and a subsequent parameter set image on PLC and the PLC project.

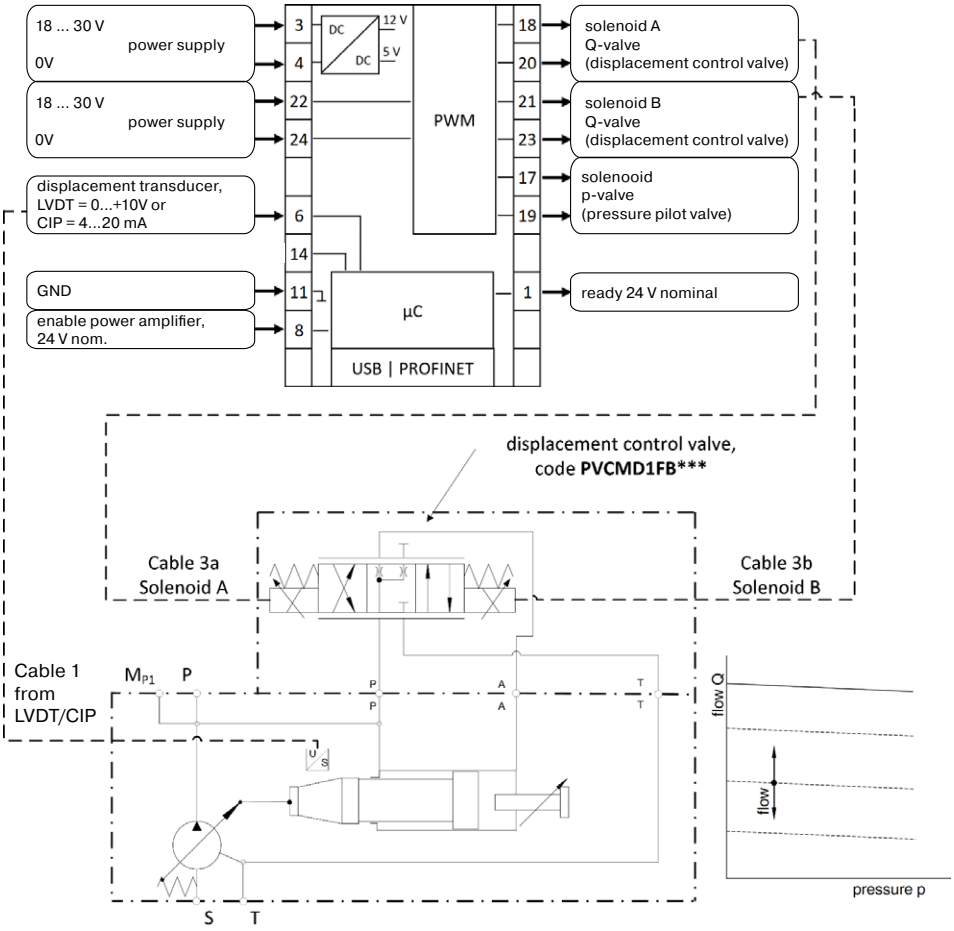
Creating a parameter image:

- Perform a READ_ALL after setting the parameter set with ProPVplus
- Take a snapshot of the online view
- Copy the snapshot to start values
- Save the TIA-Portal project

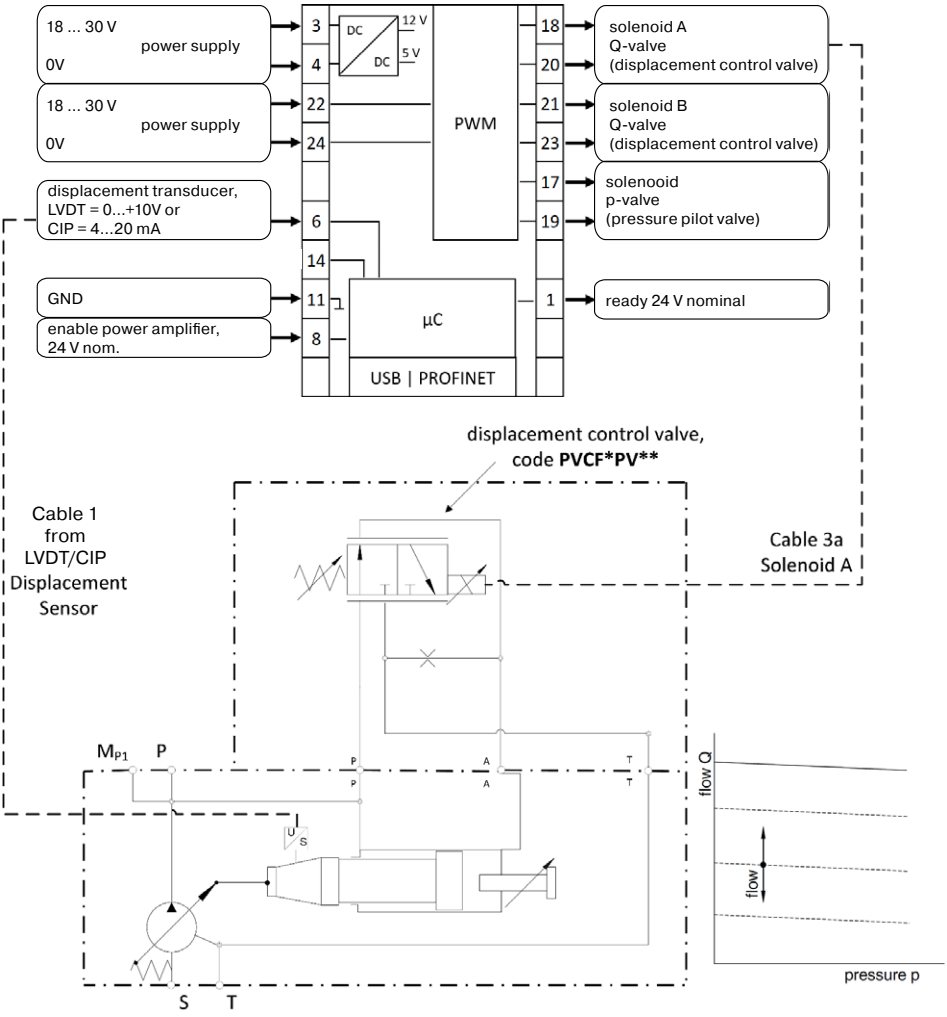
In case the controller needs to be changed, the parameter set can be downloaded easily with a WRITE_ALL command followed by a SAVE

9 CONNECTING DIAGRAMS FOR PROPORTIONAL DISPLACEMENT CONTROL AND FOR P/Q -CONTROL

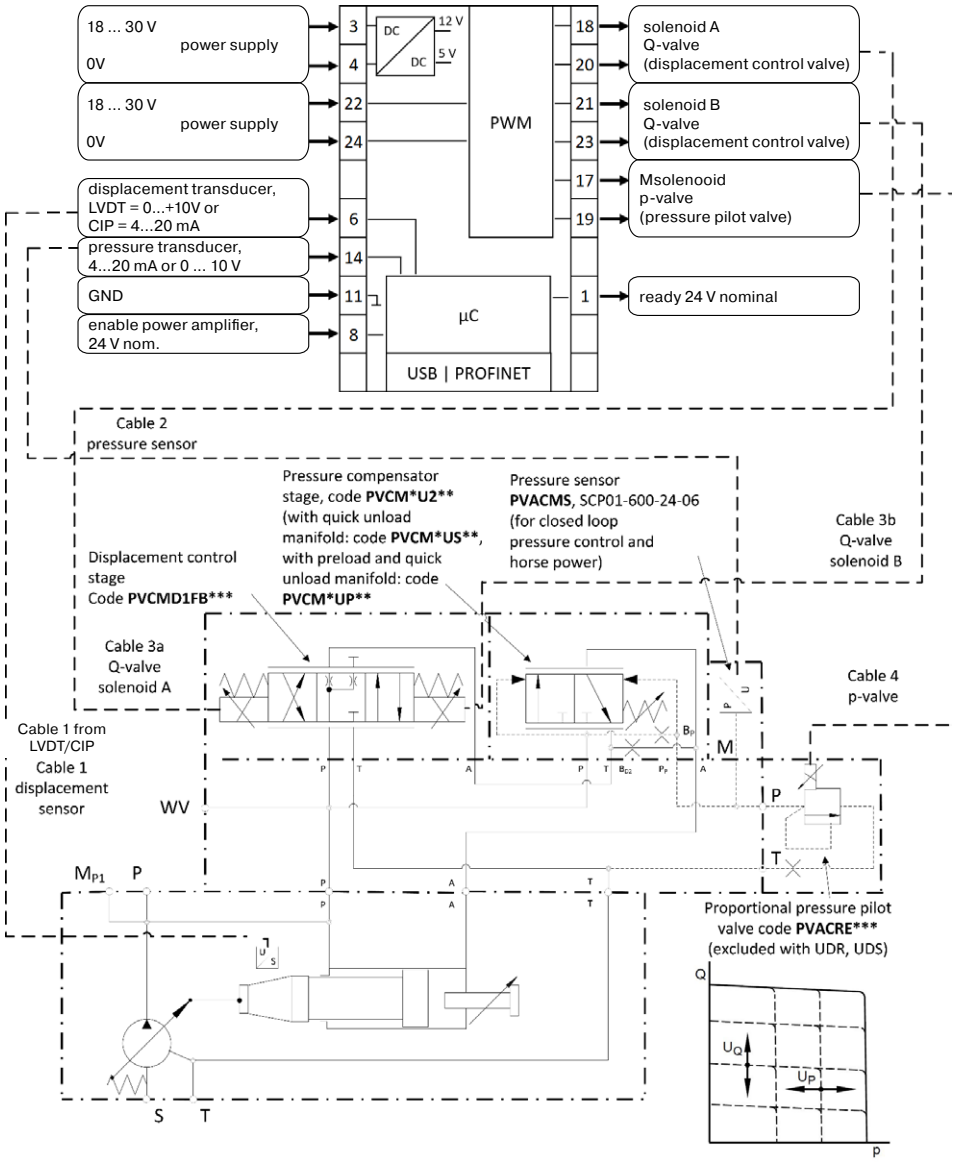
9.1 Proportional displacement control – code …FDV



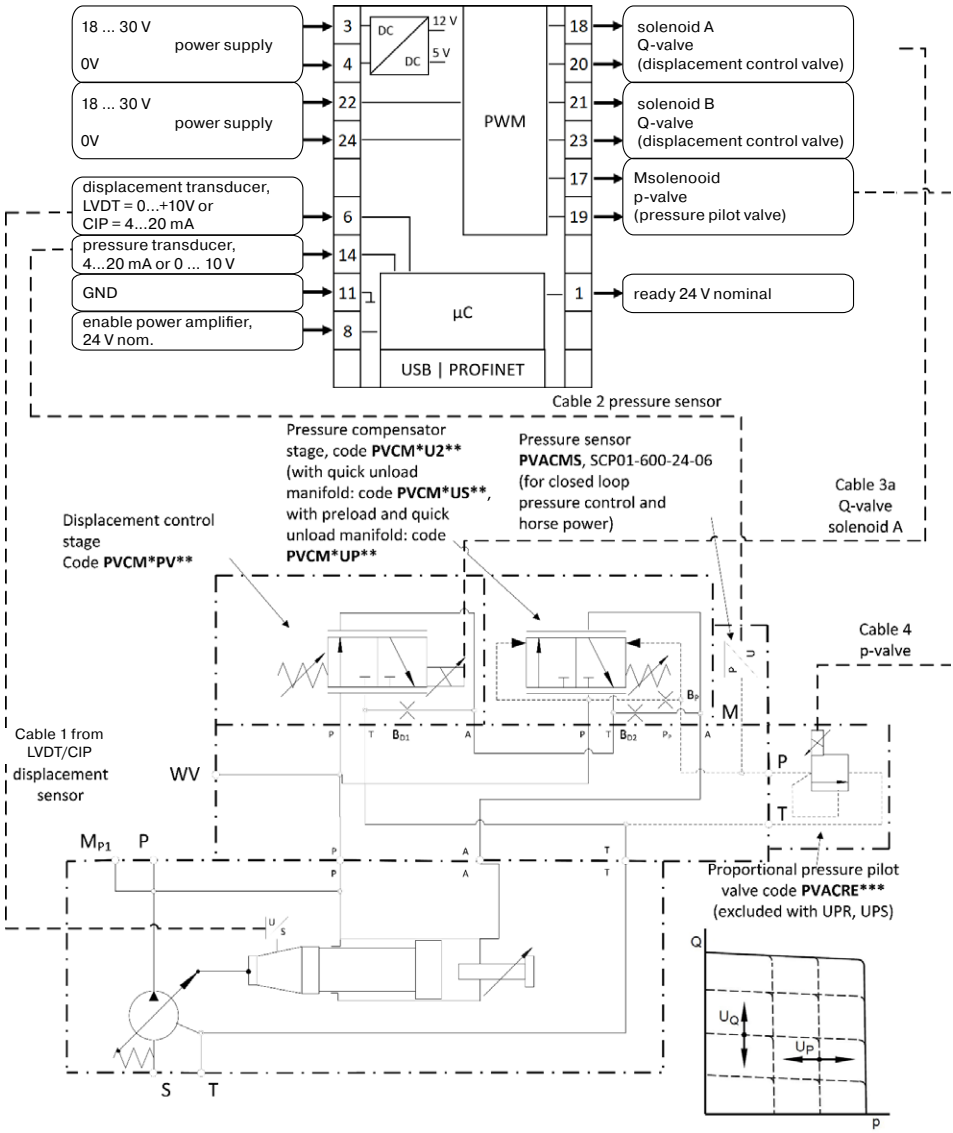
9.2 Proportional displacement control – code …FPV



9.3 p/Q control – Codes …UDR, …UDK, …UDM, …UDS, …UDQ, … UDP, …UDF



9.4 p/Q control – Codes …UPR, …UPK, …UPM, …UPS, …UPQ, … UPP and UPF



10 TROUBLE SHOOTING GUIDE

Pump delivers no output flow; Drive motor does not turn	
Reason	Motor is not connected correctly, or one of the three phases has failed. Motor does not turn smoothly when pump is disconnected from pump.
Solution	*Check motor connections, check electrical power supply.*
Reason	Pump is mechanically blocked. Motor turns smoothly when disconnected from pump.
Solution	*Send pump for service to factory.*
Pump delivers no output flow; Drive motor only turns at slow speed	
Reason	Motor is not selected properly. Installed motor has not enough torque.
Solution	*Start pump at unloaded system. Use motor with more horse power.*
Reason	Pump is hydraulically blocked. No function of compensator, no pressure relief valve; Pump stops after a few turns.
Solution	*Check function of pump compensator (see below). Start pump at unloaded system.*
Pump delivers no output flow; Drive motor turns, pump does not turn	
Reason	Coupling is not or not correctly mounted.
Solution	*Check coupling assembly and correct it.*
Pump delivers no output flow; Drive motor turns and pump turns	
Reason	Wrong direction of rotation.
Solution	*Change direction of motor rotation.*
Reason	Fluid reservoir empty or not filled to level, suction line ends above fluid level.
Solution	*Fill reservoir to required level, if necessary increase suction pipe length.*
Reason	Suction line is blocked. E.g. by plugs, cleaning tissues, plastic-plugs. Ball valve in the suction line closed. Suction filter blocked.
Solution	*Check suction line for free flow. Open valves in suction line. Valves should be equipped with electrical indicator. Check suction filter.*
Reason	Suction line not gas tight, pump gets air into suction port.
Solution	*Seal suction line against air ingression.*
Reason	Pressure line / system is not able to bleed air out.
Solution	*Unload pressure port, unload system before start, bleed air from pressure line.*
Pump does not build up pressure, but delivers full flow at low pressure	
Reason	Standard pressure compensator is set to minimum pressure.
Solution	*Adjust compensator setting to desired pressure.*
Reason	No pressure pilot valve connected to port PR.
Solution	*Install suitable pressure pilot valve and adjust it to the desired setting.*
Reason	Multiple pressure pilot selector valve is not energized; Pump works in stand-by.
Solution	*Energize selector valve solenoid.*
Reason	Differential pressure at compensator is adjusted properly (too low).
Solution	*Check differential pressure adjustment and correct it as described above.*

Pump does not build up pressure, but delivers full flow at low pressure	
Reason	Horse power compensator setting changed.
Solution	*Check setting of horse power compensator and correct it, if required.*
Reason	Proportional displacement control is not connected as required.
Solution	*Check wiring; connect according to installation manual for electronic module.*
Reason	Displacement transducer (CIP/LVDT) adjustment changed.
Solution	*Correct zero setting at displacement transducer.*
Reason	Electronic module has no supply power.
Solution	*Make sure module is powered with 22 – 36 V DC.*
Reason	Cylinder block lifts from valve plate due to excessive wear.
Solution	*Send pump to factory for service.*
Pump does not compensate	
Reason	No pressure pilot valve connected to compensator or valve is blocked.
Solution	*Connect pressure pilot valve to compensator, make sure valve opens as required.*
Reason	No or too low pressure at pump outlet port.
Solution	*Pump outlet pressure must be at least 15 bar, otherwise the bias spring in the pump cannot be compressed.*
Pump does not upstroke, sticks at zero displacement	
Reason	Compensator is blocked due to contamination.
Solution	*Clean hydraulic fluid, clean compensator valve.*
Reason	Cable to LVDT or proportional solenoid is interrupted.
Solution	*Check wiring and make sure cable is ok. Replace if necessary.*
Compensator is unstable	
Reason	Compensator spool is sticking due to contamination of hydraulic fluid.
Solution	*Clean hydraulic system, clean compensator valve.*
Reason	Compensator differential pressure changed (too low or too high).
Solution	*Adjust compensator differential pressure to required setting.*
Reason	Wrong pilot orifice or pressure pilot valve improperly selected.
Solution	*Select pilot orifice and pressure pilot valve as recommended.*

11 PNO/PI CERTIFICATE

PROFIBUS • PROFINET

Certificate

PROFIBUS Nutzerorganisation e.V. grants to

Parker Hannifin
Neerefstraße 96, 09116 Chemnitz, Germany

the Certificate No: **Z12318** for the PROFINET Device:

Model Name:	PQDXXA-PROFINET-Z10
Revision:	SW/FW: V3.1.2; HW: 1
Identnumber:	0x010F; 0x5051
GSD:	GSDML-V2.33-PARKER-PUMP-CTRL-20180703.xml
DAP:	DAP, 0xA0000000

This certificate confirms that the product has successfully passed the certification tests with the following scope:

☑ PNIO_Version	V2.33
☑ Conformance Class	B
☑ Optional Features	Legacy
☑ Netload Class	II
☑ PNIO_Tester_Version	V2.34.0
☑ Tester	AIT, Gummersbach, Germany, PN AIT-18-10

This certificate is granted according to the document:
"Framework for testing and certification of PROFIBUS and PROFINET products".
For all products that are placed in circulation by **July 09, 2021** the certificate is valid for life.

Karlsruhe, September 14, 2018

(Official in Charge)

Board of PROFIBUS Nutzerorganisation e. V.

(Karsten Schneider)

(Dr. Jörg Hähniche)

PROFINET®

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All PMDE products are designed and manufactured considering the basic as well as the proven safety principles according to:

- ISO 13849-1:2015
- SS-EN ISO 4413:2010

so that the machines in which the products are incorporated meet the essential health and safety requirements.

Confirmations for components to be proven component, e. g. for validation of hydraulic systems, can only be provided after an analysis of the specific application, as the fact to be a proven component mainly depends on the specific application.

Christian Jäger
General Manger
Pump & Motor Division Europe

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