CODESYS

EtherCAT®

OPERATION MANUAL
PARKER AUTOMATION CONTROLLER SERIES PAC120

Bulletin MSG11-5715-719/UK

Parker

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1. Preface

1.1 Nonwarranty Clause

We checked the contents of this publication for compliance with the associated hard and software. We can, however, not exclude discrepancies and do therefore not accept any liability for the exact compliance. The information in this publication is regularly checked, necessary corrections will be part of the subsequent publications.

1.2 Production Site

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1.3 Reference to Online Version

This manual is regularly updated. The latest version is available on our website http://www.parker.com/PAC120.

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2. Introduction

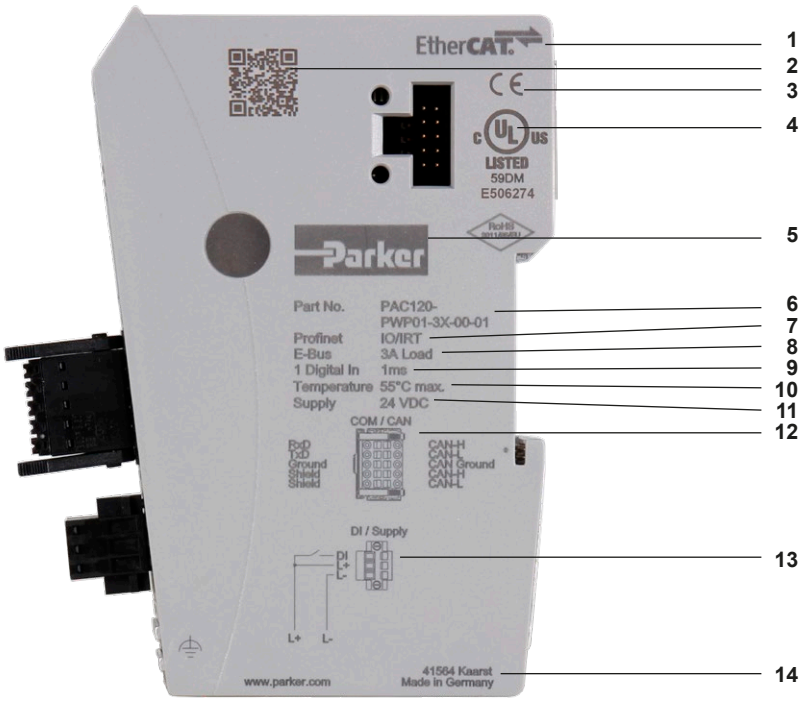
2.1 Device Assignment

This manual is valid for the following device:

- PAC120

2.1.1 Type Specification Plate PAC120

You will find the exact description of the device on the type specification plate:



Explanation of the type specification plate	
1	EtherCAT logo
2	QR code
3	CE conformity
4	UL certified
5	Manufacturer logo
6	Device name
7	Fieldbus identification
8	E-bus
9	Digital input
10	Max. ambient temperature
11	Supply voltage
12	Serial interface
13	Power supply
14	Manufacturer adress

Type specification plate on the right-side wall
Label with serial number and label with software license on aluminum frame

2.2 Certificate

c UL US
LISTED
59DM
E506274

CE

EG-Konformitätserklärung / EC-Declaration of conformity

2014/30/EU

Parker Hannifin Manufacturing Germany GmbH & Co. KG
Industrial Systems Division Europe
Gutenbergstrasse 38
41564 Kaarst, Germany

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Parker Hannifin declares that the products on page 2 corresponds to the regulations of directive of the European Parlament fulfill.

2014/30/EU Elektromagnetische Verträglichkeit
Electromagnetic compatibility

Angewandte harmonisierte Normen / used harmonised standards:

IEC 61000-6-2	Fachgrundnorm – Störfestigkeit für Industriebereiche Generic standard – Immunity for industrial environments
IEC 61000-6-4	Fachgrundnorm – Störaussendung für Industriebereiche Generic standard – Emission standard for industrial environments
IEC 61000-4-2	Prüfung Störfestigkeit gegen die Entladung statischer Elektrizität Electrostatic discharge immunity test
IEC 61000-4-3	Prüfung Störfestigkeit gegen hochfrequente elektromagnetische Felder Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4	Prüfung Störfestigkeit gegen schnelle transiente Störgrößen/Burst Electrical fast transient/burst immunity test
IEC 61000-4-5	Prüfung Störfestigkeit gegen Stoßspannung Surge immunity test
IEC 61000-4-6	Prüfung Störfestigkeit leitungsgeführte Störgrößen hochfrequenter Felder Immunity to conducted disturbances, by radio-frequency fields

Bei einer mit uns nicht abgestimmten Änderung des elektrischen Betriebsmittels verliert diese Erklärung ihre Gültigkeit.
This declaration is valid as long as the electrical equipment remains unchanged. Any modification on the Electrical equipment needs to be approved by us prior to changes.

Grundsätzlich entbindet diese Konformitätserklärung den Anwender nicht, nach der Montage der aufgeführten Produkte in seine Anlage, die Konformitätsanforderungen seines Endprodukts mit den relevanten Richtlinien sicherzustellen.
It is mandatory, that the installation of the mentioned products into the operator's application and the operation of the components is according to their designated usage. The operator has to assure the conformity of the final products (final goods) to be in accordance with these relevant declaration.

Die beschriebenen Produkte sind in Übereinstimmung mit der einschlägigen EU-Harmonisierungsvorschrift: Richtlinie 2014/30/EU.
The products of the declaration described is in conformity with the relevant Union harmonisation legislation: Directive 2014/30/EU.

Ort, Datum: Kaarst, 10.11.2021

Unterschrift:
Angaben zum Unterzeichner: Marten Steffens (ISDE Division General Manager)

2014-30-eu_Elektronik_10-11-21

EG-Konformitätserklärung / EC-Declaration of conformity 2014/30/EU

Nachstehend alle Produkte, die den Anforderungen der Richtlinie entsprechen:
Products that correspond fulfill to the requirements of directive:

1. **Parker Automation Controller**
   PAC120-**P01-3*-**-**
   PAC120-**E01-3*-**-**
   PAC120-**T01-3*-**-**

2. **Parker Hydraulic Controller**
   PACHC-460-01

2014-30-eu_Elektronik_10-11-21

RoHS 3-Konformitätserklärung / RoHS 3-Declaration of conformity 2011/65/EU

Parker Hannifin Manufacturing Germany GmbH & Co. KG
Industrial Systems Division Europe
Gutenbergstrasse 38
41564 Kaarst, Germany

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2011/65/EU **RoHS Richtlinie**
RoHS Directive

Angewandte Ausnahmen gemäß EU-Richtlinie 2011/65/EU Anhang III, 6 a – c
Exceptions used according to EU-Directive 2011/65/EU Annex III, 6 a – c

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Blei / Lead
Quecksilber / Mercury
Cadmium / Cadmium
Sechwertiges Chrom / Hexavalant chromium
Polybromiertes Biphenyle (PBB) / Polybrominated biphenyls (PBB)
Polybromiertes Diphenylether (PBDE) / Polybrominated diphenyl ethers (PBDE)
Di(2-ethylhexyl)phthalat (DEHP) / Bis(2-ethylhexyl)phthalat (DEHP)
Butylbenzylphthalat (BBP) / Butyl benzyl phthalate (BBP)
Dibutylphthalat (DBP) / Dibutyl phthalate (DBP)
Diisobutylphthalat (DIBP) / Diisobutyl phthalate (DIBP)

Ort, Datum: Kaarst, 10.11.2021

Unterschrift:
Angaben zum Unterzeichner: Marten Steffens (ISDE Division General Manager)

2011-65-eu_Elektronik_10-11-21

RoHS 3-Konformitätserklärung / RoHS 3-Declaration of conformity 2011/65/EU

Nachstehend alle Produkte, die den Anforderungen der Richtlinie entsprechen:
Products that correspond fulfill to the requirements of directive:

1. **Parker Automation Controller**
   PAC120-**P01-3*-**-**
   PAC120-**E01-3*-**-**
   PAC120-**T01-3*-**-**

2. **Parker Hydraulic Controller**
   PACHC-460-01

2011-65-eu_Elektronik_10-11-21

2.3 Safety Instructions

2.3.1 Target Group of this Operation Manual

This instruction manual contains all information necessary for the use of the described product (control device, control terminal, software, etc.) according to instructions. It is written for design, project planning, servicing and commissioning experts. For proper understanding and error-free application of technical descriptions, instructions for use and particularly of notes of danger and warning, extensive knowledge of automation technology is compulsory.

2.3.2 Hazard and other Warnings

Please refer to the additional notices which we have marked by symbols throughout this instruction manual. While some of these notices make you aware of possible dangers, others are intended as a means of orientation. They are described further down below in descending order of importance.

Every alert and hazard warning is made up as follows:

Type and source of risk

Potential consequences of non-observance

→ Preventive measures

⚠	**DANGER** A DANGER warning makes you aware of an immediately hazardous situation which will cause a serious or fatal accident if not observed.

!	**CAUTION** A CAUTION alert makes you aware of a potentially hazardous situation which may cause an accident or damage to this or other devices if not observed.

☞	**NOTE** A NOTE makes you aware of a potentially hazardous situation which may cause damage to this or other devices if not observed.

2.3.3 General Hazards

The device described in this manual is designed in accordance with the latest technology and is safe in operation. Nevertheless, the device can entail certain hazards if used improperly or for purposes other than those explicitly intended.

Electronic, moving and rotating components can

- constitute a hazard for body and life of the user, and
- cause material damage

2.3.4 Designated Use

Parker's products are designed, developed and manufactured for standard industrial use. They must not be used for any other purposes than the ones specified in the catalogue or the associated technical documentation. Proper and safe operation depends on the products being transported, stored, lined up, mounted, installed, put into service, operated, and serviced correctly. Ambient conditions must be within the admissible limits. Notes and information in the associated documentation apply at all times.

The device is designed for operation in electric power drive systems (VDE0160). Motion sequences can be automated with this device. Several motion sequences can be combined by interconnecting several of these devices.

Mutual interlocking functions must be incorporated for this purpose.

2.3.5 Safety-conscious Working

This device may be operated only by qualified personnel.

Qualified personnel in the sense of these operating instructions consists of:

- Persons who, by virtue to their training, experience and instruction, and their knowledge of pertinent norms, specifications, accident prevention regulations and operational relationships, have been authorized by the officer responsible for the safety of the system to perform the required task and in the process are capable of recognizing potential hazards and avoiding them (definition of technical personnel according to VDE105 or IEC364),
- Persons who have a knowledge of first-aid techniques and the local emergency rescue services.
- Persons who have read and will observe the safety instructions.
- Those who have read and observe the manual or help (or the sections pertinent to the work to be carried out).

This applies to all work relating to setting up, commissioning, configuring, programming, modifying the conditions of utilization and operating modes, and to maintenance work.

This manual and the help information must be available close to the device during the performance of all tasks.

2.3.6 Special Safety Instructions

- Check the correct association of the device and its documentation.
- Never detach electrical connections while voltage is applied to them.
- Safety devices must be provided to prevent human contact with moving or rotating parts.
- Make sure that the device is operated only when it is in perfect condition.
- Implement and activate the stipulated safety functions and devices.
- Operate the device only with the housing closed.
- Make sure that all devices are sufficiently fixed.

Project planning

- 24 V DC power supply: generate as electrically safely separated low voltage. Suitable devices include split-winding transformers built in compliance with European Standard EN 60742 (corresponds to VDE 0551).
- Power breakdowns or power fades: the program structure is to ensure that a defined state at restart excludes all dangerous states.
- Emergency-off installations must comply with EN 60204/IEC 204 (VDE 0113). They must be operative at any time.
- Safety and precautions regulations for qualified applications have to be complied with.
- Please refer to the notices of warning which, at relevant places, will make you aware of possible sources of dangerous mistakes or faults.
- Relevant standards and VDE regulations are to be complied with in every case.
- Control elements are to be installed in such a way as to exclude unintended operation.
- Lay control cables such that interference (inductive or capacitive) is excluded if this interference could influence controller operation or its functionality.

Maintenance and servicing

- Precautions regulation VBG 4.0 to be observed when measuring or checking a controller after power-up. This applies to § 8 (Admissible deviations when working on parts) in particular.
- Repairs must be carried out by specially trained Parker staff only. Warranty expires in every other case.
- Only use parts approved of by Parker. Only genuine Parker modules must be used in modular controllers.
- Modular systems: always plug or unplug modules in a power-down state. You may otherwise damage the modules or (possibly not immediately recognisably!) inhibit their functionality.
- Always dispose of (rechargeable) batteries as hazardous waste.

2.4 Electromagnetic Compatibility

Definition

Electromagnetic compatibility is the ability of a device to function satisfactorily in its electromagnetic environment without itself causing any electromagnetic interference that would be intolerable to other devices in this environment.

Of all known phenomena of electromagnetic noise, only a certain range occurs at the location of a given device. These kinds of noise are specified in the applicable product standards.

The design and immunity to interference of programmable logic controllers are internationally governed by standard

IEC 61131-2 which, in Europe, has been the basis for EN 61131-2.

☞	**NOTE** Refer to IEC 61131-4, User's Guideline, for general installation instructions to be complied with to ensure that hardware interface factors and the ensuing noise voltages are limited to tolerable levels.

Interference emission

Interfering emission of electromagnetic fields, HF compliant to EN 55011, limiting value class A, Group 1

☞	**NOTE** If the controller is designed for use in residential areas, high-frequency emissions must comply with limiting value class B as described in EN 55011.

Fitting the controller into earthed metal cabinets and installing filters in the supply lines may produce a shielding compliant to the above standard.

General notes on installation

As component parts of machines, facilities and systems, electronic control systems must comply with valid rules and regulations, depending on their field of application.

General requirements concerning the electrical equipment of machines and aiming at the safety of these machines are contained in Part 1 of European Standard EN 60204 (corresponds to VDE 0113).

Electrical immission safeguard

To eliminate electromagnetic interference, connect the control system to the protective earth or functional earth conductor. Practice best cable routing.

Cable routing and wiring

Keep power circuits separate from control circuits:

- DC voltages 60 V ... 400 V
- AC voltages 25 V ... 400 V

Joint laying of control circuits is allowed for:

- shielded data signals
- shielded analogue signals
- unshielded digital I/O lines
- unshielded DC voltages < 60 V
- unshielded AC voltages < 25 V

Electromagnetic compatibility

Location of installation

Ensure that temperatures, contaminations, impact, vibration or electromagnetic interference are no impediment to the installation.

Temperature

Consider heat sources such as general heating of rooms, sunlight, heat accumulation in assembly rooms or control cabinets

Contamination

Use suitable casings to avoid possible negative influences due to humidity, corrosive gas, liquid or conducting dust.

Impact and vibration

Consider possible influences caused by motors, compressors, transfer lines, presses, ramming machines and vehicles.

Electromagnetic interference

Consider electromagnetic interference from various local sources: motors, switching devices, switching thyristors, radio-controlled devices, welding equipment, arcing, switched-mode power supplies, converters / inverters.

Special sources of interference

Inductive actuators

Switching off inductances (such as from relays, contactors, solenoids or switching magnets) produces surge voltages. It is necessary to reduce these extra voltages to a minimum.

Throttling elements could be diodes, Z-diodes, varistors or RC elements. Their rating should conform to the specifications provided by the manufacturer or supplier of the actuators.

3. System Description

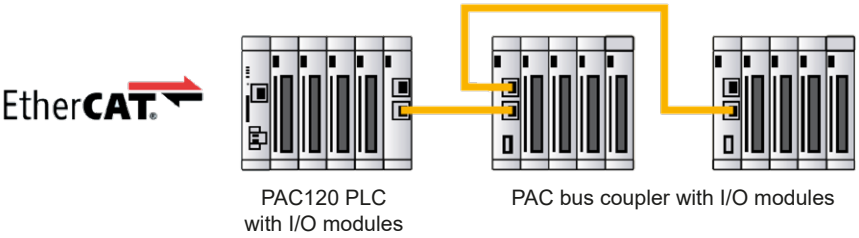
3.1 PAC

Parker PAC is a system of control I/O modules for interconnecting the process signals in an EtherCAT network.

Parker PAC consists of the Parker PAC controller, Parker PAC bus coupler and various Parker PACHC and PAC I/O modules.

Parker PAC120 is a PLC equipped with a CODESYS V3 runtime system. It also supplies the system voltage to the PAC modules directly connected to it.

The Parker PAC bus coupler converts the physical transfer technology (twisted pair) to LVDS (E-bus) and generates the system voltages required by the LVDS modules. The standard 100 Base Tx lines used for office network communications connect to the one side, the Parker PACHC and PACIO modules for the process signals connect to the other. This is how the Ethernet EtherCAT protocol is retained right through to the last I/O module.



The device description for PACIO is part of the PAC120HC package.

	NOTE
	The number of directly connected modules should not exceed 10.

3.2 Development Environment CODESYS V3.5

CODESYS is a software platform designed to handle many tasks of industrial automation technology. It is based on the IEC 61131-3 programming system. The tool benefits users with integrated solutions tailored to their practical work and aimed at providing hands-on support with whatever job needs to be done.

CODESYS supports all five languages specified in IEC 61131-3 (International Electrotechnical Commission):

- IL (Instruction List)
- ST (Structured Text), based on PASCAL for structured programming
- LD (Ladder Diagram)
- FBD (Function Block Diagram)
- SFC (Sequential Function Chart)

Apart from the standard IEC languages, the CODESYS also supports:

- CFC (Continuous Function Chart) is a FD (function diagram) editor with a fully configurable graphical layout: whereas FD editors are network-based and automatically arrange the function blocks, CFC lets users place the blocks anywhere such that feedback effects can be created without any temporary variables. This feature makes the language the perfect choice for creating an overview of the application.

Fieldbus technology

The CODESYS programming system allows the direct configuration of the CANopen and EtherCAT fieldbuses. Protocol stacks can be separately installed as CODESYS libraries for some systems.

CODESYS Control

CODESYS Control is a soft PLC runtime system installed in the PAC120 and adapted to its hardware. It turns the PAC120 into an industrial controller in conformity with IEC 61131-3. This runtime system also features some extra functions that let the controller communicate with other components in its automation environment.

Visualisation

An editor integrated in the CODESYS programming system allows users to create complex visualisation screens and to animate them by means of the application variables. The appropriate visualisation elements are provided by the software. Once created, the screens may help to test an application or to start it up in the programming system's online mode, for example. Running the optional visualisation clients CODESYS HMI and CODESYS WebVisu makes the screens a means of operating the machine or system.

SoftMotion (only PAC120-Mxx01-3X-xx-xx)

Single-axis or multi-axis movements up to cams can be configured in the familiar IEC 61131-3 development interface - together with the logic application.

A motion controller with CODESYS SoftMotion implements the motion functionality in the form of a modular system in the PLC programming system. Motion controllers with CODESYS SoftMotion allow the user extensive project planning variants for his motion tasks. Among other things, certified motion modules according to PLCopen and the full scope of the IEC 61131-3 programming interface are available for this purpose.

Alarm Manager

Note about high memory usage for alarm storage:
When using the Alarm Manager, a memory file is created and stored on the PAC120.
The internal memory size of 256 MB must be considered. For more memory an appropriate SD card must be used.

4 Product Description

4.1 PAC120

PAC120 is an ARM-based mini-IPC plus CODESYS PLC which is programmed by means of CODESYS V3.

Its SD card slot plus USB port provide a local storage volume for process and other data and the interchange of control programs. A digital interrupt input allows the controller to immediately respond to process events. On one side of the modular control unit, there is an E-bus connector which provides for a flexible extension by Parker EtherCAT control and I/O modules series PACHC and PACIO.

One way of exchanging data with other systems is to go through the on-board interfaces, i.e. Industrial Ethernet and RS232. Another way is to plug in interface and bus modules to provide further communication links and to facilitate system integration in existing control architectures. Using an extender module enables to actuate external EtherCAT slaves.

Properties

- Fanless ARM processor technology
- Expandable by Parker PACHC modules
- CODESYS V3 with EtherCAT®
- Optional CODESYS WebVisu

4.2 Contents of package

The PAC120 package includes:

- PAC120
- Set of connectors (RS232/CAN and supply voltage/DI)

4.3 Intended Use

PAC120 is a mini-IPC and a CODESYS PLC providing EtherCAT master functions for modules series PACHC and PACIO I/O which allow process signals to be directly attached to the control unit.

Place of installation

The unit is solely permitted for use in fully enclosed control cubicles or rooms. Exhaust heat develops down the side of unit, i.e. at the aluminium heat sink. Verify that the place of installation is ventilated properly.

Caution

Damage to the unit
Choosing the wrong place of installation may cause damage to the unit.
→ Check section Technical Data for the admissible ambient conditions and the unit's mounting position.

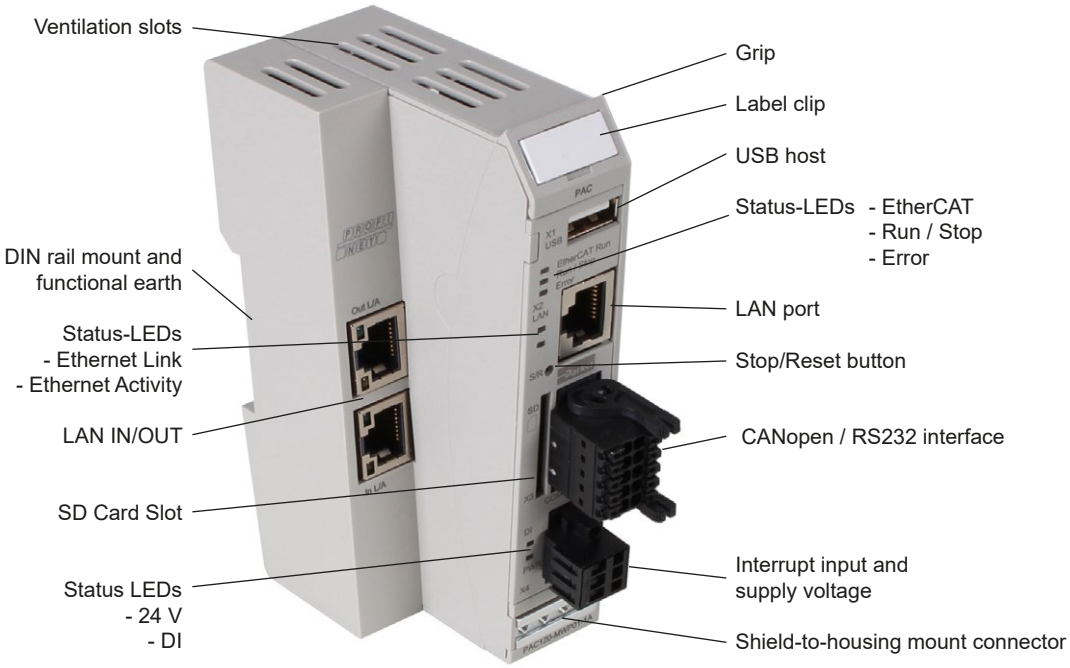
Design constraints for high-risk activities

The products licenced and supplied by Microsoft are not fault tolerant and have neither been designed nor manufactured for applications requiring faultless operation during which a failure of the licenced product would cause fatality, serious personal injury or serious material or environmental damage ("high-risk activities").

DANGER

Danger caused by malfunctions
Fatality, serious personal injury or serious material or environmental damage
→ Do not use products licenced by Microsoft for applications requiring faultless operation during which a failure of the licenced product would cause fatality, serious personal injury or serious material or environmental damage.

4.4 Front View



4.5 Connectors

While all external connectors plug in at the front of the unit, the PACHC and PACIO modules connect to the EtherCAT E-bus interface on the right side.

4.5.1 X2 Ethernet “LAN”

The onboard 10/100 Mbit base-T Ethernet adapter attaches the unit to a network through its RJ-45 connector. LEDs "Link" and "Activity" tell you whether the unit is properly connected to the network.

Pin wiring:

LAN		
Connector	Pin	Function
RJ45	1	TX+
	2	TX-
	3	RX+
	4	75 Ohm
	5	75 Ohm
	6	RX-
	7	75 Ohm
	8	75 Ohm

NOTE

For use as EtherCAT fieldbus interface, the E-bus connection on the side is provided. In the LAN configuration of the operating system this can be found under the designation eth1.

Caution

Unauthorised access to the computer
Controller failure and data loss
→ Integration in networks granting public access requires the user to take appropriate measures aimed at preventing unauthorised access.

4.5.2 X1 USB 2.0 (host)

The USB host port is made for attaching USB peripherals.

Pin wiring:

USB		
Connector	Pin	Function
USB	B1	VCC
	B2	D-
	B3	D+
	B4	GND

Caution

USB port overload by excessive power consumption
Machine failure and/or data loss
→ Only attach USB peripherals whose total power needs do not exceed 0.5 A or supply external power to the USB peripherals by adding an active hub to the line, for example.

Caution

Electromagnetic interference in industrial environments
Failure of the machine or loss of data
→ The USB interface is not intended for operation in an industrial environment, but only as a service interface for software updates or for loading data into or from the controller.

4.5.3 USB Sticks

USB stick users should consider the following points:

- The USB port is mechanically designed to support up to 1,000 plug/unplug operations.
- Pulling off a USB stick during operation is allowed only when no more file operations are being performed. Failure to comply may render the USB stick useless!
- If a program still has a file open when the USB stick is pulled, you will find it impossible to close the directory that the file belongs to. In this situation, the system will not respond to any file or directory operation requests because it would be expected to read from a device that is no longer available. Therefore, before pulling off the USB stick, you should always ensure that no program still has an open file loaded from the stick.
- Before pulling off the stick, always use the function USB_UMountDisk from the Parker System Library iMX6
- USB sticks can be found under the following path: \media\usbx (x = 1..n number of plugged USB sticks)
- Supported format(s): FAT32

4.5.4 X3 Serial Communication RS-232 / CAN1

The CAN interface complies with standard ISO 11898 and supports baud rates of up to 1 Mbps. It is electrically insulated.

The system uses COM1 for access to the RS-232 port. The RS-232 port is not electrically insulated.

The CAN interface complies with standard ISO 11898 and supprts baud rates of up to 1 Mbps. This port is electrically insulated. A bus termination resistor of 120 Ω can be connected directly to the connector between CAN_H and CAN_L.

Technical data:

RS 232	
Quantity	1
Signal	RS 232
Baud rate	max. 115.200 Baud, (57.600, 38400, 19.200, 9600...)
Electrical insulation	no galvanic isolation

CAN 1	
Signal	RS 485
Baud rate	max. 1 MBit/s, (500, 250, 125 kBaud)
Electrical insulation	galvanic isolation
Termination	attached to the connector

Pin wiring RS 232 interface:

X8 RS 232 interface		
Connector	Pin	Function
Weidmüller B2L 3,5/10/180LH SN BK BX SO 1338740000	1	RXD
	2	TXD
	3	GND
	4	Shield
	5	Shield

Pin wiring CAN interface:

X8 CAN interface		
Connector	Pin	Function
CAN open Weidmüller B2L 3,5/10/180LH SN BK BX SO 1338740000	6	CAN_H
	7	CAN_L
	8	CAN_GND
	9	CAN_H
	10	CAN_L

	NOTE
	You may connect the CAN bus termination directly to the pins.

4.5.5 X4 Digital Input and Power Supply

On-board power supply unit

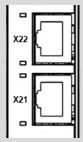
The PAC Controller features an on-board power supply unit (PSU) designed for an input voltage of 24 VDC (18 V ... 32 V). The PSU is protected against reverse polarity. It supplies power to the PAC120's CPU core and to the PACHC and PACIO modules connected to the E-bus. The modules themselves require their own power supply.

Verify that both the cord and the PSA are externally protected against short circuit and overload triggering at max. 10 A.

Pin wiring:

X9 24 VDC power supply			
Connector		Pin	Function
	Weidmüller	1	Digital input
		2	External power supply 24 VDC (18 V ... 32 V)
		3	External power supply, GND

4.5.6 Communication Modules

Connector		Profinet	EtherCAT	Ethernet
	X21	Port-001	IN	Port 1
	X22	Port-002	OUT	Port 2

4.5.7 Functional Earth

Connect functional earth to the protective earth conductor of the switching cabinet or the system that the PC is installed in. Use the flat plug (6.3 mm x 0.8 mm) or the earth bolt at the back of the unit.

Verify that the cross section is not less than 2.5 mm^2. Try to keep the lead to the cabinet terminal as short as possible.

NOTE

A low-impedance earth conductor improves the dissipation of interference received via external power supply cables, signal cables or cables of peripheral units.

4.5.8 SD Card

PAC120 features a SD card slot at its front. The slot is marked with a SD icon.

The SD card slot has a push-in/push-out plug & eject mechanism. You may use a flat object to help you plug in or eject the card.

The SD card can be found under the following path: \media\sd

SD card properties

- Supported format(s): FAT32
- Maximum memory size: 32 GB
- Maximum file size: 4 GB - 1 byte
- Quality: Industrial Grade
- Technology: SLC

CAUTION

Electrostatic discharge (ESD)
Inappropriate handling will destroy the memory card
→ SD cards are susceptible to electrostatic discharge (ESD). Please take account of the instructions on how to handle memory cards.

NOTE

The SD card slot has no hot-plug capability. It will therefore detect cards only if they were plugged in at the time of booting the unit. You cannot swap SD cards in service.

4.6 Retain Variables

From version 1.25.0 (CODESYS 3.5 SP16 Patch4) onwards, remanent variables can be declared with the keywords "RETAIN" or "PERSISTENT". In older versions, the Persistence Manager of CODESYS must be used.

Retain variables are declared by adding the keyword RETAIN in the declaration area.

Example of declaration in the Global Variable List:

```
VAR_GLOBAL RETAIN
        udiCounter: UDINT;
END_VAR
```

Persistence variables are declared by adding the keyword PERSISTENT in the declaration area.

Example of declaration in the Global Variable List:

```
VAR_GLOBAL PERSISTENT RETAIN
        udiCounter: UDINT;
END_VAR
```

Retain and persistence variables differ in their lifetime:

	Normal variables	RETAIN	PERSISTENT RETAIN PERSISTENT PERSISTENT RETAIN
Powerfail	0	X	X
Online-Change	X	X	X
Reset warm	0	X	X
Reset kalt	0	0	X
Laden	0	0	X [1)]
Reset Ursprung	0	0	0

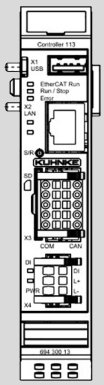
X = Value of the variable is retained.
0 = Variable is initialised.
X [1)] = Remains only if the structure within the persistent variable has not changed.
For further details, please refer to the CODESYS help.

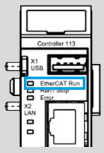
4.7 Indicators and Controls

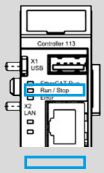
4.7.1 Status LEDs

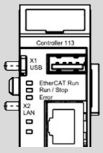
The status LEDs indicate the state of the PAC120 modules. RUN/STOP is indicative of the soft PLC status.

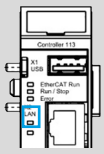
Indicators:

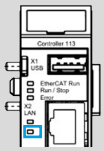
LED Description			
Label		LED flash code	Explanation
	EtherCAT Run	off	Initialising, no data exchange
		off/green, 1:1	Pre-operational, no data exchange
		off/green, 5:1	Safe operation, inputs readable
		green, on	Operational, unrestricted data exchange
	RUN/STOP	off	Boot loader active or operating system is booting
		yellow	Low voltage
		yellow 1:1 0.5 Hz	Processing USB update
		yellow 1:1 2.5 Hz	Updating firmeware
		yellow 1x flash	Service mode enabled
		yellow 2x flash	Reboot required, e.g. after an update
		green	CODESYS application is running
		red	CODESYS application stopped
	Error	off	
		flashing red	Error
	LAN Link	off	Ethernet cable not connected
		green	Ethernet cable connected
	LAN Activity	off	No Ethernet activity
		flashing yellow	Ethernet activity
	DI	off	No input signal
		green	Input signal received
	24 V	off	Supply voltage not available
		green	Supply voltage available

LED EtherCAT			
State		LED flash code	Explanation
	Init	red, cont. light	Initialisation state, no data exchange
	Pre-Op	off/green, 1:1	Preoperational state, no data exchange
	Safe-Op	red/green, 5:1	Safe operational state, Inputs are readable
	Op	green, cont. light	Operational state, full data exchange

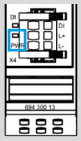
LED Run / Stop			
State		LED flash code	Explanation
	run	green	CODESYS-project is running
	stop	red	CODESYS-project is stopped
	reset	yellow	CODESYS-project is deleted
	x	flashing yellow	CODESYS connection test

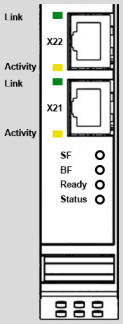
Error flash code		
State	LED flash code	Explanation
	red, 2x	Undervoltage
	red, 3x	Watchdog

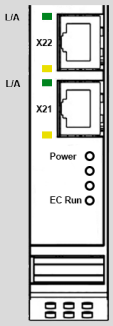
LED LAN (link)			
Status		LED flash code	Explanation
	linked	green	Connected

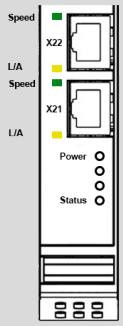
LED LAN (activity)			
Status		LED flash code	Explanation
	active	yellow	Active Data exchange

LED DI			
Status		LED flash code	Explanation
	active	green	Input active

LED 24 V			
Status		LED flash code	Explanation
	on	green	24 V DC exists

Status displays PROFINET IO device extension			
Label		LED	Meaning
	Link	off	No physical connection
		green	Physical connection
	Activity	off	No data exchange
		yellow	Data exchange
	SF	off	No PROFINET diagnosis available
		red	PROFINET diagnosis present
	BF	off	Active communication between PROFINET IO controller and this PROFINET IO device
		red	No connection status available
		red flashing	Connection status OK: no communication with a PROFINET IO controller
	Ready	off	TPS-1 has not started correctly
		green flashing	TPS-1 is waiting for synchronisation with the host CPU (firmware start completed)
		green	TPS-1 started correctly
	Status	off	n/a
		green	n/a

Status displays EtherCAT extension			
Label		LED	Meaning
	Link/Activity	off	No physical connection
		green	Physical connection
		flashing	Data exchange
	Power	off	No supply voltage at the extension module
		green	Supply voltage of extension module OK
	EC Run	off	Initialisation status, no data exchange
		off/green, 1:1	Pre-operational status, no data exchange
		off/green, 5:1	State Safe-operational, inputs are readable
		green	State Operational, full data exchange

Status displays Ethernet (EtherNet/IP) extension			
Label		LED	Meaning
	Speed	off	10 Mbit
		green	100 Mbit
	Link/Activity	off	No physical connection
		yellow	Physical connection
		flashing	Data exchange
	Power	off	No supply voltage at the extension module
		green	Supply voltage of extension module OK
	Status	off	Extension module not ready
		green	Extension module ready

4.7.2 Stop/Reset Button

The Reset/Stop button is located underneath the status indicators at the front of the unit.

To avoid it being pushed unintentionally, the Stop/Reset button can be operated using a pointed object (pen, screw-driver) only.

The first push for less than 5 seconds "Stops" the CODESYS PLC program. Run/Stop changes from green to red. Pushing the button again for less than 5 seconds "Starts" the CODESYS PLC program again, Run/Stop changes from red to green ... etc.

Pushing the Stop/Reset button for longer than 5 seconds resets the PAC120. Run/Stop extinguishes and LED Error light up green. You can now release the Stop/Reset button. This will reboot the PAC120.

	NOTE
	In reset mode, there is no communication with PAC120. CODESYS online connections will be interrupted after a "communication error". Except for the Retain and Persistent variables, all variables will reset to their initial values.

5. Operation

5.1 Installation

5.1.1 Mechanical Installation

→ PAC120 / PACHC / PACIO modules are intended for mounting rail installation (DIN EN 50022, 35 mm x 7.5 mm).

To snap on a single module

→ Push up the module against the mounting rail from below, allowing the metal spring to snap in between mounting rail and mounting area as illustrated.

→ Push the module against the mounting wall until it snaps in.

To interconnect two modules

→ After snapping on the first module to the rail, snap on the second module about 1 cm away towards the right of the first module.

→ Push the second module along the rail towards the first module until you hear the locking device snap in.

To disconnect two modules

→ Push down the unlock button (see Figure 2) of the module that you wish to disconnect from the module to the left of it.

→ Push both modules away from one another until they are about 1 cm apart.

To take down a single module

→ Push the module up and against the metal spring located on the underside of the rail guide.

→ Tip the module away from the rail as shown in the illustration.

→ Pull the module down and out of the mounting rail.

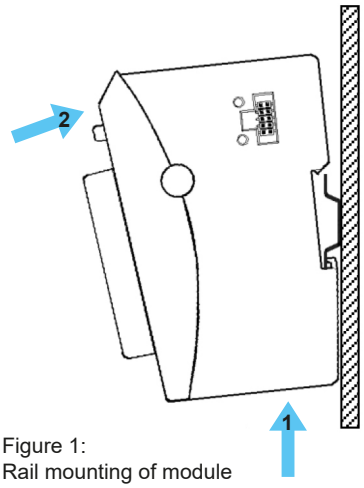


Figure 1:
Rail mounting of module

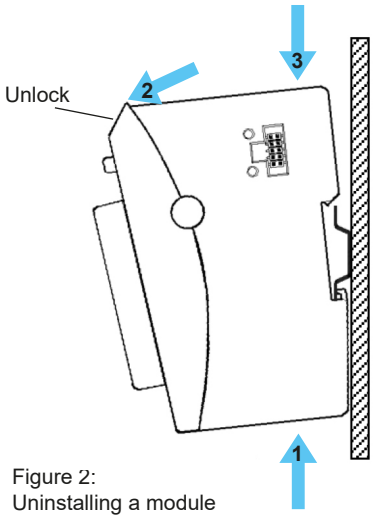
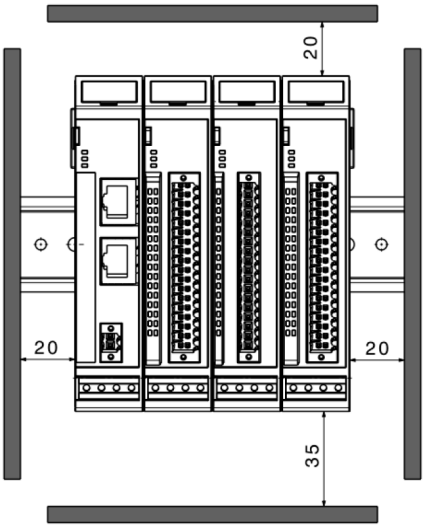


Figure 2:
Uninstalling a module

Installation position

The mounting rail is mounted horizontally, the socket connectors of the modules face forward. To ensure sufficient ventilation through the convection slits of the modules, the minimum distance of 20 mm upwards and 35 mm downwards to neighbouring units and control cabinet surfaces must not be undercut. The lateral distance to third-party devices and control cabinet surfaces must not be less than 20 mm.



	NOTE
	Order of modules in the PAC system To ensure smooth functioning of the entire PAC system, arrange the PAC modules according to their E-bus load so that the modules with the greatest E-bus load are arranged directly after the head module (bus coupler or controller). Observe the maximum bus load of the head module.

5.1.2 Electrical installation

!	**CAUTION**
	Dangerous failures due to incorrect power supply The unit can be damaged or destroyed by an incorrect voltage supply and dangerous failures can occur. Measures to avoid: → For the 24 V DC supply of controllers or bus couplers, we recommend using PELV/SELV-capable power supply units in accordance with EN50178 or EN60950-1. → If the power supply is earthed (PELV system), only an earth connection with GND is permissible. Earthing variants in which the earth is connected to +24 V are not permitted. → Furthermore, you must note that only a maximum voltage U max. < 33 V may act on these modules, even in the event of a fault. If you cannot exclude this risk, external fusing of the power supply is mandatory.. → To ensure trouble-free operation, the supply lines of a PAC module block must be laid in a star configuration with the shortest possible lines from a central supply connection.

Earthing

Connect the PAC modules to earth by attaching the metal housing to functional earth.

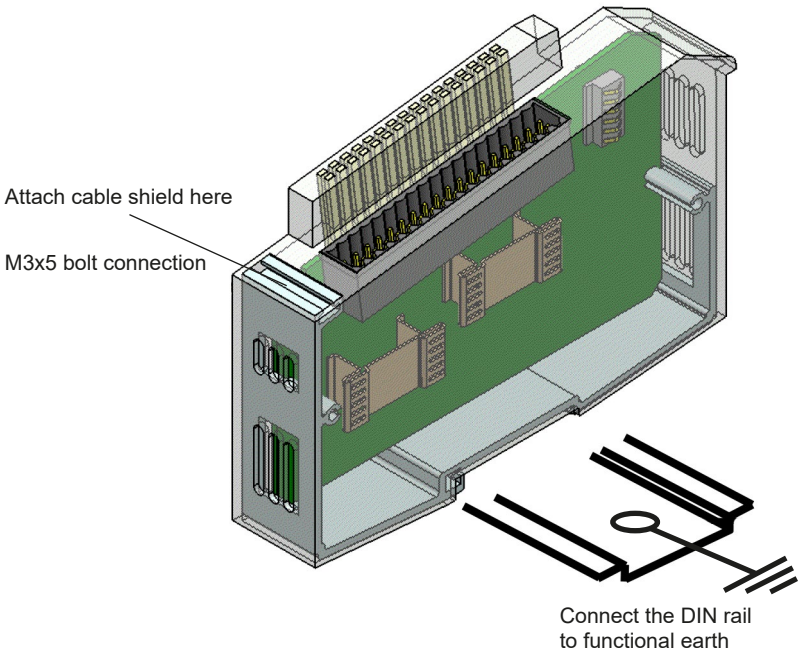
Since the functional earth connector dissipates HF currents, it is of utmost importance for the module's noise immunity.

HF interference is dissipated from the electronics board to the metal housing. The metal housing therefore needs to be suitably connected to a functional earth connector.

You will normally have to ensure that

- the connection between module housing and DIN rail conducts well,
- the connection between DIN rail and switching cabinet conducts well,
- the switching cabinet is safely connected to earth.

In special cases, you may attach the earth wire straight to the module.



☞	**Note**
	Earth wires should be short and have a large surface (copper mesh). Refer to http://en.wikipedia.org/wiki/ground_ (electricity) for further details

Module interconnection

The PAC modules electrically connect by completely pushing the modules together. This automatically connects them to the EtherCAT bus system and supplies power to the EtherCAT communication modules. PAC120 is always the first module of a PACHC/PACIO block.

Please note that the power supplied by PAC120 limits the number of PAC modules you may connect to a single block.

Logic Power Supply (24 VDC)

Power to the logic circuitry is supplied through lines L+ and L- of the module plug.

!	**CAUTION**
	Risk of electric voltage Supply voltages outside of the admissible range may destroy the unit. → Before turning on the supply voltage, verify that it is within the admissible voltage range.

Internal power supply

The PAC120 has a built-in power supply for an input voltage of 24 VDC (18 V ... 32 V). The power supply has a built-in reverse polarity protection. This power supply unit supplies the CPU core of the PAC controller, but also the PACIO modules connected to the E-bus. The supply line and the power supply unit must be provided with external short-circuit and overload protection with a tripping current of max. 10 A.

Digital input

Make sure that the cable length at the digital input is shorter than 30 m.

Ethernet cable

Only use cables that comply with the Cat5e specification according to ISO/IEC 11801 or better. The maximum permissible cable length between two network nodes is 100 m.

☞	**NOTE**
	Torsion and continuous tensile load close to the plug of the Ethernet cable stress the connection. If the plug is seated with a lot of play and not sufficiently guided in the bush, tilting effects occur in the plug connections. This can lead to contact interruptions.

5.2 Configuration

A web interface is used to configure PAC120. After logging in, you can check and change various system settings and/or display system information.

5.2.1 IP Address

The PAC120 is delivered with a fixed IP address and a fixed subnet mask.

	PAC120 -Pxx01-3X-00-01 (IEC)	PAC120 -Mxx01-3X-00-01 (IEC, PLCopen Motion)
IP adress	169.254.116.116	192.168.10.50
Subnet mask	255.255.0.0	255.255.0.0

To connect to the PAC120 for the first time, your PC must be in the same IP address range as the PAC120.

If necessary, change the IP address of your PC accordingly.

CAUTION

Duplicate IP addresses
Assigning the same IP address to two different devices may cause serious network problems.
→ Check your network for duplicate IP addresses.
→ To put PAC120 into operation for the first time, we recommend using a direct network connection between and set IP addresses for PAC120 and the programming PC. You may have to use a cross-over network cable.

CAUTION

Unknown IP address
→ When the connection to the PAC120 fails, because the IP address is not known, you can start the PAC120 in service mode (section 5.5.2).

5.2.2 IP Reset

Additionally to the set IP address, the PAC120 gets assigned a unique IP address in service mode, allowing to reach the PAC120 if the IP address settings are unknown.

IP adress: 192.168.0.116

Subnet mask: 255.255.255.0

With this IP adress the PAC120 is accessable via web interface and the preset IP adress can be readout and modified. To apply the preset IP adress and leave the service mode the device must be turned out.

5.3 Web Interface

5.3.1 Web Interface – Login

First of all, run a browser application on your PC to launch the web interface of PAC120. Internet Explorer, Chrome and Firefox are the current choice of browsers.

Type the following IP address into your browser's address bar: http://<IP-Address>

The following web site displays:

The control unit hosts several user accounts for accessing the web interface. The user passwords default to the user names.

The following users may access the web interface:

Name	Password (SerialNo < 250623XXX)	Password (SerialNo > 250623XXX)	Rights
admin	admin	Serial Number	Unrestricted access
webuser	webuser	Serial Number	Restricted access

Overview rights

User name	FTP/web	Rights FTP	Rights Web
admin	No/Yes	none	Read/Write
webuser	No/Yes	none	Read

Note

Change of passwords
Change the passwords of the user accounts before setting the control unit to productive or network use. Otherwise, the control unit can easily be accessed by using the default passwords.
→ Write down the password and keep it in a suitable place.

Provided that logging in is successful, another page showing the menu items below displays.

5.3.2 Menü – Configuration

5.3.2.1 Menu Item “Network”

Use this page to change various of the control unit's network settings. The new network settings will be enabled when you restart the unit.

Host name

The host name identifies the control unit in a unique manner. In CODESYS V3, the host name is called device name and computer name in Windows. Host names are made up of one or several labels separated by a dot. A label consists of one or more characters.

A label may be comprised of up to 24 ASCII characters:

- a–z or A–Z (no distinction is made between upper and lower case)
- Numerals 0–9
- Hyphen/minus sign –

RFC952 disallows all other characters because they may cause problems. You may also use a Fully Qualified Domain Name (FQDN) such as plc24.mycompany.de as the host name.

Please note that the control unit does not run any DNS or WINS services. Accessing the control unit using the host name therefore requires an extra configuration (e.g. an entry in the network's DNS server).

DNS server

Specify at least one valid DNS server if you wish the control unit to gain access to the domain name system (DNS), that is to say, if you wish it to access other hosts by their name instead of their IP address. The second DNS server is a fallback name in case access to the first server fails. Retain the default for both entries (0.0.0.0) if you do not wish to use the DNS.

Default gateway

Enter the IP address of the router or gateway if the control unit needs to be connected to the Internet. You may retain the default (0.0.0.0) if the control unit will be used in the local area network only. The gateway settings only apply to the first network interface (eth0).

ETH0

ETH0 is the device name of the second network interface of the operating system. This interface supports various modes (inactive, static, dhcp, ethercat, profinet device).

The factory setting is a static IP address for the first network interface, i.e. eth0 (mode: static).

ETH0:1

Virtual extension of network interfaces eth0 and eth1 which allows you to set a second static IP address for the network interface concerned, e.g. for providing separate service access. Only supports mode: static and IP addresses from another IP address range than that of the basic interface. It will not activate if the basic interface mode "ethercat" is active.

Network mode: inactive

This mode entirely disables the network interface.

Network mode: static

This mode lets you set a static IP address. Apart from the static IP address you will need the net mask (called NetMask or Subnetmask). This mode should also be enabled if you wish to use the interface for BACnet, Ethernet/IP or as a Modbus/TCP interface.

Network mode: dhcp

This mode supports a DHCP server's IP address automatically assigned to the network interface when starting the control unit. Set fields IP Address and NetMask to 0.0.0.0 (default).

Network mode: ethercat

This mode defines the network interface as an EtherCAT device. We recommend using eth1 for EtherCAT. In CODESYS V3, you will then have to tell the EtherCAT master configuration that the interface selected for EtherCAT (e.g. "eth1") is a bus interface.

Network mode: profinet device

This function is not supported by PAC120. The left-sided Profinet interface is configured within CODESYS.

ETH1

ETH1 is the device name of the second network interface of the operating system. This network interface is permanently set up as a EtherCAT device (mode: ethercat).

ETH2

These settings are only visible if the PAC120 is equipped with the Ethernet IP expansion module. ETH2 is the device name of the third network interface in the operating system. This interface supports different modes (inactive, static, dhcp, ethercat, profinet device).

In the delivery state, the network interface eth2 is configured with the static IP address 169.254.116.117 (mode: static).

ETH2:1

Virtual extensions of the eth2 network interfaces, which makes it possible to set a second static IP address for the respective network interface, e.g. for a separate service access. It can only be operated in mode: static and the IP address must have a different IP range than the base interface. If Mode ethercat is active on the basic interface, it cannot be activated.

5.3.2.2 Menu Item “CAN”

The settings on this page allow you to omit CODESYS V3 and still operate the CAN interfaces at a specific baud rate. By default ("set by codesys"), the interface remains inactive until initialised by the CODESYS V3 application.

If you tick one of the available baud rates, the CODESYS V3 application will be ignored when booting the system and the CAN interface will be enabled at the set baud rate. The application can still access the interface.

5.3.2.3 Menu Item „Time and Date“

Use this page to set time of the control unit's real-time clock (RTC) and the time zone. The default time zone on is set to the Coordinated Universal Time (UTC). What is making this a special setting is that UTC is equivalent to the control unit's RTC. Changing the UTC time also changes the RTC. Upon delivery, the control unit's RTC is set to the current German time.

You will need this information to change the time zone of the control unit in order to run functions such as changing between winter and daylight saving time. Remember to change the default German time to the actual UTC time before choosing a new time zone. The time and the changed time zone will not display correctly until you have properly set the RTC/UTC.

Please note that some of the CODESYS V3 system libraries read the time as RTC(UTC).

To show the time and the time zone together, the time reading must first be converted into the local time.

5.3.2.4 Menu Item „VNC-Server“

Use this page to change the resolution and colour settings of the control unit's on-board VNC server. Depending on the connected e-terminal, the values should be adapted accordingly. If images with alpha channel (e.g. transparent PNGs) are used for visualization, 32 bit colour depth is recommended. The VNC server can be disabled optionally.

5.3.2.5 Menu Item „FTP-Server“

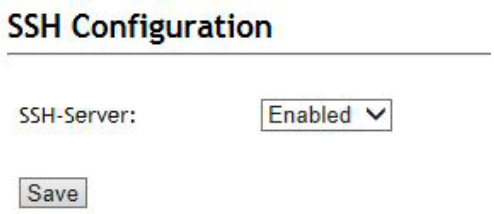
Use this page to enable or disable the control unit's on-board FTP server which uses TCP port 21. The following users are privileged to log in to the FTP server:

User name	Root Directory	Change Root Directory	Rights
root	/root	yes	read/write
ftpuser	/flash/ftpupload	no	read/write (ftpupload only)
ftpadm	/flash/ftpupload	yes	read/write (ftpupload only)
ftpreader	/flash/ftpupload	no	read
ftp custom user (ftpreader/ftpuser/ftpadm)	Einstellbar	adjustable	adjustable

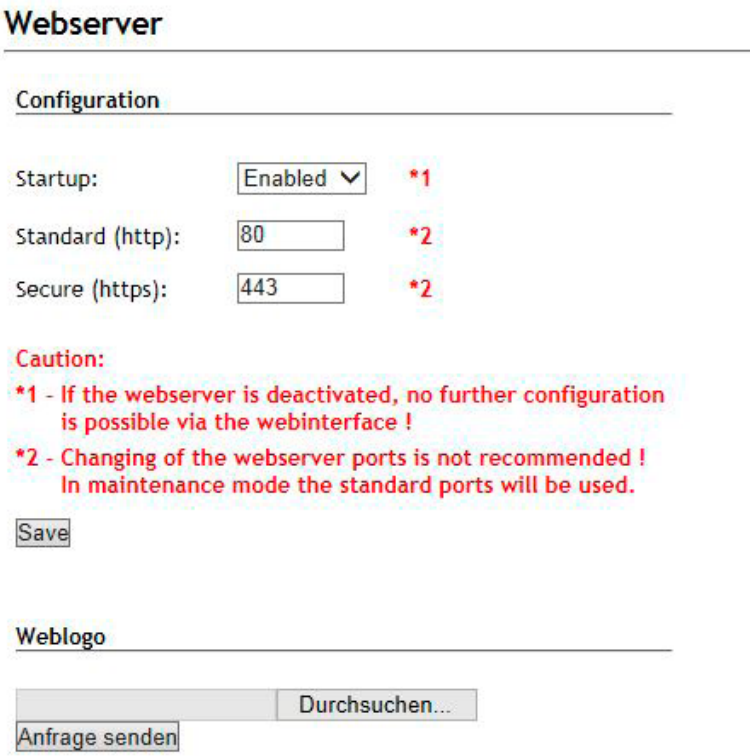
For security, brute force detection and FTPS (FTP over TLS) can be activated.

5.3.2.6 Menu Item „SSH-Server“

The SSH server can be disabled optionally.



5.3.2.7 Menu Item „Web-Server“



5.3.2.8 Menu Item „Users“

Use this page to change the passwords of the users registered with the control unit.

You may also create up to five custom "ftpusers", assign any user name and root directoy to them, enable or disable them and set their privileges based on the three default "ftpuser". Change the passwords of all or some users before running the control unit in a productive environment or make sure that nobody has physical access to the control unit or the network connected to it.

User Name	FTP / web	Rights FTP	Rights web
root	yes / yes	read/write	read/write
admin	no / yes	none	read/write
ftpuser	yes / no	read/write (ftpupload only)	none
ftpadm	yes / no	read/write (ftpupload only)	none
ftpreader	yes / no	read	none
webuser	no / yes	none	none
ftpuser1-5 (ftpreader/ftpuser/ftpa dm)	yes / no	adjustable	none

5.3.2.9 Menu Item „Reset Config“

Use this page to restore the control unit's condition as delivered or its factory defaults. This includes the network, date/time, display and FTP server settings as well as all user passwords. Mind that all user data, CODESYS V3 applications and settings will be cleared in the process. Only the licenses installed in the control unit will be retained.

Restart the control unit after resetting the settings.

5.3.3 Menu – System

5.3.3.1 Menu Item „Info“

This page displays all major details of the control unit.

Option	Example	Explanation
Part-name	PAC120	Name of control unit
Firmware-version	1.19.1	Release of the firmware currently installed in the control unit
Codesys RTS version	3.5.11.40	Release of the CODESYS V3 runtime system currently running in the control unit. The first two digits are the main CODESYS release, the third digit is the service pack, the fourth digit is the patch level and the fifth digit (if any) is the hotfix level.
Licenses	ETHERCAT-MASTER CANOPEN-MASTER MODBUSTCP-MASTER MODBUS-RTU-MASTER	All licenses installed in the control unit. Some libraries such as Modbus TCP requires extra licenses which you may have to install separately.
System operation time	1612 hours 0 min	Total runtime since first putting the control unit into operation
System uptime	0 day 0 hour 19 min	Control unit runtime since last starting the operating system

5.3.3.2 Menu Item „Licenseinfo“

This page displays which licenses are used.

5.3.3.3 Menu Item „Update“

Use this page to upload various files to the control unit in order to install firmware updates or further licenses. Remember to stop all CODESYS V3 applications on the control unit before installing an update. First of all, pick the required file (e.g. firmware_mx6-plc_x.x.x.tgz) by clicking on "Search…", then click on "Send data" to upload the file. This may take up to several minutes, depending on the file size and the quality of the connection. After the upload, the web interface displays a description and the release of the uploaded file for you to review this information. Now click on "Start" to initiate the update process which may take up to two minutes to complete, depending on the size of the .tgz file.

CAUTION

Damage to the unit
Once started, you must not interrupt the update process. Do not disconnect the unit from the power supply during that time. Prematurely interrupting the upload process will turn the unit into a case of repair.
→ Make sure that the power supply cannot be interrupted by mistake.

Note

Attention:
After the update, the controller must be restarted. No applications or user data on the controller are deleted during the update. After the required restart, the controller tries to set existing boot applications to the "AS_RUN" status. The controller starts up again immediately after an update.

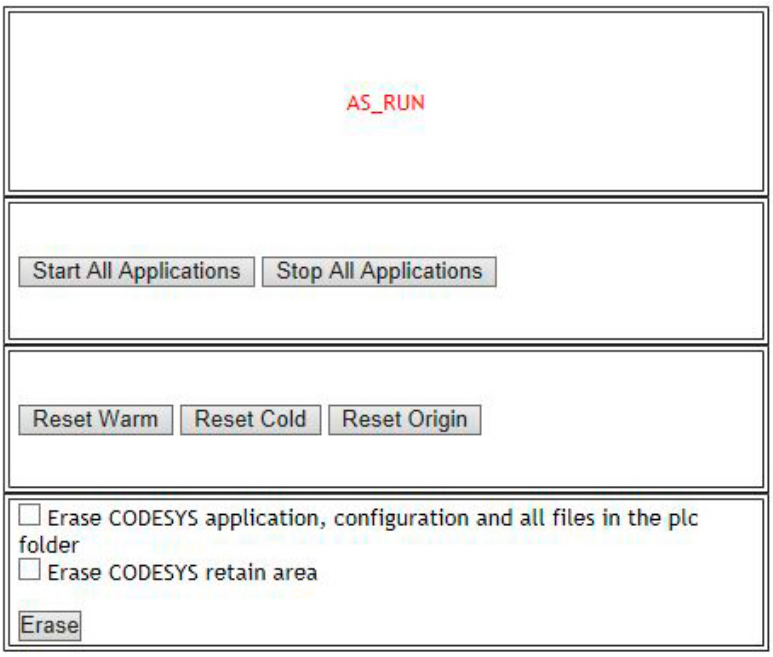
5.3.3.4 Menu Item „Reboot“

Use this page to restart the control unit. You have to restart the control unit when you change some of the control unit settings. This will interrupt all applications currently running in the control unit.

5.3.4 Menu – PLC-Manager

5.3.4.1 Control

Use this page to control the CODESYS V3 applications hosted by the control unit.



Panel 1 displays the status of all applications hosted by the control unit.

State	Explanation
AS_PARTIALLY_STOPPED	The state of at least one application is "AS_STOP"
AS_RUN	The state of all control unit applications is "AS_RUN"
AS_STOP	The state of all control unit applications is "AS_STOP"
AS_NONE	There are no control unit applications.

Panel 2 allows you to start or stop all applications at once.

Option	Explanation
Start All Applications	The software will try to change the status of all applications to "AS_RUN".
Stop All Applications	The software will try to change the status of all applications to "AS_STOP".

Panel 3 lets you reset the control unit.

Option	Explanation
Reset Warm	The status of all control unit applications changes to "AS_STOP" and all normal variables are reset.
Reset Cold	Same as "Reset Warm" except that all RETAIN variables will reset also.
Reset Origin	Erases all control unit applications and resets all control unit variables, including the RETAIN and RETAIN PERSISTENT variables of all applications. Afterwards, you will not be able to log in unless you download the applications to the control unit first.

Panel 4 lets you reset the control unit.

Option	Explanation
Erase CODESYS application, configuration and all files in the plc folder	Erases all control unit applications and resets all control unit variables, including the RETAIN and RETAIN PERSISTENT variables of all applications. The function also erases all files and folders in directory /home/plc/applications. This action has to be followed by restarting the control unit.
Erase CODESYS retain area	Erases the RETAIN and RETAIN PERSISTENT variables of all applications. This action has to be followed by restarting the control unit.

5.3.4.2 Config

On this page some special settings of the controller can be made.

- PLC application on SD-Card
  This option causes the SD memory card to be integrated in such a way that the control can execute applications directly from the memory card.
- CODESYS Gateway: Can be disabled (optionally) or set to configuration mode
- CODESYS OPC UA-Server: Can be disabled (optionally)
- CODESYS Security: Enforced user management can be disabled (optionally) and IEC File Path can be forced

!	**NOTE** If you want to use this feature, you must use a special SD card provided by Parker. Commercially available SD cards are only recognised as mass storage, but not as additional system memory. If the option is activated, the system will not start without a Parker SD card and it will not be possible to load an application. In this case, however, the web interface remains accessible so that the option can be deactivated again.

5.3.4.3 Application Info

This page displays details of the control unit applications.

- Applicationname
  Unique name of the application. Can be changed in the CODESYS V3 development environment by changing the name of the "Application" object.
- State
  Current status of the application.
  AS_RUN: application is running.
  AS_STOP: application stopped either manually or because of an error during execution.
- Projectname, Projectauthor, Projectversion, Projectprofile, Projectdescription
  Displays the project details specified on the CODESYS V3 development platform. To change any of these details, run CODESYS V3, open the "Project" menu from the menu bar and choose "Project Information".
- Exception-ID
  Tells you whether an error occurred in the application. Exception ID 0x00000000 means that there is no error.
- Exception
  Name of error state.

5.3.4.4 Application Files

This page lists all files stored in the control unit. You can separately download every file or use one of the following additional options:

- Download folder from PLC
  Creates a downloadable archive of all files in directory /home/plc and further re-inflating information. Neither modify or unzip the archive if you wish to upload it for use on another control unit.
- Upload folder to PLC
  Uploads a previously downloaded archive to the control unit. Use this option to quickly produce and restore backup files or to quickly send application to many other control units which cannot be accessed via the network.
  Attention! The feature will overwrite existing files and applications without a security prompt. Restart the control unit after you have uploaded an image.
- Clean folder
  Removes all applications from the control unit. CODESYS V3 configuration files are retained. To also remove the CODESYS V3 configuration files, run function "Erase CODESYS application, configuration and all files in the plc folder" on panel PLC Control as described in section 5.4.3.1. Restart the control unit after running this function.

5.3.4.5 Font Files

This page lists all fonts currently installed in the control unit. Fonts are distinguished as "System Fonts" and "PLC Fonts". Section 5.4.3 explains how to install new fonts in the control unit.

Please note that you can either use the system fonts or any custom fonts. In case you wish to use both, your own fonts and fonts previously installed in the control unit, you will first of all have to download the system fonts and upload them back to the control unit's "PLC Fonts" folder together with your own fonts.

- System fonts
  Lists the fonts previously installed in the control unit by default. You can neither modify nor delete these default fonts.
- PLC fonts
  Lists the fonts you uploaded to the control unit.

5.3.5 Menü – Diagnostics

5.3.5.1 PLC Log

This page shows the log of CODESYS V3 Runtime. Log details include:

- The CODESYS V3 release installed and active licenses.
- The system libraries you are using plus their version.
- Network information.
- CODESYS V3 events such as user logins and logouts or the downloading of applications.
- Errors or exceptions that occurred in CODESYS V3 Runtime.

5.3.5.2 System Log

This page has two panels:

Panel "System Log" displays the system log located in the file system at /var/log/messages. It contains general details of the operating system and the services and programs currently running. The lighttpd web server, for example, also logs accesses to the web interface.

Panel "System Diag" logs all interaction between the system and CODESYS V3 Runtime. Entries include information about changes to the retain memory, CODESYS V3 Runtime states, times of boot and power fail events.

5.3.5.3 Ethernet

Use this page to view details of the control unit's network interface. The difference to the "Network" item (see section 5.3.2.1) is that you cannot make any changes on this page. Instead it lists detailed information such as the MAC address, IP address as well as the data packets and volumes sent and received.

5.3.5.4 CAN

This page displays details of the CAN interfaces. A counter of internal error states informs you of the bus state:

can state: ERROR_ACTIVE	CAN active (<96 error frames)
can state: ERROR_WARNING	CAN active (<128 error frames)
can state: ERROR_PASSIVE	CAN inactive (<256 error frames)
can state: ERROR_BUS_OFF	CAN off (>=256 error frames)
can state: ERROR_SLEEPING	CAN running in stand-by mode
can state: STOPPED	CAN stopped

Further details you may view include the current baud rate setting, data packets and volumes received and sent and the total number of error frames received.

5.3.5.5 Storage

Use this page to view details of the control unit's memory state. The most important information for you will be the flash memory state (green highlight) and the state of the external SD card (blue highlight), if any.

You will find the one or several USB memory sticks connected (via a hub if several) in column "/media/usbx". The x marks the order in which the sticks have been mounted (i.e. 1 if one stick is connected).

Filesystem	Size	Used	Available	Use%	Mounted on
ubi0_0	47.5M	15.6M	31.9M	33%	/
devtmpfs	106.8M	0	106.8M	0%	/dev
/dev/ubi0_1	47.5M	31.5M	16.0M	66%	/usr
None	196.6M	32.0K	196.6M	0%	/tmp
None	122.9M	0	122.9M	0%	/media
None	122.9M	116.0K	122.8M	0%	/run
None	122.9M	60.0K	122.8M	0%	/var/log
None	122.9M	116.0K	122.8M	0%	/var/run
None	122.9M	0	122.9M	0%	/var/lock
None	122.9M	0	122.9M	0%	/var/tmp
/dev/ubi1_0	104.3M	596.0K	103.7M	1%	/flash
/dev/ubi1_0	104.3M	596.0K	103.7M	1%	/home/plc
/dev/ubi1_0	104.3M	596.0K	103.7M	1%	/usr/local
/dev/ubi1_0	104.3M	596.0K	103.7M	1%	/var/cache
/dev/ubi1_0	104.3M	596.0K	103.7M	1%	/var/spool
/dev/ubi0_1	47.5M	31.5M	16.0M	66%	/etc
None	196.6M	32.0K	196.6M	0%	/var/www/tmp
/dev/mmcblk0p1	945.7M	3.8M	941.9M	0%	/media/sd
/dev/sda1	7.5G	24.9M	7.5G	0%	/media/usb1

5.3.5.6 System Dump

This page allows you to create an image of the control unit's entire diagnostics realm. Use this function to analyse errors occurring in an application or the control unit. We recommend creating the image file immediately after the error occurred, i.e. without restarting the control unit first. It may take several minutes to create the image file. Once it is available, the browser will provide it for download. Save this file and send it to Parker for analysis.

5.3.6 Logout

Find the logout link in the bottom right corner of the screen.

5.4 System Functions

5.4.1 FTP-Server

Run the FTP server of PAC120 to allow an FTP client to access the controller. Refer to section 5.3.2.5 menu Item "FTP server". FTP lets you exchange recipe data with the control unit, for example.

File System and Folder Tree

Most of the control unit's file system folders and files can either not be accessed or just read by the user. To be able to use certain control unit functions, however, there are some directories that end users have write and use access to.

Folder	Description
/flash	Unit's internal flash memory
/flash/plc	CODESYS V3 root directory. Also mounted at /home/plc.
/flash/plc/applications	Location of the CODESYS V3 application
/flash/plc/applications/fonts	Location of some fonts which needs to be created once if you intend to use your own fonts.
/flash/ftpupload	FTP users root. Use this as your default directory for files downloaded or uploaded via FTP.
/media/sd	External flash memory (SD card); only available if a SD card is used.
/media/usb1	External USB memory; only available if a storage medium has been plugged in.

5.4.2 Service Mode

Service mode differs from normal operation in the following points:

- CODESYS V3 Runtime will not run, i.e. no control program will be running.
- The factory defaults will be loaded when configuring the network to ensure that every control unit can be addressed by a unique IP address. Refer to section 5.3.2.1 to learn more about this kind of network configuration.
- Underneath the name of the control unit, the web interface will display "(maintenance)" instead of "(plcactive)".

Service mode is enabled by turning off PAC120. Now press and hold the button to restart PAC120. Keep pressing the button until Run/Stop lights up yellow every 2 seconds.

5.4.3 Installing more Fonts

By default, DejaVu series fonts are installed. If you wish to use other fonts such as Windows fonts for your WebVisu or TargetVisu visualisations, you may copy any set of Truetype fonts (*.ttf) to folder "/flash/plc/applications/fonts/" and use them afterwards.

If you have not used any own fonts yet, you will have to create this folder once. We recommend running the control unit's FTP server application and downloading the fonts into the control unit via FTP.

Attention: For system reasons, you will have to use lowercase letters for the font file extension because the system will otherwise fail to recognize the file and you may have to rename the file. For example, be sure Arial unicode font file is called "ARIALUNI.ttf". The control unit will not recognize "ARIALUNI.TTF" or "ARIALUNI.Ttf".

Attention: You can choose to use the on-board or additional fonts. To make parallel use of your own and the on-board DejaVu fonts, first of all download the DejaVu fonts from directory "/var/lib/fonts" or via the web interface and upload them to folder "/flash/plc/applications/fonts/" together with your own fonts.

	Note
☞	Many fonts you may know from daily PC use are subject to a license! Arial, for example, is a Microsoft font covered by your Windows license. Before using alternative fonts, please verify that they non-licensed freeware or that you own the license.

5.4.4 Update functions

The PAC120 can be updated via USB stick or SD card.

- USB stick: The update must be saved in the directory "usbupdate-mx6" on a USB stick.
- SD card: The update must be saved in the directory "sdupdate-mx6" on an SD card.

The file "usbupdate.ini" in the update directory ("usbupdate-mx6" or "sdupdate-mx6") is the central configuration file. It is used to set which actions are carried out when the unit is booted.

The usbupdate.ini is divided into five sections. In each of these sections there is at least one pair of key and value. Furthermore, the file "usbupdate.tgz" must be in the update directory.

A complete template can be found on our website at:

http://www.parker.com/PAC120

☞	**NOTE** The SD card slot is not hot-pluggable. This means that only cards that were inserted during booting are recognised. It is not possible to exchange the SD card during operation.

All entries in usbupdate.ini have a short description of the function in English. Most values are of the type "boolean" and can therefore take the values "yes" or "no".

There are the following five sections:

- [firmware]: Settings for upgrading or downgrading the firmware.
- [webtheme]: Settings for replacing the logo visible in the web interface.
- [sysconfig]: Settings for changing the system configuration.
- [plcapp]: Settings for executing an application update or a copy operation.

For each of these sections, there is a folder with the same name on the USB memory. The files required for the respective execution are stored in this folder. Since the usbupdate.ini is only a text file with a special formatting, it can be edited with any text editor. However, it is recommended to use an editor (e.g. the free software Notepad++) that masters the ini format and formats the text and also displays it in colour.

Each section and also each key/value pair can be used independently. It is possible to create a USB update that changes only one setting or an update that copies files to the controller afterwards. The user can choose freely here and, if necessary, create different USB memories for different occasions. Entries that do not exist or are commented out are ignored.

In the following chapters, the possible entries of all sections are briefly presented.

Update: Section [firmware]

The firmware section consists of the following keys:

Overview		
Key	**Value range**	**Description**
do_update	yes / no	
firmware_name	Filename	The file must be in the subfolder "firmware". Example: Firmware_PAC120_x.xx.x.tgz

Update: Section [webtheme]

The webtheme section consists of the following key:

Overview		
Key	**Value range**	**Description**
do_update_webtheme	yes / no	

The logo must be a GIF image file with the name "logo.gif" and must be in the subfolder "webtheme". The image is scaled by the browser in the web interface. It is recommended to create the logo directly in the resolution suitable for the intended use.

Update: Section [sysconfig]

The Sysconfig section consists of the following keys:

Overview		
Key	**Value range**	**Description**
do_reset_syscfg_to_factory_defaults	yes / no	This key specifies whether the configuration of the controller is to be set to the delivery state.
do_sysconfig_from_file	yes / no	This key specifies whether the configuration of the controller is to be updated with the settings from the "configuration.ini".
replace_config_file_instead_of_merge	yes / no	This key specifies that the configuration of the controller will be reset to the delivery state and

The configuration settings to be updated are defined in the "configuration.ini" file in the "sysconfig" folder. The individual options are described in more detail in one of the following chapters.

Update: Section [plcapp]

The plcapp section consists of the following keys:

Overview		
Key	**Value range**	**Description**
do_clean_plcfolder	yes / no	This key specifies whether the application folder on the controller (/flash/plc/applications/) should be deleted completely
do_update_plcapp	yes / no	This key specifies whether a programme update of the controller programme should be carried out. All files from the update archive are written to the controller. Files with the same name are overwritten.
plcapp_name	Filename	Filename for the action "do_update_plcapp". This file must be in the subfolder "application". An update file must have been previously created and downloaded via the web interface from another controller.
do_copy_plcdata	yes / no	This key specifies whether all files contained in the subfolder "application\data" are to be copied to the directory "/flash/plc/applications/".

Update: Changing Controller Settings via the "configuration.ini" File

All controller settings that can be adjusted via the web interface can be changed automatically via a USB update. The "configuration.ini" file in the "sysconfig" folder serves as the basis.

In this file, as in the "usbudate.ini", various sections with key/value pairs are stored.

Section [network]

Overview		
Key	**Value range**	**Description**
eth0.mode	„static“ / „dhcp“ / „inactive“	Interface Mode
eth0.ip	xxx.xxx.xxx.xxx	IP address, e.g. 169.254.116.116
eth0.netmask	xxx.xxx.xxx.xxx	Network Mask,. e.g. 255.255.0.0
default_gateway	xxx.xxx.xxx.xxx	IP address, e.g. 169.254.116.1

Of course, the second network card of the controller can also be configured via the corresponding eth1.xxx keys.

Section [ftp]

Overview		
Key	**Value range**	**Description**
enabled	0 / 1	0 deactivates the FTP server. 1 activates the FTP server.

6. Development Environment CODESYS V3.5

6.1 Installing CODESYS V3.5 on the Project Engineering PC

CODESYS V3.5 is based on a CODESYS V3 runtime system and is a device-independent system for programming control units.

It conforms to standard IEC 61131-3 and supports all standardized IEC programming languages plus the integration of C code routines and object-orientated programming.

In conjunction with runtime system CODESYS Control Win V3 it also allows the use of "multi-device" and "multi-application" programs. Owing to its component-based architecture, it supports customer-specific configurations of and extensions to the user interface.

Before installing CODESYS V3.5, please read and take note of the system requirements:

Windows XP / 7 / 8 / 10, appropriate PC hardware matching the Windows version installed.

6.1.1 Installing the Device Description

Before the IEC 61131-3 development tool CODESYS V3.5 can be used to operate a device, the device and its properties are to be made known to the runtime system.

A separate plug-in, the Device Repository, provides the local system and your projects with the device definition management functions. Among other features, it contains commands of category devices which you will normally find in the Tools menu.

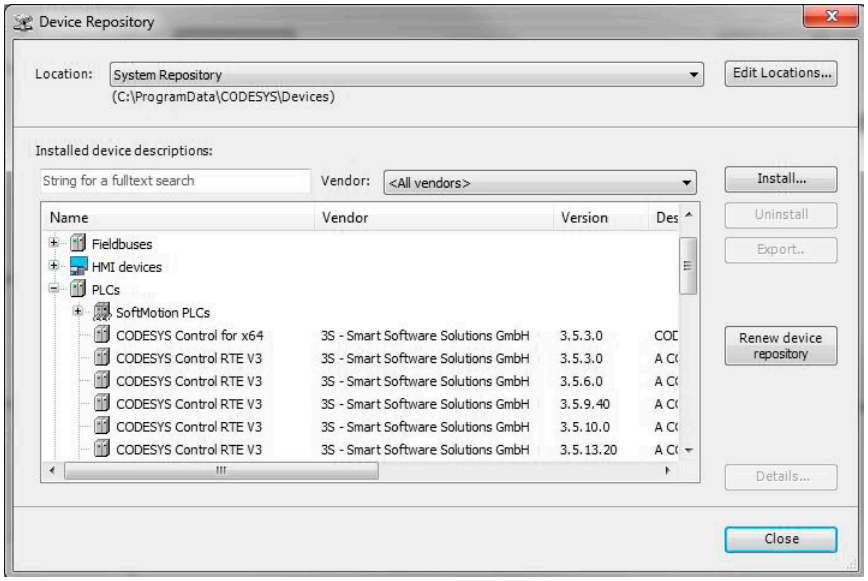
→ Open the Tools menu and pick Device Repository...

→ Screen Device Repository is displayed

→ Expand the tree with the name “Control Units (PLC)”

The Device Repository hosts the descriptions of all devices currently installed on the local system and makes the devices available for programming in CODESYS Devices are installed in and uninstalled directly from the Device Repository.

The screen “Device Descriptions Installed” displays the “Name”, “Vendor” and “Version” of every device that is currently installed. Click on the plus and minus signs to expand or collapse the branches.



Click on “Install...” to install a new device on the local system and make it available for use in the programming system.

Dialog “Device Descriptions” Installed is displayed. Use it to search the system for a specific device description file. If you are looking for a standard device, set the file type filter to "*.devdesc.xml" (device description).

Clicking on “OK” confirms your settings, closes the screen and adds the device to the tree shown on screen “Device Repository”. Look at the bottom of screen Device Repository to find messages on any installation error (e. g. missing files referenced by the device description).

6.1.2 Installing Device-specific Libraries

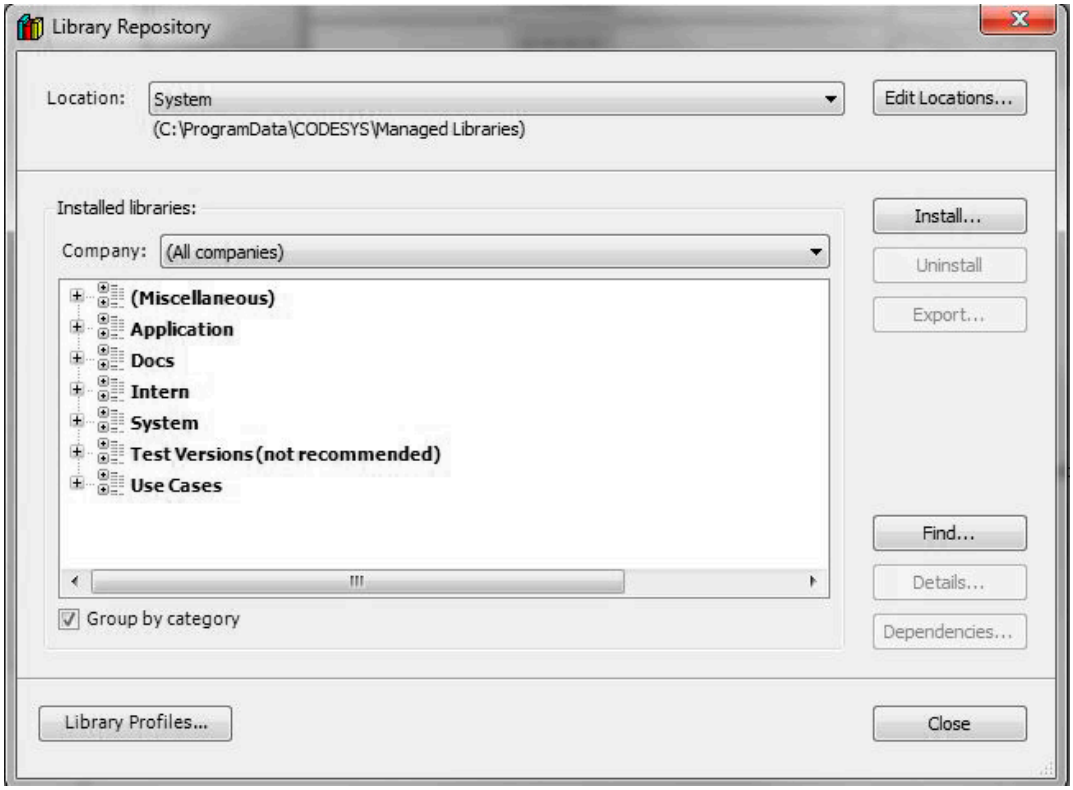
Similar to the device description files, CODESYS keeps libraries in a dedicated repository, i.e. the Library Repository in this case.

The following device-specific libraries are available for PAC120:

- Parker System Library iMX6
  Library providing access to the system settings
- Parker iMX6 Onboard IO Library
  Library of functions of the on-board IO module

→ Open the Tools menu and pick Library Repository

→ The Library Repository dialog is displayed



Click on “Install”... to install a new library in the local system and make it available for use in the programming system.

Browse to the location where your libraries are saved. The default filter is Compiled Libraries (*.compiled-library) which is the format in which libraries are normally made available. Choose the library you wish to install and click on Open. Once installed, the library will appear on tree Installed Libraries.

6.1.3 Further installation and update references

The required device descriptions and libraries as well as sample programmes and application templates for the PAC120 and other PAC modules such as the PACHC are combined in a package and can be installed together. This simplifies handling considerably compared to the steps in 6.1.1 and 6.1.2.

For installation, the package manager must be available within CODESYS and must be installed from the CODESYS homepage if necessary.

→ Open the 'Package Manager' in the 'Tools' menu.
→ Click on 'Install‘
→ Select the package file on your computer and click on Open.

The PAC120+PACHC package can be found on the product homepage

http://www.parker.com/PAC120

For further instructions on installation, firmware updates and CODESYS specific functionalities refer to Parker_PAC120_PACHC_Package_and_Firmware_Migration_Manual_V2-0-0-4 on Parker homepage.

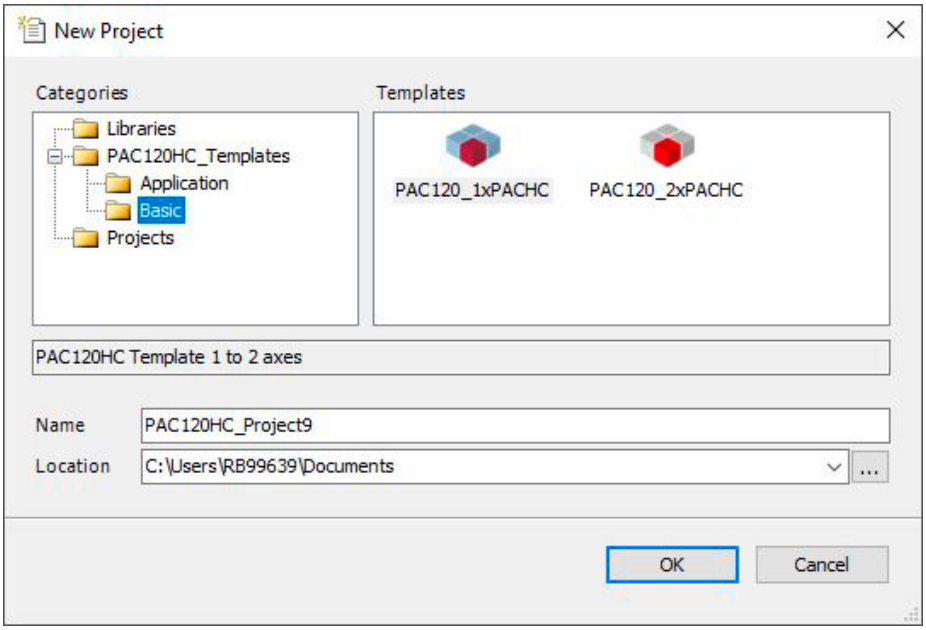
6.2 Creating a Project in CODESYS

New projects can be created within CODESYS as new empty project or from a project template.

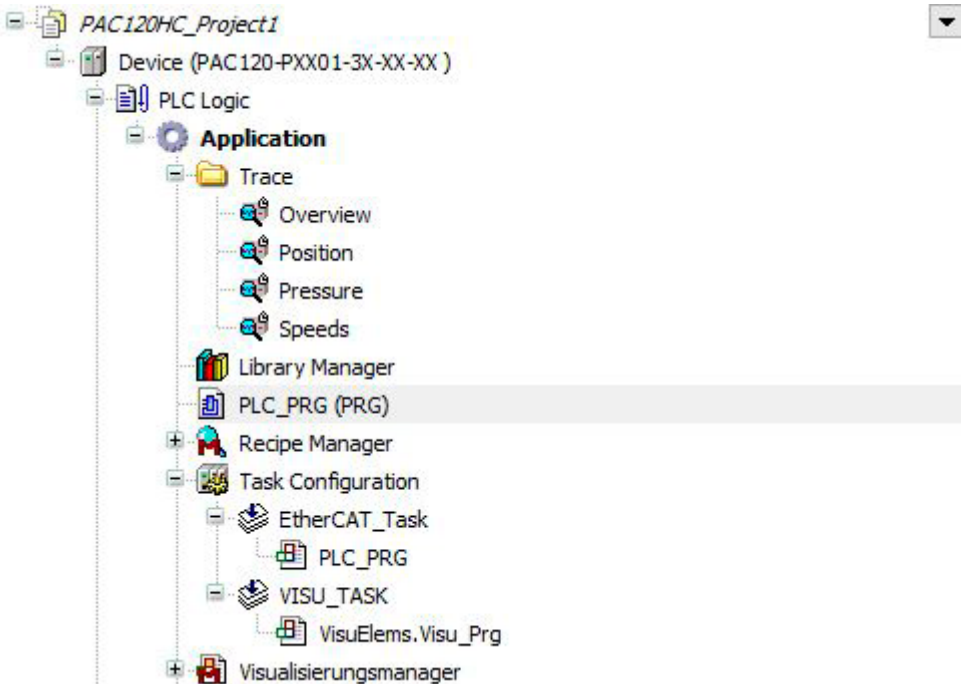
6.2.1 Using the Project Templates

The PAC120HC package on the Parker website for the PAC contains project templates for various applications that can be used as a starting point for your own programme development.

The templates from the PAC120HC package are displayed under File New Project.



In the project template, the complete device tree consisting of one PAC120 and one PACHC (PAC120_1xPACHC) or one PAC120 and two PACHCs (PAC120_2xPACHC) is already included and no longer needs to be created manually. In addition, the template also adds the visualisation for the PACHC set-up and trace settings to the application.



How the device tree is set up without a template and how further components can be added to it is described in the following chapter.

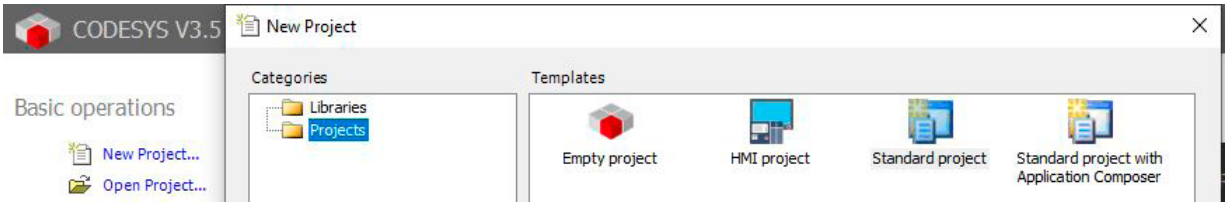
6.3 Creating a new Project

You can create a new PAC project off line with no access to the controller.

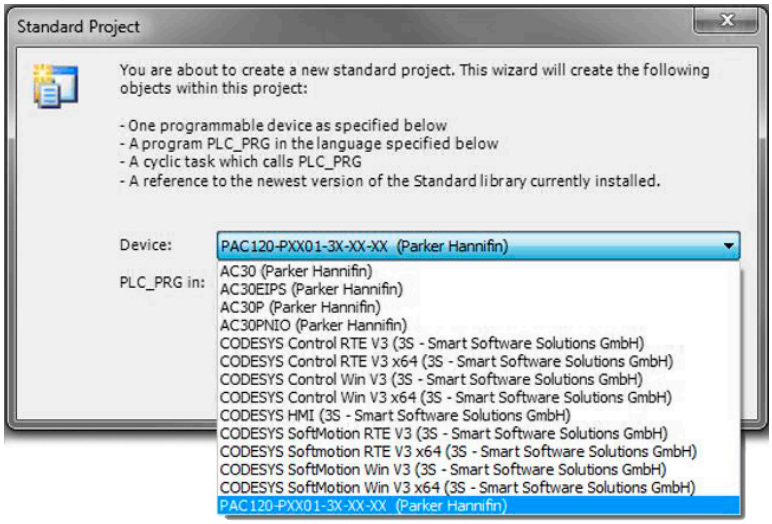
→ Launch the CODESYS software.

→ Choose “New Project”.

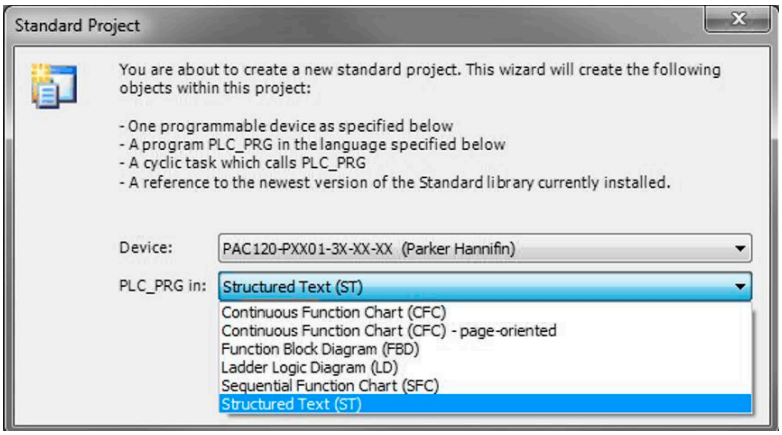
→ Choose Standard Project and choose the location you would like to store the project. Click “OK”.



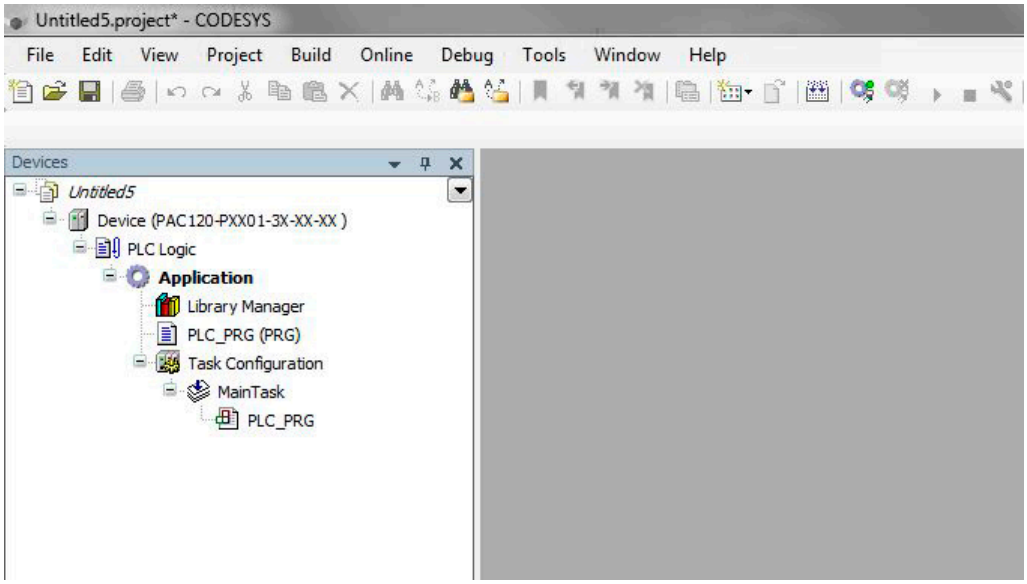
→ Choose “PAC120” as device from the device list and confirm with “OK”.



→ Choose the programming language for the program module “PLC_PRG”.



After adding the device, further objects are available in the project tree.



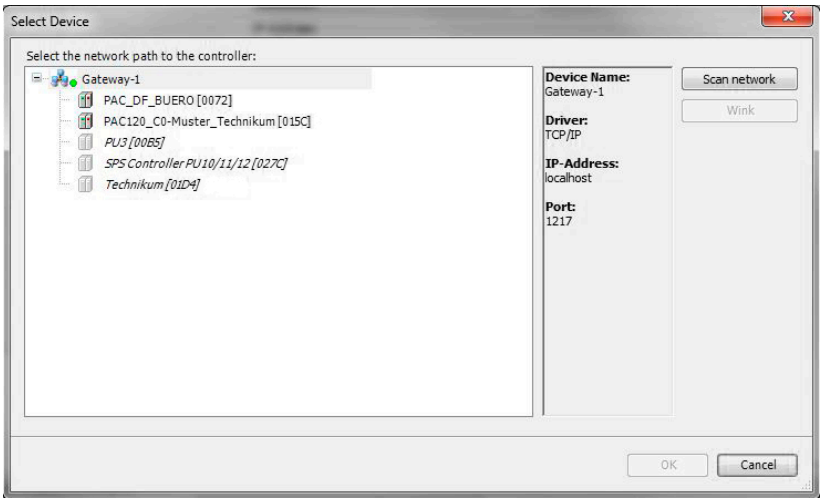
6.3.1 Connecting with a PAC

CODESYS connects to the PAC via Ethernet. To establish a connection to the device, follow these steps:

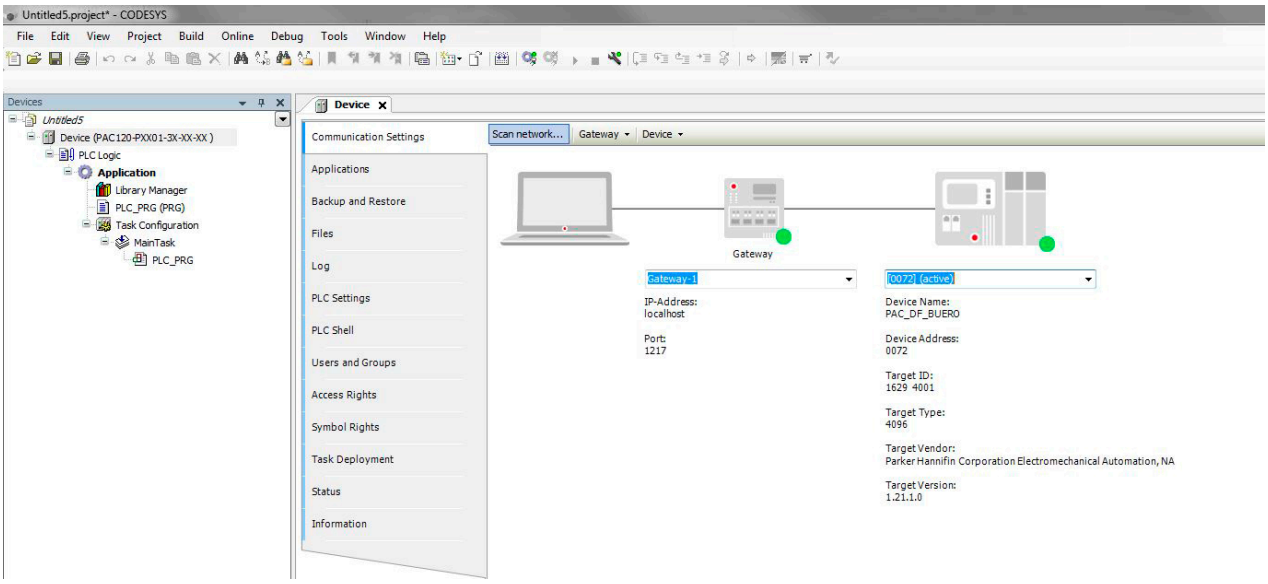
→ Double-click on the device PAC120 in the project tree.

→ On the tab page “Communication Settings”, click on “Scan Network”. The network is scanned for available devices.

→ Choose “PAC120” as device. If several devices are available, you can identify your device through “Flashing”. The LED Run/Stop flashes repeatedly. Subsequently confirm your selection with “OK”.



On the tab page “Communication Settings”, the green dot at the device symbol indicates that the device was found and the computer is now connected to the PAC.



6.3.2 Configuring the EtherCAT Master Task

The EtherCAT Master Task is created automatically by the PAC device description and the program call EtherCAT_Master.EtherCAT_Task is inserted.

This task should always have top priority. By default priority is 0.

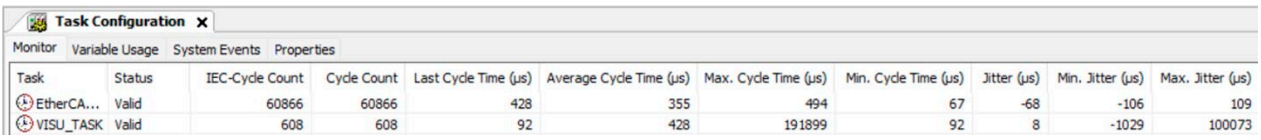
The cyclic interval must be adapted to the performance of the connected components. The minimum cycle time for the EtherCAT is 0.5 ms.

The following summary helps to select the correct cycle time for EtherCAT master task.

Number of Axes	Recommended EtherCAT Cycle Time(µs)
< 5 axes	1000
> 5 axes	2000

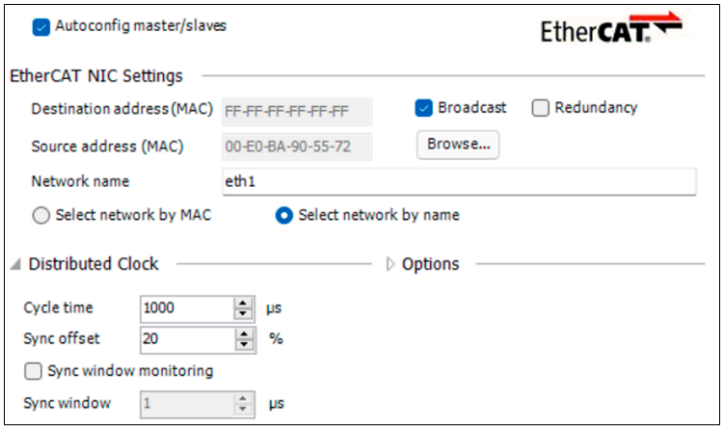
NOTE

All tasks should be checked in the Task Configuration via the Monitor function, everything is running perfect.



Task	Status	IEC-Cycle Count	Cycle Count	Last Cycle Time (µs)	Average Cycle Time (µs)	Max. Cycle Time (µs)	Min. Cycle Time (µs)	Jitter (µs)	Min. Jitter (µs)	Max. Jitter (µs)
EtherCA...	Valid	60866	60866	428	355	494	67	-68	-106	109
VISU_TASK	Valid	608	608	92	428	191899	92	8	-1029	100073

The EtherCAT Cycle Time is set in the EtherCAT_Master.

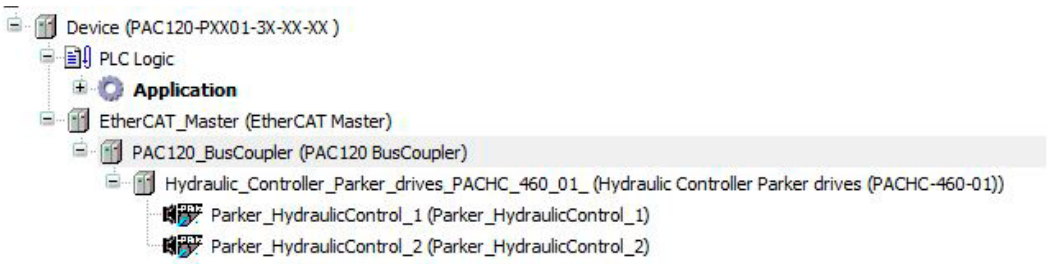


6.3.3 Setting up EtherCAT Master

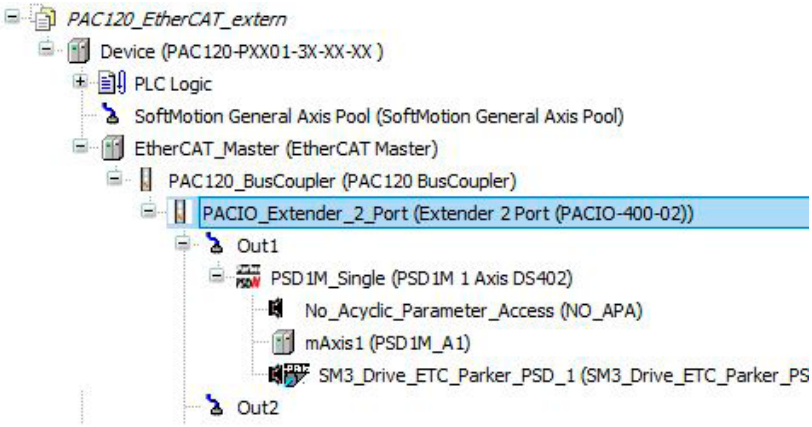
Append the "EtherCAT Master" device to PAC120. Double-click to configure it. Go to the general settings and enter "eth1" as the interface.

Now append the PAC120 BusCoupler (Internal E-Bus) to the EtherCAT Master. The device is the starting point of appending all further Parker PACIO EtherCAT series modules, e.g. PAC DI16/DO16.

Devices tree with EtherCAT



If an external EtherCAT device is to be used, the PACIO 400-02 extender module is attached to the EtherCAT Master. Subsequently, the external EtherCAT device can be attached to Out1 or Out2 of the extender module.



<u>PAC120 and CODESYS</u>

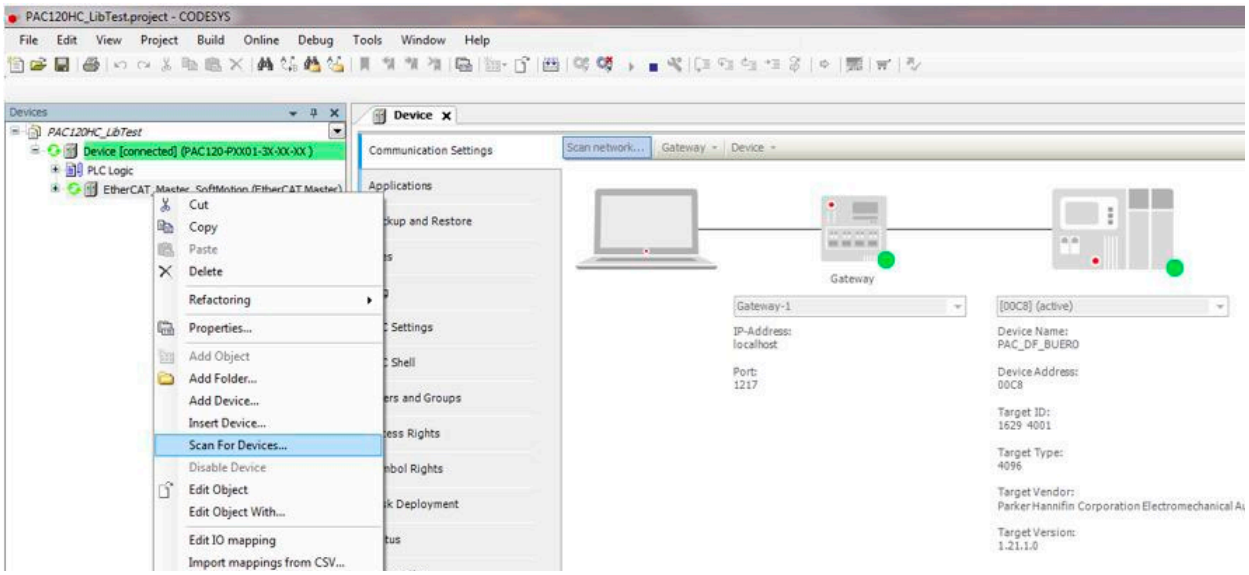
PAC120 supports several ways to capture and process signals. These can be provided locally as well as via different bus systems. To do so, append the corresponding devices to the devices tree by clicking with the right mouse button on “Device (PAC120)” and selecting “Append device” in the context menu.

6.3.4 Adding PACHC or PACIO (online)

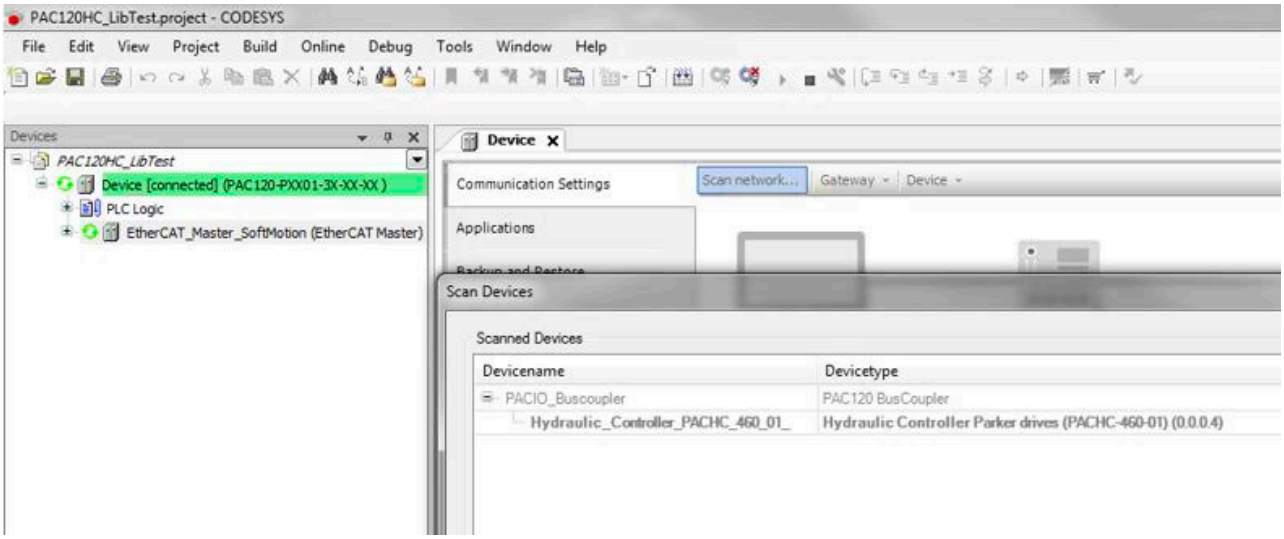
Connected EtherCAT components are recognized automatically by PAC120. For this, the PAC must be connected to the computer (-> see “Connecting with a PAC”).

→ Click with the right mouse button on “EtherCAT Master”.

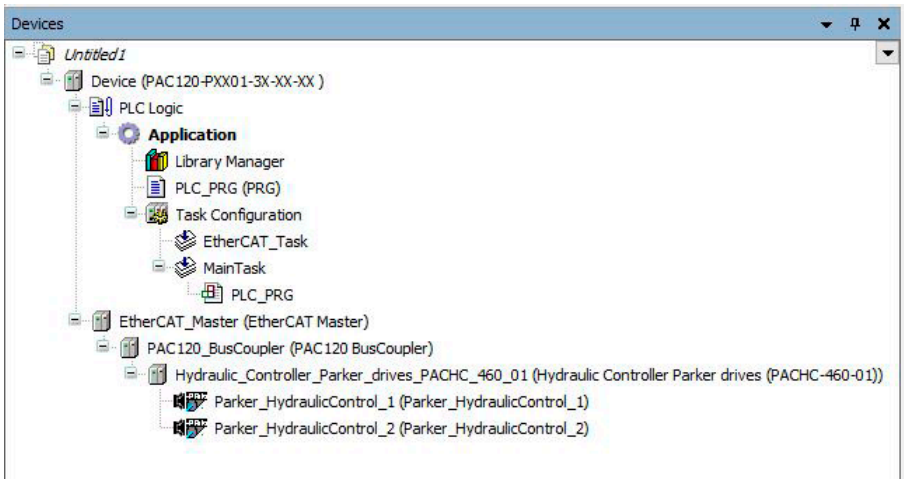
→ Search device



→ A list with connected EtherCAT Slaves is displayed. If a slave is missing, make sure that it is connected and supplied with power. Click for a new scan again on “Device Scan”.



→ As soon as the list is completed, click on “Copy all devices to the project” and the PACIO will be displayed in your project tree under “PAC120_BusCoupler”. If there are several device descriptions available for one device, the desired device description must be selected before.



→ If a “PACHC_xxx” is added, two axes with the name “Parker_xxx” are created and inserted into the device tree below the device. If you click with the right mouse button on the axes and select “Rename”, you can change the names. These axis names are used in the application program as reference for the function blocks and for accessing to axis objects. Up to 10 PACHC (20 axes) can be added at PAC120.

6.3.5 Adding PACHC or PACIO (offline)

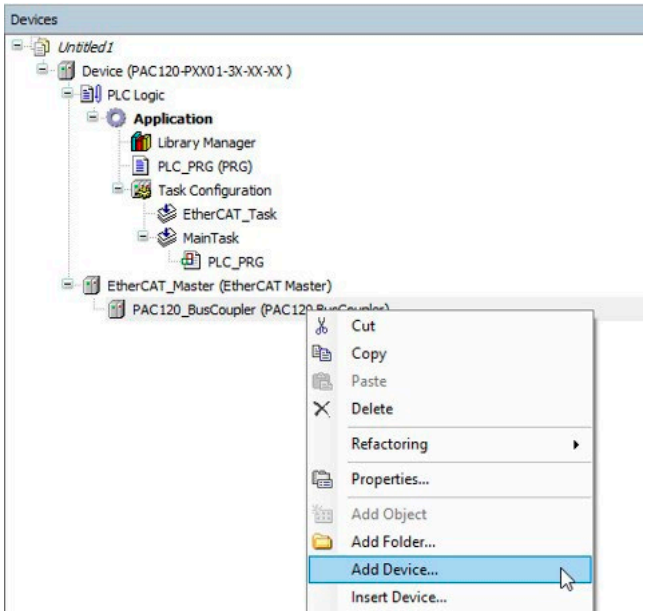
EtherCAT devices can also be added offline.

- Click with the right mouse button on “EtherCAT Master”
- Select option “Add Device”.
- Select the desired device.

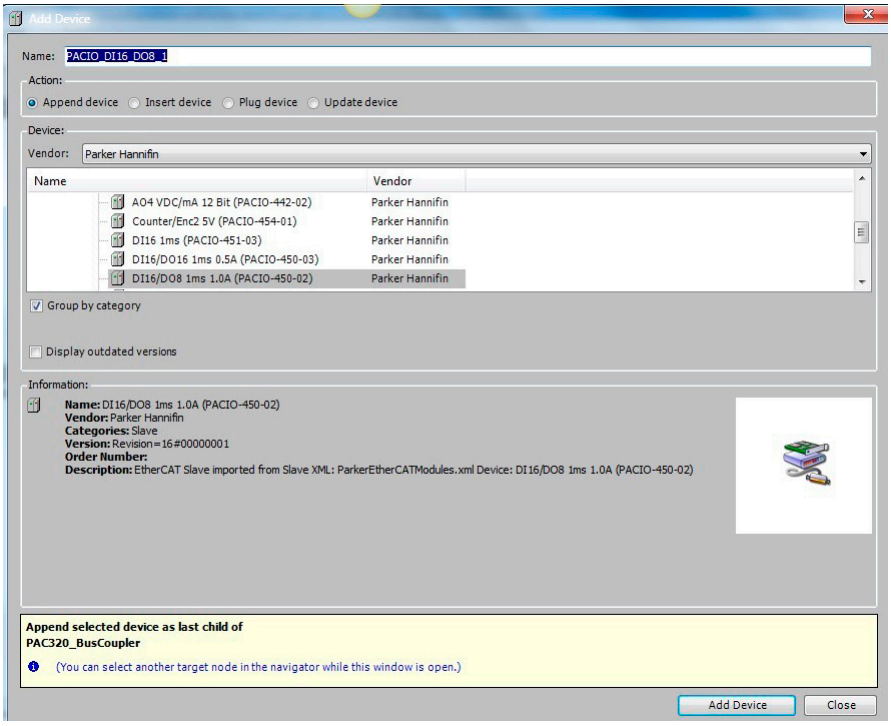
The device will be added to the project tree and the required libraries will be installed.

As soon as you have configured the PAC120 as EtherCAT Master, you can add your PACHC and PACIO modules without Ethernet connection to the PAC. They will be added as EtherCAT Slaves under “PAC120_BusCoupler”.

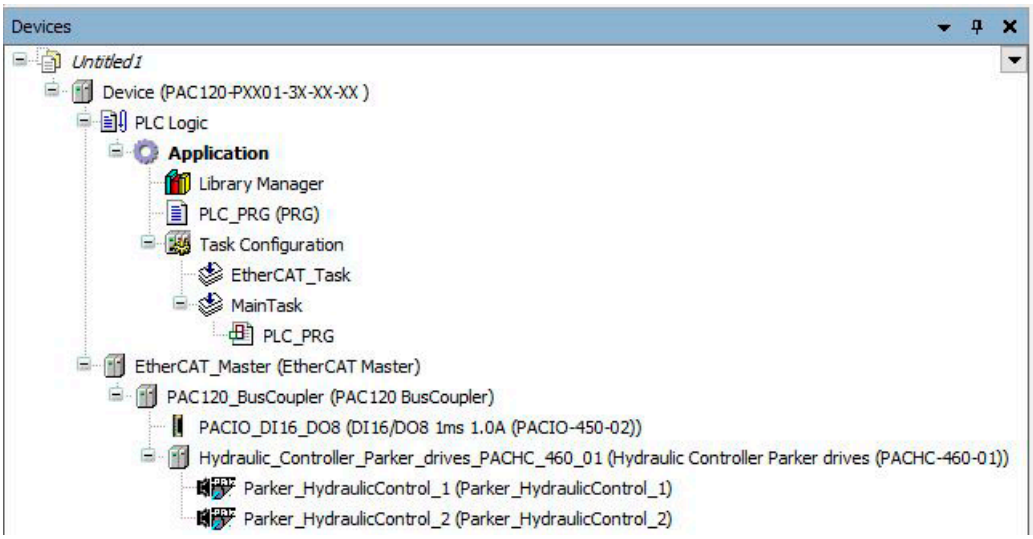
→ Click with the right mouse button on “PAC120_BusCoupler” and select “Add Device”.



→ Select Parker Hannifin as vendor and choose the PACHC or PACIO Slave Modul which matches with the hardware in your system. Then click “Add Device”.



→ The new module shows up on the list. If required, you can add more PACHC or PACIO modules by repeating the steps described above.



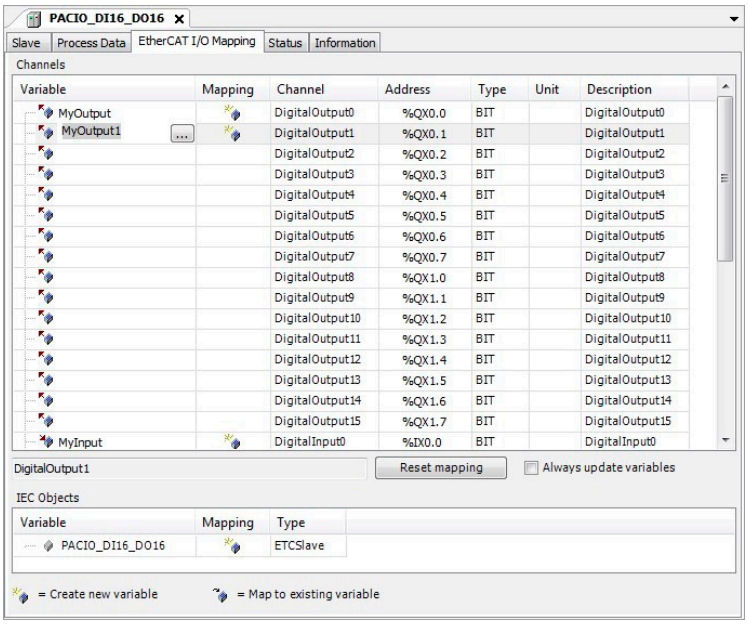
→ If a “PACHC_xxx” is added, two axes with the name “Parker_xxx” are created and inserted into the device tree below the device. If you click with the right mouse button on the axes and select “Rename”, you can change the names. These axis names are used in the application program as reference for the function blocks and for accessing to axis objects. Up to 10 PACHC (20 axes) can be added at PAC120.

6.3.6 Mapping the PACIO

After you have assigned the PACIO module to the project, the next step is to assign the I/O points.

→ Double-click on “PACIO Module Nodes” in the device tree.

→ Then click on the tab “EtherCAT I/O Mapping”. This will open the I/O mapping dialogue which contains a table with all I/O points.

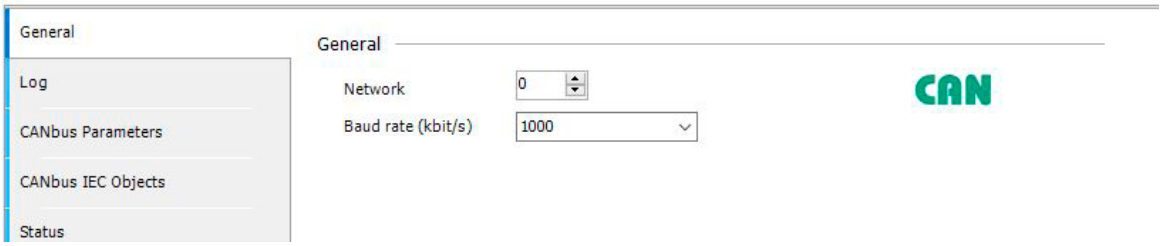


→ Double-click on the desired I/O point in the “Variable” column and name it. Note: Variables created this way are global for the project.

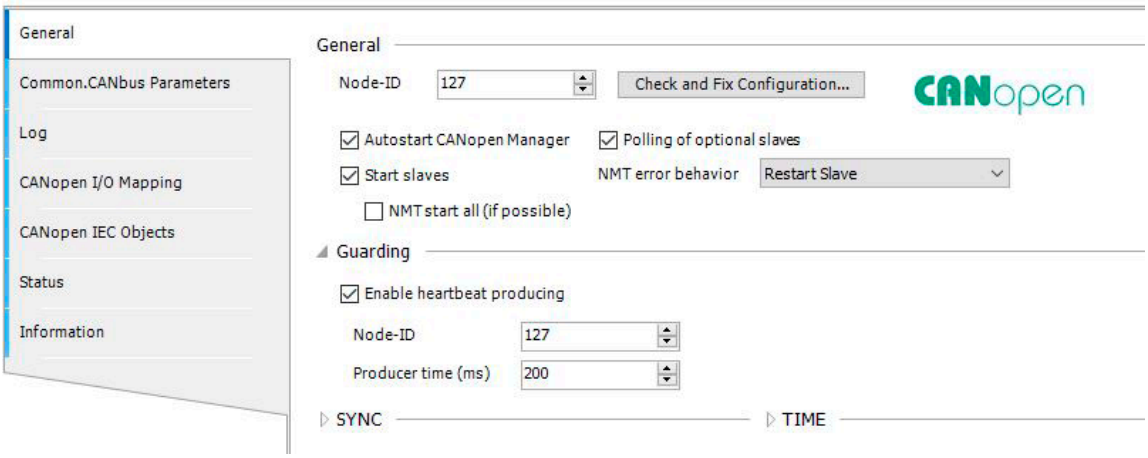
The I/O point can now be accessed in any POU through the variable name.

6.3.7 CANopen Master

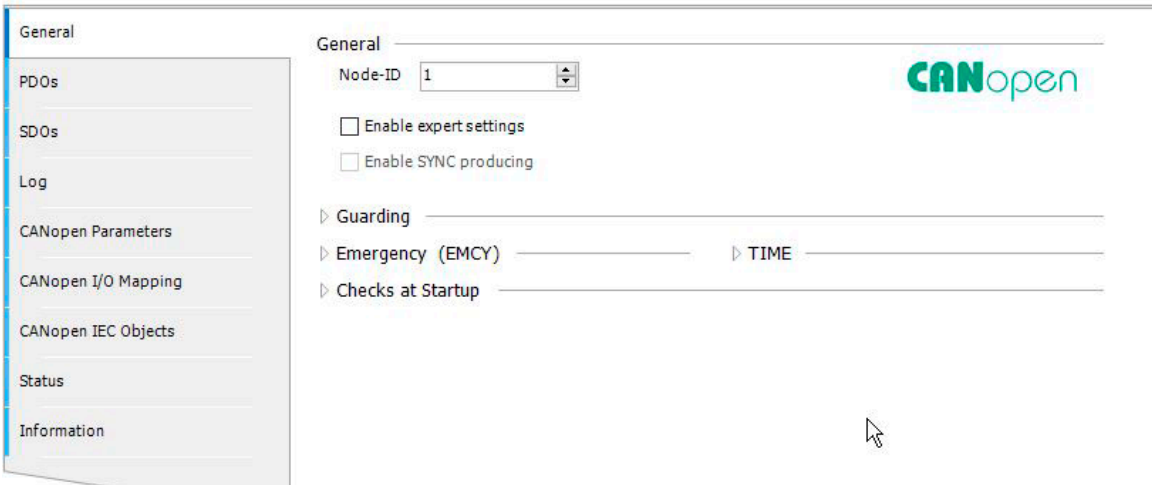
Attach the CAN-Bus device to the PAC120. For configuration double click on the device. Set the desired baud rate in the general settings. The Network setting remains at 0:



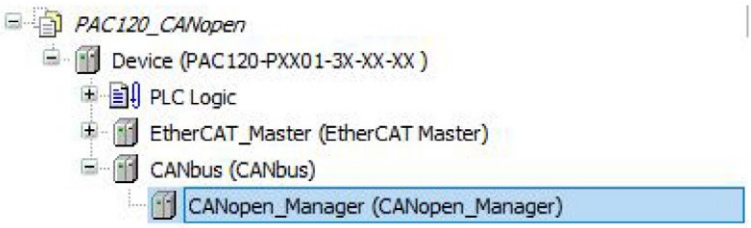
Then attach the CANopen_Manager device to the CAN bus. The settings of this device depend on the following devices and must be adapted to them if necessary.



Now connect the desired CANopen slaves to the CANopen_Manager. For the configuration of the slaves, please refer to the instructions of the slave manufacturer.

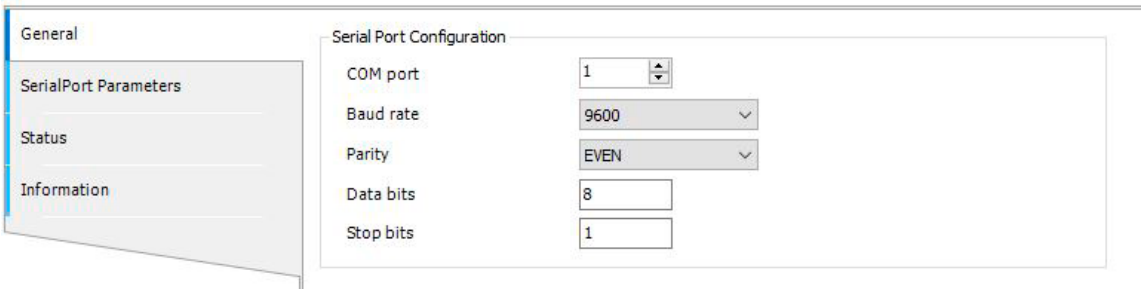


Device tree with CANopen bus

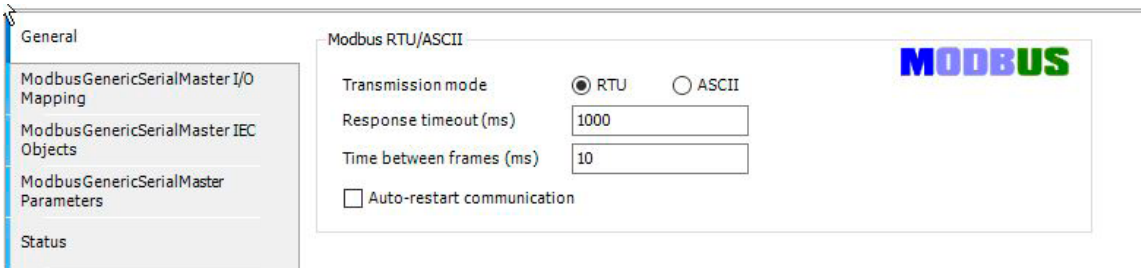


Modbus RTU Master

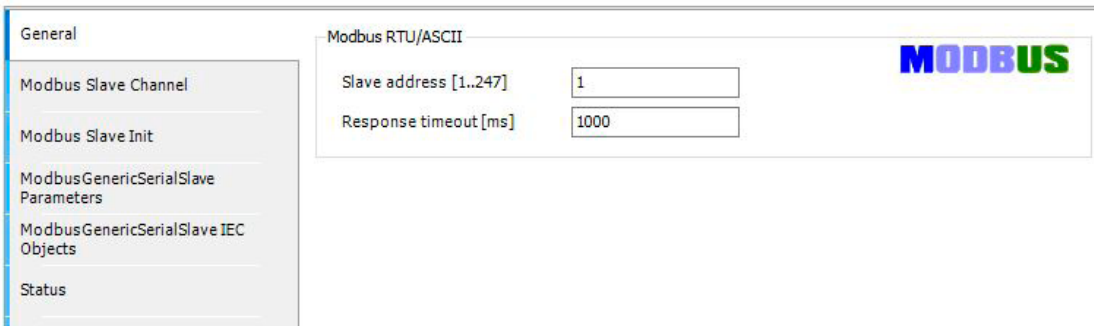
Attach the Modbus COM Port device to the PAC120. Double click on the device to configure it. Set the COM port (1) in the general settings. The other settings such as baud rate, parity as well as data and stop bits of this device depend on the following devices and must be adapted to them if necessary.



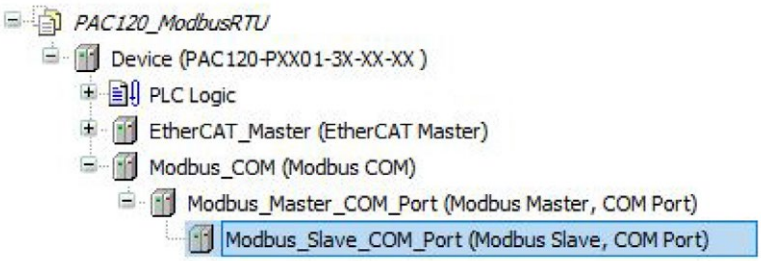
Then connect a Modbus RTU master. This configuration also depends on the subsequent devices and may have to be adapted to them.



Now connect the desired Modbus RTU slaves to the Modbus RTU master. For the configuration of the slaves, please refer to the instructions of the slave manufacturer.

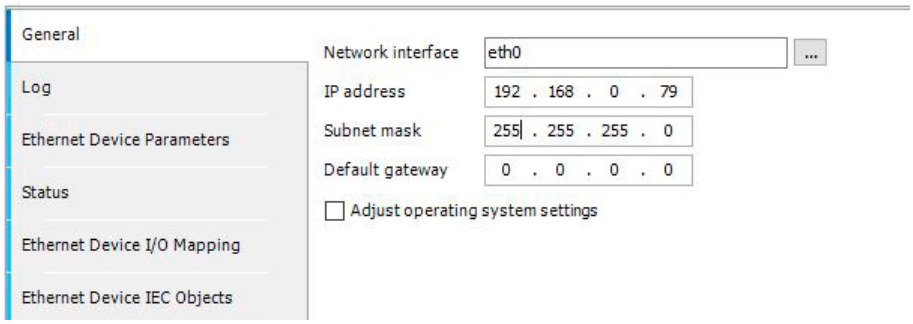


Device tree with Modbus RTU

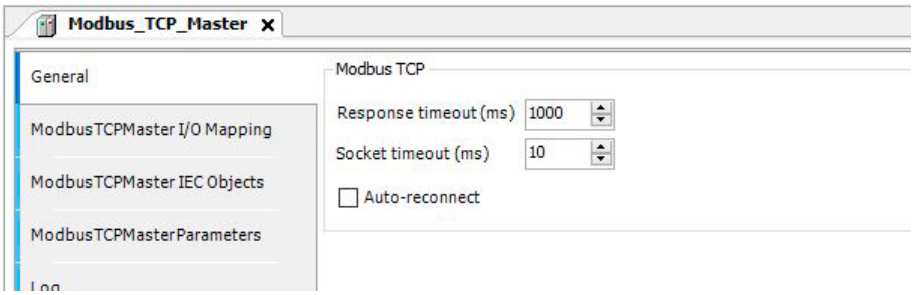


Modbus TCP Master

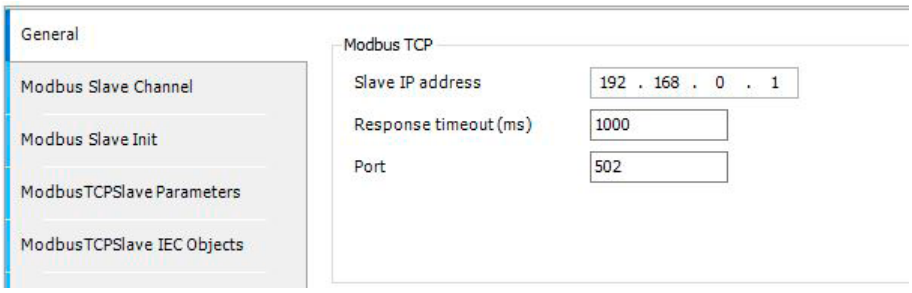
Attach the Ethernet device to the PAC120. Double click on the device to configure it. Set the network interface (eth0) in the general settings. If there is a connection to the controller, use the button ... and select the interface eth0. The IP address as well as the subnet mask and standard/gateway are then taken over by the controller.



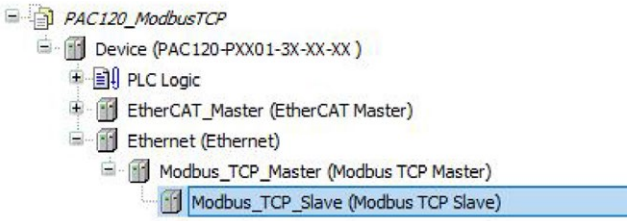
Then connect a Modbus TCP master. The settings of this device depend on the following devices and must be adapted to them if necessary.



Now connect the desired Modbus TCP slaves to the Modbus TCP master. For the configuration of the slaves, please refer to the instructions of the slave manufacturer.



Device tree with Modbus TCP

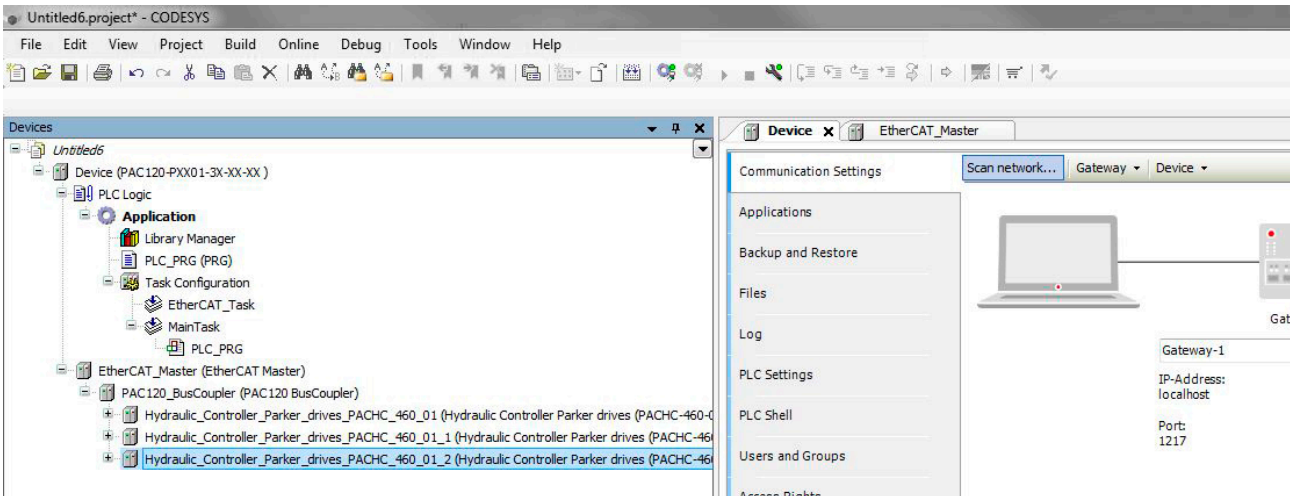


6.4 Downloading Projects

6.4.1 Downloading Configuration and Program

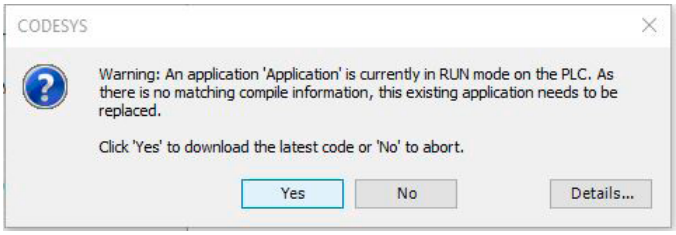
After you have completed your project and it is ready to download to PAC120, proceed as follows. Please note that the program will be translated and subsequently downloaded and saved on PAC120 if it is error-free. Only the executable program is saved but not the CODESYS project with the source code.

→ To download the project, select the Login icon on the toolbar or via the menu “Online -> Log in”.

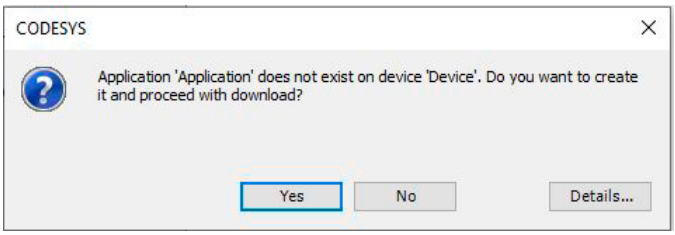


→ If the computer was not connected to PAC120 afterwards, you may be prompted to select an active path. To have the PAC automatically scan, select “Yes”. To open the Communication Settings page and select PAC120 manually, select “No”.

→ If there is a project already on PAC120 and you want to replace it with this application, click “Yes”.



→ If you are downloading the project the first time to PAC120 without a project, it may appear the following pop up window. To download the project to PAC120, click “Yes”.



6.4.2 Updating the Application Program

CODESYS basically offers you two options for transferring a changed application to the controller: download and online change.

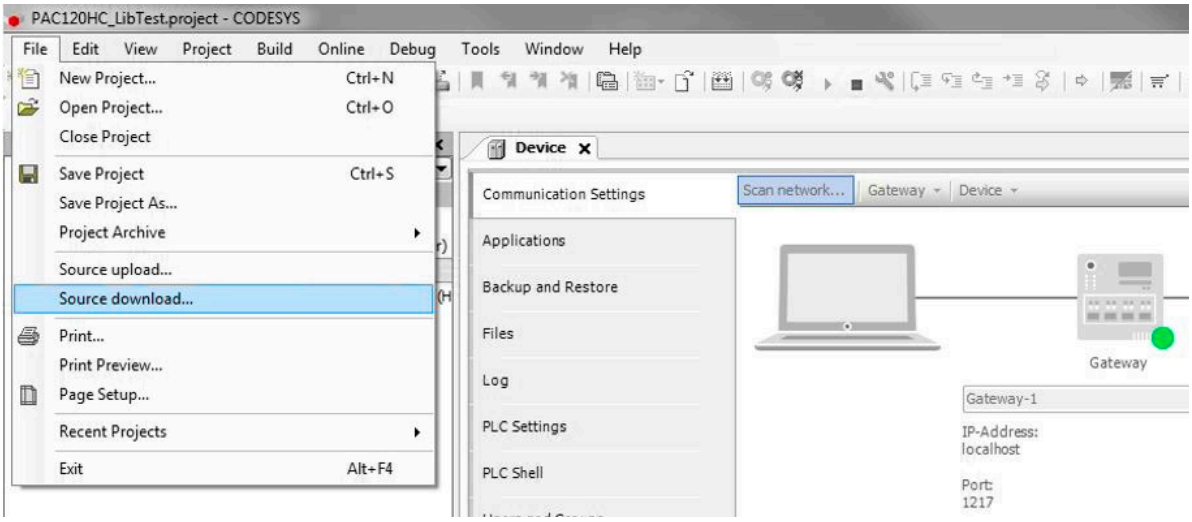
A download leads to a new translation of the application. In addition to a syntax check, application code is also generated and loaded onto the control. This leads to a stop of the running programme. A download is the recommended type of data transfer, since a defined output state is always created due to the programme stop and reinitialization.

With an online change, only the changed parts are reloaded into the controller. A running programme is not stopped in the process. Only carry out an online change for small changes to the application. With extensive changes, the behaviour of a programme cannot be predicted with certainty.

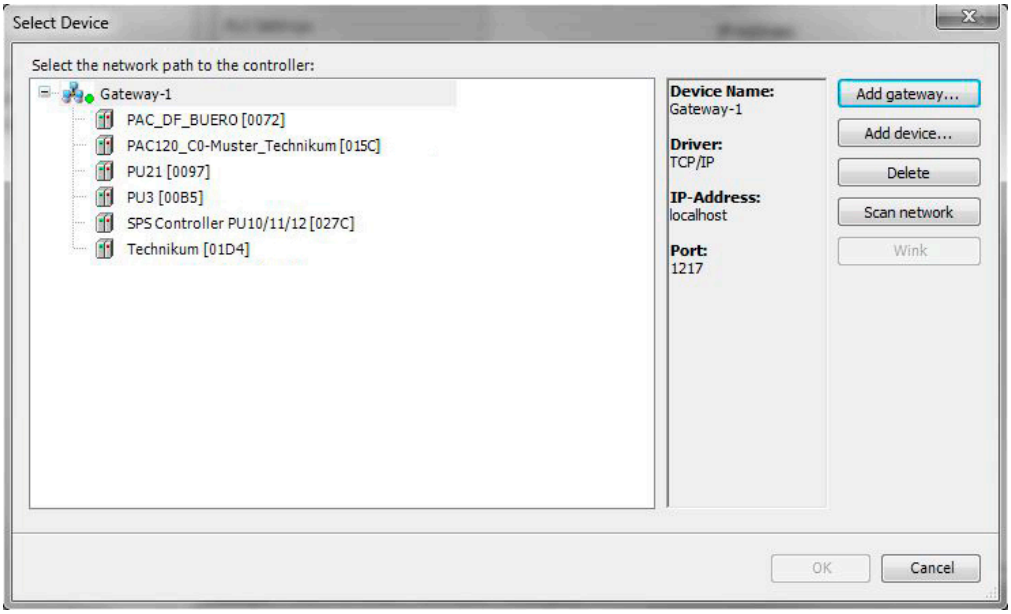
6.4.3 Downloading CODESYS Projects

To download the CODESYS project itself to PAC120, proceed as follows.

→ For downloading the source file, select “Download Source Code” in CODESYS.



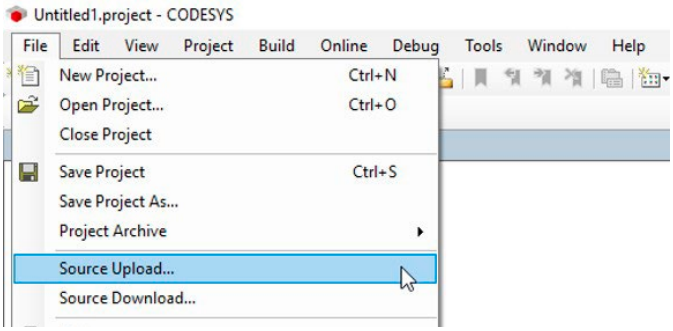
→ Select “PAC120” under the Gateway as the device for the download. If PAC120 does not show up under the Gateway, select “Scan network” to locate PAC120. Select “OK” to download the project.



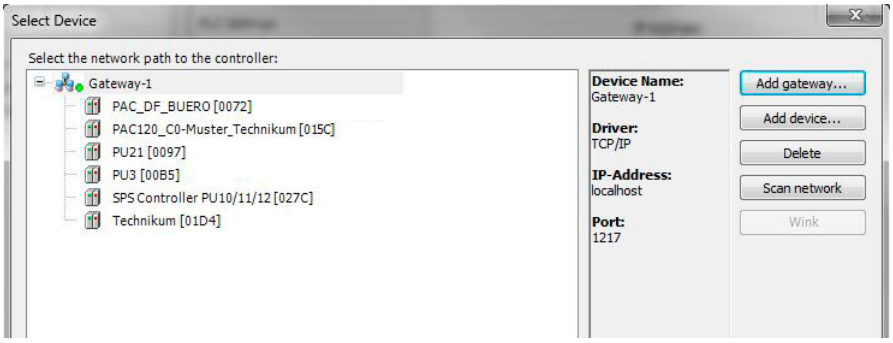
6.5 Uploading Projects

To upload a project from a connected PAC120, proceed as follows.

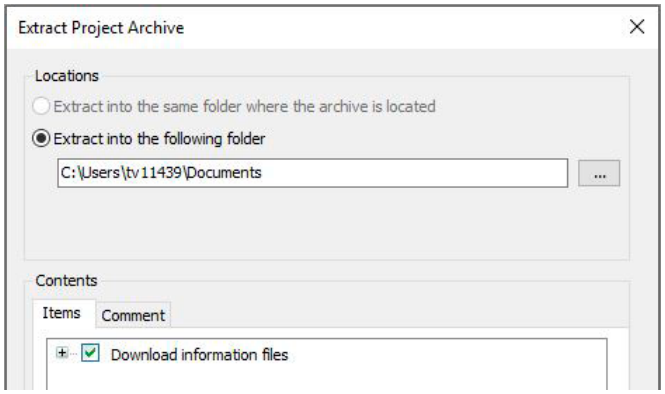
→ Select “File -> Source Upload” in CODESYS.



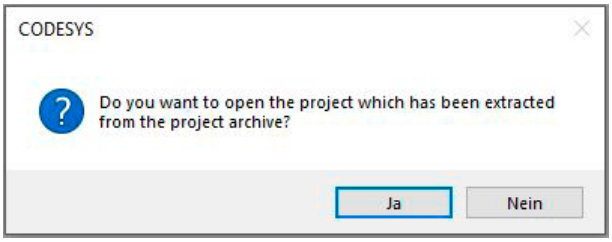
→ Select “PAC120” on the Gateway as device for the upload. If PAC120 does not show up under the Gateway, select “Scan network” to locate PAC120. Select “OK” to download the project.



→ Choose the folder location on your computer where you would like to extract and save the source files. Then click on “Extract”. Your project and source files are now saved on your computer.



→ If you would like to open the project, click “Yes”. Your project and source files are now opened in CODESYS.

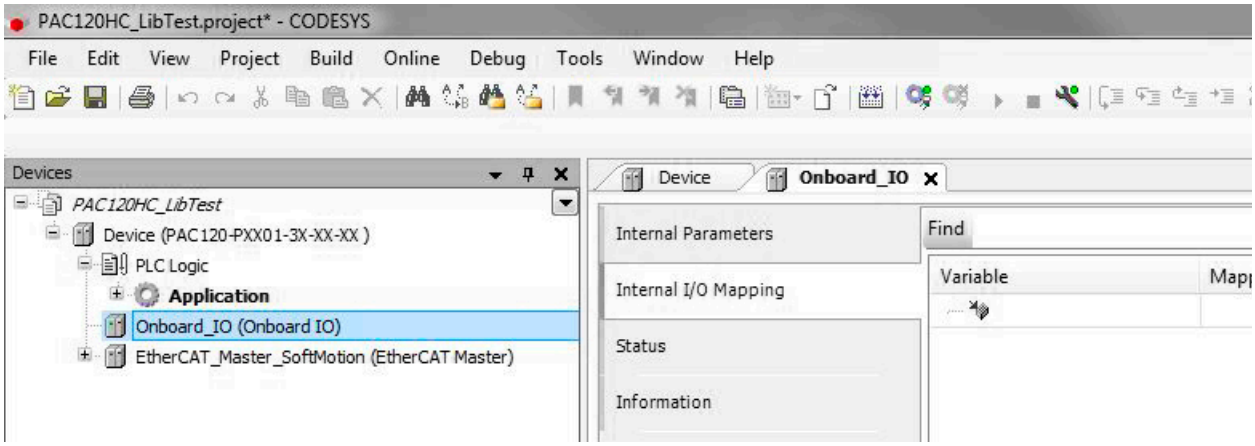


6.6 PAC120 and CODESYS V3.5

PAC120 features an internal digital input which you may use as a simple digital (status) input or as an interrupt input.

6.6.1 Digital Input

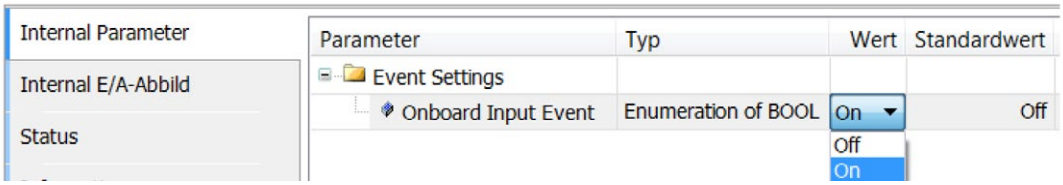
Object "Onboard IO" for using the digital input of PAC120 is automatically added to the device tree when you create a project in CODESYS. Double-clicking on the object displays the configuration screen. Check tab "Parker:Internal I/O Map" for the address of the digital input. This tab also lets you do or create the mapping.



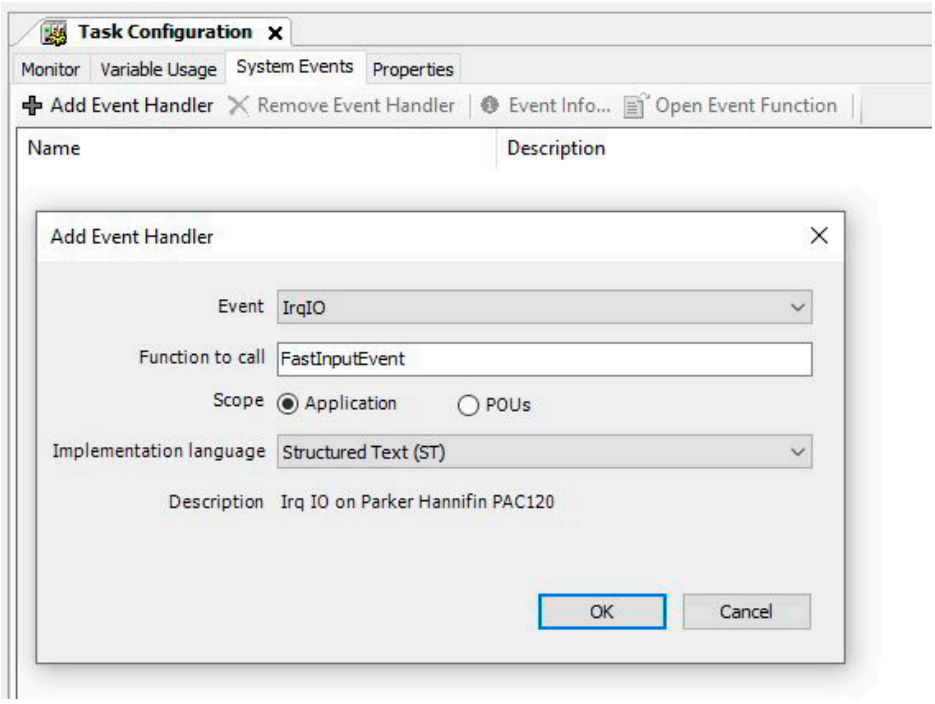
6.6.2 Interrupt Input

To process fast signals, the digital input can also be configured as an event input. Activate this under "Internal Parameter".

	NOTE
	If the input is to be used as an event input, the library "PKR_PAC120_OnboardIO" must be added in the library manager.



Then a system event of the type "IrqIO" must be defined in the task configuration.



The function to be called is automatically created in the project tree. The reaction to the input signal can be programmed here.

6.7 ProfiNet Communication (PAC120-xxP01-3X-xx-xx only)

The PAC120 has a flexible mapping and supports acyclic data communication. Suitable function blocks for the Siemens Tia portal are available, which will simplify communication with a S7 PLC. These files can be found on the PAC120 webpage.

The address range for the input and output data for synchronous communication is 256 bytes each. It is divided into the data types INT, DINT and REAL as follows:

- 32x INT
- 16x DINT and
- 32x REAL

PAC120

For the communication via Fieldbus, the function block Fieldbus_Init must be called in the application program. The function block is part of the system library PKR_PAC120_System of the PAC120.

Cyclic communication

The values to be sent to the machine PLC need to be assigned to the send arrays

- Fieldbus_SyncDataTransmit.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataTransmit.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataTransmit.Real32[x] with x: 0 - 31

according to their data type.

The values to be received from the machine PLC can be read from the receive arrays

- Fieldbus_SyncDataReceive.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataReceive.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataReceive.Real32[x] with x: 0 - 31

depending on their data type.

Acyclic communication

Acyclic data can be exchanged via pre-defined objects. To the following objects the machine PLC has read and write access:

- 200x INT,
- 200x UINT,
- 200x DINT,
- 200x UDINT,
- 200x DINT,
- 200x REAL,
- 20x STRING[63]

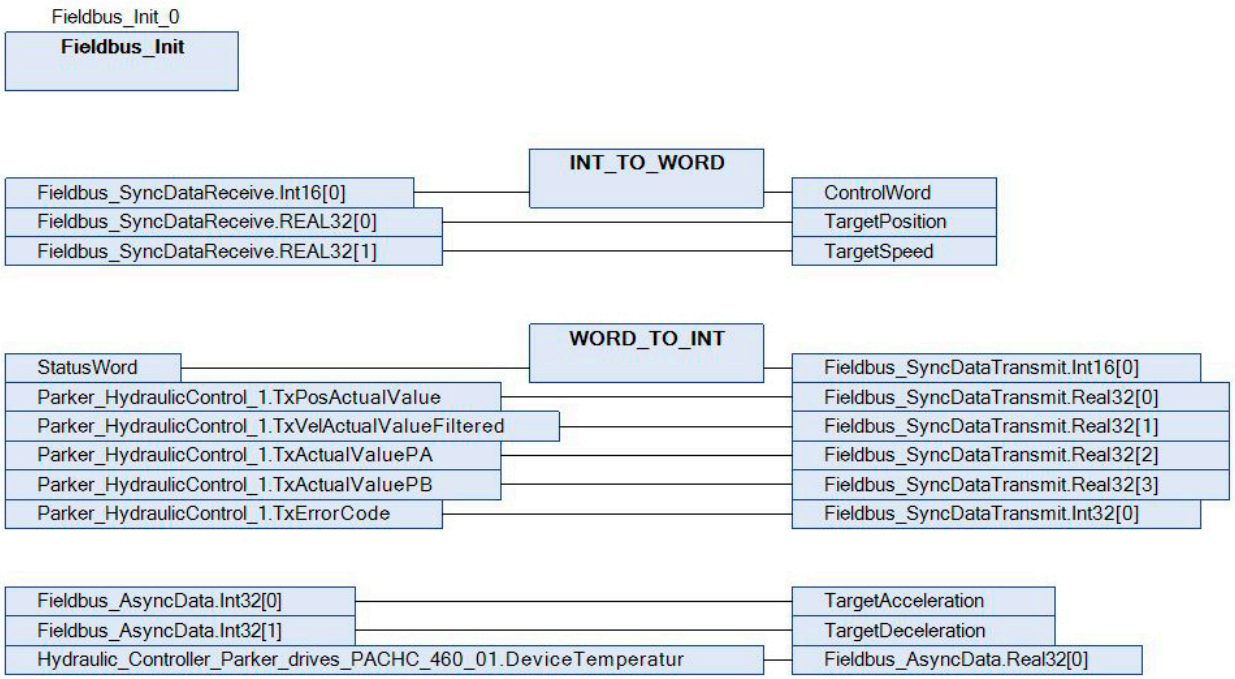
The data can be written or read from the following arrays:

- Fieldbus_AsyncData.Int16[x] with x: 0 - 199,
- Fieldbus_AsyncData.UInt16[x] with x: 0 - 199,
- Fieldbus_AsyncData.Int32[x] with x: 0 - 199,
- Fieldbus_AsyncData.UInt32[x] with x: 0 - 199,
- Fieldbus_AsyncData.Real32[x] with x: 0 - 199 and
- Fieldbus_AsyncData.String[x] with x: 0 - 19

Example

The following example shows an exemplary data exchange for the values of a connected PACHC controller module:

CFC:



ST

```
// Fieldbus initialization
Fieldbus_Init_0();


// Read data from PLC
ControlWord := INT_TO_WORD(Fieldbus_SyncDataReceive.Int16[0]);
TargetPosition := Fieldbus_SyncDataReceive.Real32[0];
TargetSpeed := Fieldbus_SyncDataReceive.Real32[1];

// Send data to PLC
Fieldbus_SyncDataTransmit.Int16[0] := WORD_TO_INT(StatusWord);
Fieldbus_SyncDataTransmit.Real32[0] := Parker_HydraulicControl_1.TxPosActualValue;
Fieldbus_SyncDataTransmit.Real32[1] := Parker_HydraulicControl_1.TxVelActualValueFiltered;
Fieldbus_SyncDataTransmit.Real32[2] := Parker_HydraulicControl_1.TxActualValuePA;
Fieldbus_SyncDataTransmit.Real32[3] := Parker_HydraulicControl_1.TxActualValuePB;
Fieldbus_SyncDataTransmit.Int32[0] := Parker_HydraulicControl_1.TxErrorCode;

// Acyclic data
// Read data
TargetAcceleration := Fieldbus_AsyncData.Int32[0];
TargetDeceleration := Fieldbus_AsyncData.Int32[1];

// Prepare data for request
Fieldbus_AsyncData.Real32[0] := Hydraulic_Controller_Parker_drives_PACHC_460_01.DeviceTemperatur
```

S7

Cyclic communication

For cyclic communication with the PAC120 the communication objects for data transmit and data receive must be defined and mapped to a variable table NAME.

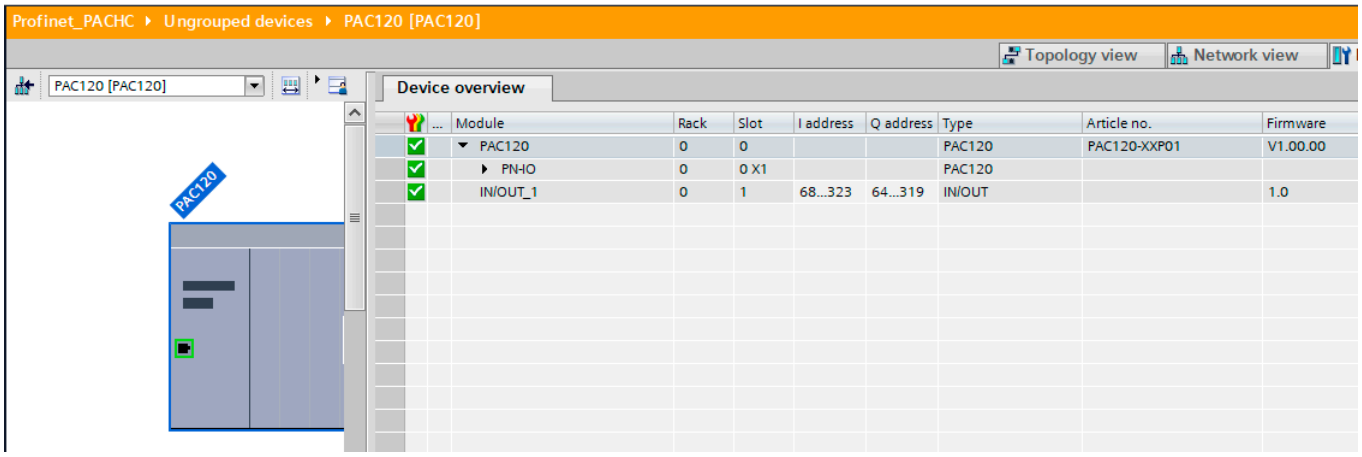
The transmit data from the PAC120 must be assigned to the OUT-variables of the function block according to the data type:

- Sync_GVAR_OUT_INT[x] with x: 0 - 31,
- Sync_GVAR_OUT_DINT[x] with x: 0 - 15 or
- Sync_GVAR_OUT_REAL[x] with x: 0 - 31

The receive data from the PAC120 must be assigned to the IN-variables of the function block according to the data type:

- Sync_GVAR_IN_INT[x] with x: 0 - 31,
- Sync_GVAR_IN_DINT[x] with x: 0 - 15 or
- Sync_GVAR_IN_REAL[x] with x: 0 - 31

The IN- and OUT-variables have to be connected with the data type to “physical” address I/O word (%Q, %I) space of the PAC120 as shown in the following picture (in red OUTPUT in green INPUT):



S7_PAC120_Profinet

	Name	Data type	Address	Retain
1	Sync_GVAR_IN_INT	"VAR_IN_INT"	%I68.0	
2	Sync_GVAR_IN_DINT	"VAR_IN_DINT"	%I132.0	
3	Sync_GVAR_IN_REAL	"VAR_IN_REAL"	%I196.0	
4	Sync_GVAR_OUT_INT	"VAR_OUT_INT"	%Q64.0	
5	Sync_GVAR_OUT_DINT	"VAR_OUT_DINT"	%Q128.0	
6	Sync_GVAR_OUT_REAL	"VAR_OUT_REAL"	%Q192.0	
7	Async_All_Par_Read_Done	Bool	%M2.1	
8	Async_All_Par_Write_Done	Bool	%M2.2	
9	Async_Counter_Read	Int	%MW10	
10	Async_Counter_Write	Int	%MW12	
11	Async_Offset_Read	Int	%MW18	
12	Async_Offset_Write	Int	%MW22	
13	Async_Record_Read_Str	DWord	%MD30	
14	Async_Record_Read_Dw	DWord	%MD50	
15	Async_Record_Read_W	Word	%MW54	
16	Async_Record_Write_Dw	DWord	%MD60	
17	Async_Record_Write_W	Word	%MW64	
18	Async_Record_Write_Str	DWord	%MD70	
19	Async_Support_Value_Read_Int	Int	%MW80	
20	Async_Support_Value_Read_Dint	DWord	%MD90	

To simplify the communication, you can use the function block PAC120_Profinet_Synchron_DB. In this block all functions to connect to the table variables IN/OUT (e.g. swap and data conversions) are included.

If the mapped variable in the table NAME is updated the new value only will be send directly by the next call of the function block. Therefore, the function block should be executed in every PLC cycle to transmit and receive the complete table.

Acyclic communication

The acyclic communication is handled by Standard Function Blocks by Siemens “RDREC” and “WRREC” (for more info please check Siemens PLC Manual).

In addition to that Parker provides the function block PAC120_Profinet_Asyncron_DB to send and receive parameters in which all data conversions and error handling is implemented. It uses the two Data Blocks Asynchron_Read_DB and Asynchron_write_DB for the data handling. All parameters to be sent and received must be configured in these data blocks according to this legend:

1. INT is the data type (1: integer, 2: Dint, 3: Real, 4: String)
2. INT is the ID:
   - ID: 100 + x for Int16[x], with x: 0 - 199
   - ID: 500 + x for Int32[x], with x: 0 - 199,
   - ID: 900 + x for Real32[x], with x: 0 - 199,
   - ID: 1100 + x for Strings[x], with x: 0 - 19
3. INT, DINT or REAL value to be sent to or received from NET.

After the configuration the PAC120_Profinet_Asyncron_DB can be used in the program. The function block needs the following inputs:

- ID Hardware (HWID Value, used by standard block Siemens)
- Number of parameters to read (INT value)
- Number of parameters to write (INT value)
- Number of data block with Parameters to read (INT value)
- Number of data block with Parameters to write (INT value))

and provides the following outputs:

- Number of read parameter in the Data Block read (INT Value)
- Number of written parameters in the Data Block write (INT Value)
- ID error/info for read procedure (INT Value) directly read from Siemens FB “RDREC”
- ID error/info for write procedure (INT Value) directly read from Siemens FB “WRREC”
- All parameters to read have been read successfully (Bool Value)
- All parameters to write have been written successfully (Bool Value)

Example

The following screen shots show the communication of a PAC120 with a PACHC controller module according to the example from the chapter before.

Cyclic communication

Network 1: Variable write by Syncro

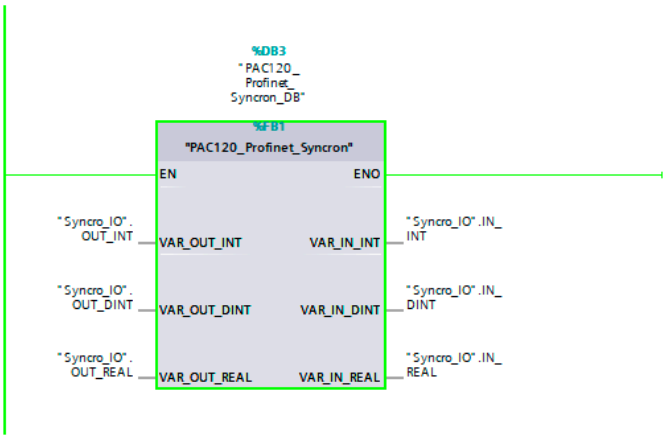
Comment

```
1  "Target_Position" := 100.23;
2  "Target_Speed" := 1001.12;
3  "Syncro_IO".OUT_INT[0] := "Control_Word1";
4  "Syncro_IO".OUT_REAL[0] := "Target_Position";
5  "Syncro_IO".OUT_REAL[1] := "Target_Speed";
```

"Target_Position"	%MD402	100.23
"Target_Speed"	%MD406	1001.12
"Syncro_IO".OUT_INT[0]		0
"Syncro_IO".OUT_REAL[0]		100.23
"Syncro_IO".OUT_REAL[1]		1001.12

Network 2: Call Profinet Syncron FB

Comment



Network 3: Variable read by Syncro

Comment

```
1  "Status_Word1" := "Syncro_IO".IN_INT[0];
2  "Actual_Position":="Syncro_IO".IN_REAL[0];
3  "Actual_Speed" := "Syncro_IO".IN_REAL[1];
4  "Actual_Pressure_pA" := "Syncro_IO".IN_REAL[2];
5  "Actual_Pressure_pB" := "Syncro_IO".IN_REAL[3];
6  "Error_ID" := "Syncro_IO".IN_DINT[0];
```

"Status_Word1"	%MW198	0
"Syncro_IO".IN_INT[0]		0
"Actual_Speed"	%MD223	0.0
"Actual_Pressure_pA"	%MD215	0.0
"Actual_Pressure_pB"	%MD219	0.0
"Error_ID"	%MD202	0

Acyclic communication

Before calling up the Parker function block, the configuration for the read parameters with the data block Asynchron_ Read_DB is done.

In this example Int16[1], Int32[1], Real32[1] and String[1] are configured for reading.

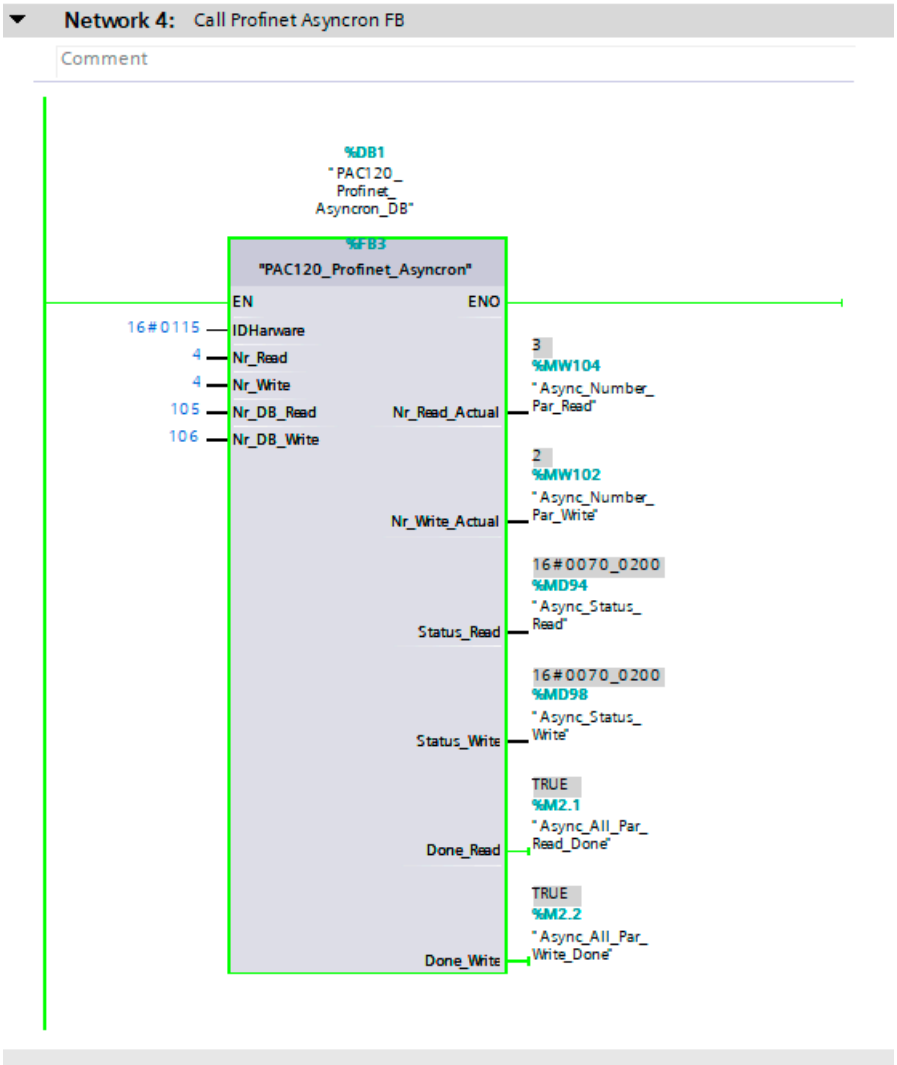
Asyncron_Read_DB (snapshot created: 12/9/2019 2:32:21 PM)

	Name	Data type	Offset	Snapshot	Comment
1	Static				
2	Type_1	Int	0.0	1	INT_16
3	Index_1	Int	2.0	101	
4	Value_1	Int	4.0	11	
5	Dummy	Int	6.0	0	
6	Type_2	Int	8.0	2	INT_32
7	Index_2	Int	10.0	501	
8	Value_2	DInt	12.0	21	
9	Type_3	Int	16.0	3	REAL
10	Index_3	Int	18.0	901	
11	Value_3	Real	20.0	33.22	
12	Type_4	Int	24.0	4	String (only Two Char)
13	Index_4	Int	26.0	1101	
14	Value_4	DWord	28.0	16#4B4F_0000	"KO"

In this example Int16[0], Int32[0], Real32[0] and String[0] are configured for writing.

Asyncron_Write_DB

	Name	Data type	Offset	Start value	Setpoint	Comment
1	Static					
2	Type_1	Int	0.0	1		INT_16
3	Index_1	Int	2.0	100		
4	Value_1	Int	4.0	1000		
5	Dummy	Int	6.0	0		
6	Type_2	Int	8.0	2		INT_32
7	Index_2	Int	10.0	500		
8	Value_2	DInt	12.0	1200		
9	Type_3	Int	16.0	3		REAL
10	Index_3	Int	18.0	900		
11	Value_3	Real	20.0	11.11		
12	Type_4	Word	24.0	4		String (Only two char)
13	Index_4	Word	26.0	1100		
14	Value_4	String	28.0	'ON'		



In this example the Hardware ID is 0x0115 and the number of parameters to send is 7 (equal to the number parameters in the data block). The number of the read DB is 105 and of the write DB is 106. The outputs show that two parameters have been read and one has been written to the PAC120.

6.8 EtherCAT-Salve communication (only PAC120-xxT01-3X-xx-xx)

The PAC120 has flexible mapping and supports acyclic communication via CoE. The address range for the input and output data for synchronous communication is 256 bytes each. It is divided into the data types INT, DINT and REAL as follows:

- 32x INT
- 16x DINT und
- 2x REAL

PAC120

For the communication via EtherCAT, the function block Fieldbus_Init must be called in the application program. The function block is part of the system library PKR_PAC120_System of the PAC120.

Cyclic communication

The values to be sent to the machine PLC need to be assigned to the send arrays

- Fieldbus_SyncDataTransmit.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataTransmit.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataTransmit.Real32[x] with x: 0 - 31

according to their data type.

The values to be received from the machine PLC can be read from the receive arrays

- Fieldbus_SyncDataReceive.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataReceive.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataReceive.Real32[x] with x: 0 - 31

according to their data type.

Acyclic communication

Acyclic data can be exchanged via pre-defined objects. To the following objects the machine PLC has read and write access:

- 200x INT,
- 200x UINT,
- 200x DINT,
- 200x UDINT,
- 200x DINT,
- 200x REAL,
- 20x STRING[63]

The data can be written or read from the following arrays:

- Fieldbus_AsyncData.Int16[x] with x: 0 - 199,
- Fieldbus_AsyncData.UInt16[x] with x: 0 - 199,
- Fieldbus_AsyncData.Int32[x] with x: 0 - 199,
- Fieldbus_AsyncData.UInt32[x] with x: 0 - 199,
- Fieldbus_AsyncData.Real32[x] with x: 0 - 199 and
- Fieldbus_AsyncData.String[x] with x: 0 - 19

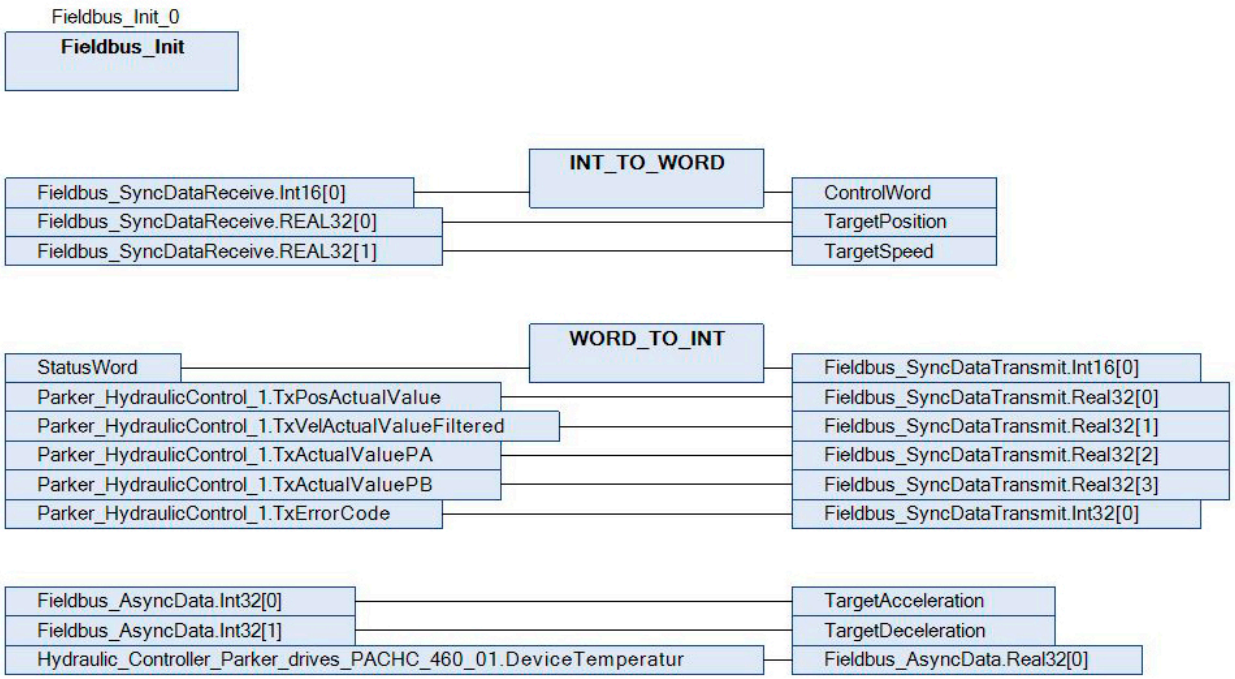
The acyclic data can be written or read by the EtherCAT master via the following objects:

- Int16: Index 16#2100, Subindex 16#01 – 16#C8
- UInt16: Index 16#2101, Subindex 16#01 – 16#C8
- Int32: Index 16#2102, Subindex 16#01 – 16#C8
- UInt32: Index 16#2103, Subindex 16#01 – 16#C8
- Real32: Index 16#2104, Subindex 16#01 – 16#C8
- String: Index 16#2105, Subindex 16#01 – 16#14

Example

The following example shows an exemplary data exchange for the values of a connected PACHC control module:

CFC:



ST

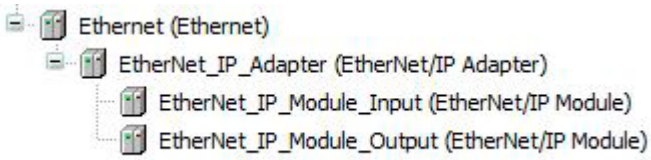
```
// Fieldbus initialization
Fieldbus_Init_0();


// Read data from PLC
ControlWord := INT_TO_WORD(Fieldbus_SyncDataReceive.Int16[0]);
TargetPosition := Fieldbus_SyncDataReceive.Real32[0];
TargetSpeed := Fieldbus_SyncDataReceive.Real32[1];

// Send data to PLC
Fieldbus_SyncDataTransmit.Int16[0] := WORD_TO_INT(StatusWord);
Fieldbus_SyncDataTransmit.Real32[0] := Parker_HydraulicControl_1.TxPosActualValue;
Fieldbus_SyncDataTransmit.Real32[1] := Parker_HydraulicControl_1.TxVelActualValueFiltered;
Fieldbus_SyncDataTransmit.Real32[2] := Parker_HydraulicControl_1.TxActualValuePA;
Fieldbus_SyncDataTransmit.Real32[3] := Parker_HydraulicControl_1.TxActualValuePB;
Fieldbus_SyncDataTransmit.Int32[0] := Parker_HydraulicControl_1.TxErrorCode;

// Acyclic data
// Read data
TargetAcceleration := Fieldbus_AsyncData.Int32[0];
TargetDeceleration := Fieldbus_AsyncData.Int32[1];

// Prepare data for request
Fieldbus_AsyncData.Real32[0] := Hydraulic_Controller_Parker_drives_PACHC_460_01.DeviceTemperatur
```

6.9 EtherNet/IP-Slave communication (PAC120-xxE01-3X-xx-xx only)

The PAC120 has a flexible mapping that can be configured directly in the device tree. For this purpose, the components

- Ethernet adapter
- EtherNet/IP → Ethernet adapter
- 2x EtherNet/IP → Ethernet adapter → EtherNet/IP-modules Parker Hannifin

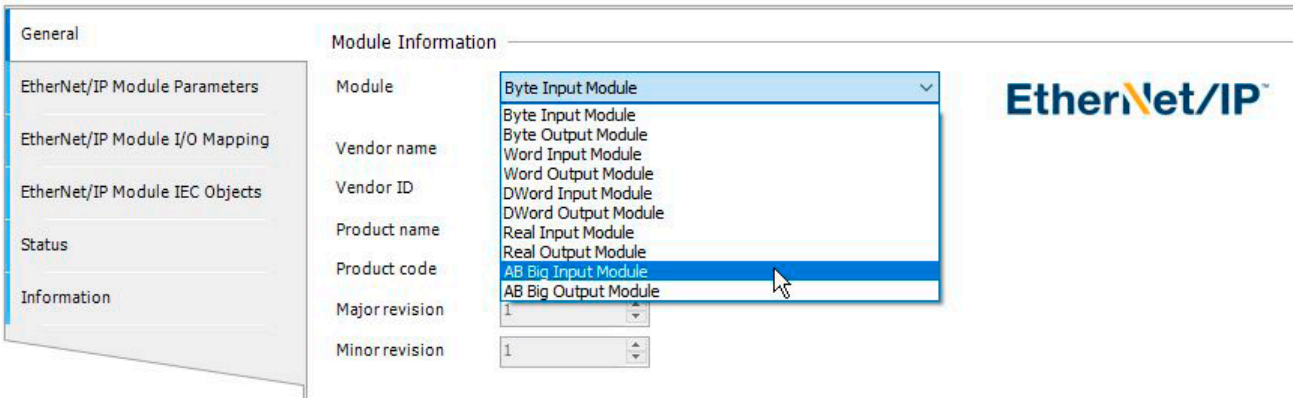
must be inserted into the device tree.



To simplify handling, an address range of 256 bytes each was predefined for the input and output data of synchronous communication. It is divided among the data types INT, DINT and REAL as follows:

- 32x INT
- 16x DINT and
- 32x REAL

For this, one EtherNet module must be configured to AB Big Input and the other to AB Big Output.

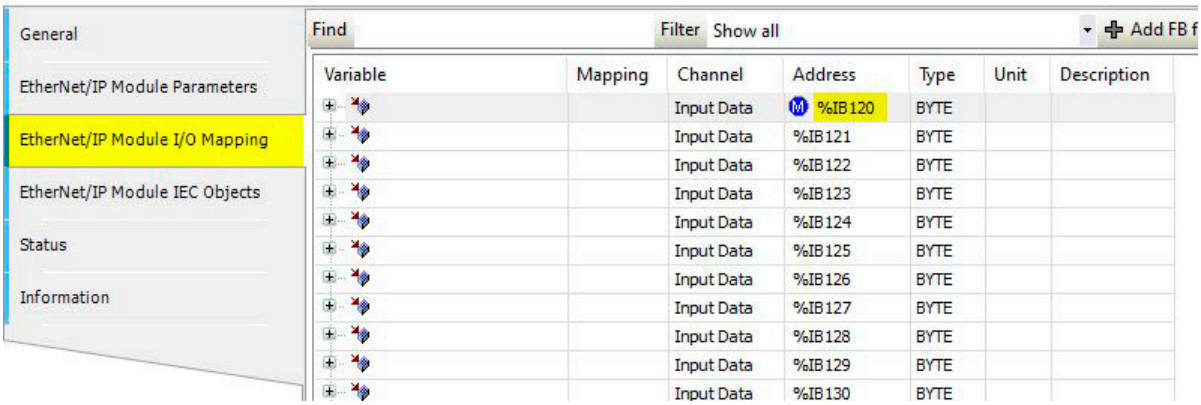


The PAC120HC package contains a template with the settings described above for the simplified EtherNet/IP communication.

PAC120

To use the simplified communication via EtherNet/IP, the function block EtherNetIP _Init must be called in the application program. The function block is part of the system library PKR_PAC120_System of the PAC120.

The input and output addresses of the EtherNet/IP modules are transferred to the function block. The addresses depend on the hardware configuration in the project and can be read in the tab EtherNet/IP Module I/O Mapping of the device dialogue of the EtherNet/IP modules.



Cyclic communication

The values to be sent to the higher-level controller (EtherNet/IP scanner) must be assigned, depending on the data type, to the transmit arrays

- Fieldbus_SyncDataTransmit.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataTransmit.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataTransmit.Real32[x] with x: 0 - 31 can be assigned.

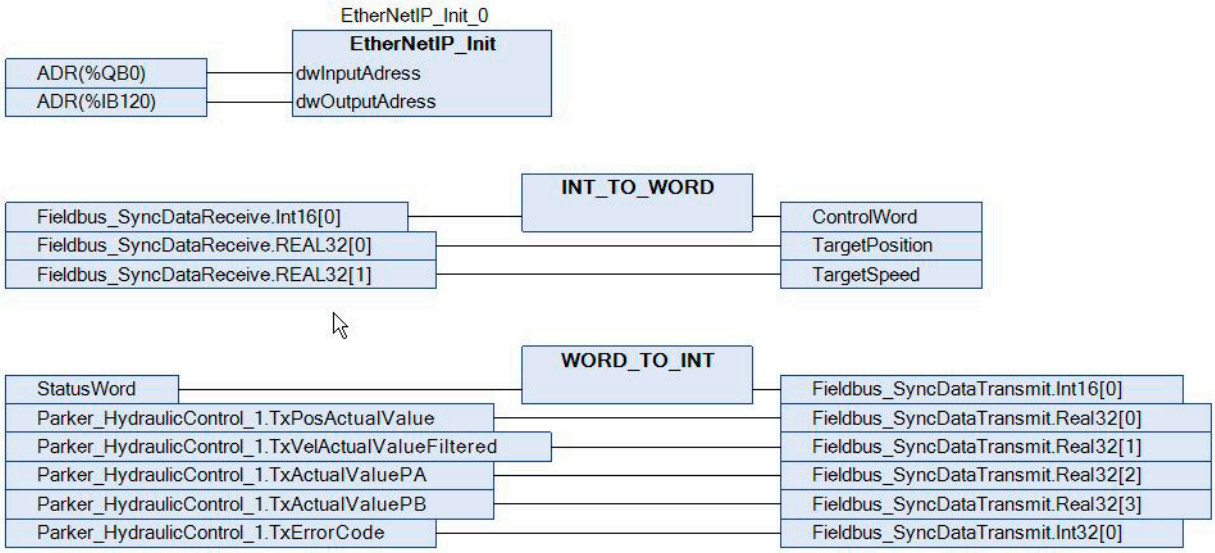
The data to be received from the higher-level controller (EtherNet/IP scanner) must be assigned, depending on the data type, to the receive arrays

- Fieldbus_SyncDataReceive.Int16[x] with x: 0 - 31,
- Fieldbus_SyncDataReceive.Int32[x] with x: 0 - 15 or
- Fieldbus_SyncDataReceive.Real32[x] with x: 0 - 31

Example

The following example shows an exemplary data exchange for the values of a connected PACHC control module:

CFC:



ST

```
1
2   // EtherNetIP initialization
3   EtherNetIP_Init_0(dwInputAdress := ADR(%QB0),dwOutputAdress := ADR(%IB120));
4
5
6   // Read data from PLC
7   ControlWord := INT_TO_WORD(Fieldbus_SyncDataReceive.Int16[0]);
8   TargetPosition := Fieldbus_SyncDataReceive.Real32[0];
9   TargetSpeed := Fieldbus_SyncDataReceive.Real32[1];
10
11  // Send data to PLC
12  Fieldbus_SyncDataTransmit.Int16[0] := WORD_TO_INT(StatusWord);
13  Fieldbus_SyncDataTransmit.Real32[0] := Parker_HydraulicControl_1.TxPosActualValue;
14  Fieldbus_SyncDataTransmit.Real32[1] := Parker_HydraulicControl_1.TxVelActualValueFiltered;
15  Fieldbus_SyncDataTransmit.Real32[2] := Parker_HydraulicControl_1.TxActualValuePA;
16  Fieldbus_SyncDataTransmit.Real32[3] := Parker_HydraulicControl_1.TxActualValuePB;
17  Fieldbus_SyncDataTransmit.Int32[0] := Parker_HydraulicControl_1.TxErrorCode;
```

System priorities

A task is a time sequence unit of an IEC programme. It is defined by a name, a priority and a type that determines which condition triggers the start of the task. You can define this condition either temporally (cycle interval, free-wheeling) or by an internal or external event.

By combining priority and condition, you determine the time sequence in which the tasks are executed. For the design of real-time applications, it is important to have knowledge of the system priorities.

Priorities sorted in descending order

- CODESYS Scheduler
- Event Task (e.g. interrupt input, if configured as an event)
- EtherCAT
- CAN
- UART (RS232)
- PLC task, priority 0
- PLC task, priority 15
- Ethernet
- USB
- SD card
- PLC task priority 16
- PLC task priority 31

Rules for the processing order of the tasks:

- If the task condition is fulfilled, CODESYS processes the task.
- If several tasks simultaneously fulfil the condition for processing, CODESYS first processes the one with the highest priority.
- If several tasks simultaneously fulfil the condition for processing and have the same priority level, CODESYS first processes the task that has already been waiting the longest.
- The program calls are processed in the order in which the programs are arranged in the configuration dialogue of the task.

For further details, please refer to the CODESYS help.

7. Maintenance / Servicing

7.1 General

Only qualified persons may work on PAC120.

!	**CAUTION**
	Do not plug, unplug, mount or touch the connectors during operation. Doing so may destroy the unit or provoke malfunctions → Before working on the unit, turn off all power sources including those feeding power to peripherals such as externally fed sensors, programming devices etc.

!	**CAUTION**
	Overheating Overheating may destroy the unit or provoke malfunctions → Verify that the unit's ventilation slots are not covered and that air can circulate.

7.2 Servicing

PAC120 requires neither servicing for the specified service life nor any action if it is kept and operated at the admissible ambient conditions specified in section Technical Data.

7.3 Maintenance

Cleaning

Prevent inadmissible contamination while operating and storing PAC120.

To replace modules

Refer to section 5.1.1 Mechanical Installation

7.4 Repairs / Customer Service

☞	**Note**
	Only the manufacturer or customer service providers authorized by the manufacturer may do repairs and perform corrective maintenance.

7.5 Warranty

The statutory period and conditions of warranty apply. Warranty expires if unauthorized attempts are made to repair the unit / product or any other intervention is performed.

7.6 Taking out of Service

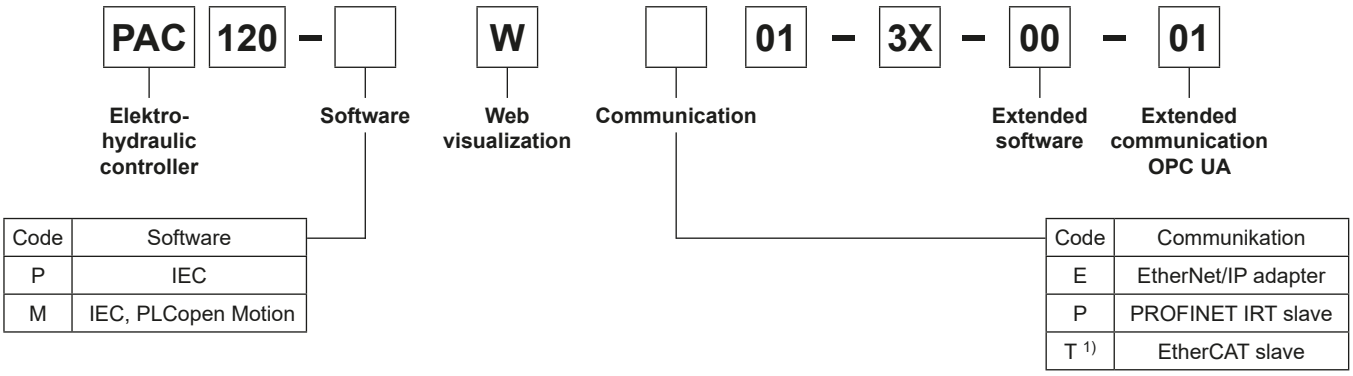
Before disposing of PAC120 you must disassemble it and completely take it apart. All metal components can be given to metal recycling.

Electronic scrap

Sort and dispose of electronic components by type. For details on proper disposal please check your national laws and regulations making sure that your method of disposal complies with them.

Treat the packaging as recyclable paper and cardboard.

8. Ordering Code



Code	Software
P	IEC
M	IEC, PLCopen Motion

Code	Communikation
E	EtherNet/IP adapter
P	PROFINET IRT slave
T [1]	EtherCAT slave

9. Technical Data

General data	
Product indication	PAC120
Item number	PAC120-*W*01-3X-00-01
CPU	i.MX6 SoloX Freescale 1 GHz
RAM / remanent memory	256 MB / buffering in flash
Drives	256 MB internal flash memory, SD (HC) card slot
Software	Application: CODESYS V3 Soft SPS optional with SoftMotion WebVisu, TargetVisu and SoftMotion CNC + Robotics on request
Interfaces	1 x RS232, 1 x USB 2.0
Network	1 x Ethernet 10/100MBit – RJ45
Field bus interfaces	1 x CAN galvanic isolated EtherCAT® internal via E-Bus interface, external via extender modul
Integrated I/Os	1x DI 1 ms
Clock	Real time clock with battery buffering
Power supply	24 V DC (19.2… 28.8)
Ebus current supply	2A @ 50°C and 1.5A @ 55°C
Output	ca. 3.5 W (@ 24 V DC)
Potential separation	Modules are potential separated against each other and bus
Noise stability	Zone B according to EN 61131-2, Mounting on grounded rail in grounded control cabinet
Environmental conditions	
Protection class	IP20
Mounting position	vertical, stackable
Storage temperature	-25 °C...+70 °C
Operation temperature	0 °C...+55 °C
Relative humidity	5 % … 95 % w/o dew
Mechanical features	
Mounting	35 mm DIN rail
Connection IO/power	36-pol spring-type connector with mech. ejector
Signal display	LEDs next to interface
Diagnostics	LED: bus state, module state
Housing (B x H x T)	Aluminum strap, plastic 25 x 120 x 90 mm
Shielding connection	Straight to housing
Conformity	
2004/108/EC	According to CE
UL	E506274
RoHS	According to RoHS
2014/30/EU	Electro magnetic compatibility EMC
2011/65/EU	Restriction of use of certain hazardous substances in electrical and electronic equipment (RoHS-2)

[1] Only in combination with software option "P".

Device data PROFINET IO Device Extension

Additional device data	
Product code	PAC120-xxP01-3X-xx-xx
Interfaces	2x Ethernet (switch) PROFINET®
Fieldbus	PROFINET IO device
PROFINET chip	Renesas TPS-1
Process data	256 Byte In / 256 Byte Out

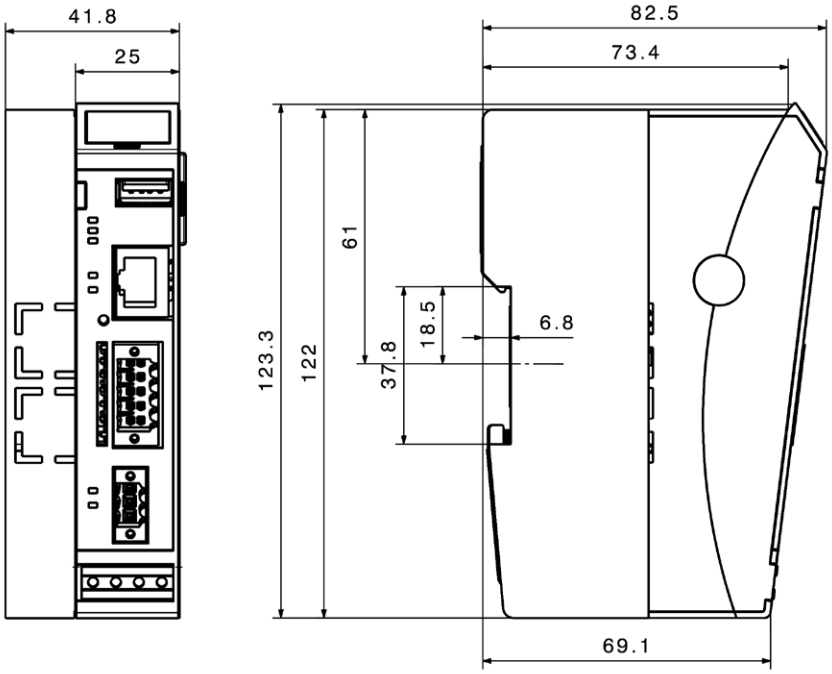
Device data EtherCAT slave extension

Additional device data	
Product code	PAC120-xxT01-3X-xx-xx
Interfaces	2x EtherCAT (In / Out)
Fieldbus	EtherCAT slave device
EtherCAT slave controller	Microchip LAN9252 / Microchip LAN9253
Process data	256 Byte In / 256 Byte Out

Device data EtherNet/IP extension

Additional device data	
Product code	PAC120-xxE01-3X-xx-xx
Interfaces	2x Ethernet (switch) 10 Mbit, 100 Mbit

Dimensions



10. Accessories

Modul type	Item number	Description
Accessories	43-026590-01	PACIO 2-Pole Connector
	43-026591-01	PACIO 18-Pole Connector
	43-026592-01	PACIO 36-pole Connector
	PACIO-412-01	PACIO Shield 2x8 mm
	PACIO-412-02	PACIO Shield 14 mm
Analogue	PACIO-441-01	PACIO AI4-mA 12 Bit
	PACIO-441-02	PACIO AI4/8-VDC 13 Bit
	PACIO-441-51	PACIO AI4-mA 12 Bit CoE
	PACIO-441-52	PACIO AI4/8-VDC 13 Bit CoE
	PACIO-442-02	PACIO AO4-VDC/mA 12 Bit
	PACIO-442-52	PACIO AO4-VDC/mA 16 Bit CoE
Controller	PACHC-460-01	PACHC Electrohydraulic Control Module
Counter	PACIO-454-01	PACIO Counter/Enc
Digital I/O modules	PACIO-450-02	PACIO DI16/DO8 1 A
	PACIO-450-03	PACIO DI16/DO16 1ms/0.5 A
	PACIO-450-05	PACIO DI8/DO8 1ms/0.5 A
	PACIO-450-13	PACIO DI16/DO16 1ms/0.5 A LS
	PACIO-451-02	PACIO DI32 1 ms
	PACIO-451-03	PACIO DI16 1 ms
	PACIO-452-01	PACIO DO16 0.5 A
	PACIO-452-02	PACIO DO8 1 A
Interfaces	PACIO-400-02	PACIO Extender 2 Port
	PACIO-400-00	PACIO Bus Coupler 3 A
Temperature	PACIO-443-01	PACIO AI4-Pt/Ni100 16 Bit
	PACIO-443-03	PACIO AI4-Pt/Ni1000 16 Bit
	PACIO-443-06	PACIO AI8 Thermocouple 16 Bit
	PACIO-443-57	PACIO AI4-Pt/Ni/Thermo 16 Bit CoE
	PACIO-443-58	PACIO AI8-Pt/Ni/Thermo 16 Bit CoE

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