ENGINEERING YOUR SUCCESS.

PARKER AUTOMATION CONTROLLER

PAC Installation Guide

Effective: November 2014

Document Number: 88-026666-01, Revision A

Trademark Information

The Programmable Logic Controller® and PLC® are registered trademarks of the Allen-Bradley Company (Rockwell Automation).

EtherCAT® is a registered trademark and a patented technology of Beckhoff Automation GmbH, Germany.

CoDeSys® is a registered trademark of 3S-Smart Software Solutions GmbH.

Windows® is a registered trademark of Microsoft® Corporation.

PROFINET® is a registered trademark of PROFIBUS and PROFINET International (PI).

MODBUS® is a registered trademark of Modbus Organization, Inc.

Ethernet/IP is a trademark of Open DeviceNet Vendor Association (ODVA)

SD is a trademark or registered trademark of SD-3C, LLC in the United States, other countries or both.

Important User Information

Please read and follow all safety information for the Parker Automation Controller (PAC), including the warning and caution statements in this guide, before installing or operating the system.

Safety Information

WARNING: The PAC is used to control electrical and mechanical components of motion control systems in industrial environments. To avoid serious injury or damage to equipment, test the motion system for safety under all potential conditions.

WARNING: The PAC and PAC Input\Output (PACIO) Modules are not fault-tolerant and are not designed or intended for any use in any systems, machines, or applications where failure or fault of any kind of the Products could reasonably be seen to lead to death or serious bodily injury of any person, or to severe physical or environmental damage ("High Risk Use"). You are not permitted to use, distribute, or sublicense the use of these Products in High Risk Use. High Risk Use is STRICTLY PROHIBITED.

WARNING: The PAC contains no user-serviceable parts. To avoid personal injury or damage to the product, do not attempt to open the case or to replace any internal component of the PAC, Modules, or accessories.

WARNING: USER RESPONSIBILITY- Failure or improper selection or improper use of the products described herein or related items can cause death, personal injury and property damage.

This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Statement of Compliance

Product Type Parker Automation Controller (PAC), PACIO Modules and accessories

The PAC Controller complies with the protection requirements set up by the European Community (EC) Electromagnetic Compatibility (EMC) Directive 2004/108/EC as defined by the Product Specific Standard EN/IEC 61326-1, which includes both emissions and immunity requirements and the power line emissions standards EN/IEC 61000-3-2, Limits for Harmonic Current Emissions and EN/IEC 61000-3-3, Limits of Voltage Fluctuations and Flicker in Low Voltage designated for Equipment used in Industrial Locations. Compliance of the PAC Controller is demonstrated by the application of the following standards:

- 2006/95/EC Low Voltage Directive when installed, operated, and maintained as intended
- 2004/108/EC Electromagnetic Compatibility when installed, operated, and maintained as intended
- EN61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use, Part 1 General Requirements
- EN61010-2-201:2013 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use Part 2-201: Particular Requirements for Control Equipment

The PACIO Modules and accessories are sold as complex components to professional assemblers. The Parker Installation Guidelines described in this document offer information regarding how to install the PAC in a manner most likely to minimize the effects of drive emissions and to maximize the immunity of the PAC from externally generated interference. Compliance of the PACIO Modules is demonstrated by the application of the following standard:

- 2004/108/EC Electromagnetic Compatibility when installed, operated, and maintained as intended.

In order to comply with the EMC Directive for installation, the PAC system must meet the following criteria:

- The PAC must be mounted in a suitable tool-accessed fire enclosure.
- PAC input power is rated at: 24 VDC (-15%/+25%) SELV Limited Energy, 1.2 A, 29W. External power to the PAC must be provided by a Class 2 power source. For customer convenience, Parker offers an AC-input, Model PS-60W, Class 2, 24VDC power supply, which is available for purchase, to provide power to the PAC and PACIO Modules.

Underwriters Laboratories Approval

The PAC Controller has been evaluated and complies with UL61010-1 and UL61010-2-201 standards (UL File E243373). In order to obtain Underwriters Laboratories (UL61010-1/IEC61010-2-201) approval for the installation, the product must meet the following criteria:

- The PAC must be mounted in a suitable tool accessed, fire enclosure.
- PAC input power is rated at: 24 VDC (-15%/+25%) SELV Limited Energy, 1.2 A, 29W. External power to the PAC must be provided by a Class 2 power source. For customer convenience, Parker offers an AC-input, Model PS-60W, Class 2, 24VDC power supply, which is available for purchase, to provide power to the PAC and PACIO Modules.

Note: The PAC Controller has been evaluated to UL61010-2-201 and complies with the same level of safety as PAC's evaluated to UL508, or vice versa.

The PACIO Modules have been evaluated and complies with the UL508 standard (UL File E243373).

WARNING: If PAC system is used in a manner not specified by Parker, the protection provided by the equipment may be impaired.

Contents

About This Guide

This installation guide is intended for those who are responsible for installing, configuring, and troubleshooting programmable logic devices and their associated software and accessories.

Assumptions of Technical Experience

Parker Hannifin Corporation assumes you are qualified in the servicing of industrial control systems, and trained in recognizing hazards in products with hazardous energy levels. To install and troubleshoot the PAC, you should have a fundamental understanding of the following:

- Electronic concepts such as voltage, current, and switches
- Mechanical motion control concepts such as inertia, torque, velocity, distance, and force

Product Naming

This guide describes the following products:

- **Parker Automation Controller (PAC):** This product is also known as the PAC or Controller.
- **PACIO Modules:** These modules are also called I/O Modules.
- **PAC System:** The combination of the PAC and PACIO Modules.

Notes, Cautions, and Warnings

This guide uses notes, cautions, and warnings throughout the text to draw your attention to information that is especially important or useful.

WARNING: A warning provides information about a potential for property damage, personal injury, or death.

CAUTION: A caution provides information intended to help prevent malfunction of the product or damage to the product hardware or software.

NOTE: A note provides information intended to help you make the best use of your product from Parker Hannifin Corporation.

CHAPTER 1:
Product Overview

Product Description

The Parker Automation Controller (PAC) is a specialized control device with programmable software designed to automate high-speed, electromechanical processes such as those involved in operating assembly line equipment. The PAC is engineered to offer a wide variety of input/output arrangements for fast-motion control, while withstanding the temperature ranges, vibrations, and electrical noise of industrial environments.

The PAC features a modular design that makes it a highly flexible solution. The PAC connects to a series of PACIO Modules, which you choose based on the requirements of your specific application. The selection of PACIO Modules includes a bus coupler, a variety of digital or analog input/output modules, a counter, temperature modules, and interface modules.

The PAC also accommodates connections to remote I/O Modules, industrial control networks, terminals, factory displays, and Internet-connected devices such as PCs, notebooks, and even smart phones.

The PAC includes ports for Ethernet and EtherCAT communications. For applications requiring additional communication capabilities, customers can order the PAC with an optional communication protocol, such as PROFINET or Ethernet/IP.

The PAC operating system and runtime software reside on a standard Secure Digital (SD) memory card inserted into a slot at the top of the PAC. LED indicators on the PAC front panel help you to monitor and troubleshoot the status of the system. The PAC's compact footprint conserves space on the DIN rail, and its installation requires only a small screwdriver.

Product training videos are available on our website. These include videos on: Quick Start, Software Introduction and Configuration, as well as other topics.

Discrete Logic Capabilities: The PAC incorporates an internal, high-speed EtherCAT bus (E-Bus) that can communicate to locally attached I/O Modules for discrete control and sensing. In addition, the PAC incorporates an external EtherCAT RJ45 connector for connection of EtherCAT motor drives, remote discrete I/O (via EtherCAT Bus Couplers) racks or other miscellaneous EtherCAT sensors, and devices.

Motion and 3D Coordinated Motion: The PAC offers two levels of motion control software utilizing IEE1388 distributed clocks —one for simple motion and another for advanced CNC. An external EtherCAT connector provides communications to up to 32 axes of EtherCAT motor drives.

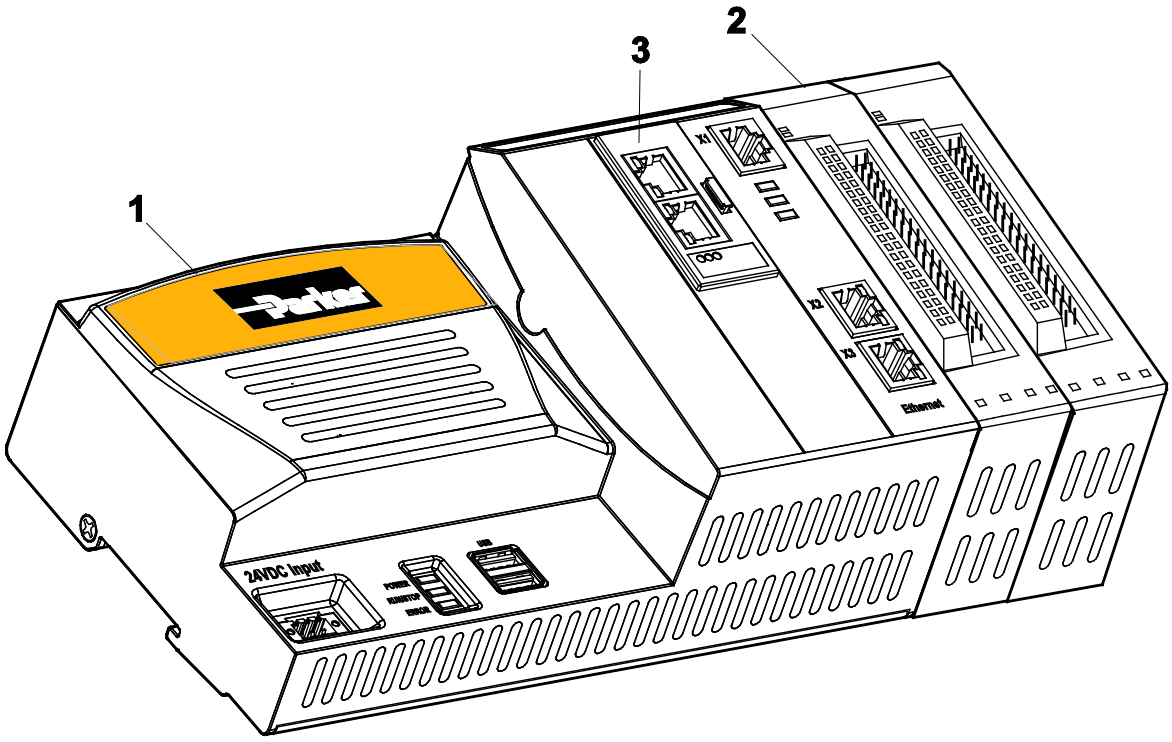
Visualization: The PAC offers two options for visualization. For complete HMI capabilities, the PAC connects via MODBUS to Parker's XPR2 PowerStations with the award winning Interact Xpress software. The MODBUS communication driver comes standard with each PAC system. The PAC also offers a Web visualization option that allows users to visualize project screens in a web browser.

Communication Interface Protocols: The PAC offers several options for communications to external devices. The PAC comes standard with MODBUS TCP Master and Slave capabilities. The PAC has an optional Ethernet/IP option to produce tags to and Allen Bradley PLC. The PAC also offers a PROFINET Slave option via a communication module.

Product Features

Overall, the PAC System consists of the Controller, PACIO Modules, and an optional communication module. The following sections highlight the various features of the PAC.

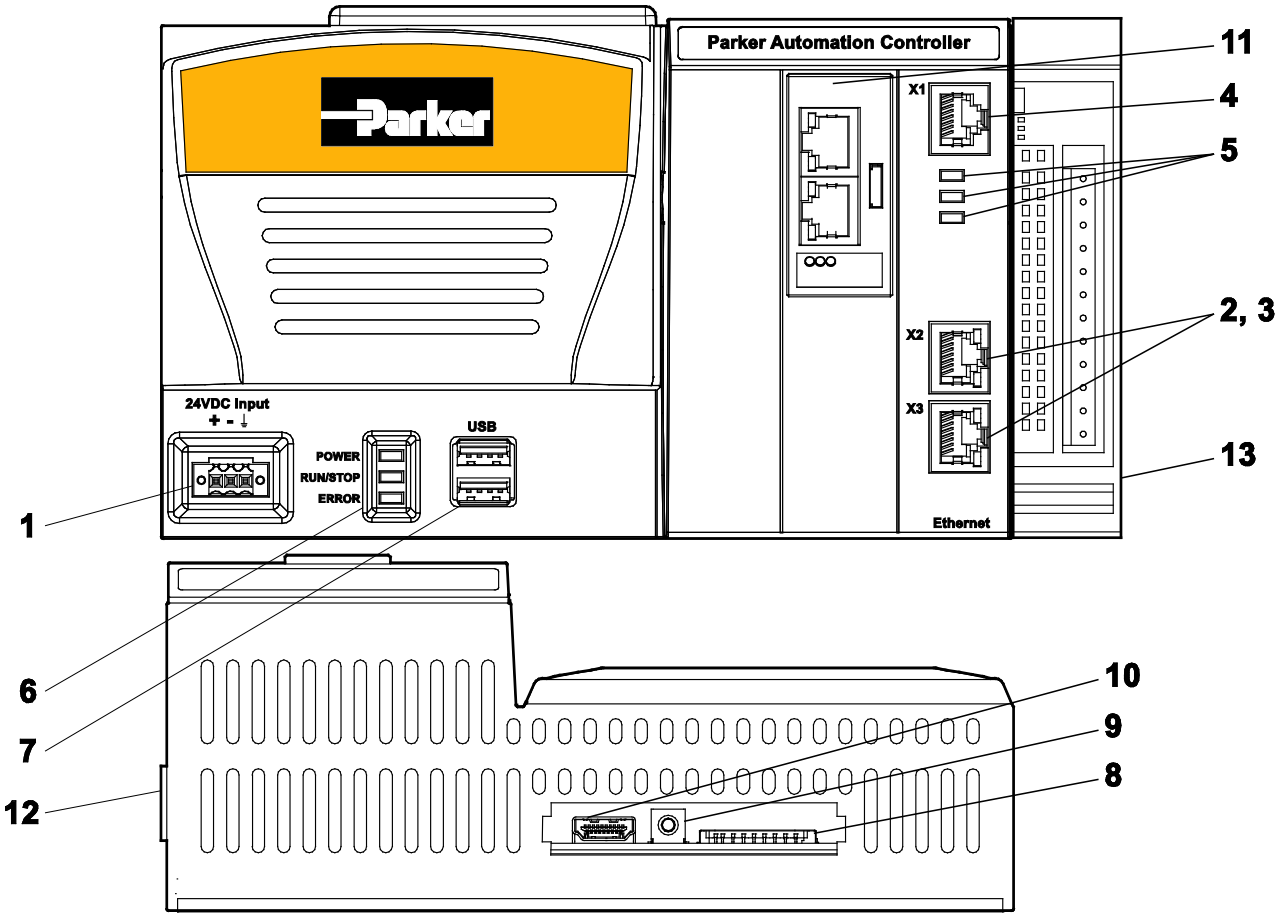
Features of the PAC and PACIO Modules



PAC and PACIO Modules

Number	Feature Name	Description
1	PAC Controller	The main control unit of the PAC
2	PACIO Modules	Series of plug-in PACIO Modules
3	Communication Module (optional)	Optional PROFINET Slave Communication module

PAC Features

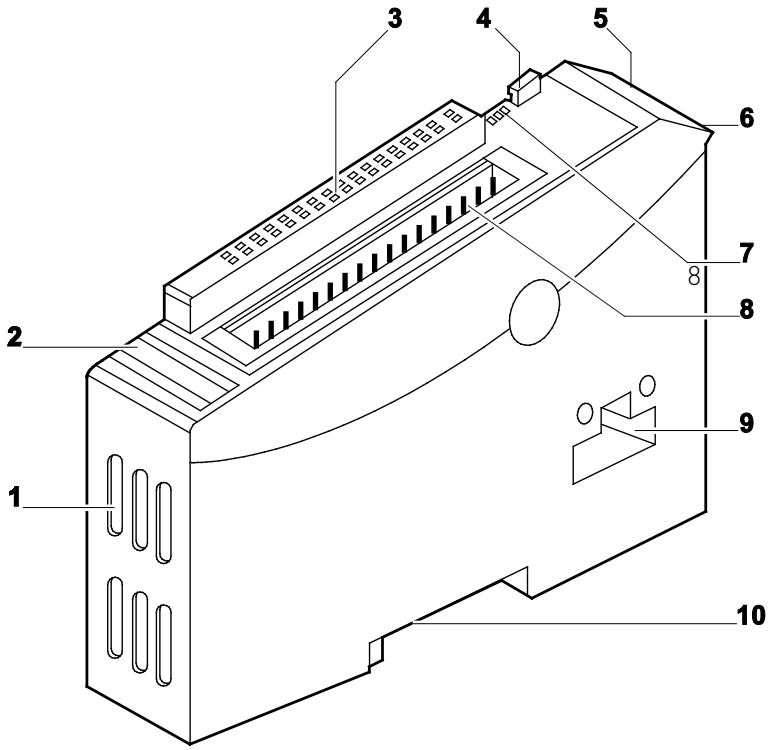


PAC Features

Number	Feature Name	Description
1	Power Connector	Connector for input power, +24VDC nominal.
2	Ethernet Ports	Two standard RJ45 connectors for LAN communications.
3	Ethernet LEDs	Two LEDs on each port indicate network connectivity and link status.
4	EtherCAT Port	Single RJ45 connector, provides EtherCAT connectivity.
5	EtherCAT LEDs	3 LEDs ("ECAT Run", "E-Bus Link/Act", "X1 Link/Act") indicate internal and external EtherCAT network status and bus link/activity.
6	System Status LEDs	3 LEDs ("POWER", "RUN/STOP", "ERROR") indicate the system status
7	USB Ports	Dual standard USB 2.0 ports, type A
8	SD Card	Parker removable SD (or SDHC) memory card
9	Button	Push button used for logging the IP address
10	HDMI Connector	Not Functional, for Factory Use Only
11	Communication Module	Optional PROFINET communication module
12	E-Bus Connector	Provides EtherCAT connectivity for local PACIO Modules
13	I/O Module(s)	Series of plug-in PACIO Modules

PACIO Module Features

For the basic layout of the PACIO Modules see the illustration below. The PACIO Modules consist of a plastic housing and an internal aluminum profile with an integral mechanism to snap the Module to a 35mm DIN rail. The PACIO Modules differ from one another in their functionality, connectors and indicators.



PACIO Modules Features

Number	Description
1	Ventilation slots
2	Earth ground bar for attachment of Shield Connection Terminal Block
3	I/O signal state indicators (LEDs)
4	Module unlock button
5	User label for module identification
6	Grip for module removal
7	Status LEDs
8	I/O wiring connector
9	Module lock and E-Bus connector
10	DIN rail mount and Earth ground connection

Ethernet Ports

The PAC provides two Gigabit Ethernet ports with full duplex operation at 10/100/1000 Mb/s and half duplex operation at 10/100 Mb/s. Both ports provide auto MDI, MDI-X crossover support at all speeds. The RJ45 connectors provide standard Speed and Link/Activity LEDS. Both ports are ESD-protected.

EtherCAT Port

The PAC provides a single, ESD-protected EtherCAT port that operates at 100Mb/s. It features an RJ45 connector as well as three LEDs that indicate the status of the connection. See "EtherCAT Status LEDs" in the Troubleshooting chapter for more information on the meaning of the LEDs.

EtherCAT is one of the fastest and most powerful Ethernet-based fieldbus systems available. For example, EtherCAT can achieve speeds that allow it to address 1,000 I/Os in 30 µs. Its flexible topology and simple configuration make it ideally suited to control extremely fast processes. Its interconnections among the PAC at one end, and both the I/O Modules and drives at the other, are as fast as those of a backplane bus. An EtherCAT-connected I/O bus acts much like centralized control systems, overcoming the issue of bus transfer times that burden conventional fieldbus systems.

LED Indicators

In addition to the Ethernet and EtherCAT LEDs, the PAC has three LEDS that indicate the state of the system. See "LED Status Indicators" The multicolor Power LED indicates that the 24V input and all internal power rails are operational. The multi-color "Run/Stop" LED indicates the status of the runtime system. The red "Error" LED indicates that the runtime system has detected a problem.

USB

The PAC provides two USB 2.0 compliant ports to connect USB Flash drives. Both ports are ESD protected and have over-current shutdown at loads greater than 500mA (combined, both ports).

SD Card

The PAC is equipped with a 2GB Secure Digital (SD) card (minimum capacity). This card contains the OS, runtime application, and all projects. Any additional spare or replacement SD cards (part number 33-026611-01) are recommended to be purchased directly from Parker or a Parker distributor.

Button

The PAC features a button that logs the current IP address of the controller. For more information, see "Push Button."

Optional Communication Module

The PAC includes the option for installation of a communication module that is factory configured as a PROFINET slave. This fully enclosed module snaps onto a carrier board that is, in turn, connected to the PAC via PCI Express.

PACIO Modules

The PACIO Modules are attached to the PAC Controller to process input and output signals and communications from the Controller to each of the Modules is via an internal EtherCAT E-Bus network. The first PACIO Module plugs into the E-Bus connector on the PAC Controller, and each additional Module plugs in to the proceeding Module, making a chain of up to 20 interconnected Modules. You choose from a variety of PACIO Modules to add, based on the requirements of your specific application. The selection of PACIO Modules consists of several different types including a variety of digital or analog input/output modules, a counter/encoder module, temperature modules, interface modules, and a bus coupler (for connecting additional PACIO Modules).

Internally, the PAC converts twisted pair EtherCAT to LVDS EtherCAT (E-Bus) and also provides the module power required by the PACIO Modules. At the end of the modular devices, the connection between the forward and return lines is automatically closed. This allows an EtherCAT bus coupler to be added to the external EtherCAT RJ45 connector to provide for additional local or remote PACIO Modules or motor drives.

CHAPTER 2:
Installation

Checking Your Shipment

Use the following steps to check your PAC shipment. Note that PACIO Modules may be shipped in packaging that is separate from the PAC Controller.

Remove all items from the packaging.

Confirm that you have received each item listed in the table below.

If you are missing an item, please call the factory. For contact information, see "Technical Assistance from Parker Hannifin" in the Troubleshooting chapter of this guide.

PAC Ship Kit	
Part Name	**Part Number**
Parker Automation Controller	PAC320-xxxxx-xx
SD Card	33-026611-01
DC Power Input Connector, 3-Pin with tension-clamp wire terminals	43-026582-01 (inserted in the PAC)
Parker Software License Agreement	A4-04291-102
Getting Started Sheet	88-032477-01

Required Tools

Installing the PAC and PACIO Modules on the DIN rail requires no tools. However, a small flat blade screwdriver (tip size 0.04mm x 2.5mm) is required for attaching the wiring to the PAC Controller and PACIO Modules.

Installation Safety Requirements

The PAC meets the requirements of the European Low Voltage Directive (LVD) 2006/95/EC and the Electromagnetic Compliance (EMC) directive 2004/108/EC, and Safety Requirements EN61010 when installed according to the instructions provided in this chapter.

WARNING: To avoid injury or electrical shock, always remove power to the PAC before connecting electrical devices (for example, PACIO Modules).

WARNING: The PAC connects to other mechanical and electrical components of your system. Be sure to test your system for safety under all potential conditions. Failure to do so may result in serious personal injury or damage to equipment.

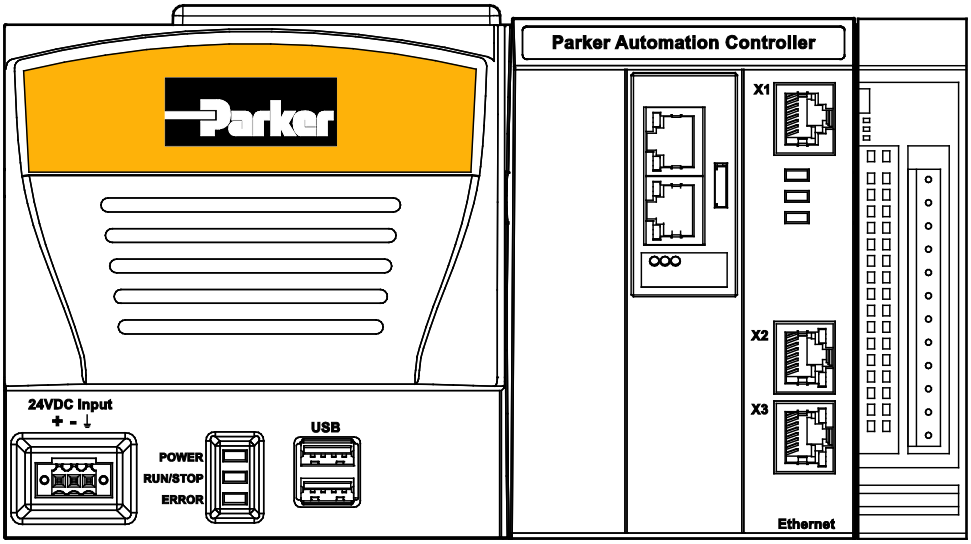
Important: Mount the Controller and PACIO Modules in a suitable tool accessed, fire enclosure to comply with requirements set forth by CE Safety directives.

Important: A Limited Power Source (LPS) power supply or circuit according to IEC 60950-1, or an NEC Class 2 power source must be used to provide power to the PAC. NEC Class 2 circuits are considered to be safe from a fire ignition standpoint and provide acceptable protection against electric shock.

- Consider power interruptions or brownouts when developing the I/O program to ensure that a defined state at restart excludes all dangerous conditions.
- Incorporate emergency disconnect circuits to ensure safe and effective machine shutoff.
- Comply with local and national safety regulations and precautions for the installation.
- Control elements are to be installed in such a way as to exclude unintended operation.
- Route control and communication cables in a manner that reduces EMI interference (inductive or capacitive) which would disturb system operation or functionality. For example, do not run communication and low-voltage cables in the same raceways with power lines, motor leads, or similar.
- Always attach or remove PACIO Modules in a powered-down state. Damage to the modules or unintended I/O functionality might occur.

Installation Overview

The illustration below shows the components that you need to install the PAC. It shows the Controller connected to multiple PACIO Modules. The recommended installation process follows.



Basic Installation Steps

The following steps give a high-level overview of the installation process. See the remainder of the chapter for additional details on completing each step.

1. Verify the shipment is correct.
2. Mount the PAC Controller on a DIN rail in a suitable tool-accessed fire enclosure.
3. Remove the protective rubber E-Bus cover from the right side of the Controller.
4. Connect the desired PACIO Modules to the right side of the controller.
5. Connect all input and output field wiring to the PACIO Modules.
6. Connect an Ethernet communication cable between the Controller and a network, laptop computer or PC.
7. Connect 24VDC power to the Controller and PACIO Modules.
8. Use the PAC Configuration Tool to configure the PAC system settings, such as Machine Name, IP addresses, and system date and time.

Installation Guidelines

The following section provides installation guidelines to ensure the use of best practices regarding agency, thermal, safety, and EMI considerations.

Regulatory Installation Guidelines

The PAC System is designed for use in industrial environments. It is to be installed in an industrial enclosure and factory wired according to National Electric Code (NEC) guidelines.

When installing the Controller and PACIO, you can either use a 24VDC Limited Power Source (LPS) or Class 2 power circuit available in the control cabinet, a purchased LPS or Class 2 power supply, or an optional Parker model PS-60W Class 2 power supply, purchased separately.

Important: The Controller and PACIO Modules must be mounted in a suitable tool-accessed fire enclosure to comply with requirements set forth by CE Safety directive.

Important: A Limited Power Source (LPS) power supply or circuit according to IEC 60950-1, or an NEC Class 2 power source must be used to provide power to the PAC. NEC Class 2 circuits are considered to be safe from a fire ignition standpoint and provide an acceptable protection against electric shock.

Thermal Guidelines

You can safely operate the PAC System within the temperature specified in the Environmental Specifications in Appendix A. However, when using a protective enclosure, remember that the temperature within an enclosure is generally higher than the external temperature. Read the following guidelines to fully understand temperature implications.

- Limit the PAC's exposure to adverse conditions, such as dust, oil, moisture, and corrosive vapors in order to minimize maintenance and repair costs.
- Be sure to choose an area for the PAC that is free from moisture or condensing humidity.

Heat builds up rapidly in enclosed environments, compromising the performance and life span of electrical equipment. If the PAC operates inside an enclosure at temperature levels above its rated ambient temperature, you must cool the enclosure.

The PAC has been tested for use in 50 degrees Celsius (ºC) ambient, still-air locations. This means that when installed, the ambient air surrounding the Controller is not expected to exceed 50ºC. An example of this type of installation would be the PAC mounted in a small, sealed industrial enclosure.

The most commonly overlooked aspect of this type of installation is that heat generated by the device, and other devices in the enclosure, becomes trapped and increases the ambient temperature immediately surrounding the PAC. This increase in temperature can sometimes exceed an additional 10 ºC or more.

Although the thermal dynamics are not always linear, a temperature rise of 10 ºC degrees inside the enclosure would imply that the environment outside the sealed enclosure could not exceed 40 ºC , or the PAC would surpass its maximum operating temperature.

Do not install the PAC with its 50 ºC operating temperature limit into a sealed enclosure without considering the effects of the internal heat buildup.

Since elevated operating temperatures can have an adverse effect on the life of electronics, it is wise to consider the internal thermal rise. Passive venting for thermal convection, internal air circulation fans, filtered exhaust fans with filtered inlets, air conditioners, and other products are available in the market to assist in reducing the heat buildup in the industrial enclosure.

There are many attractive industrial NEMA Type 12, dust-tight fan/filter assemblies available today which allow the filter to be inexpensively replaced or cleaned as part of a periodic maintenance schedule. In some cases, simply increasing the size of the enclosure can have a significant, positive effect on the installation's thermal response.

Here are some points to consider when performing a site review:

- What is the expected maximum outside ambient temperature surrounding the industrial enclosure?
- Are there any additional heat-generating components inside the enclosure?
- What is the size of the enclosure? Larger enclosures dissipate more thermal energy than smaller ones.
- What kind of environment will the enclosure be installed in - clean, water-tight, dust-tight? Can the enclosure be convection cooled or is active cooling required?

It is a wise investment to thermally plan the installation by anticipating and eliminating the heat build-up inside a sealed enclosure. Not only will this extend the life of the electronics, but it will also reduce costly equipment downtime.

Orientation and Clearance Guidelines

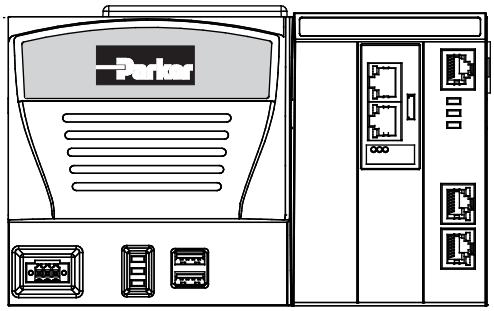
Select an enclosure that is large enough to allow free airflow in and around the Controller.

Allow a minimum of two inches between the inside of the enclosure and the top, bottom, and sides of the PAC. Verify that the surface of the enclosure on which the PAC is mounted is flat and free of raised or depressed areas.

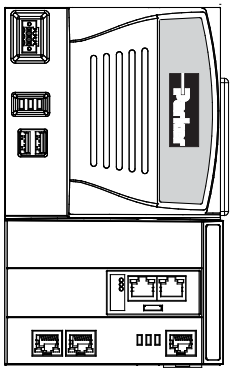
Consider additional clearance above the PAC to allow access to the SD card for insertion and removal.

Mount the PAC in a vertical orientation to allow for proper ventilation. Refer to the following illustrations for correct mounting orientations. Failure to follow these guidelines may result in overheating the PAC.

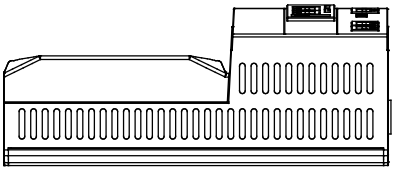
√ Correct (Vertical)



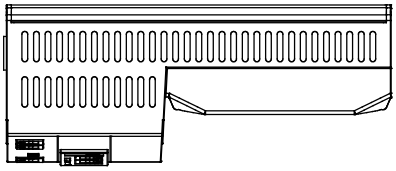
X Incorrect (Sideways)



X Incorrect (Horizontal)



X Incorrect (Upside-down)



PAC Mounting Orientation

Radiated Emissions Guidelines

The PAC and PACIO Modules have been tested to comply with international electromagnetic and emission standards (IEC/EN61010-1). To reduce radiated emissions, ensure that there is a low impedance earth connection to the PAC, which can be accomplished by attaching the DIN rail to a suitable Earth ground and also utilizing Pin-3 on the Controller 24VDC power input connector. This connection must be made with the shortest possible, heavy gage wire or braided cable. Low-resistance (<0.5 ohms) continuity should be verified with an ohmmeter for proper grounding. In addition, all communication cables should be shielded and grounded, preferably only on one end.

Earth Grounding Guidelines

To minimize unwanted electrical interference, select a location away from equipment that produces intense electrical noise (motor drives, for example). Use good engineering practice and isolate input power to the unit and separate all data communication cables from AC power lines.

Important: Use the Controller ground terminal (Pin-3 on the 24VDC power connector) to connect the unit to a suitable ground reference, such as earth ground or building steel. This ensures the unit is in compliance with immunity and emissions requirements necessary for proper operation.

Switching inductances from relays, contactors, solenoids, or switching magnets can produce significant surge voltages. It is necessary to reduce these inductive spikes to a minimum whenever possible, which

may require diodes, Z-diodes, varistors, or RC elements. We recommend that you contact the manufacturer or supplier of the corresponding actuators relevant information regarding surge protection.

DIN Rail Guidelines

It is highly recommended that the Controller and PACIO Modules are assembled on a DIN rail, even during temporary setups for application development. The Controller and PACIO must be mounted on a DIN rail in the final installation. Failure to do so may cause damage to the E-Bus interconnections or result in intermittent or unintended system operation.

The mounting system is designed to attach to an EN 50022, 35 x 7.5 mm DIN rail.

Mount the DIN rail horizontally on the enclosure sub-plate. Remember to allow for ventilation clearance above, below, and at each side. (Refer to Thermal Guidelines.)

Provide additional DIN rail length to allow for sliding the PACIO Modules to the right for module removal and/or replacement.

Ensure that the DIN rail is properly Earth grounded to the enclosure sub-plate. Remove any paint from any threaded mounting holes or around the mounting nut area to ensure a good connection to the Earth ground.

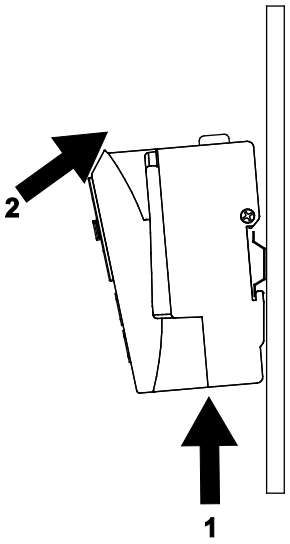
Calculate the overall length of DIN rail required for the installation base on the following component widths. Be sure to include extra length for adding additional modules in the future and a clearance allowance for removing modules.

- Width of Controller: 8.02" (203.71mm)
- Width of PACIO Modules: 1.00" (25.4mm)
- Extra DIN rail clearance (recommended): 2.00" (50.8mm)

Mounting the Controller

To mount the PAC Controller to the DIN Rail:

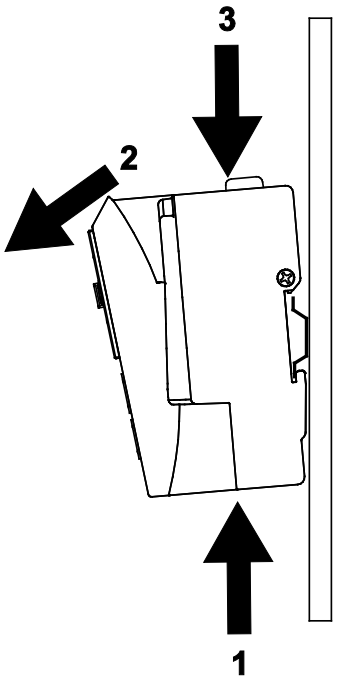
1. Push the module up against the mounting rail from below, allowing the metal spring to snap in between the mounting rail and mounting area.
2. Push the module against the mounting wall until it snaps into place.



Removing the Controller

To remove the PAC Controller from the DIN rail:

1. Push the module up and against the metal spring located on the underside of the rail guide.
2. Tip the module away from the rail as shown in the illustration.
3. Pull the module down and out of the mounting rail.



Adding PACIO Modules

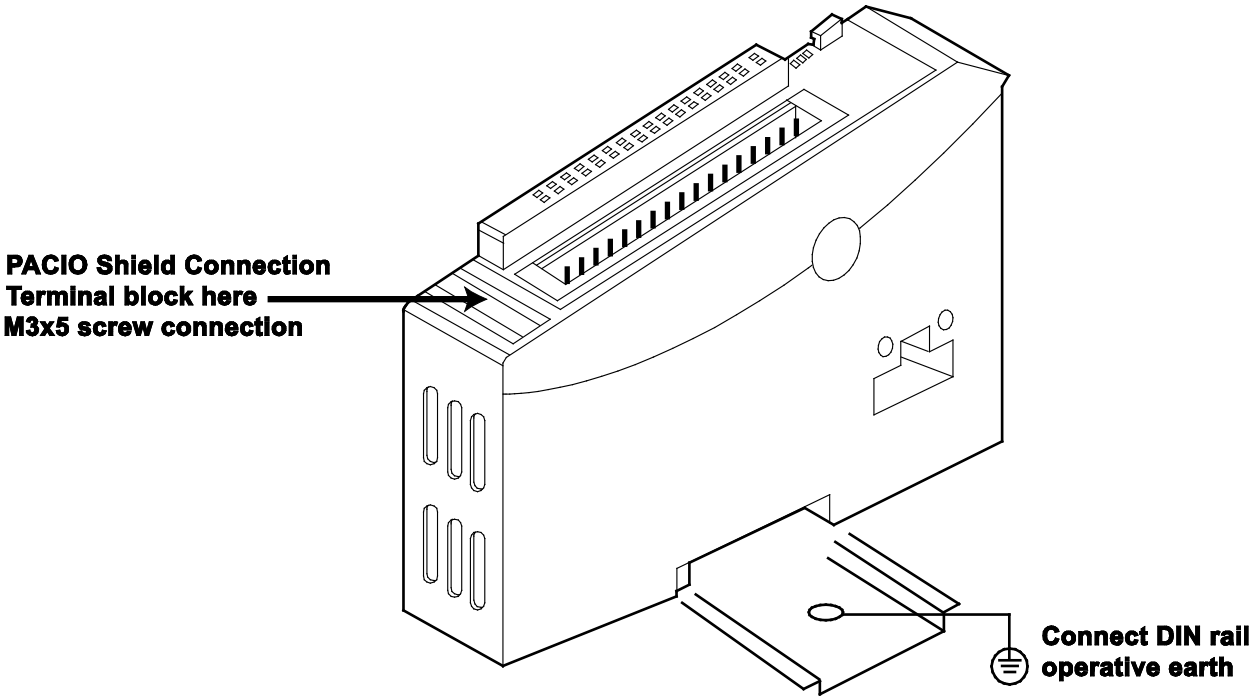
WARNING: Always attach or remove PACIO Modules with the system in a powered-down state. Damage to the modules or unintended I/O functionality might occur.

Earth Ground

Just as with the PAC Controller, connect the PACIO Modules to Earth by attaching the metal housing to operative Earth via the grounded DIN rail.

Check all connections to verify that:

- The connection between the PACIO Module housing and DIN rail conducts well.
- The connection between the DIN rail and control cabinet conducts well.
- The control cabinet is connected to Earth.



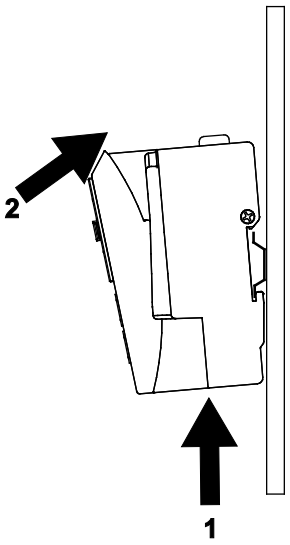
PACIO Module on DIN Rail

PACIO Module Installation

Follow the instructions below to mount the PACIO Modules on the DIN rail (DIN EN 50022, 35 x 7.5 mm), and attach them to the Controller.

To add modules to the PAC

1. About 1 cm to the right of the Controller, push the PACIO Module up against the mounting rail from below, allowing the metal spring to snap in between the mounting rail and mounting area.
2. Push the Module against the mounting wall until it snaps into place.

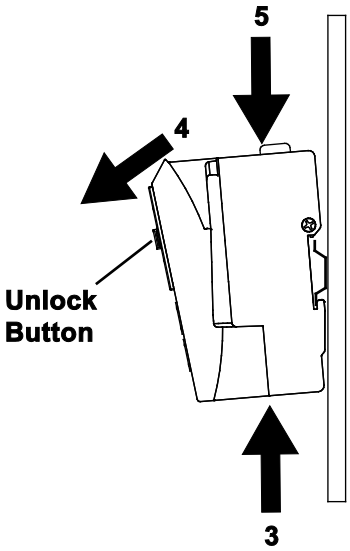


Rail mounting of single Module

3. Slide the module to the left until it engages with the E-Bus connector on the Controller.
4. Repeat steps 1 through 3 to add additional modules.

To Remove a PACIO Module from the PAC Controller

1. Press the Unlock Button on the PACIO Module that needs to be removed, and slide all modules about 2 cm to the right.
2. Push the Unlock Button on the adjacent Module to the right of the Module to be removed and slide the Module that needs to be removed to the left, just enough to clear the E-Bus connector on the right Module.
3. Push the Module up and against the metal spring located on the underside of the rail guide.
4. Tip the Module away from the rail as shown in the illustration.
5. Pull the Module down and out of the mounting rail.



Removing a Module

Fieldbus Communication Module (optional)

An optional Fieldbus Communication Module is available with the PAC Controller in order to provide PROFINET I/O data via a PCI Express interface. Refer to Chapter 6 for more information on the configuration or installation of the PROFINET Slave option.

Note: The PROFINET communication modules are shipped with their firmware already loaded.

Attaching Cables

Ethernet, EtherCAT, and Fieldbus Communication Cables

WARNING: Do not install Ethernet communication cables in the same conduit or cable tray with AC power wiring, motor leads, or any other high potential switching currents.

To ensure reliable communications with the best performance possible, the cabling components used must conform to US standard EIA/TIA 568 or European standard EN50173-1 Class D.

Category 5 (CAT5 or preferably CAT5e) cable is recommended for Ethernet and EtherCAT communications. The maximum allowed channel length is 100 meters or 328 feet.

The cable must not be kinked or bent too tightly (the bend radius should be at least four times the outer diameter of the cable).

Either shielded or unshielded cables may be used. Consider using shielded cables in electrically noisy environments. All shielded cables must be grounded for safety and effectiveness and a continuous shield connection maintained from end to end. Ground loops may develop when there is more than one ground connection and the difference in common mode voltage potential at these ground connections can introduce noise into the cabling.

CHAPTER 3:
System Start-up and Configuration

Overview of System Start-up

Once the installation location has been properly determined and the PAC Controller and PACIO Modules have been mounted to the DIN rail and properly grounded, it is time to apply power and configure the PAC Controller.

Steps

1. Connect 24VDC, Class 2 power to the Controller and I/O modules.
2. Configure the PAC IP Settings, Machine Name, Date and Time, and other settings.

Powering the PAC

Connecting Power to the Controller

Warning: The PAC has no power switch. It will start functioning as soon as live power is applied.

The PAC operates on nominal 24VDC, SELV Limited Power Source or Class 2 power. Note that both the +24VDC and the 24VDC return is isolated from the Earth ground inside the Controller. Attach the following:

Pin Number	Marking	Description
Pin-1	(L+)	+24VDC
Pin-2	(L-)	0 VDC
Pin-3	(Earth)	Earth Ground

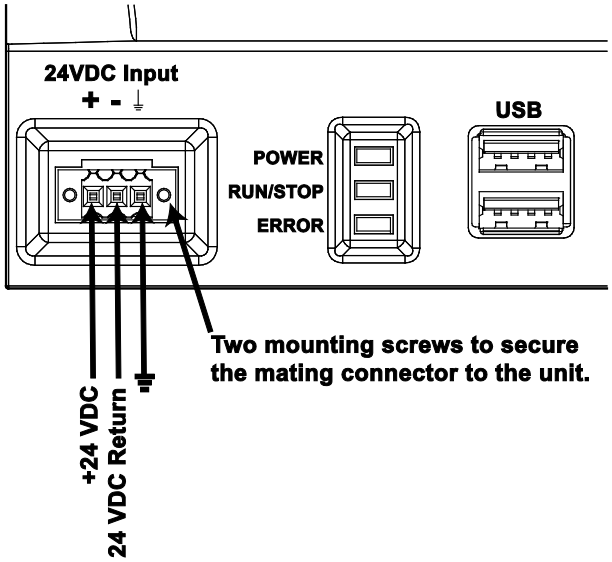
The system input power rating to the Controller and up to approximately 20 I/O modules is:

- 24VDC @ 1.2A, SELV Limited Energy, or a total of 29 Watts
- Wire gage for connection to the Controller: 0.20 - 1.0 mm² (IEC) / 26 – 16 AWG (UL), stripped to <10mm in length, solid or stranded wire

Connection Diagram

For convenience, the 24VDC input connector can be prewired and then plugged into the mating connector on the unit. Remember to tighten the two screws located on each side of the connector to prevent unintended disconnection.

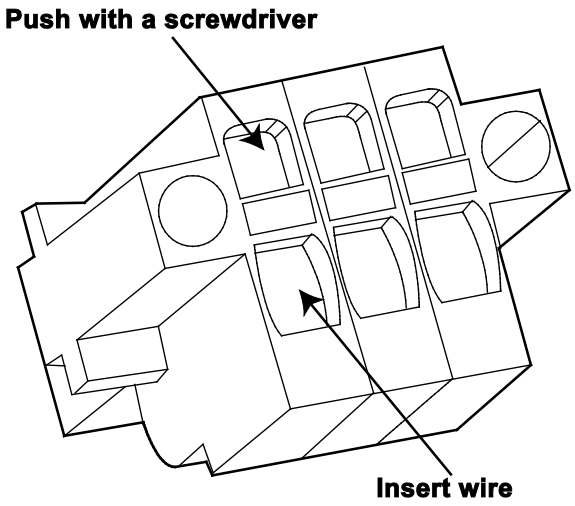
CAUTION: To reduce issues associated with noise on the input DC power, keep the 24VDC wiring away from any AC interfering sources, such as motor leads or other devices, and keep the wiring as short as possible.



Input Power Connection Diagram

How to attach the wires to the tension clamp terminals:

1. Push a small screwdriver (tip size 0.04mm x 2.5mm) into the small square opening on the back of the connector (refer to the next figure).
2. Insert the stripped wire (<10mm) into the adjacent rectangular opening on the connector.
3. Remove the screwdriver.
4. Gently tug on the wire to confirm that it is tightly captured.



Attach Wires to Tension Clamp Terminals

Switch Disconnect

Although a DC power switch is not provided on the Controller or PACIO Modules, a rapid shut-down of all outputs can be performed by incorporating an external switch on the Controller +24 (L+) and the PACIO Module supply voltage (L+) power wires. For safety, power disconnect can also be incorporated into the Emergency Stop power loop.

CAUTION: Permanently connected equipment must include a switch or circuit breaker between the Controller and power source. This disconnect must be in a suitable location within reach of the Controller and must be properly marked to indicate that its purpose is to disconnect power.

Installing an Optional AC Power Supply

PAC Systems operate on 24 VDC input nominal power. You can purchase an optional PS-60W Power Supply available from Parker to provide 24VDC input power if DC machine power is not available.

The optional Parker PS-60W power supply has the following ratings:

Parker PS-60W AC/DC Power Supply Specifications		
INPUT	AC Voltage, Nominal	115/230 VAC Auto Select
	AC Voltage Range	85-264 VAC
	Frequency Range	47-63 Hz
	Nominal Current	1.3A / 0.7A
	Inrush Current (max)	Typ. < 25A
OUTPUT	DC Voltage, Nominal	24VDC, (22.5 – 28.5VDC adj.)
	DC Current, Nominal	2.5A (60W)
	Overvoltage Protection	>30VDC, but <33VDC, auto recovery
GENERAL	Environmental Rating	IP20, Indoor Use Only Pollution Degree 2
	Agency Certifications	Class 2 per UL 1310, CSA C22.2 No. 223 UL508, CSA C22.2 No. 107.1 CE Low Voltage Directive, IEC/EN60950-1, 2nd Edition RoHS Compliant
	Temperature, Storage	-25°C to +85°C
	Temperature, Operating	-10°C to +60°C Convection cooling, no forced air required Operation up to 50% load permissible with sideways or front side up mounting orientation.
	Relative Humidity	<90% RH, non-condensing IEC 68-2-3, 68-2-3
	Overvoltage	Category II
	Protection/Safety	Protected against continuous short-circuit, overload, open-circuit. Protection Class 1 (IEC536), degree of protection IP20 (IEC 529) Safe low voltage: SELV (acc. EN60950)
INSTALLATION	Fusing, Input	Internally Fused, External 10A slow acting fuse recommended
	Mounting	Snap-on system to DIN Rail EN 50022, 35 x 7.5 or 35 x 15
	Input Connections	16-10 AWG (1.5 – 6 mm^2) Solid Conductors 16 -12 AWG (0.5 – 4 mm^2) Flexible Conductors
	Output Connections	16-10 AWG (1.5 – 6 mm^2) Solid Conductors 16 -12 AWG (0.5 – 4 mm^2) Flexible Conductors
	Clearance, cooling	25mm above and below, 25mm left and right, 10mm front
	Dimensions H, W, D in. (mm)	4.88 x 1.97 x 4.55 (124 x 50 x 116mm)

If you provide your own machine power or a separate AC/DC power supply, the nominal input to the PAC Controller and up to approximately 20 PACIO Modules is 24VDC @ 1.2A or a total of 29 Watts.

CAUTION: Do not apply AC line input power directly to the PAC Controller, or damage may occur.

Mounting the Optional PS-60W AC Power Supply

The optional PS-60W AC power supply can be mounted on the DIN rail, conveniently on the left side of the Controller. To reduce issues associated with noisy DC power input, keep the 24VDC wiring away from any AC interfering sources such as motor leads or other devices. Refer to the PS-60W or the user-supplied power supply for information regarding topics such as mounting, AC power connections, or ratings.

Add I/O wiring to the PACIO Modules

All PACIO Modules require either input power wiring or field I/O wiring. The following section describes the general wiring guidelines for the Modules.

Power circuits are conductors carrying high voltages, motor leads, or any other high potential switching circuits. Control circuits are considered to be low voltage digital or analog signals, communication or data signals, fieldbus or network wiring, or similar.

Keep the following power circuits separate from control circuits:

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

The following control circuits can be combined:

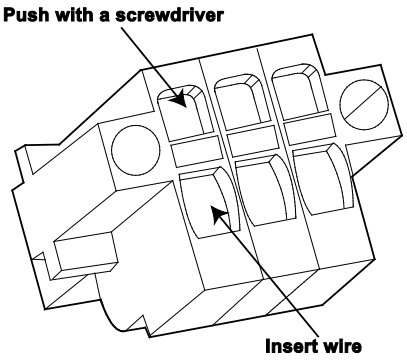
- Shielded data or communication signals
- Shielded analog signals
- Unshielded digital I/O lines
- Unshielded DC voltages < 60 V
- Unshielded AC voltages < 25 V

The following wire sizes are recommended for the PACIO Module field and power wiring:

- 0.20 - 1.0 mm² (IEC) / 26 – 16 AWG (UL), stripped to <10mm in length, solid or stranded wire
- Rated current: 5 A (CSA) / 10 A (UL)
- For convenience, the PACIO Module connectors can be prewired and then plugged into the module. The Module connectors also facilitate easy replacement of a Module with requiring removal of the individual field wires.

How to attach the wires to the tension clamp terminals:

1. Push a small screwdriver (tip size 0.04mm x 2.5mm) into the small square opening on the back of the connector.
2. Insert the stripped wire (<10mm) into the adjacent rectangular opening on the connector.
3. Remove the screwdriver.
4. Gently tug on the wire to confirm that it is tightly captured.



Attach Wires to Tension Clamp Terminals

PACIO Power Distribution Module

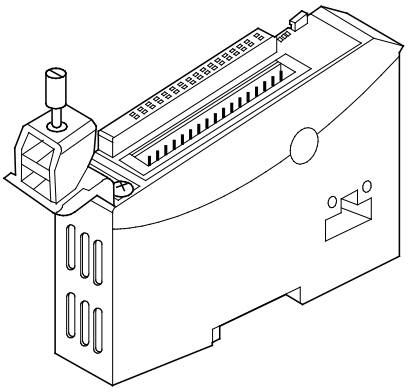
- Many PACIO Modules require 24VDC to provide power to field outputs. To ensure that there is as little cross interference as possible, do not connect the PACIO field power supply lines from one PACIO power supply port to the next. Install a central power supply point and establish a star topology using the shortest wires possible between the central point and PACIO Modules. To simplify this wiring, the use of a PACIO Power Distribution 2 x 16 Module is recommended. For more information, see page 137.
- PACIO Modules that require 24VDC field power have a corresponding "POWER" LED indicator located on the Module.
- Some PACIO Modules have under voltage monitoring, and can report this status to the control unit.

TIP: A rapid shut-down of all PACIO outputs can be performed by externally switching-off of the I/O supply voltage L+.

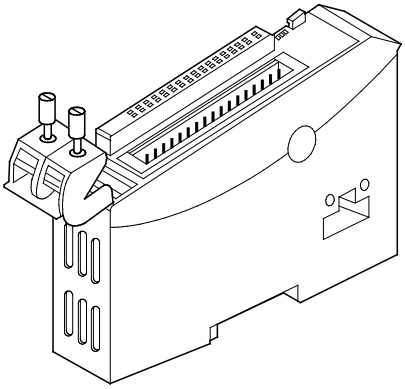
TIP: If you need to monitor the presence of the PACIO power supply in the control program, connect the 24VDC L+ input power to a PACIO digital input to represent the status of the field 24VDC power.

It is recommended that the PACIO Module field wiring be properly shielded and the wiring shield be connected to Earth ground to prevent analog or digital I/O interference.

- Shielding the wiring of low voltage analog and digital I/O signals is particularly important
- Each PACIO Module contains an Earth ground bus bar for connection of an optional PACIO Shield Connection Terminal Block (see page 138). These products are useful in grounding the I/O wiring cable shields to Earth ground for EMI noise suppression.



PACIO Shield 14 mm



PACIO Shield 2x8mm

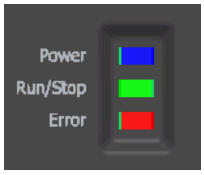
Apply power to the PAC for the First Time

Once the following steps have been completed, 24VDC can be applied to the Controller and PACIO Modules:

- PAC Controller has been mounted to a DIN rail
- PACIO Modules are attached to the Controller
- 24VDC input power wiring has been connected to the Controller
- Field wiring and 24VDC power wiring has been connected to the PACIO Modules
- Communication/Network cables are connected to the Controller

Once the 24VDC power is turned on to the system, the LED's will provide information on the PAC's status per the following table:

LED Color Status Table

LED	Software Controlled	Color States	Description	
Power	no	Blue Red Off	Internal Controller power supplies good Internal Controller power supplies bad Off indicates no power or fuse blown	
Run/Stop	yes	Red Green White Off	No programs running Programs running Push button is pressed	
Error	yes	Red Off	System error No system error.	

Configuring the Network and System Settings

Upon powering the system for the first time, use the PAC Configuration Tool to configure the initial system parameters. After commissioning the machine, these parameters need to be changed.

To run the PAC Configuration Tool located in the PAC Controller, perform the following steps:

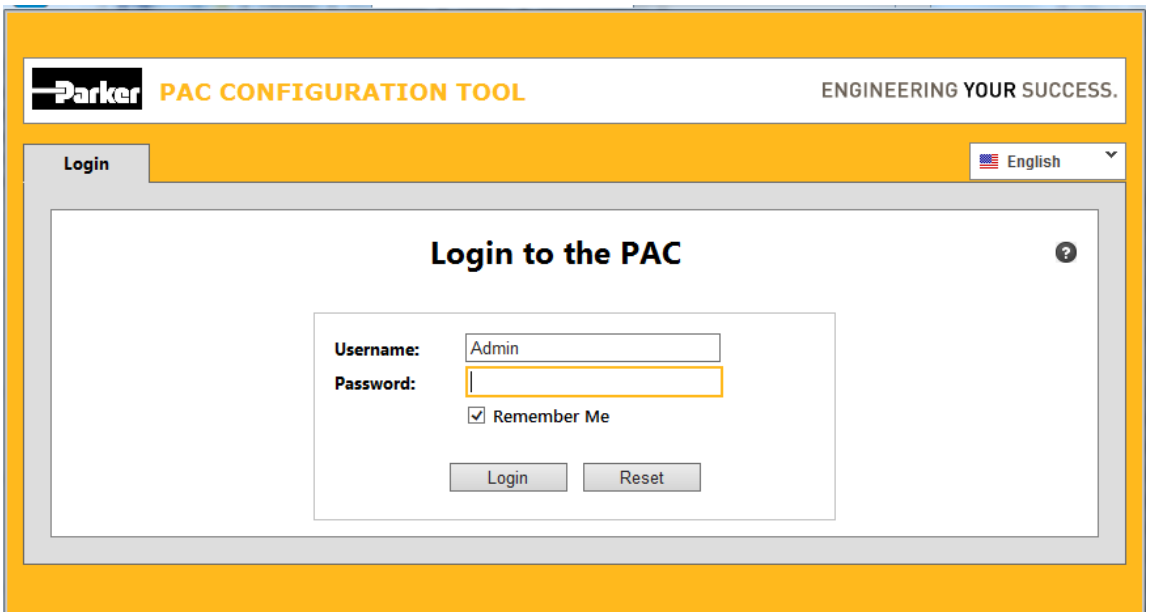
1. Attach an Ethernet cable between the Controller Ethernet connector "X2" and a laptop or PC.
2. As shipped from the factory, the PAC Controller IP Address is defaulted to 192.168.10.50. To avoid network IP address conflicts, set the Network Settings on the laptop/PC to IP 192.168.10.51 and Subnet Mask to 255.255.0.0 by following the procedure below.
    a) For Microsoft Windows 7, open the Network connections dialog box Network connections:

    Start > Control Panel > Network and Sharing Center.

    b) Select "Change Adapter Settings".
    c) Right-click the "Local Area Connection" that is connected to the PAC Controller.
    d) Click **Properties**.
    e) Select Internet Protocol Version 4 (TCP/IPv4).
    f) Click **Properties**.
    g) Select "Use the following IP address:" and:
        - Enter the following IP address that will not conflict with the Controller: 192.168.10.51.
        - Enter the following subnet mask: 255.255.0.0
    h) Close the individual dialog windows by clicking **OK** to exit the Network Configuration tool.
3. Open a Microsoft Windows Internet Explorer browser window (IE 8 or later).
4. To communicate with the controller, type the following IP address in the browser address bar: http://192.168.10.50:81
5. You should see the following:

Login Tab

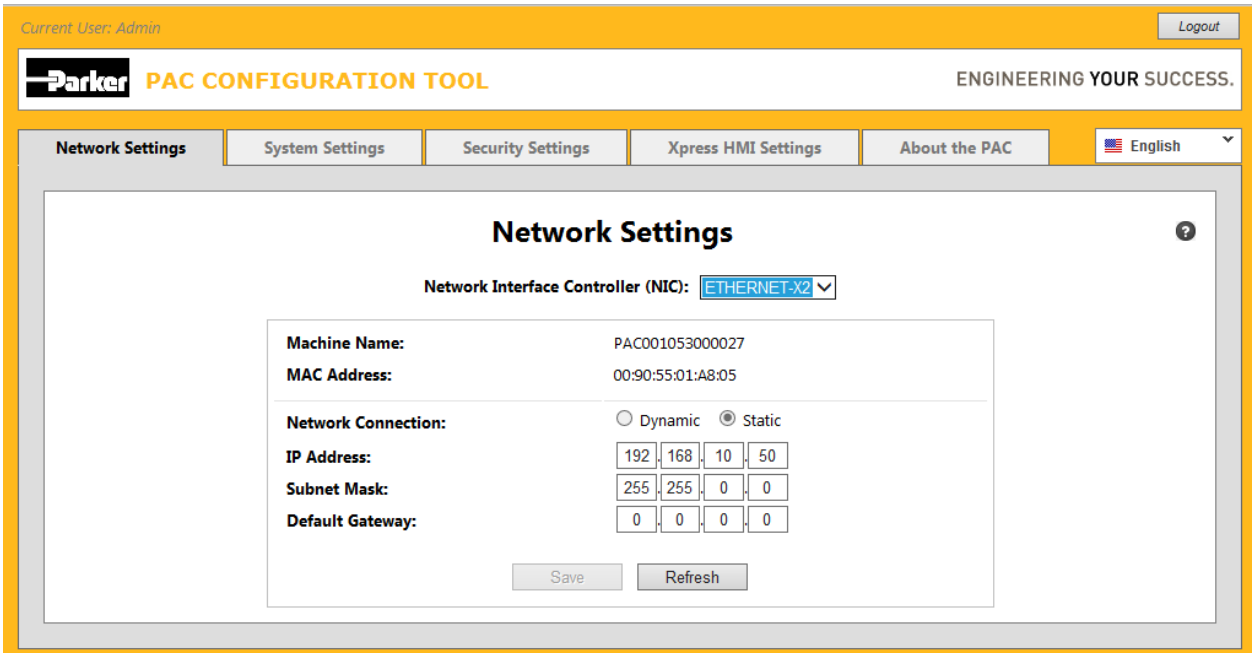
This tab is used to log into the PAC Configuration Tool. Enter your Username and Password to gain access to the configuration tool. The default username and password from the factory are Admin with the password box empty (no password). If you do not know your username or password, please consult with the Administrator of the PAC Controller.



Click on the [?] button at the upper right corner of the page to display online help at any time to learn more about using the PAC Configuration Tool. This tool is useful for setting or changing the Controller system parameters.

Tab1 –Network Settings

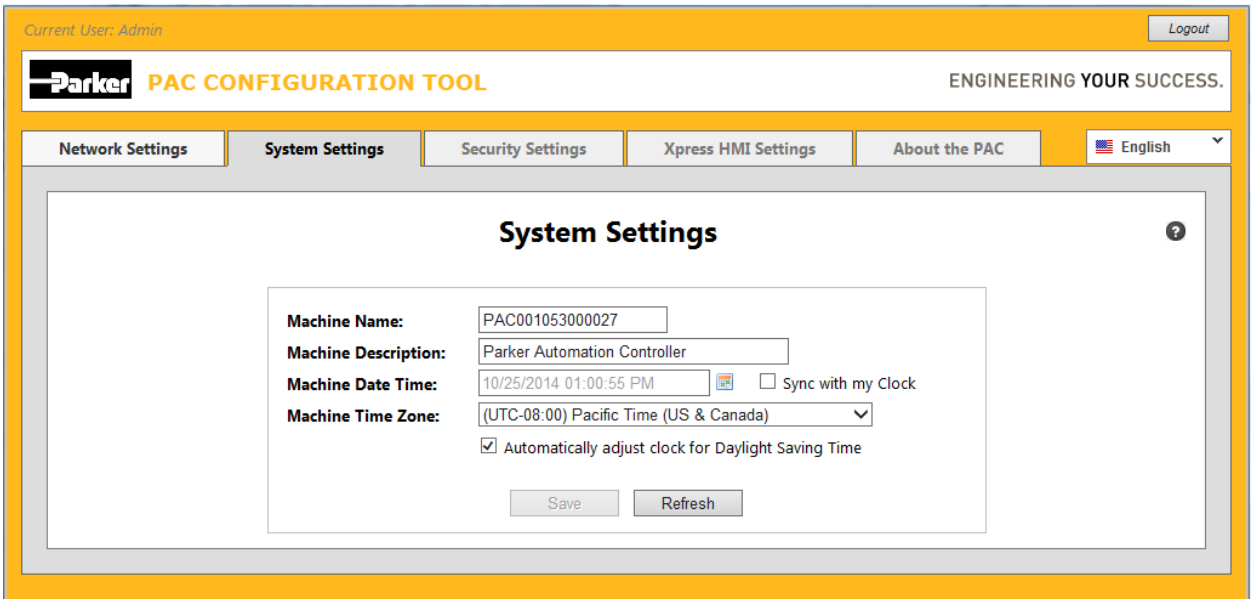
This tab is used to set the PAC Ethernet port ("X2" or "X3") to which the local network is attached and to change the IP address of the controller.



TIP: If more than one PAC Controller is connected to the same network, each Controller must be assigned a unique IP address to avoid network conflicts. Also confirm that the IP addresses of the PAC Controller(s) do not conflict with any other devices on the same network

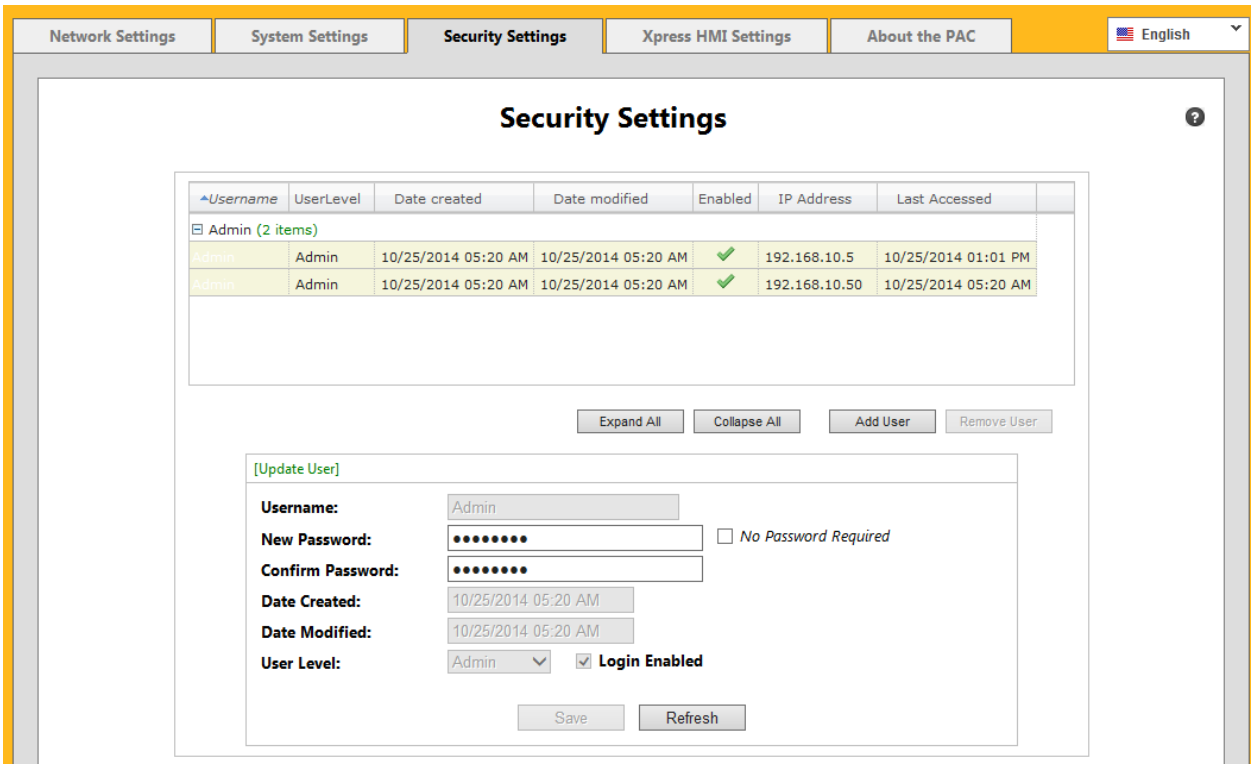
Tab 2 – System Settings

This tab is used for assigning a "Machine Name" to the PAC Controller and for setting the date and time parameters.



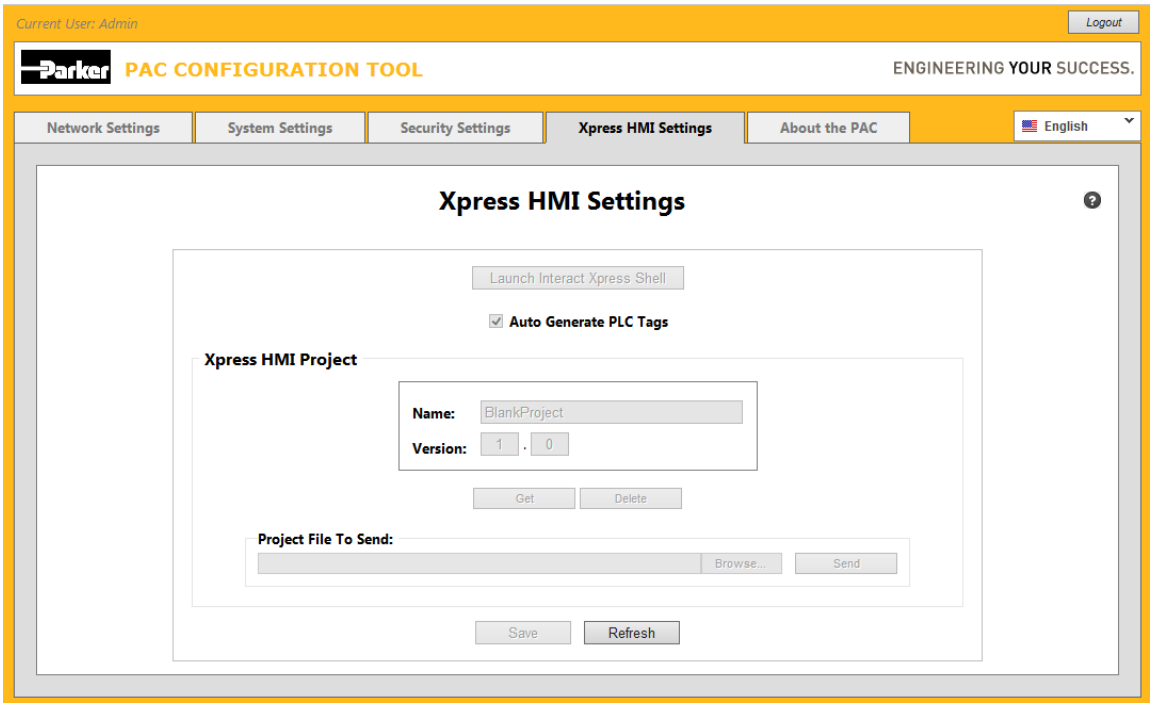
Tab 3 – Security Settings

This tab is used for assigning user names, passwords and user levels. It also provides detailed information on each user's access history.



Tab 4 – Xpress HMI Settings

This tab is used for the Xpress HMI option on the PAC. It allows the user to launch the Xpress Shell and Upload/Download Xpress projects.



Tab 5 – About the PAC

This tab is useful for inquiring the Controller "Model Number", "Serial Number", and the software and firmware version numbers. Note that these parameters are read-only. In addition, various file downloads can be initiated in this tab.

Configuring the PAC with the Parker Automation Manager Software

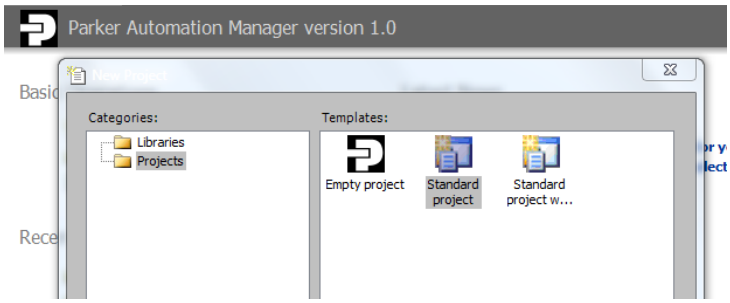
The Parker Automation Manager Software package is used to configure the PAC as the EtherCAT master and to program the PAC with the IEC611-31 language. The Parker Automation Manager software can be downloaded from parkermotion.com under the PAC product page or in the Support and Downloads page.

After installing the Parker Automation software package, follow these instructions to get started with your project.

Creating a new PAC project

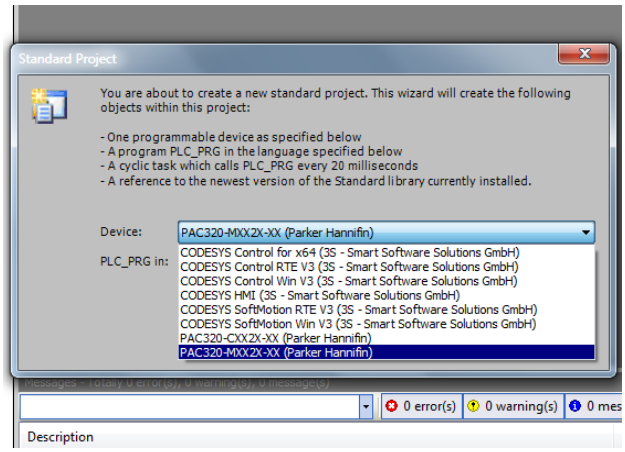
You can create a new PAC project off line with no access to the controller.

1. Launch the Parker Automation Manager Software.
2. Choose "New Project".
3. Choose "Standard Project" and name your project (Project1 in this example) and choose the location you would like to store the project. Click OK.

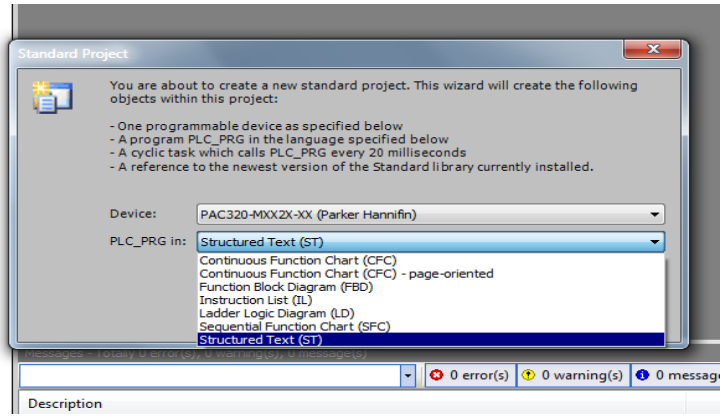


4. Choose the appropriate PAC320 device in the pull down menu depending on your version of the PAC320. If you have a PAC with motion (PAC320-M…) then choose **PAC320-MXX2X-XX**. If you have a PAC with CNC motion (PAC320-C…) then choose **PAC320-CXX2X-XX**. If you have a PAC with PLC only (PAC320-P…) then chose PAC320-PXX2X-XX.

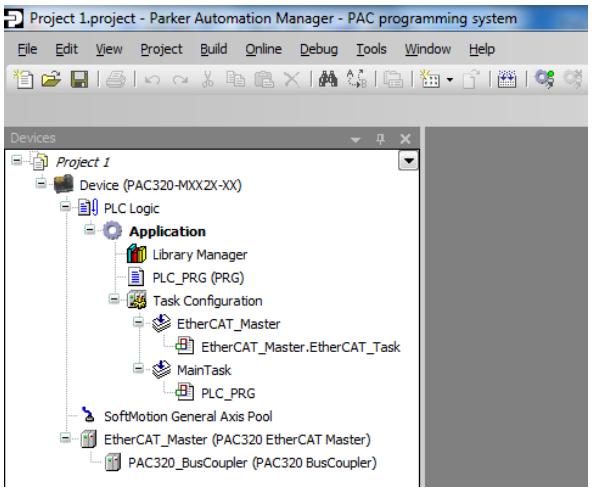
5. Choose **Add Device**. This will add the PAC320 to your device tree.



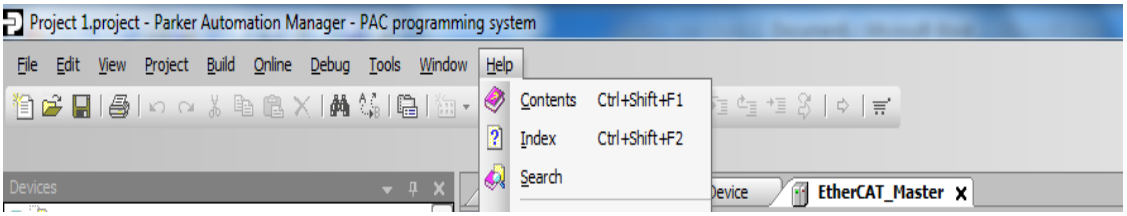
6. Choose the PLC_PRG language you would like to use in your project. Choose **OK**.



7. The PAC will now show up in the Device Tree and you are now ready to start building your project with the PAC.



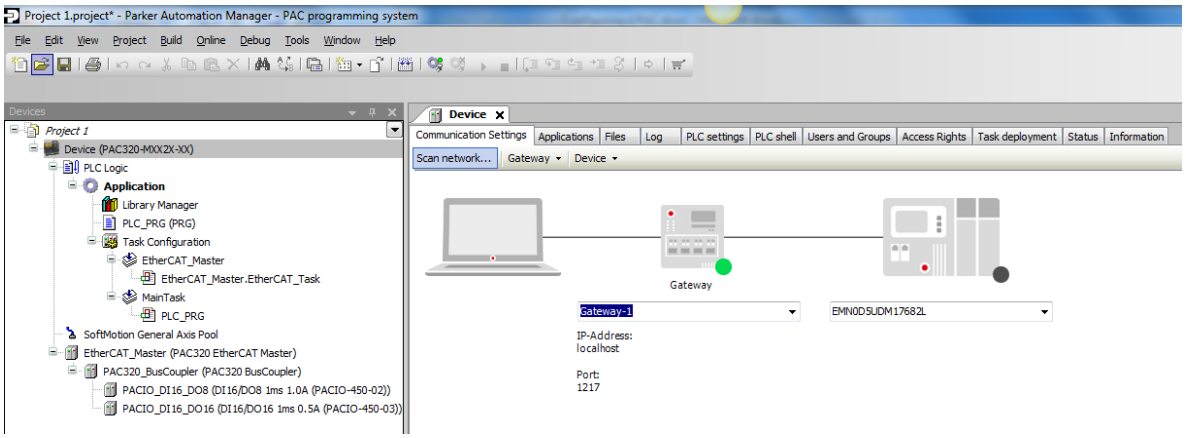
8. The Help menu in Parker Automation Manager is a great resource with documentation to help you start programming your project.



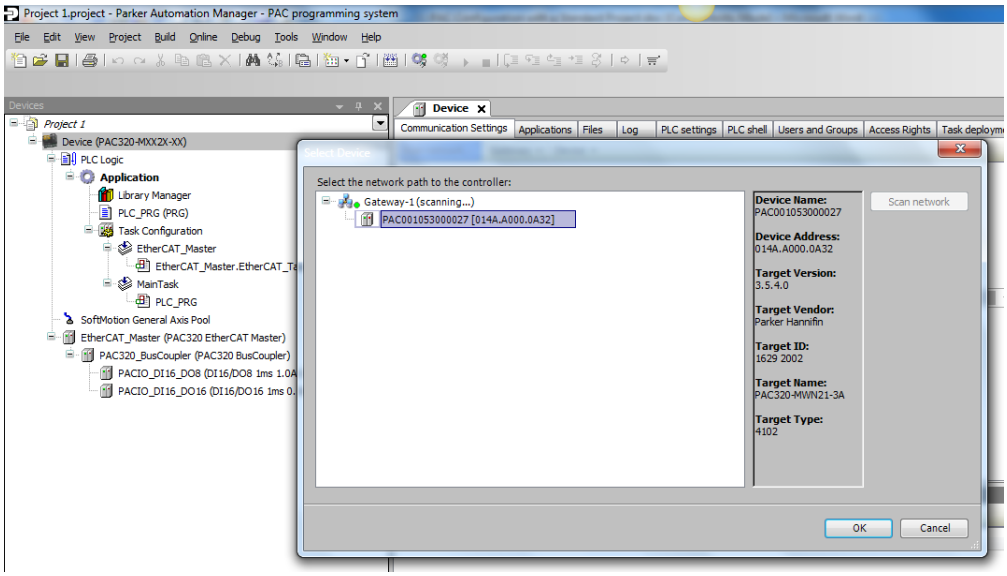
Connection to the PAC

The following section will step you through the process to connect Parker Automation Manger to the PAC via Ethernet. It is recommended that you complete the "Configuring the System" section before this section.

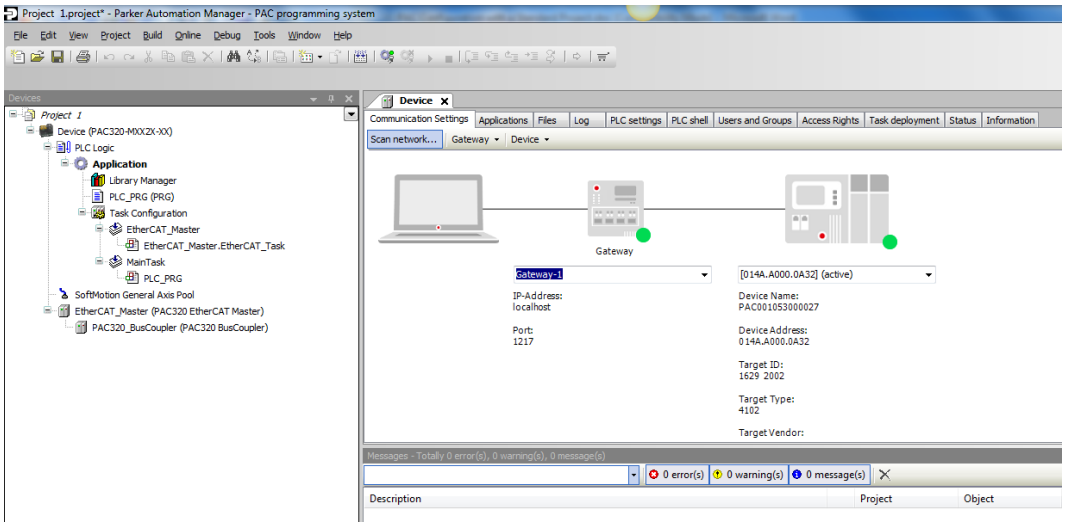
1. Double click on "**Device (PAC320-MXX2X-XX)**." Under the Communications Settings tab, select **Scan Network**.



2. After the scanning process finds the PAC, select the PAC and click **OK.**



3. The Green dot on the device indicates that the device was found and you are now connected to the PAC.

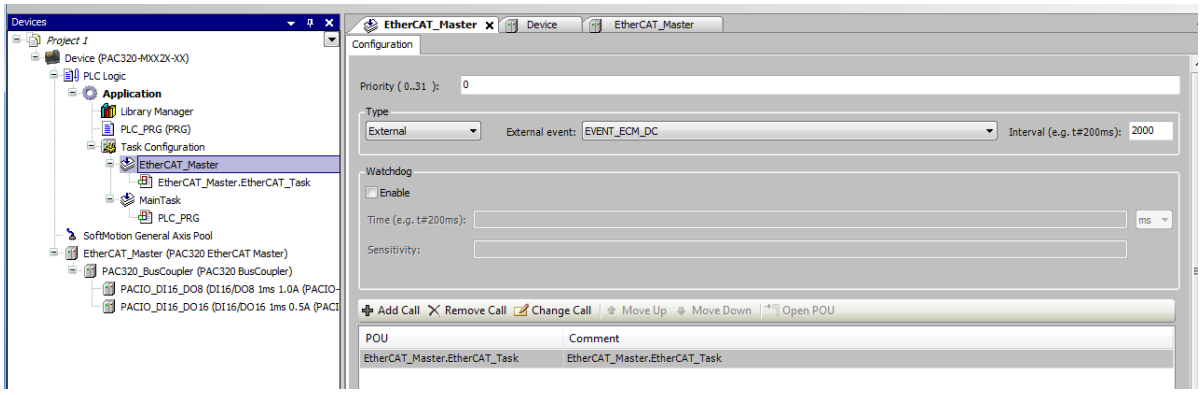


Configure the EtherCAT_Master Task

For projects that require real-time synchronization via distributed clocks (i.e., servo drive applications), use the following steps to configure the PAC as an EtherCAT master. This assumes that your EtherCAT slave also supports distributed clocks functionality. If your PAC will only be used with the PACIO Modules, distributed clocks is not required. But if you are using the PAC with a servo drive such as the Compax3, then these steps are required.

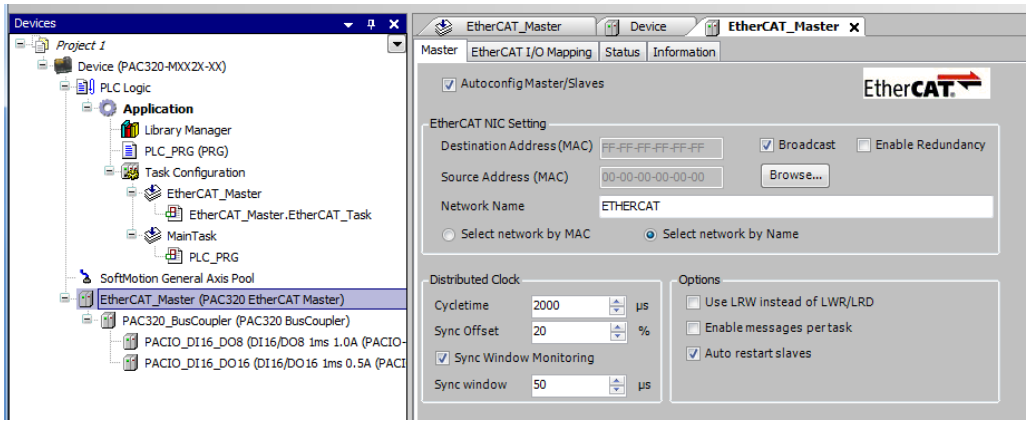
1. In the Devices tree, double click the **PLC Logic->Application->Task Configuration->EtherCAT_Master node** to bring up the Task Configuration dialog.

2. In the Configuration dialog, change the Type to be **External** and the External event to be **EVENT_ECM_DC**. Ensure that the Priority is set to 0. The Interval value is not set by the value in this dialog box. It is set in the Cycletime in EtherCAT_Master_Node(see the next section) ***NOTE*** You MUST set the Type to **External** and the External Event to **EVENT_ECM_DC** to have the EtherCAT and distributed clocks to run correctly.



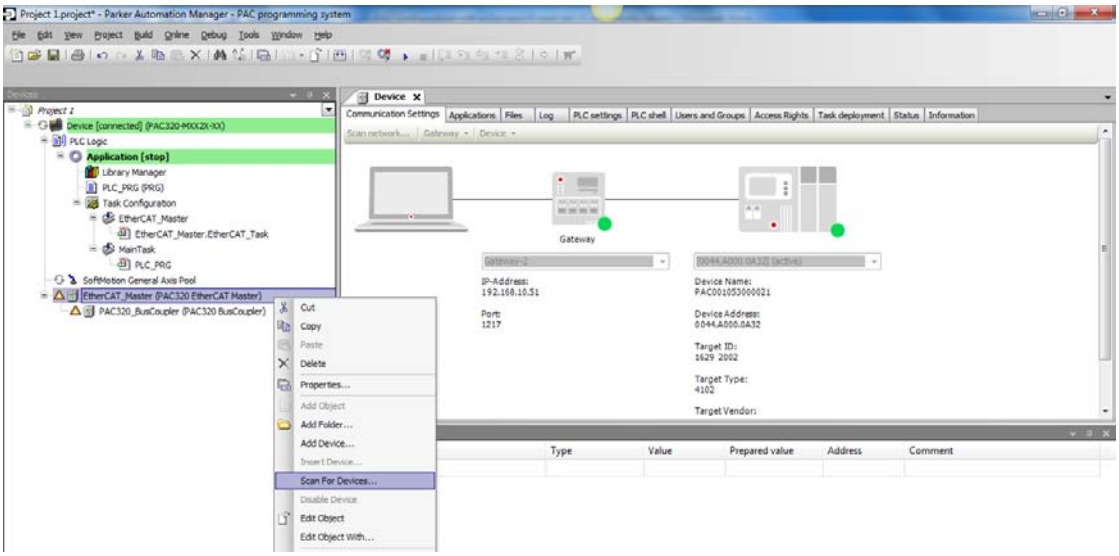
Configure EtherCAT_Master Node

1. In the **Devices** tree, double click the **EtherCAT_Master** node to bring up the **EtherCAT_Master Configuration** dialog.
2. Ensure that the **Autoconfig Master/Slave** checkbox is checked.
3. Change the **Distributed Clock Cycletime** to the EtherCAT cycle time that you wish to achieve. (2000 usec in this example). For an EtherCAT network that includes a Compax3, the **Distributed Clock Cycletime** should not be lower than 500 usec and must be a multiple of 250 usec. A **Distributed Clock Cycletime** of 1000 usec is a reasonable starting point.
4. Check the **Sync Window Monitoring** checkbox and set the **Sync window** to 50.

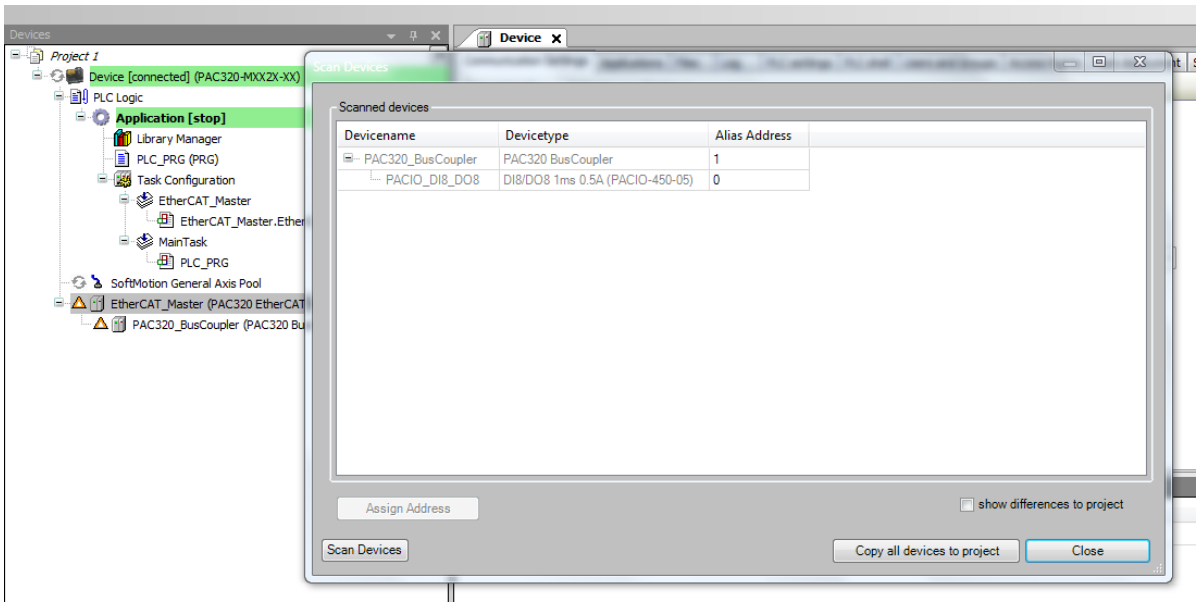


Configuration of the PACIO (Online Method)

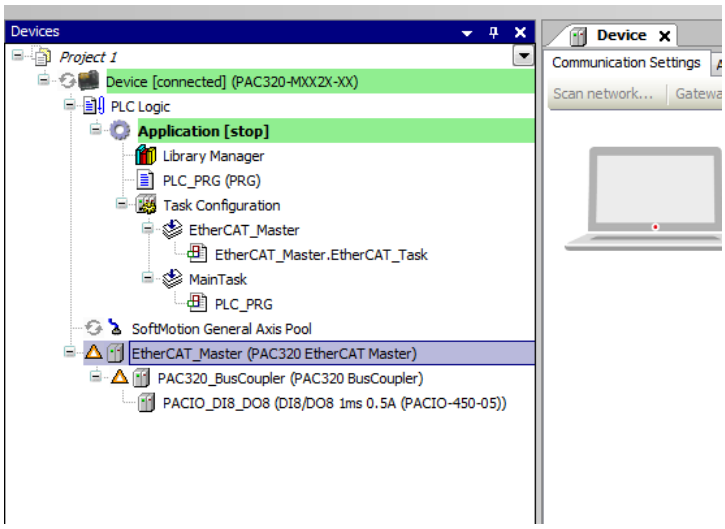
1. Ensure that you are connected to the PAC (See Connection to the PAC).
2. Right-click on "**EtherCAT_Master (PAC320 EtherCAT Master)**" in the Devices tree and select "**Scan for Devices...**".



3. A list of connected EtherCAT slaves will be displayed. If this list is missing a slave, ensure the slave is connected and powered on, and then click the **Scan for Devices** button to re-scan.



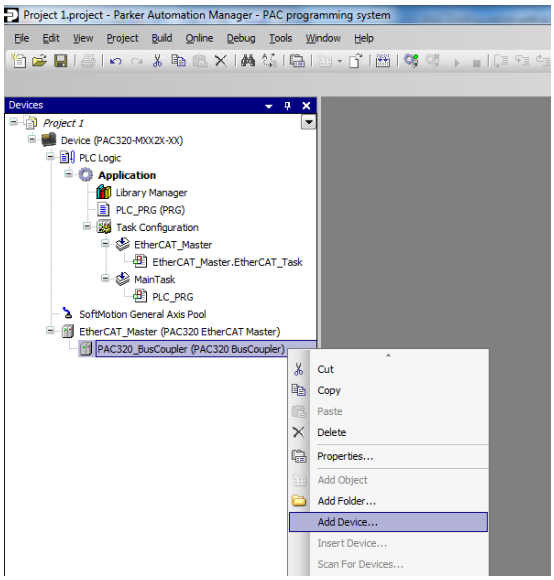
4. When the list is complete, click the "**Copy all devices to project**" and the PACIO will show up on your device tree under the PAC320_BusCoupler.



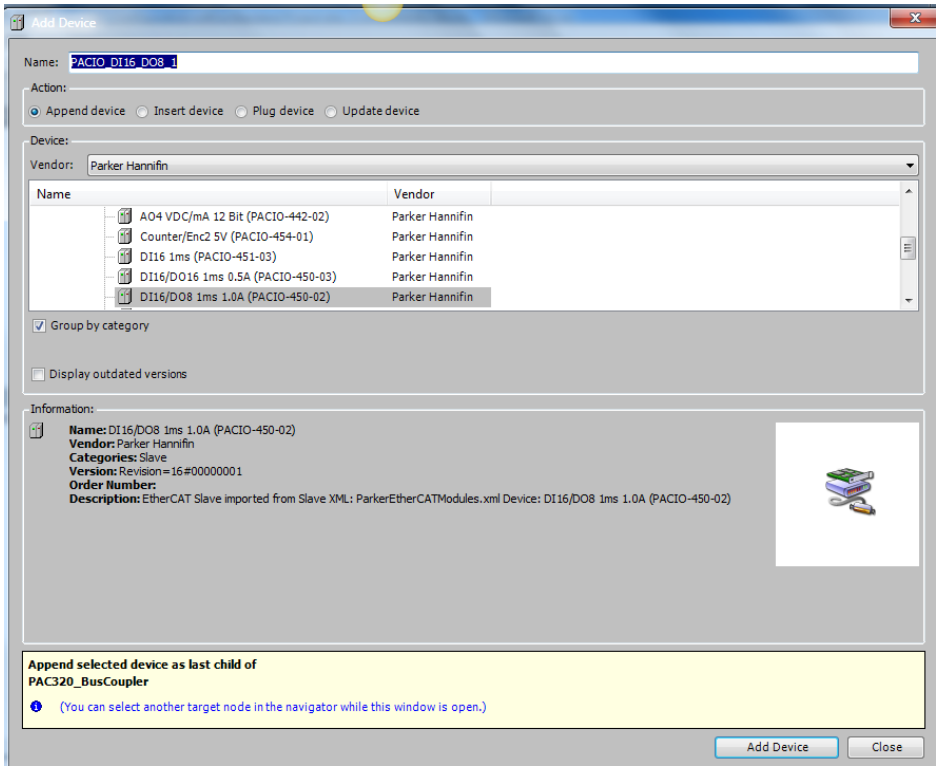
Configuration of the PACIO (Online Method)

After you have configured the PAC as an EtherCAT master, you can now add your PACIO Modules as slaves under the PAC320_BusCoupler. You can add the modules to the project without having an Ethernet connection to the PAC.

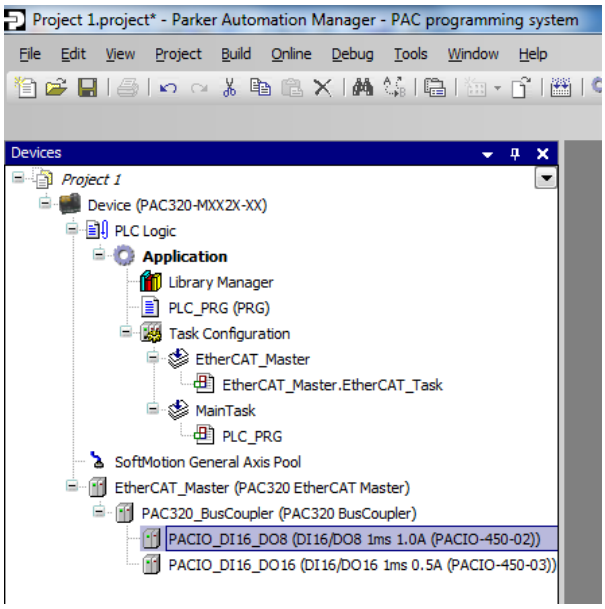
1. Right click on the PAC320_BusCoupler and select "**Add Device**".



2. Find Parker Hannifin as the Vendor and select the appropriate PACIO slave module that corresponds to the PACIO hardware on your system. Then click "**Add Device**."



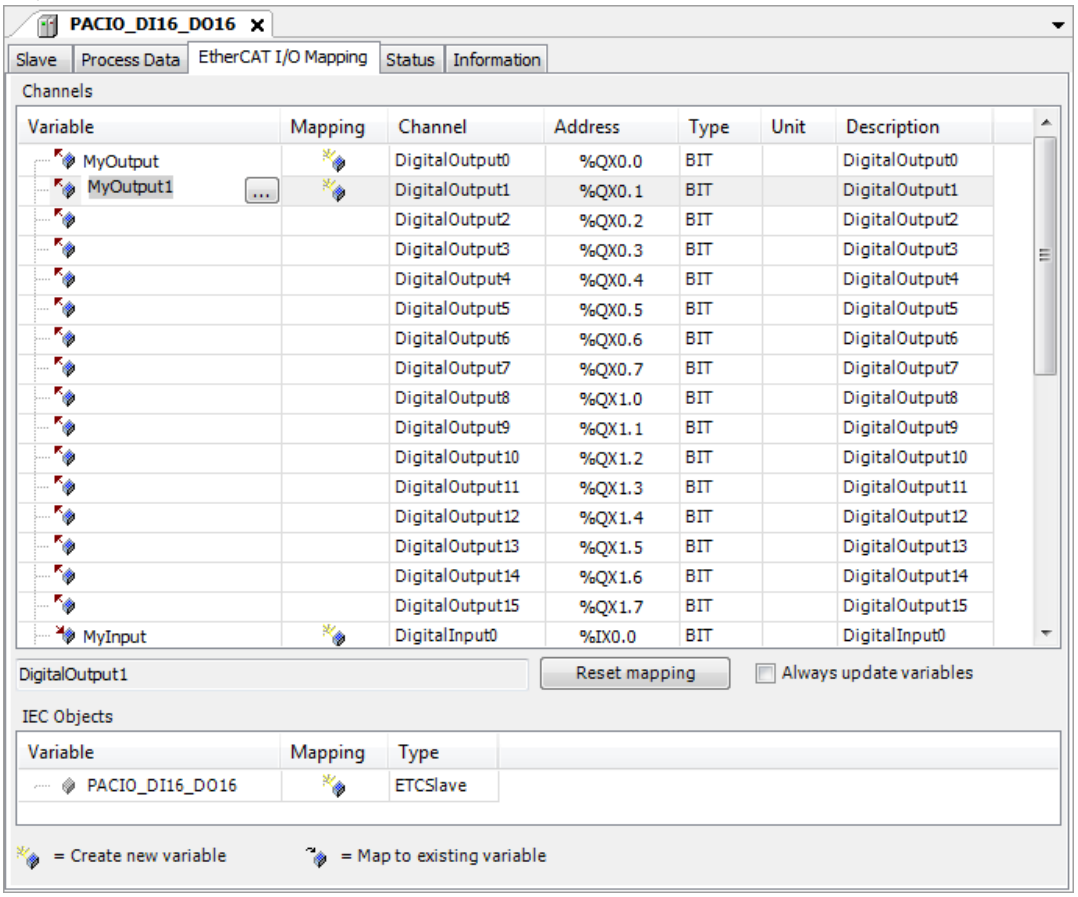
3. The new module appears in the list. You can continue to append more PACIO Modules as needed to match your hardware by repeating these steps.



Mapping the PACIO

After adding the PACIO module to the project, the next step is to map the IO points.

1. Double click the PACIO module node in the device tree.
2. Next, click on IO Mapping tab. This will open the IO Mapping dialog that contains a table of all the IO point



2.

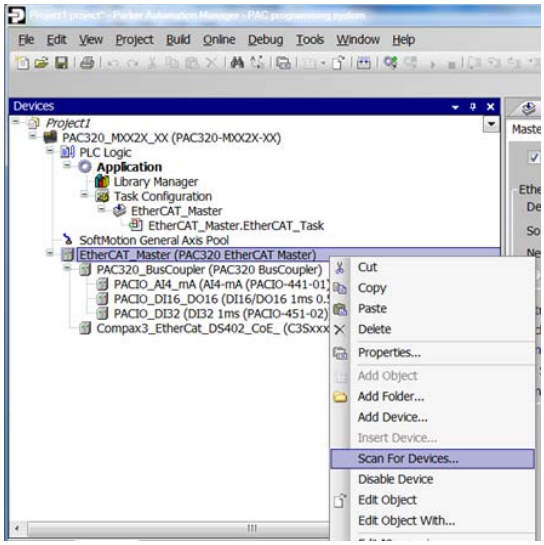
3. Double click in the Variable column for the desired IO point and create a name for this point. *Note: Variables created this way are global for the project.

The IO Point can now be accessed in any POU through the variable name.

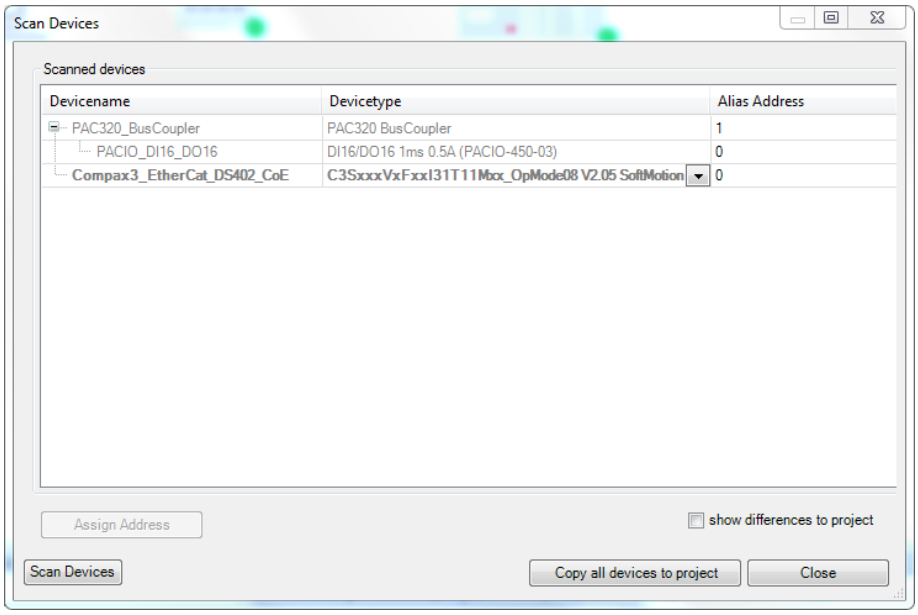
Add the Compax3 as an EtherCAT slave (Online Method)

1. Double-click the **PAC320_XXX2X_XX** device in the Devices tree to bring up the **PAC320** node and the **Communication Settings** tab. Set up communications and go online by clicking the **Online** menu and selecting **Login.**

2. In the **Devices** tree, right-click the **EtherCAT Master** node and select **Scan For Devices...**. This opens the **Scan For Devices...** dialog.



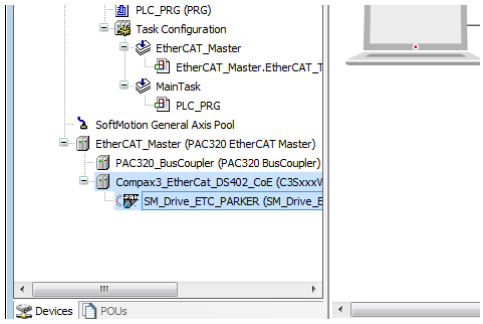
3. In the **Scan For Devices...** dialog, select the **Compax3_EtherCat_DS402_CoE** device and click **Copy to project**.



4. The dialog sets the default name "**Compax3_EtherCAT_DS402_CoE_**". The Compax3 is now added as a slave to the PAC in the project.

5. Notice that along with the "**Compax3_EtherCAT_DS402_CoE**" EtherCAT slave device, the "**SM_Drive_ETC_Parker**" axis is created. Right-click on the **SM_Drive_ETC_Parker** node and

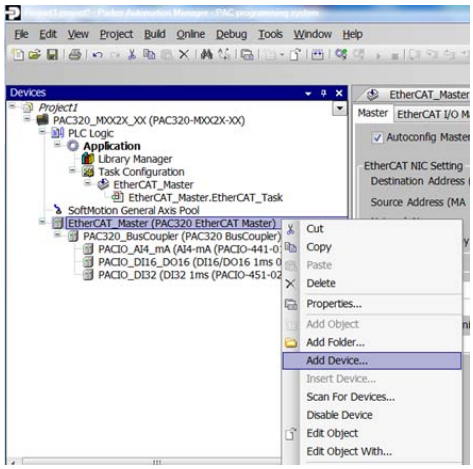
select **Rename**. Change the name as appropriate. This will also be the main name used for the SoftMotion Function blocks.



6. Go to the menu **Online** and select the **Logout** item to go offline with the PAC and continue configuration in the **Configuring the Compax3 EtherCAT slave node** section

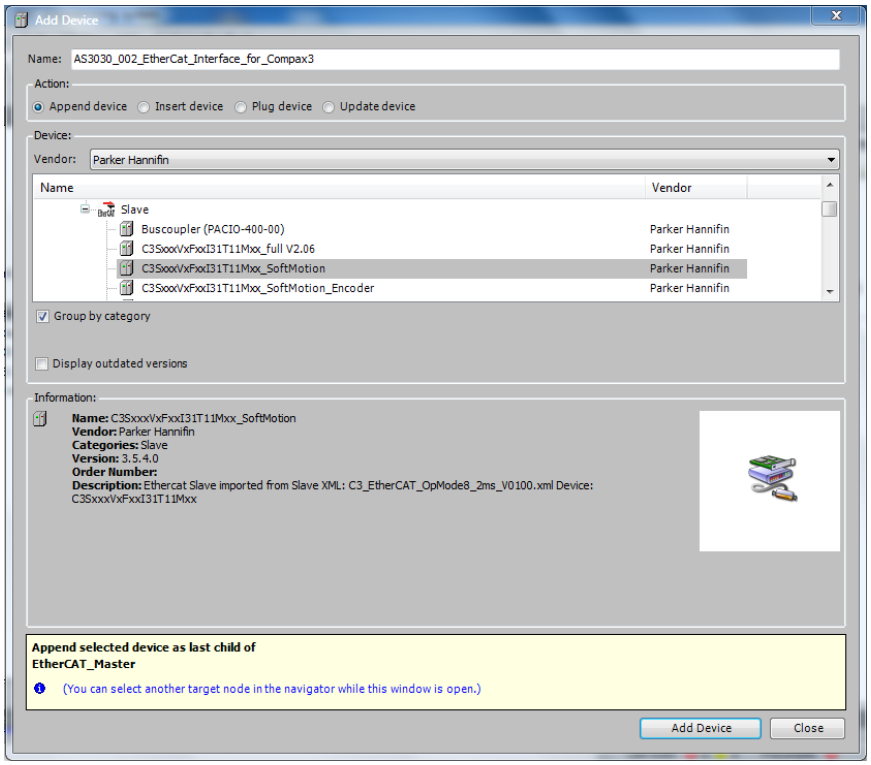
Add the Compax3 as an EtherCAT slave (Offline Method)

1. In the **Devices** tree, right-click the **EtherCAT Master** node.
2. Select **Add Devices...**. This opens the **Add Devices...** dialog.



3. In the **Add Devices**... dialog, select **Append device** for the Action and **Parker Hannifin** for the Vendor.
4. Select **C3SxxxVxFxxI31T11Mxx_OpMode8 V2.05 Softmotion**.
5. The dialog sets the default name "**Compax3_EtherCAT_DS402_CoE**". You can change the name as appropriate for your application.

6. Click **Add Device**.



7. In the Devices tree, the C3SxxxVxFxxI31T11Mxx_OpMode8 V2.05 SoftMotion node is added under the EtherCAT_Master node.

8. Notice that along with the "**Compax3_EtherCAT_DS402_CoE**" EtherCAT slave device, the "SM_Drive_ETC_Parker" axis is created. Right-click on the **SM_Drive_ETC_Parker** node and select Rename. Change the name as appropriate. This will also be the main name used for the SoftMotion Function blocks.

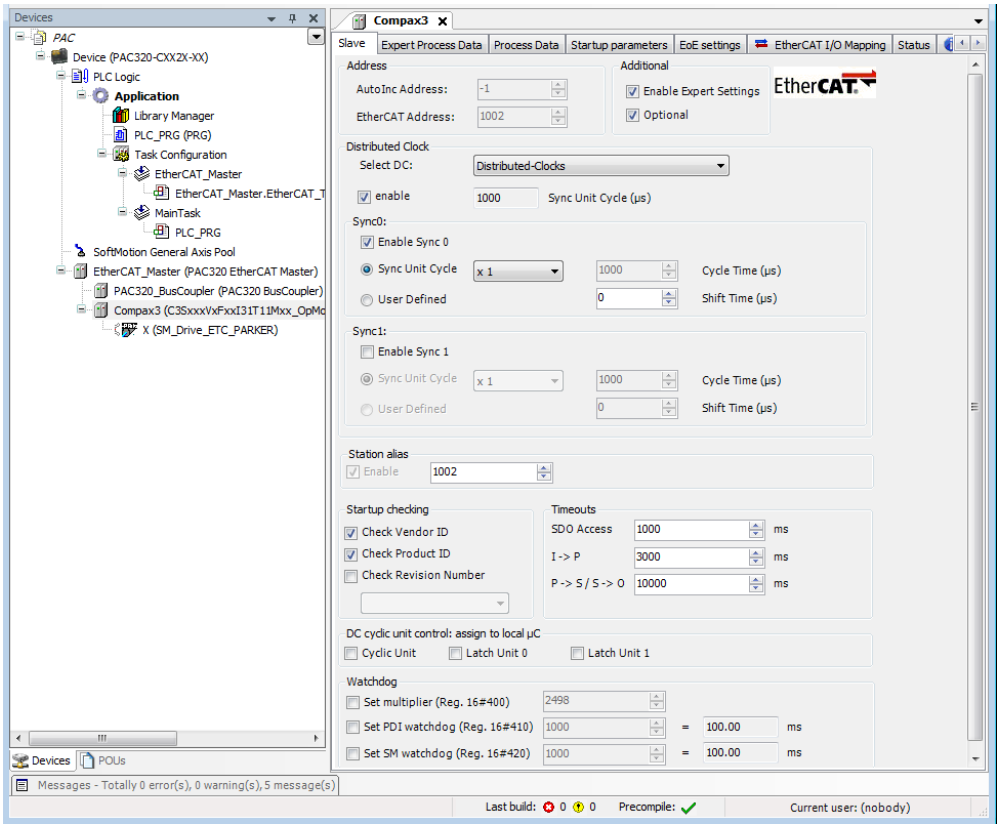
Configuring the Compax3 EtherCAT slave node

After you have added the Compax3 EtherCAT slave (either offline or online), now you should configure the Compax3 EtherCAT slave node:

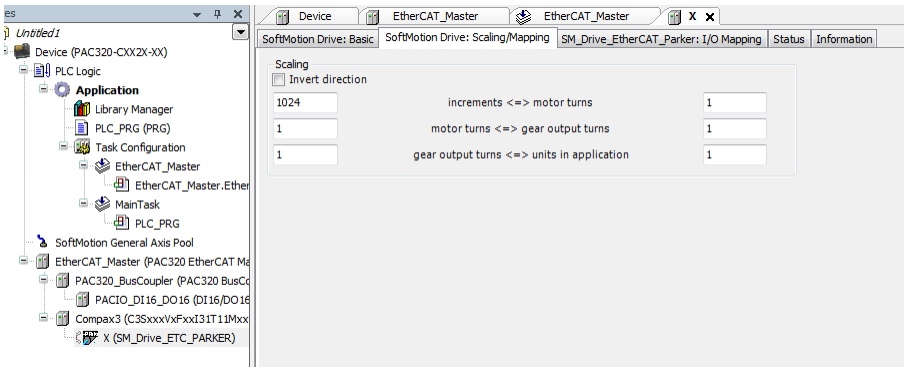
9. Double-click the **C3SxxxVxI31T11Mxx_OpMode8 V2.05 SoftMotion** node and check the **Enable Expert Settings** checkbox.

10. Check the **Distributed Clock** enable checkbox

11. Check the **Enable Sync0** checkbox



12. Double-click the **SM_Drive_ETC_Parker** node. The **SM_Drive_ETC_Parker** dialog is opened and can be used to configure the SoftMotion properties of the axis. Use the **Basic** tab to configure limits and the **Scaling/Mapping** tab to configure scaling, the relationship between user units and drive input counts. *Note: The Compax3's drive input counts are configured using the Compax3 Servo Manager and are in drive input counts per motor revolution, regardless of the feedback counts of the motor.



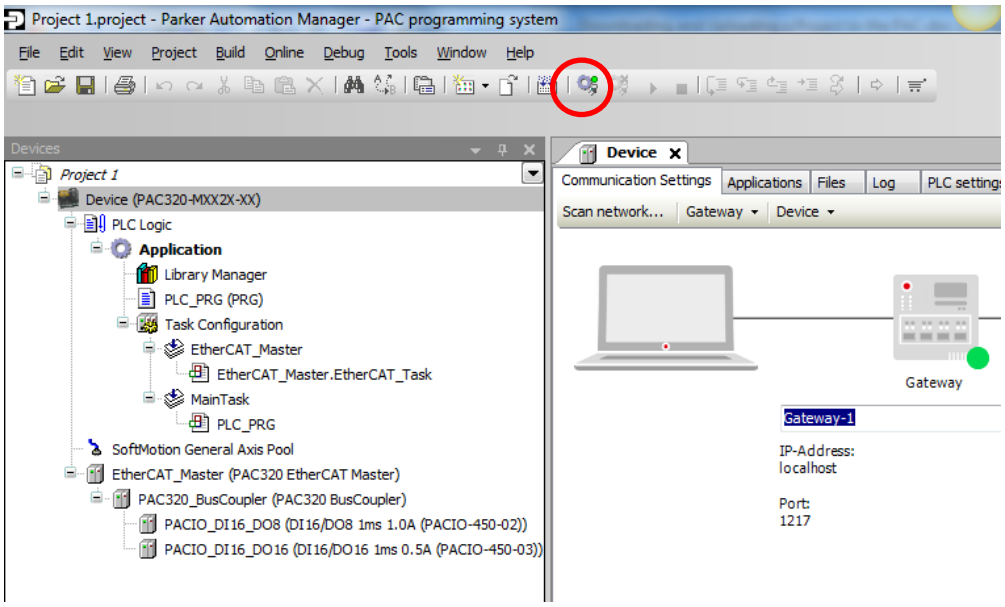
Your Compax3 is now configured as an EtherCAT Slave with the PAC.

Downloading and Uploading a Project to the PAC

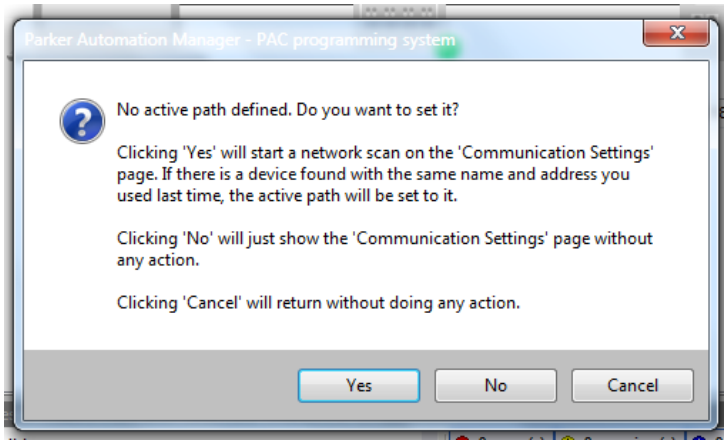
Downloading Project Execution Code

After you have completed your project and it is ready to download to the PAC, use the following instructions to help with this process.

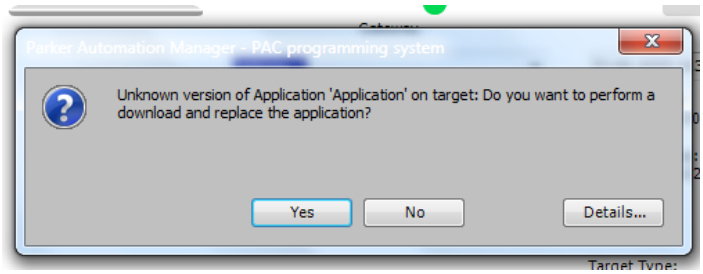
1. To download the project execution code, select the **Login** Icon on the Toolbar.



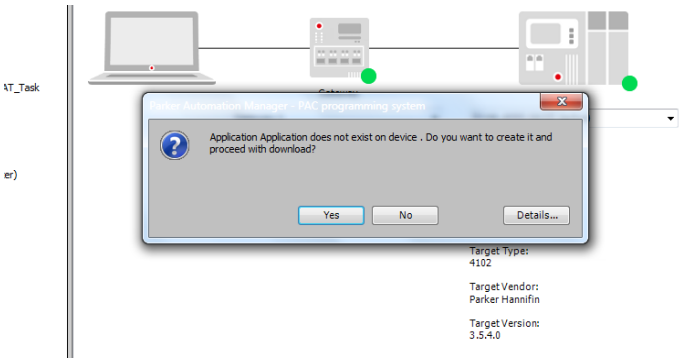
2. You may be prompted to find an active path. To have the PAC automatically scan, select **Yes**. To open the Communications Settings Page, select **No** and then proceed to scan the network for the PAC.



3. If there is a project already on the PAC and you want to replace it with this application, click **Yes**.



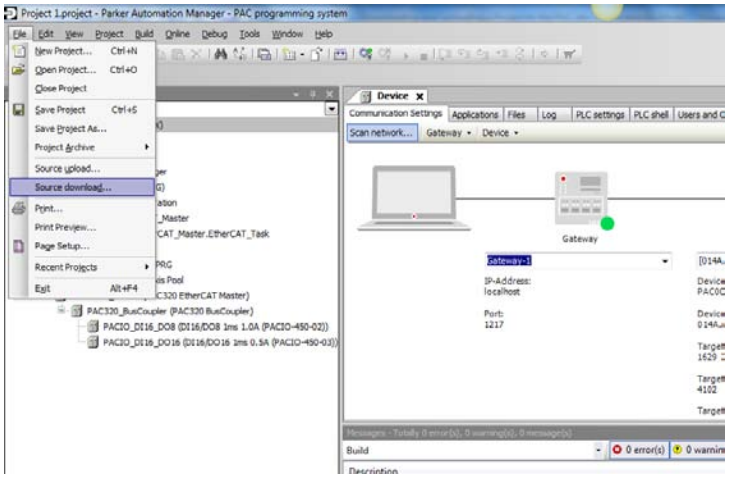
4. If you are downloading the project the first time to a PAC without a project, it may prompt you with a pop up window asking if you want to download the application, click **Yes**. The project is now downloaded to the PAC.



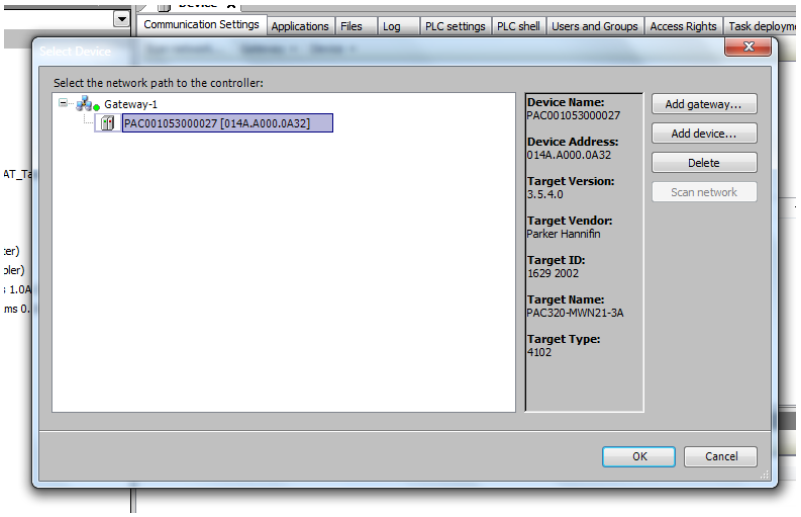
Downloading Project Source Code

In order for the Source Upload feature to work, the Source files must be downloaded to the PAC.

1. To download the source files to the PAC, in Parker Automation Manager select **File→Source Download**.



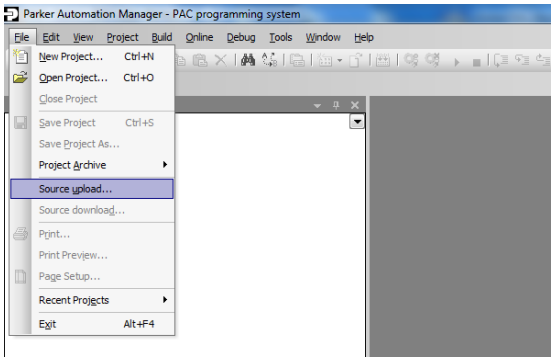
2. Select **PAC320** under the Gateway as the device to download the project. If the PAC does not show up under the Gateway, select **Scan Network** to locate the PAC. Select **OK** to download the project.



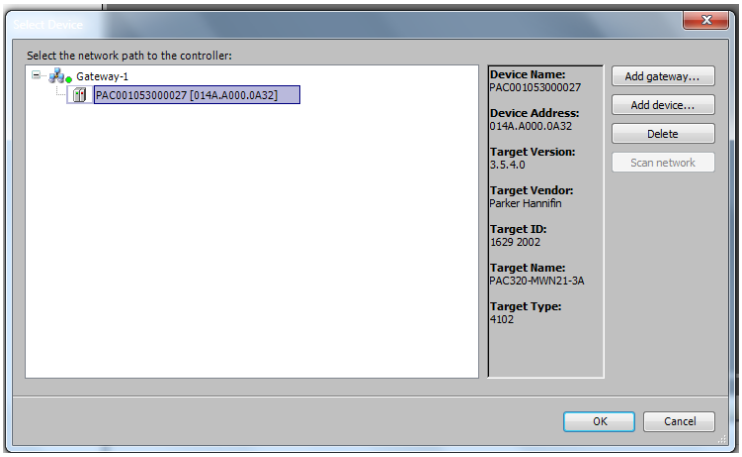
Uploading Project Source Code

To upload a project from the PAC, use the following instructions to help with this process:

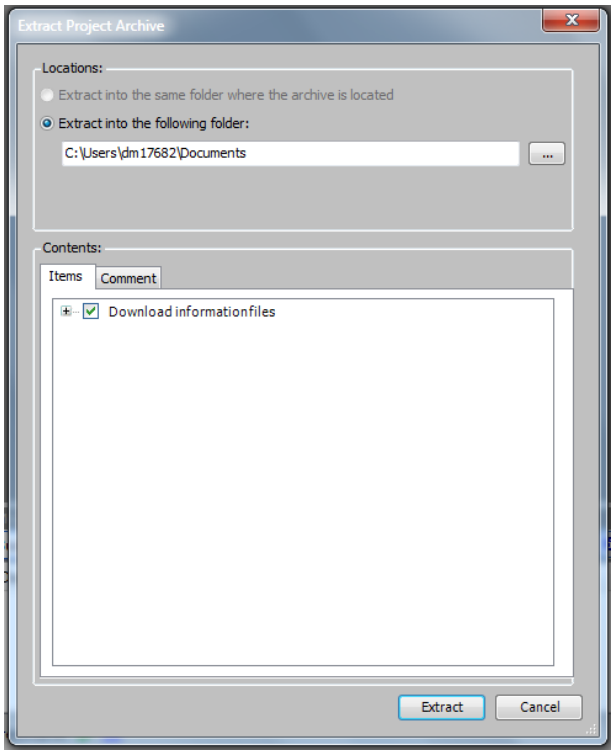
1. In Parker Automation Manger select **File→Source Upload**.



2. Select the PAC on the Gateway and select **OK**. If a PAC does not show up on the Gateway, select **Scan network**.

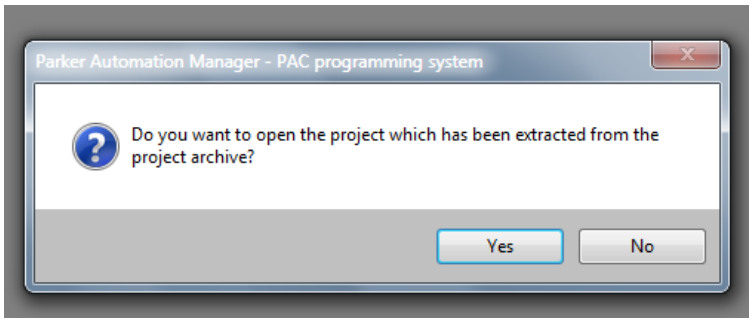


3. Choose the folder location on your computer where you would like to extract and save the source files. Then click on **Extract**.



Your project and source files are now saved to your computer.

4. If you would like to open the project, click **Yes**.



Your project and source files are now opened in Parker Automation Manager.

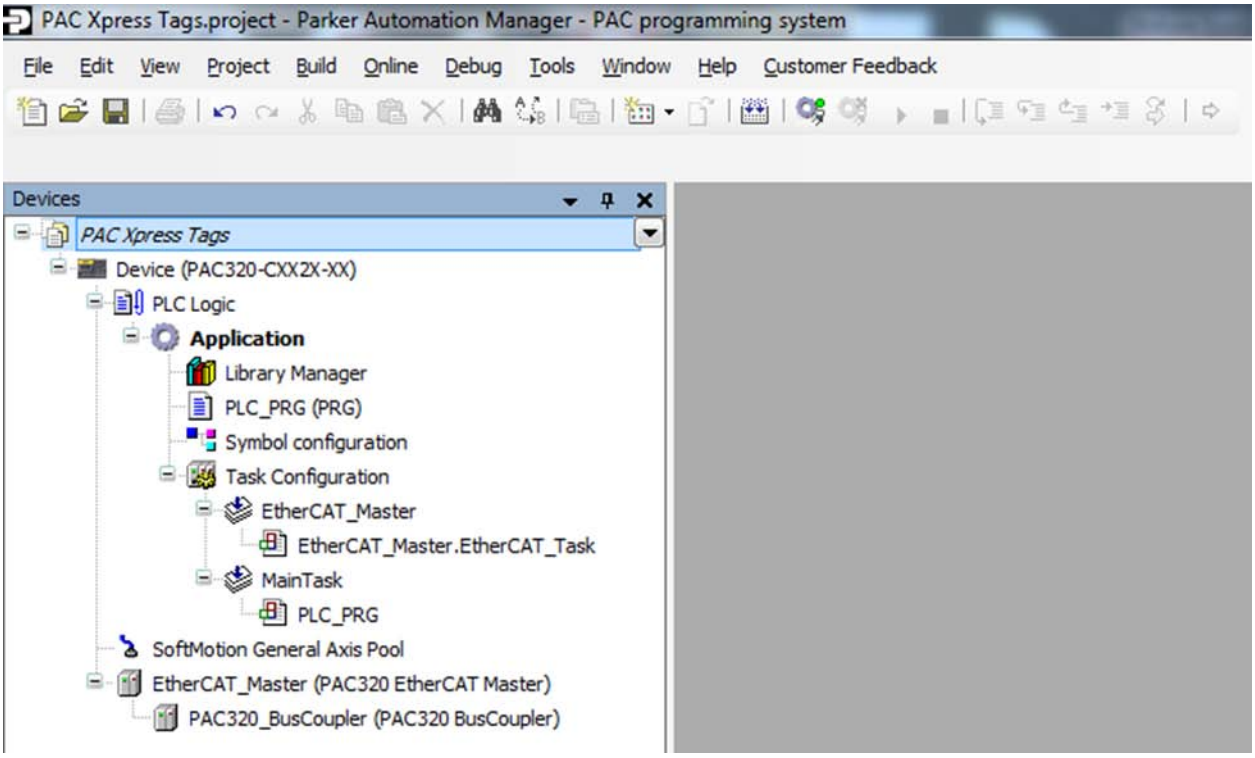
Programming your Xpress HMI in the PAC

The PAC can be ordered with the optional Xpress HMI software embedded in the PAC. This option allows you to develop and run your Xpress HMI program from the PAC. To begin development of your project, type in the IP Address of the PAC in a browser such as Internet Explorer. (you do not need the ":81" at the end of the IP Address like the Configuration Tool). The Xpress Shell will show up in your browser and you are ready to begin developing your PAC Xpress HMI project. Please refer to the Interact Xpress User Guide to help develop your project on the PAC. The Interact Xpress user guide can be downloaded from the PAC product page on www.parkermotion.com.

The PAC with the embedded Xpress HMI option allows you to easily share tags between the two projects to make it easier to create your application. Any POU, Global Variable, or Persistent list in your PAC project can share tags with Xpress. To expose your PAC project tags to your Xpress project, follow these instructions:

PAC Project Configuration

1. Open the Parker Automation Manager software, select **'File'**, **'New Project'** and **'Standard project'**. Name the Project '**PAC Xpress Tags**'. Choose OK.
2. Select the appropriate Device for use with the PAC. (PAC320-MXX2X-XX, PAC320-CXX2X-XX, PAC320-PXX2X-XX) and select Structured Text (ST) for the 'PLC_PRG ' option.
3. Choose OK

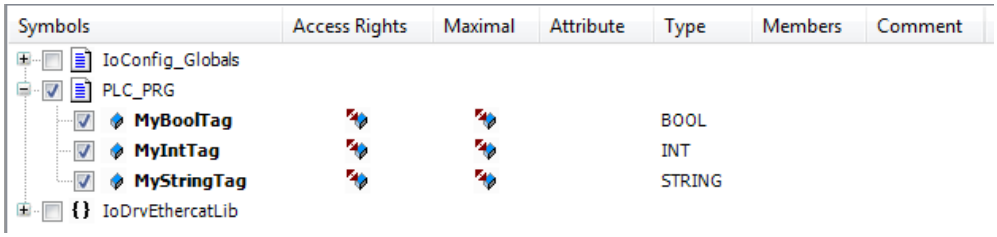


4. Double-click PLC-PRG (PRG) in the tree.
5. Enter the following text into the Declarations section of this POU.

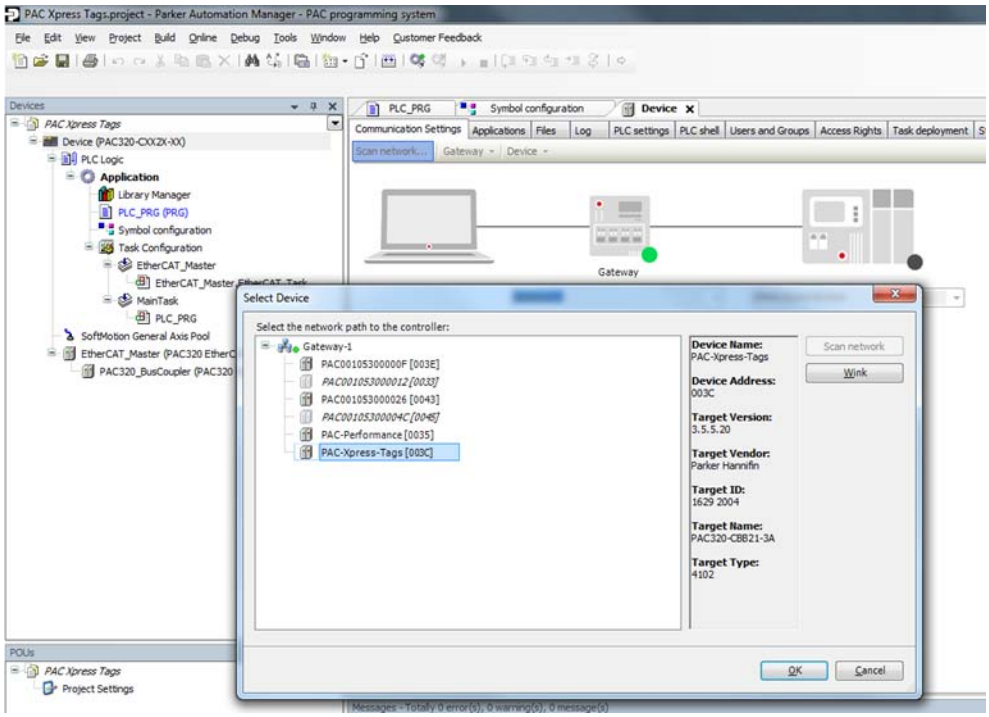
```
PROGRAM PLC_PRG
VAR
        MyBoolTag : BOOL;
        MyIntTag : INT;
        MyStringTag : STRING;
END_VAR
```

6. Double-click on Symbol configuration to open the symbol configuration worksheet.
7. At this point, you will select 'Build' from the upper menu bar. Choose 'Build'.
8. You will see a branch titled 'PLC_PRG'. Expand that location and select the all three variables as shown below. This will expose them for use with the Xpress HMI.

Note: In order to expose your tags to Xpress, you must check the box for each tag. Any POU, Global Variable, or Persistent list in your PAC project can share tags with Xpress



9. Save the project.
10. Download your project to the PAC controller.
    a. Double Click on Device (PAC320-XXX2X-XX) from the Devices tree.
    b. Click Scan network... from the Communication Settings dialog.
    c. Choose your PAC from the Select Device dialog. Click OK.

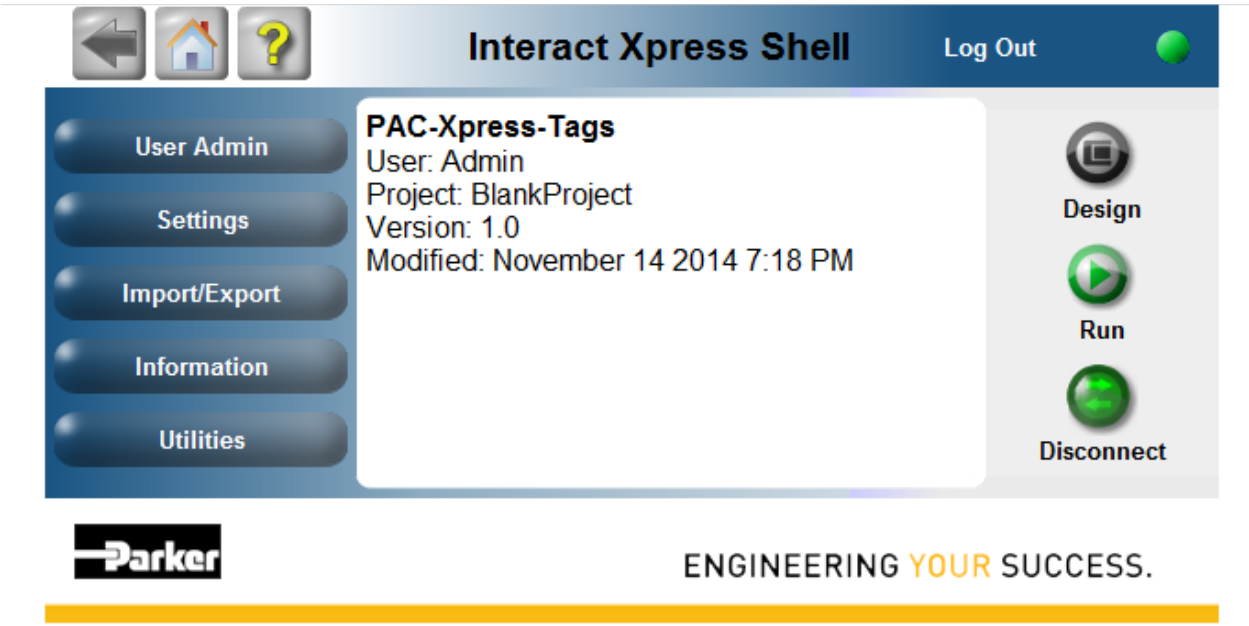


    d. Expand the Online Menu.

e. Choose Login.
f. Choose Yes. This will download the PLC project to the PAC and allow the variables to be accessed by Xpress.

To develop your Xpress project on the PAC and access the tags from your PAC program, follow these instructions:

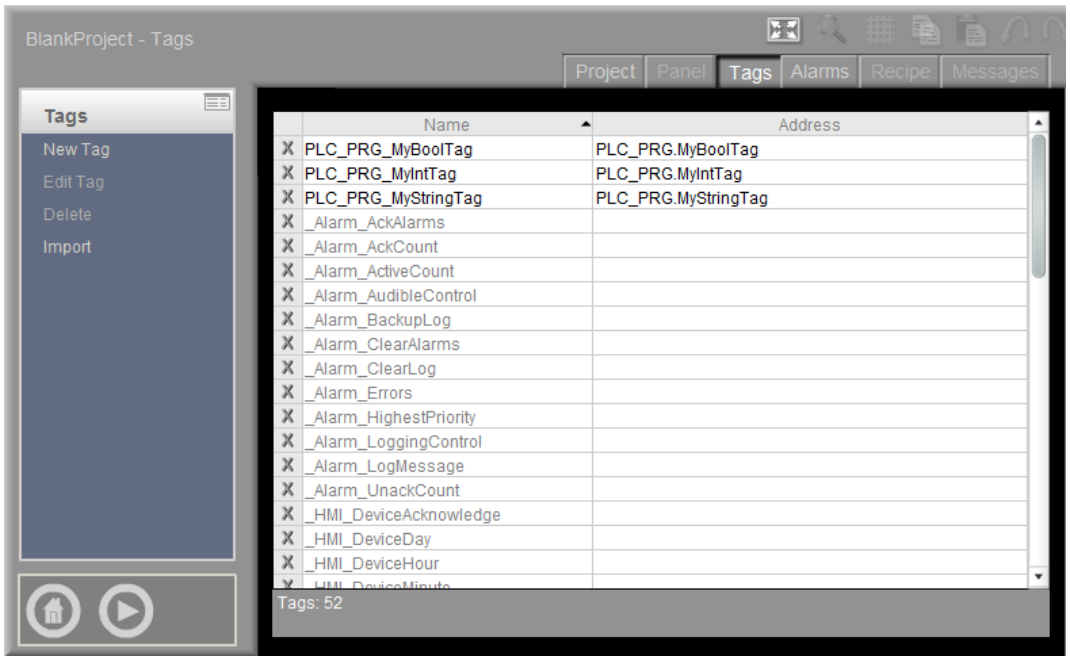
11. Launch a Web Browser.
12. Point it to the IP of the PAC. (i.e. 192.168.10.50)
13. Interact Xpress Shell loads.



14. Press the Disconnect button.
15. Press the Design button.
16. Interact Xpress Designer loads. Press the Tags Tab. The Variables are now accessible tags in the Xpress HMI.

Note: Not all data types are allowed to be shared to your PAC project. The data types NOT allowed are: TIME, DATE, BITORBYTE, TOD, DT, REF, VOID, LTIME, BIT.

Note: An Xpress tag will be created for each element in an array. An Xpress tag will be created for each element in a User Defined Data Type.



To help program your Xpress project, refer to the Interact Xpress user guide that can be downloaded from the PAC product page on line at address: www.parkmotion.com/globalpac

CHAPTER 4:
PACIO Modules

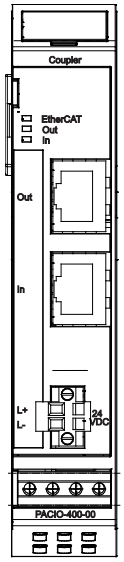
PACIO Module Overview

The PACIO Module family consists of a variety of Input and Output modules that are directly connected to the controller via a high speed EtherCAT network (E-Bus). These include digital or analog I/O Modules, analog temperature Modules, counters and interface Modules. Each of the PACIO Modules listed in the table below are compatible with the PAC. See the remainder of this chapter for details about each Module

To order, contact your local Automation Technology Center (ATC) or distributor.

PACIO Module	Part Number
Bus Coupler Modules	
PACIO Bus Coupler 3A	PACIO-400-00
Digital Input and Output Modules	
PACIO DI16/DO8 1A	PACIO-450-02
PACIO DI16/DO16 1ms/0.5A	PACIO-450-03
PACIO DI8/DO8 1ms/0.5A	PACIO-450-05
PACIO DI16/DO16 1ms/0.5A LS	PACIO-450-13
PACIO DI32 1ms	PACIO-451-02
PACIO DI16 1ms	PACIO-451-03
PACIO DO16 0.5A	PACIO-452-01
PACIO DO8 1A	PACIO-452-02
Analog Input and Output Modules	
PACIO AI4-mA 12 Bit	PACIO-441-01
PACIO AI4/8-VDC 13 Bit	PACIO-441-02
PACIO AO4-VDC/mA 12 Bit	PACIO-442-02
Analog Temperature Input Modules	
PACIO AI4-Pt/Ni100 16 Bit	PACIO-443-01
PACIO AI4-Pt/Ni1000 16 Bit	PACIO-443-03
Counter Modules	
PACIO Counter/Enc	PACIO-454-01
Interface Modules	
PACIO PROFIBUS-DP-Slave	PACIO-455-03
PACIO Extender 2 Port	PACIO-400-02
PACIO Accessories	**Part Number**
PACIO Power Distribution 2X16	PACIO-411-00
PACIO Shield 2x8mm	PACIO-412-01
PACIO Shield 14mm	PACIO-412-02
PACIO 2-Pole Connector	43-026590-01
PACIO 18-Pole Connector	43-026591-01
PACIO 36-pole Connector	43-026592-01

PACIO Bus Coupler 3A



Although a bus coupler is built in to the PAC, the PACIO Bus Coupler 3A Module serves as a bus for remote I/O modules. It converts CAT5e (twisted pair cable) to a low-voltage differential signaling (LVDS) E-Bus and also provides the system power required by the remote PACIO modules. At the end of the modular device, the connection between the forward and return lines is automatically closed, retaining EtherCAT protocol through to the last module.

Each Bus Coupler 3A can provide up to 3 Amps on the E-Bus connector to power up to 20 individual I/O Modules. The PAC Controller also has an internal Bus Coupler and you can attach approximately 20 modules locally. A Bus Coupler 3A Extender Module is required when exceeding the 3 Amps and you would like to add additional modules. The figure below shows how to add the Extender module to the end of the first 20 modules and the Bus Coupler to the next 20 modules. Only one Extender module is required in the system, but a Bus Coupler is required for each additional 20 modules (or 3 Amps total E-Bus current).

PACIO Bus Coupler 3A Module Front View

Technical data	PACIO Bus Coupler 3A
Part number	PACIO-400-00
Controller	ASIC ET1100
Baud Rate	100 Mbit/s
Cable	CAT5
Length Of Cable	Maximum 100 meters (or 325 feet) between two bus couplers
Ports	2x RJ45
Power Supply	24 VDC -20% +25%
Connector Power	Plug 2-pole (43-026590-01)
Input Current	50mA and E-Bus power supply
E-Bus Power Supply	Maximum 3A (approx. 20 Modules)
E-Bus Load	195 mA

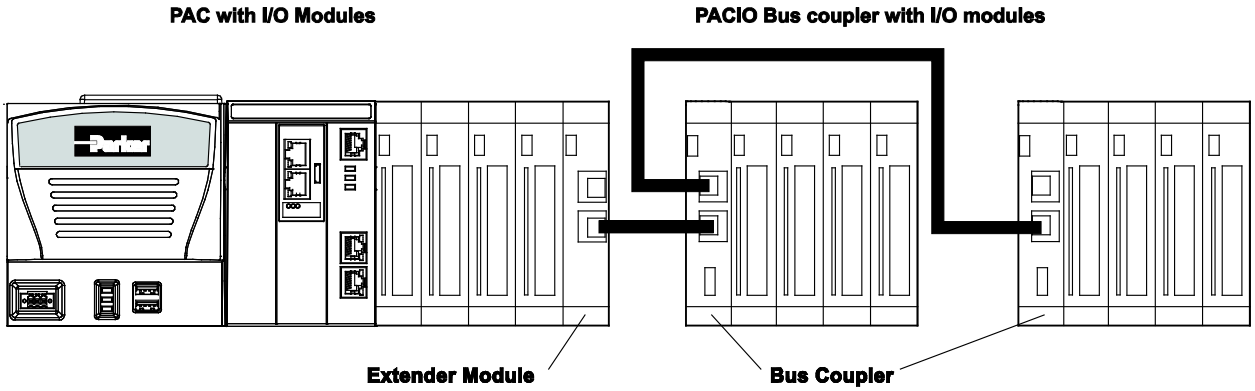


Diagram that shows how to use the Extender Module with the Bus Coupler for additional PACIO modules.

NOTE: For the best emission results, connect the shielding of the EtherCAT cable to Earth ground (see PACIO Shield Connection Terminal Block on page 138).

Module State

Variable	Data Type	Explanation
Undervoltage	BOOL	Low voltage (supplied power < 19.2V)

Terminals

Module Power Supply	
L+	24 VDC
L-	0 V

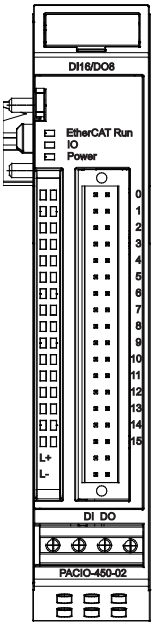
EtherCAT		
IN	RJ45 socket	input (from previous EtherCAT station)
OUT	RJ45 socket	output (to next EtherCAT station)

Status LEDs

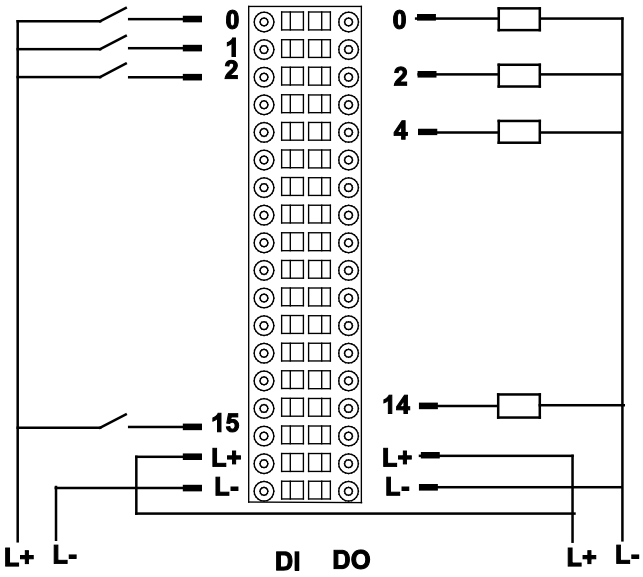
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The “In” and “Out” LEDs indicate the physical state of the Ethernet ports to which they are allocated.

“EtherCAT Run” LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“In L/A” LED, “Out L/A” LED		
State	**LED Flash Code**	**Explanation**
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Exchanging telegrams

PACIO DI16/DO8 1A



Front view of PACIO DI16/DO8 1A Module



I/O Connection

Out	Pin
0	0
1	2
2	4
3	6

Out	Pin
4	8
5	10
6	12
7	14

The PACIO DI16/DO8 1A Module features 16 digital inputs and 8 digital outputs.

Technical data	PACIO DI16/DO8 1A
Part number	PACIO-450-02
Digital Inputs	16
Input Delay	5 ms typically
Signal Level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Typical sink current 5mA per input at 24V PNP
Digital Outputs	8
Maximum Current	1A per output PNP
Total Current	Maximum 8A
Connector IO/Power	Plug 36-pole (43-026592-01)
Controller	ASIC ET1200
Baud Rate	100 Mbit/s
Power Supply	24 VDC -20% +25%
E-Bus Load	135mA

Variable

Variable	Data Type	Explanation
DigitalInputn	BOOL	Digital input (n=0...15)
DigitalOutputn	BOOL	Digital output (n=0...7)
reserved	BOOL	Unused output addresses

Terminals

Module Power Supply	
L+	24 VDC
L-	0 V

NOTE: Connect L+ to both L+ terminals if the total current exceeds the 6A limit. L+ and L- on both the inputs and outputs are internally connected.

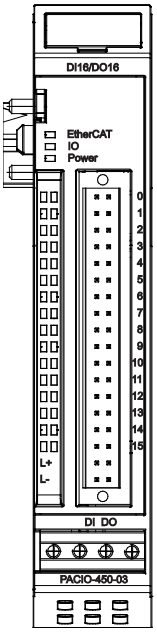
Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

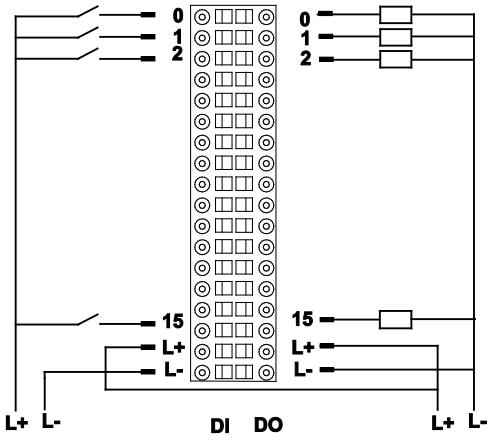
"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output
Traffic	Green, flashing	Exchanging telegrams
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Input signal TRUE / output enabled
Off	Off	Input signal FALSE / output disabled

CAUTION: **The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.**

PACIO DI16/DO16 1ms/0.5A



Front view of PACIO DI16/DO16 1ms/0.5A Module



I/O connections

The PACIO DI16/DO16 1ms/0.5A Module features 16 digital inputs and 16 digital outputs.

Technical data	PACIO DI16/DO16 1ms/0.5A
Part number	PACIO-450-03
Digital Inputs	16
Input Delay	1 ms
Signal Level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Typical sink current 5mA per input at 24V PNP
Digital Outputs	16
Maximum Current	0.5A sink per output
Total Current	Maximum 8A
Connector IO/Power	Plug 36-pole (43-026592-01)
Controller	ASIC ET1200
Baud Rate	100 Mbit/s
Power Supply	24 VDC -20% +25%
E-Bus Load	135mA

Variable

Variable	Data Type	Explanation
DigitalInputn	BOOL	Digital input (n=0...15)
DigitalOutputn	BOOL	Digital output (n=0...15)

Terminals

Connect L- to both L- terminals if the total current exceeds the 6A limit. L+ and L- on both the inputs and outputs are internally connected.

Power Supply to Module I/Os	
L+	24 VDC
L-	0 V

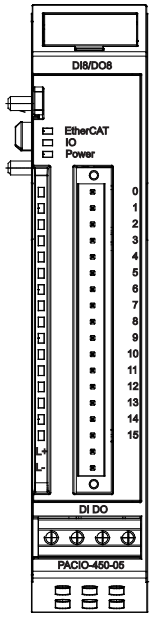
Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low-voltage states.

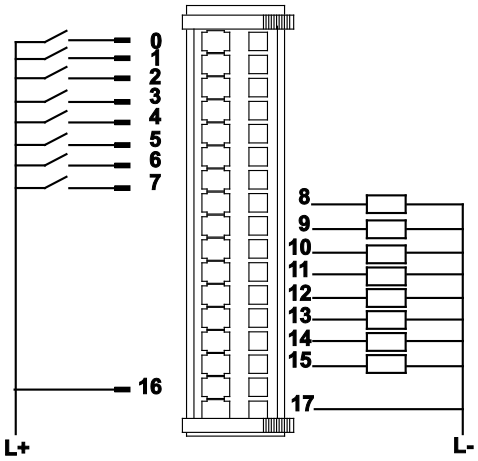
"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Code**	**Explanation**
On	Green, on	Input signal Low (TRUE) / output enabled
Off	Off	Input signal High (FALSE) / output disabled

CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO DI8/DO8 1ms/0.5A



Front view of PACIO DI8/DO8 1ms/0.5A Module



I/O connection

The PACIO DI8/DO8 1ms/0.5A Module has 8 digital inputs and 8 digital outputs.

Technical Data	PACIO DI8/DO8 1ms/0.5A
Part number	PACIO-450-05
Digital inputs	8
Input delay	1 ms
Signal level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Typical sink current 5mA per input at 24V PNP
Digital outputs	8
Maximum current	0.5A per output
Total current	Maximum 8A
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	135mA

Variable

Variable	Data type	Explanation
DigitalOutputn	BOOL	Digital output (n=0...15)

Terminals

Power supply to Module I/Os	
L+	24 VDC
L-	0 V

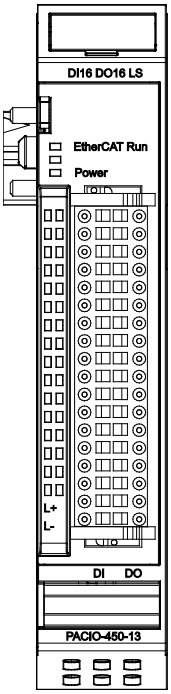
Status LEDs

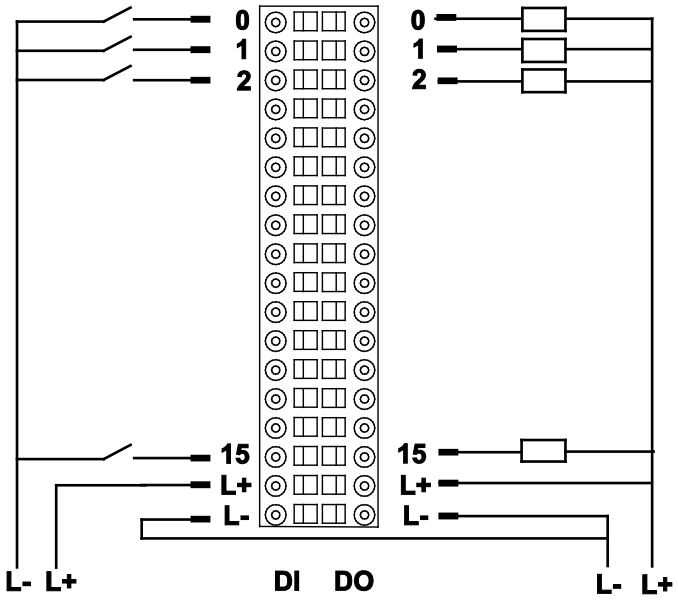
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Input signal TRUE / output enabled
Off	Off	Input signal FALSE / output disabled

CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO DI16/DO16 1ms/0.5A LS(Low Side)





Front view of PACIO DI16/DO16 1ms/0.5A LS Module

I/O connections

The PACIO DI16/DO16 1ms/0.5A LS Module features 16 digital low-side inputs and 16 digital low-side outputs.

Technical data	PACIO DI16/DO16 1ms/0.5A LS
Part number	PACIO-450-13
Digital Inputs	16
Input Delay	1 ms
Signal Level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Input current typically 2mA per input at 24V NPN
Digital Outputs	16
Maximum Current	0.5A sink per output
Total Current	Maximum 8A
Connector IO/Power	Plug 36-pole (43-026592-01)
Controller	ASIC ET1200
Baud Rate	100 Mbit/s
Power Supply	24 VDC -20% +25%
E-Bus Load	135mA

Variable

Variable	Data Type	Explanation
DigitalInputn	BOOL	Digital input (n=0...15)
DigitalOutputn	BOOL	Digital output (n=0...15)

Terminals

Connect L- to both L- terminals if the total current exceeds the 6A limit. L+ and L- on both the inputs and outputs are internally connected.

Power Supply to Module I/Os	
L+	24 VDC
L-	0 V

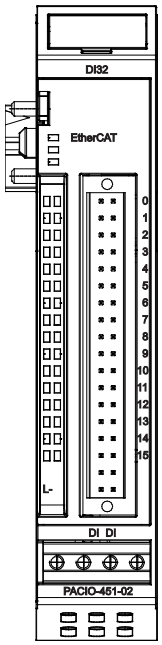
Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low-voltage states.

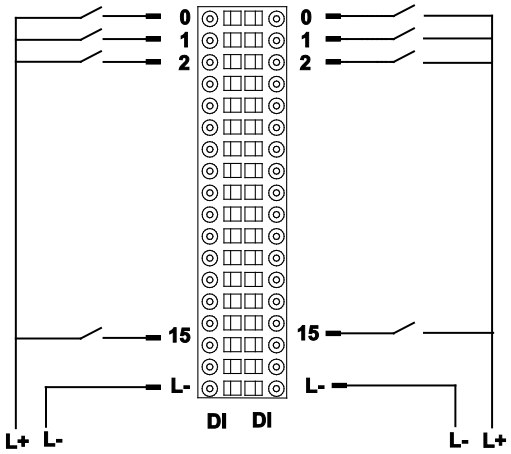
"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Code**	**Explanation**
On	Green, on	Input signal Low (TRUE) / output enabled
Off	Off	Input signal High (FALSE) / output disabled

CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO DI32 1ms



Front view of PACIO DI32 1ms Module



I/O connections

The PACIO DI32 1ms Module features 32 digital inputs.

Technical data	PACIO DI32 1ms
Part number	PACIO-451-02
Digital inputs	32
Input delay	1 ms
Signal level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Typical sink current 5mA per input at 24V PNP
Connector IO/Power	Plug 36-pole (43-026592-01)
Controller	ASIC ET1100
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	85mA

Variable

Variable	Data Type	Explanation
DigitalInput	BOOL	Digital input (n=0...31)

Terminals

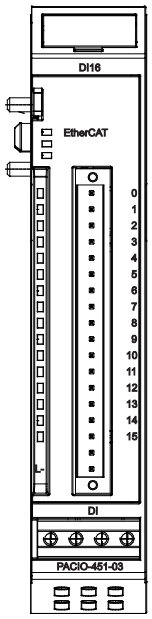
Power Supply to Module I/Os	
L-	0 V

Status LEDs

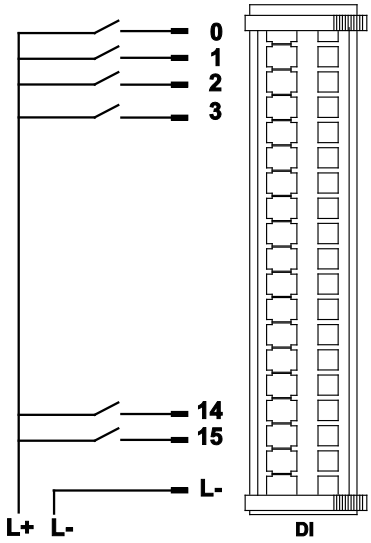
The "EtherCAT Run" LED indicates the state of the Module's EtherCAT ASIC.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"Channel" LEDs		
State	**State**	**State**
On	Green, on	Input signal = TRUE
Off	Off	Input signal = FALSE

PACIO DI16 1ms



Front view of PACIO DI16 1ms Module



I/O connection

The PACIO DI16 1ms Module has 16 digital inputs.

Technical Data	PACIO DI16 1ms
Part number	PACIO-451-03
Digital inputs	16
Input delay	1 ms
Signal level	Off: -3V ... 5V (EN 61131-2, type 1) On: 15V ... 30V Typical sink current 5mA per input at 24V PNP
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	100 mA

Variable

Variable	Data type	Explanation
DigitalInputn	BOOL	Digital input (n=0...15)

Terminals

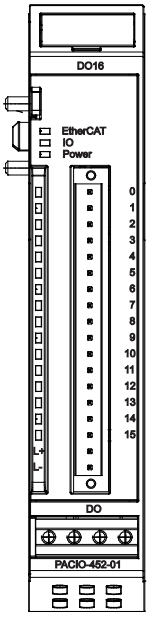
Power supply to Module I/Os	
L-	0 V

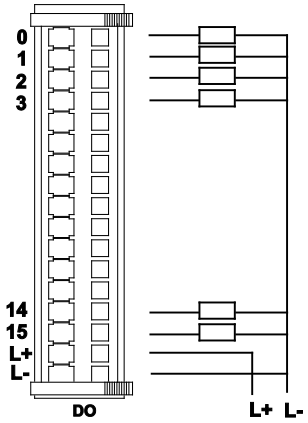
Status LEDs

The "EtherCAT Run" LED indicates the state of the Module's EtherCAT ASIC.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"Channel" LEDs		
State	**State**	**State**
On	Green, on	Input signal = TRUE
Off	Off	Input signal = FALSE

PACIO DO16 0.5A





Front view of PACIO DO16 0.5A Module *I/O connection*

The PACIO DO16 0.5A Module features 16 digital outputs.

Technical data	PACIO DO16 0.5A
Part number	PACIO-452-01
Digital outputs	16
Maximum current	0.5A per output PNP
Total current	Maximum 8A
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	130mA

Variable

Variable	Data type	Explanation
DigitalOutputn	BOOL	Digital output (n=0...15)

Terminals

Power supply to Module I/Os	
L+	24 VDC
L-	0 V

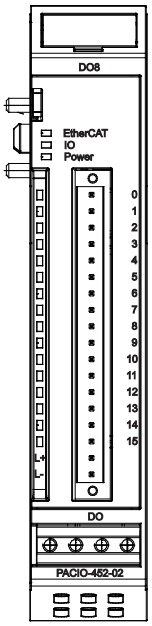
Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

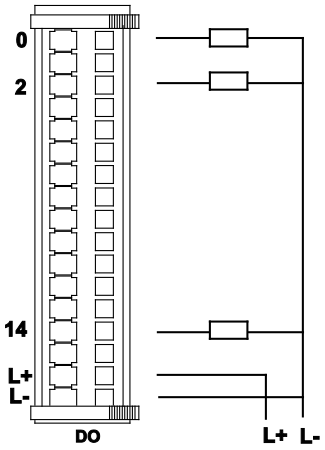
"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Output enabled
Off	Off	Output disabled

CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO DO8 1A



Front view of PACIO DO8 1A Module



I/O connection

Out	Pin
0	0
1	2
2	4
3	6
4	8
5	10
6	12
7	14

The PACIO DO8 1A Module features 8 digital outputs.

Technical Data	PACIO DO8 1A
Part number	PACIO-452-02
Digital outputs	8
Maximum current	1A per output PNP
Total current	Maximum 8A
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	130mA

Variable

Variable	Data type	Explanation
DigitalOutputn	BOOL	Digital output (n=0...7)
Reserved	BOOL	Unused output addresses

Terminals

Power supply to Module I/Os	
L+	24 VDC
L-	0 V

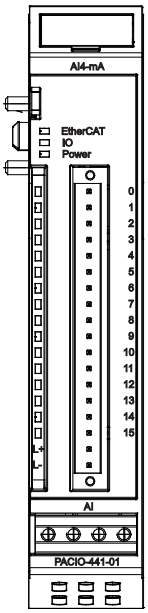
Status LEDs

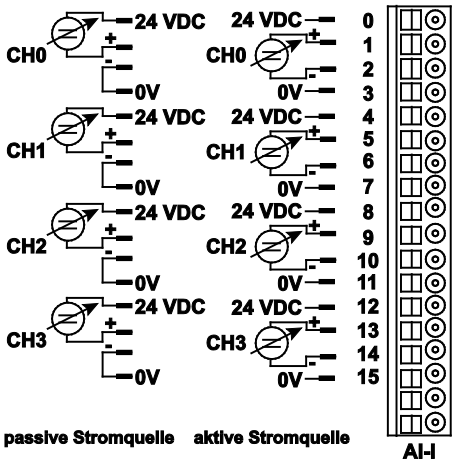
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Output enabled
Off	Off	Output disabled

CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO AI4-mA 12 Bit





Front view of AI4-mA 12 Bit Module *I/O Connection*

The PACIO AI4-mA 12 Bit Module offers 4 analog current signal inputs. Their measuring range can be set separately for every channel (that is, either to 0-20mA or to 4-20mA).

Technical Data	PACIO AI4-mA 12 Bit
Part number	PACIO-441-01
Analog inputs	4 single-ended
Resolution	12 bit
Measuring range	0-20mA, 4-20mA (limit 21.3675mA)
Temperature drift	< ± 25 ppm/°C regarding range limit
Critical frequency	typical 12.5 Hz
Impedance	< 75 Ω
Sampling frequency	1.45 kHz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	from coupler through E-Bus connector
E-Bus load	140mA

Terminals

Power supply to Module I/Os	
L+	24 VDC
L-	0 V

For information on operative earth shielding of analog wire, see Adding PACIO Modules on page 26.

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Off	Short-circuited digital output
		Inoperative if E-Bus LED = Off
	Red, 2x	Under voltage (not implemented)
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module Defective
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Channel enabled

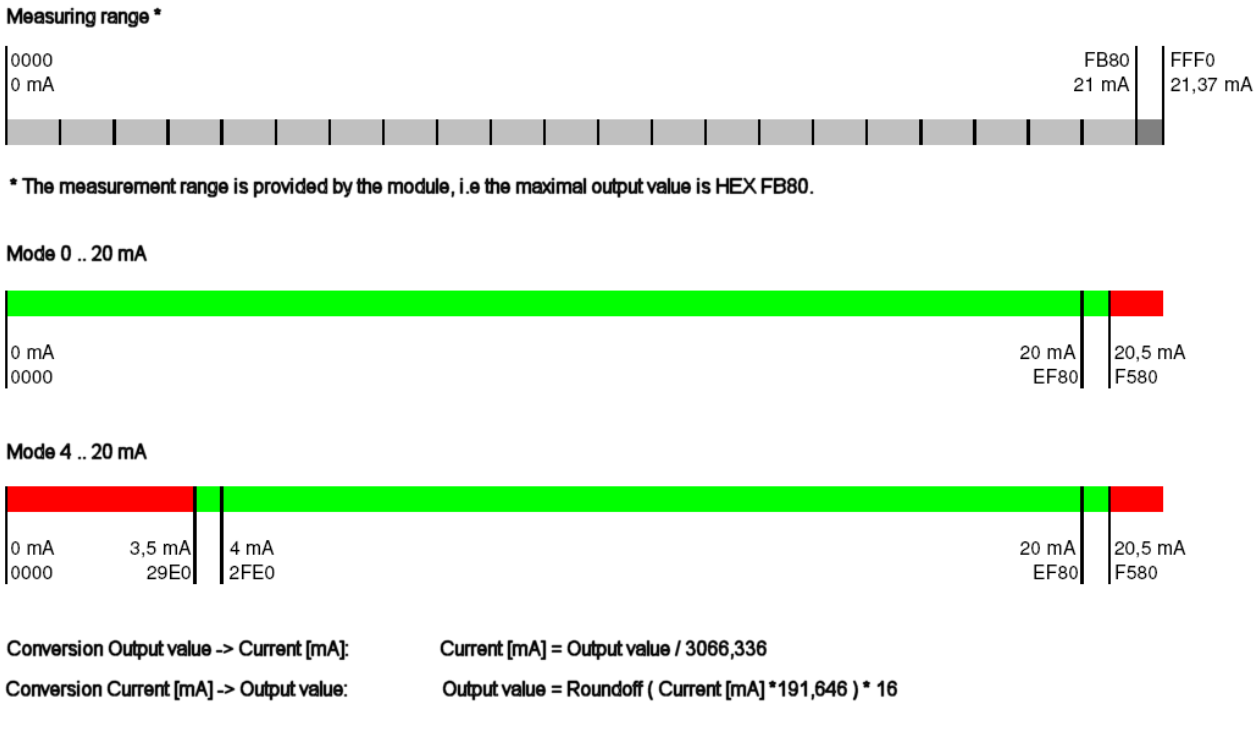
Analog Inputs

Check the following variable for the digitized input values.

Variable	Data type	Explanation
Channel_n	INT	Value measured on channel n (n= 0...3)

Measured Value

The maximal measuring value (0xFFF0) of the current input module is 0.5V/23.4 Ω = 21.3675mA. The status is shown by the channel LED.



Conversion Output value -> Current [mA]: Current [mA] = Output value / 3066,336

Conversion Current [mA] -> Output value: Output value = Roundoff (Current [mA] *191,646) * 16

Measuring values, Variable values, Status

Analog Values Current

Measuring	Variable Values		Measuring	Variable Values	
mA	Decimal	Hexadecimal	mA	Decimal	Hexadecimal
0	0	0	12	36784	16#8FB0
1	3056	16#0BF0	13	39856	16#9BB0
2	6128	16#17F0	14	42928	16#A7B0
3	9184	16#23E0	15	45984	16#B3A0
4	12256	16#2FE0	16	49056	16#BFA0
5	15328	16#3BE0	17	52112	16#CB90
6	18384	16#47D0	18	55184	16#D790
7	21456	16#53D0	19	58256	16#E390

8	24528	16#5FD0	20	61312	16#EF80
9	27584	16#6BC0	20.5	62848	16#F580
10	30656	16#77C0			
11	33728	16#83C0	≥ 21.37	65520	16#FFF0

Module Control

The module provides you with various operational options:

To set up the module choose the options as appropriate and accept by setting control bit "SetOptions" to a rising edge. The module will confirm by returning "OptionsSet".

There are various "module error" bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the "IO" LED.

To reset the error bits set control bit "ResetError" to a rising edge.

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge → accepts module options
ResetError	BOOL	Rising edge → acknowledges error

Module Options

The following options are available for the Module. To set and accept options, see "Module Control."

Variable	Data type		Explanation
Channel_n_0_20mA	BOOL	TRUE	Channel n to 0...20mA
		FALSE	Channel n to 4...20mA
Channel_n_On	BOOL		Enables channel n
Channel_n_Filter	USINT	0..255	Filter on channel n New values avail. in k/3 ms (k=1..255)
n		**0 ... 3**	**Channel number**

Module State

The following states are indicated by the Module messages. To reset the messages, see "Module Control."

Variable	Data type	Explanation
Shortcut	BOOL	Short circuit
Undervoltage	BOOL	Low voltage (supplied power < 19.2V)
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

Module-Specific Messages

Apart from the Module error messages, the set of messages below contains details about the current state of the PACIO AI4-mA 12 Bit Module. These messages are automatically reset when the state concerned has returned to normal. They are combined into a single "Specific_Error" state of the Module and output to the IO LED as "Module-specific error."

Variable	Data type	Explanation
Channel_n_Overcurrent	BOOL	Input current > 20 mA → Specific_Error = TRUE
Channel_n_Open	BOOL	4..20mA mode: input current < 4mA → Specific_Error = TRUE

Conversion Time

The analog signals are converted one-by-one down every channel. Disabling one or more channels will shorten the entire analog-to-digital (A/D) conversion cycle.

"Filter" in this case means to compute an average when the set filter time is over.

Analog value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analog value conversion plus transmitting the values into the EtherCAT data area. The PACIO AI4-mA 12 Bit Module accepts the following times as the ideal EtherCAT cycle setup.

Number of Channels	Cycle Time in ms
1	0.27
2	0.41
3	0.55
4	0.69

NOTE: If you are aiming for a high sampling frequency, the PAC should do the filtering (averaging) because it will normally have much more processing power. Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date.

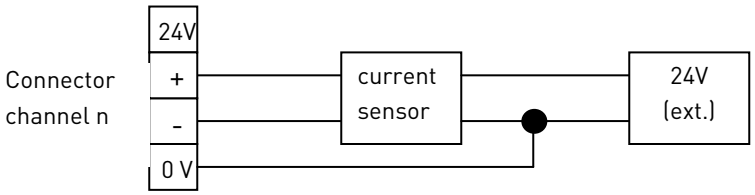
Quality of Analog Values

The Module inputs connect to both active and passive current sensors. See Figure "I/O Connections" on page 85 for an illustration of the Module's I/O connections. The module provides terminals for the 24VDC-supply to the transmitter of every channel

For the passive current sensors, interconnect the "–" and "0V" terminals.

Active current sensors:

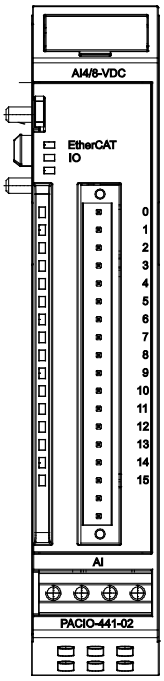
- Use the power supplied by the module if at all possible.
- If power to the current sensors is supplied by an external source, connect the 0V terminal of that power source to the 0V terminal of the module.

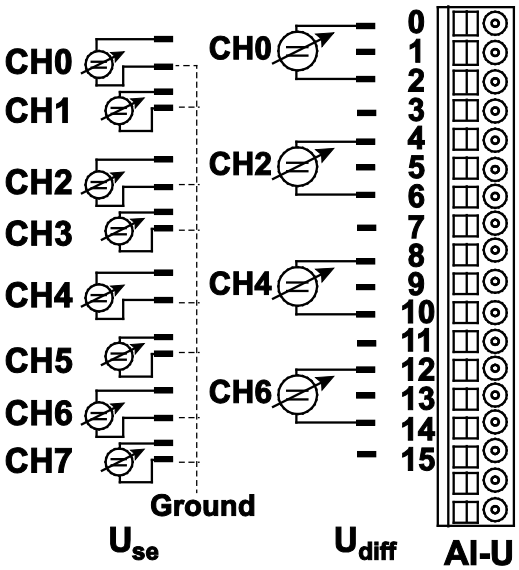


Sensor Connections

NOTE: Best results are obtained by connecting the shield of the signal cables to operative earth.

PACIO AI4/8-VDC 13 Bit





Front view of PACIO AI4/8-VDC 13 Bit Module *I/O connection*

The PACIO AI4/8-VDC 13 Bit Module features eight analog inputs. If signal lines are single-ended (measured against earth, L-), eight channels are available. To measure differential signals, you need two channels for every signal (that is, you can pick up no more than four differential signals). Channels can be combined as follows: 0/1, 2/3, 4/5, and 6/7.

Technical data	PACIO AI4/8-VDC 13 Bit
Part number	PACIO-441-02
Analog inputs	8 single-ended or 4 differential
Resolution	13 bit (1.221 µV unipolar, 2.442 µV bipolar)
Measuring range	0 ... 10V, ± 10V
Temperature drift	< -15 ppm/°C regarding range limit
Critical frequency	typical 1 MHz
Input impedance	input impedance is 66 MΩ each channel in the bipolar mode and 54 MΩ in the unipolar mode, when all channels are working
Input resistance	> 100 MΩ
Sampling frequency	1.12 kHz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	from coupler through E-Bus connector
E-Bus load	190 mA

Terminals

The Module needs no separate 24V connector. Power is supplied to the Module through the E-Bus connector. For information on operative earth shielding of analog wire, see Adding PACIO Modules on page 26.

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-Bus LED= Off
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module Defective
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled

Analog inputs

Check the following variable for the digitized input values.

Variable	Data type	Explanation
Channel_n	INT	Value measured on channel n (n= 0...7)

Analog Voltage Values

Measuring	Variable Value			
Volt	Bipolar		Unipolar	
	Decimal	Hexadecimal	Decimal	Hexadecimal
-10	32768	16#8000		
-9	36044	16#8CCC		
-8	39321	16#9999		
-7	42598	16#A666		
-6	45875	16#B333		
-5	49152	16#C000		
-4	52428	16#CCCC		
-3	55705	16#D999		
-2	58982	16#E666		
-1	62244	16#F324		
0	0	0	0	0
1	3276	16#0CCC	6553	16#1999
2	6553	16#1999	13107	16#3332
3	9830	16#2666	19660	16#4CCC
4	13106	16#3332	26214	16#6665
5	16383	16#3FFF	32767	16#7FFF
6	19660	16#4CCC	39320	16#9998
7	22936	16#5998	45874	16#B332
8	26213	16#6665	52427	16#CCCB
9	29490	16#7332	58981	16#E665
10	32767	16#7FFF	65534	16#FFFE

Module Control

The Module provides you with various operational options. To set up the Module, choose the options as appropriate and accept by setting control bit "SetOptions" to a rising edge. The Module will confirm by returning "OptionsSet".

There are various "Module error" bits that the Module uses to indicate errors. The states of the error bits are retained and also used for error indication by the "IO" LED. To reset the error bits, set control bit "ResetError" to a rising edge.

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge → accepts Module options
ResetError	BOOL	Rising edge → acknowledges error

Module Options

The following options are available for the PACIO AI4/8-VDC 13 Bit Module. To set and accept options, see "Module Control" above.

Variable	Data type	Explanation	
Channel_n_On	BOOL	Enables channel n	
Channel_n_Filter	USINT	Filter on channel n New values avail. in k/3 ms (k=1..255)	
Channel_n_Unipolar	BOOL	Change measuring range of channel n from bipolar +10V ... -10V to unipolar 0... 10V (doubles the resolution)	
Channel_n_n+1_Differential	BOOL	The difference in voltages of channel n and channel n+1 is measured and output to channel n.	
n		**0 ... 7**	**Channel number**

Module State

The following states are indicated. To reset the messages, see "Module Control" above.

Variable	Data type	Explanation
Shortcut	BOOL	not used
Undervoltage	BOOL	not used
Watchdog	BOOL	Module internal watchdog
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by Module to acknowledge SetOptions

Conversion Time

The analog signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.

'Filter' in this case means to compute an average when the set filter time is over.

Analog value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analog value conversion plus transmitting the values into the EtherCAT data area.

Number of channels	Cycle time in ms	Number of channels	Cycle time in ms
1	270µs	5	630µs
2	360µs	6	710µs
3	450µs	7	800µs
4	540µs	8	890µs

NOTE: If you are aiming for a high sampling frequency, the PAC should do the filtering (averaging) because it will normally have much more processing power.

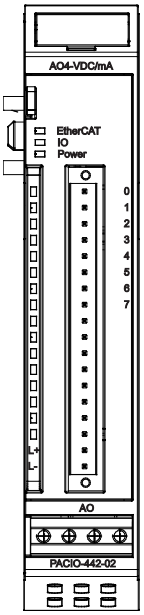
Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The Module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of Analog Values

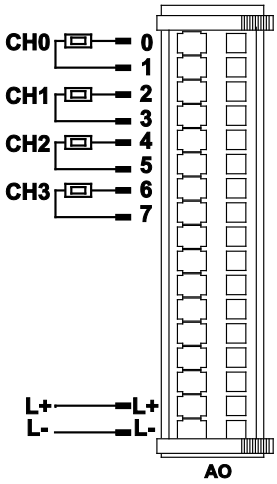
Best results are obtained by:

- Connecting the shield of the signal cables to operative earth
- Connecting unused single-ended lines to Ground
- Short-circuiting unused differential inputs

PACIO AO4-VDC/mA 12 Bit



Front view of PACIO AO4-VDC/mA 12 Bit Module



I/O connection

Channel	+	-
Channel0	0	1
Channel1	2	3
Channel2	4	5
Channel3	6	7

The PACIO AO4-VDC/mA 12 Bit Module features four analog outputs. Every channel can be separately set to the unipolar or bipolar output of voltages or currents.

Technical Data	PACIO AO4-VDC/mA 12 Bit
Part number	PACIO-442-02
Analog inputs	4
Resolution	12 bit
Measuring range	0 ... 10V, ± 10V, 0...20mA, ± 20mA
Output impedance	22.1 Ω each channel
Output frequency	3.125 kHz
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Terminals

Power Supply to Module I/Os	
L+	24 VDC
L-	0 V

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-Bus LED = Off
	Red, 1x	Short circuit
	Red, 2x	Low voltage
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
"Power" LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Short circuit
	Red, 3x	Broken wire
	Red, 5x	Excessive temperature of output drivers

Analog outputs

NOTE: The letter "n" in the following tables represents the channel number (n=0...3).

Write the output values into the following variables.

Variable	Data type	Explanation
Channel_n	UINT	Output value for channel n (n=0...3).

- **Current:** 0 ... 0xFFF0 for 0 ... 20mA
- **Voltage:** Analog Voltage Values table below

Analog Voltage Values

Measuring	Variable Value			
	Bipolar		Unipolar	
Volt	Decimal	Hexadecimal	Decimal	Hexadecimal
-10	32768	16#8000		
-9	36044	16#8CCC		
-8	39321	16#9999		
-7	42598	16#A666		
-6	45875	16#B333		
-5	49152	16#C000		
-4	52428	16#CCCC		
-3	55705	16#D999		
-2	58982	16#E666		
-1	62244	16#F324		
0	0	0	0	0
1	3276	16#0CCC	6553	16#1999
2	6553	16#1999	13107	16#3332
3	9830	16#2666	19660	16#4CCC
4	13106	16#3332	26214	16#6665
5	16383	16#3FFF	32767	16#7FFF
6	19660	16#4CCC	39320	16#9998
7	22936	16#5998	45874	16#B332
8	26213	16#6665	52427	16#CCCB
9	29490	16#7332	58981	16#E665
10	32767	16#7FFF	65534	16#FFFE

Module control

The Module provides you with various operational options. To set up the Module, choose the options as appropriate and accept by setting control bit "SetOptions" to a rising edge. The Module will confirm by returning "OptionsSet".

There are various "Module error" bits that the Module uses to indicate errors. The states of the error bits are retained and also used for error indication by the "IO" LED. To reset the error bits, set control bit "ResetError" to a rising edge.

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge → accepts Module options
ResetError	BOOL	Rising edge → acknowledges error

Module Options

The following options are available for the PACIO AO4-VDC/mA 12 Bit Module. To set and accept options, see "Module Control" above.

Variable	Data type	Explanation	
Channel_n_On	BOOL	Enables channel n (set to high impedance to disable)	
Channel_n_Current	BOOL	Sets channel n to current output mode	
Channel_n_n+1_Unipolar	BOOL	Sets channels 1 and 2 or 2 and 3 to unipolar mode	
Outputs_Active_Shortcut	BOOL	Leave outputs unchanged after short circuit	
Outputs_Active_Undervoltage	BOOL	Leave outputs unchanged after low voltage	
Outputs_Active_Specific_Error	BOOL	Leave outputs unchanged after Module-specific error	
Outputs_Active_EtherCAT_Error	BOOL	Leave outputs unchanged after short circuit	
n		**0 ... 7**	**Channel number**

Module State

The following Module states are indicated. To reset the messages, see "Module Control" above.

Variable	Data type	Explanation
Shortcut	BOOL	Short circuit (not used)
Undervoltage	BOOL	Low voltage (supplied power < 19.2V)
Watchdog	BOOL	Module internal watchdog
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by Module to acknowledge SetOptions

Module-Specific Messages

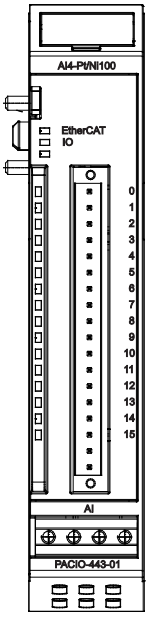
Apart from the Module error messages, the set of messages below contains details about the current state of the PACIO AO4-VDC/mA 12 Bit Module. These messages are automatically reset when the state concerned has returned to normal. They are combined into a single "Specific_Error" state of the Module and output to the IO LED as "Module-specific error."

Variable	Data type	Explanation
Channel_n_Shortcut	BOOL	Voltage mode: channel n load is lt 600Ω → Specific_Error = TRUE
Channel_n_Open	BOOL	Current mode: channel n load is gt 500Ω → Specific_Error = TRUE
Channel_n_Overtemp	BOOL	Temperature of output driver of channel n is gt 140°C (automatic switch-off) → Outputs_Active_Shortcut = TRUE
Undervoltage_24	BOOL	Power supplied to Module is gt 19.2V → Outputs_Active_Undervoltage = TRUE

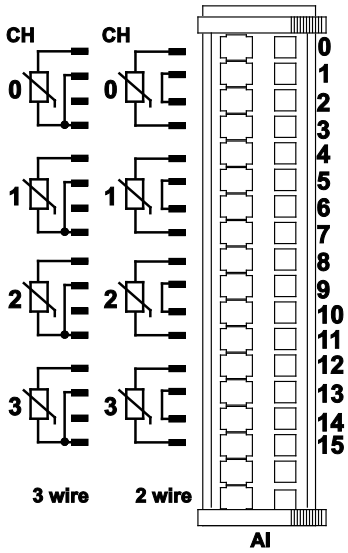
Conversion Time

The PACIO AO4-VDC/mA 12 Bit Module has a set cycle time of 320µs that is not affected by the number of active channels. The cycle time is the time between receipt of the output values and the start of the D/A converters.

PACIO AI4-Pt/Ni100 16 Bit, PACIO AI4-Pt/Ni1000 16 Bit



Front view of PACIO AI4-Pt/Ni100 I/O Module



I/O connection

The PACIO AI4-Pt/Ni100 16 Bit Module has 4 analog inputs for Pt100 or Ni100 temperature sensors. It also can measure resistances between 70 and 330 Ω. The PACIO AI4-Pt/Ni1000 16 Bit Module has 4 analog inputs for Pt1000 or Ni1000 temperature sensors. It also can measure resistances between 700 and 3000 Ω.

Technical Data	PACIO AI4-Pt/Ni100 16 Bit
Part Number	PACIO-443-01
Analog inputs	4
Resolution	16 bit (resistance 0.01 temperature 0.1°C)
Pt100 measuring range	- 75°C...+ 670°C
Ni100 measuring range	- 60°C...+ 250°C
Resistance	70...330
Temperature drift	< ± 50ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.50 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Technical Data	PACIO AI4-Pt/Ni1000 16 Bit
Part number	PACIO-443-03
Analog inputs	4
Resolution	16 bit (resistance 0.1 temperature 0.1°C)
Pt100 measuring range	- 75°C...+ 570°C
Ni100 measuring range	- 60°C...+ 250°C
Resistance	70...3000
Temperature drift	< ± 60ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.12 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Terminals

The PACIO AI4-Pt/Ni100 16 Bit and PACIO AI4-Pt/Ni1000 16 Bit Modules do not need a separate 24V connector. Power is supplied to the Modules through the E-Bus connector. For information on operative earth shielding of analog wire, see "Earth Grounding Guidelines." The Controller and I/O modules have been tested to comply with international electromagnetic and emission standards. To reduce radiated emissions, ensure that there is a good earth connection to the PAC, which can be accomplished by attaching the DIN rail to a suitable Earth ground and also utilizing Pin-3 on the Controller DC power input connector. This connection must be made with the shortest possible, heavy gage wire or braided cable. Low-resistance (<0.5 ohms) continuity should be verified with an ohmmeter for proper grounding. In addition, all communication cables should be shielded and grounded, preferably only on one end.

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module inputs and outputs.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

"IO" LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
"Channel" LEDs		
State	**LED Flash Code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Short circuit, Broken wire

Analog Inputs

NOTE: The letter "n" in the following tables represents the channel number (n=0...7).

Check the following variable for the digitized input values.

Variable	Data type	Explanation		
Channel_n	INT	Value measured on channel n (n= 0...3)		
		Default	as 1/10 °C	
		ResMode	Pt100	as 1/100
			Pt1000	as 1/10

Module Control

The PACIO AI4-Pt/Ni100 16 Bit and PACIO AI4-Pt/Ni1000 16 Bit Modules provide you with various operational options. To set up the Modules, choose the options as appropriate and accept by setting control bit "SetOptions" to a rising edge. The Modules will confirm by returning "OptionsSet".

There are various "Module error" bits that the Modules use to indicate errors. The states of the error bits are retained and also used for error indication by the "IO" LED. To reset the error bits, set control bit "ResetError" to a rising edge.

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge → accepts Module options
ResetError	BOOL	Rising edge → acknowledges error

Module Options

The following options are available for the PACIO AI4-Pt/Ni100 16 Bit Module and PACIO AI4-Pt/Ni1000 16 Bit Module. To set and accept options, see "Module Control" above.

Variable	Data type	Explanation	
Channel_n_Ni	BOOL	Set channel n to Ni100 or Ni1000 sensors	
Channel_n_On	BOOL	Enables channel n	
Channel_n_ResMode	BOOL	Set channel n to resistance mode	
Channel_n_Filter	USINT	Set filter for channel n. The arithmetic mean is output after n+1 conversions	
n		**0 ... 3**	**Channel number**

Module State

The following Module states are indicated below. To reset the messages, see "Module Control" above.

Variable	Data type	Explanation
Shortcut	BOOL	not used
Undervoltage	BOOL	not used
Watchdog	BOOL	Internal watchdog of Module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by Module to acknowledge SetOptions

Module-Specific Messages

Apart from the Module error messages, the set of messages below contains details about the current state of the PACIO AI4-Pt/Ni100 16 Bit and PACIO AI4-Pt/Ni1000 16 Bit Modules. These messages are automatically reset when the state concerned has returned to normal. They are combined into a single "Specific_Error" state and output to the IO LED as "Module-specific error."

Variable	Data type	Explanation
Channel_n_Open	BOOL	- Channel n load is gt minimum - Broken wire of connector 0 * - Broken wire of connector 3 * - Broken wire of connector 0/3 * → Specific_Error = TRUE
Channel_n_Shortcut	BOOL	- Channel n load is lt minimum - Short circuit of connector 0-3 * - Broken wire of connector 2 * → Specific_Error = TRUE

*The causes of 'short circuit' and 'broken wire 0.3' are shown for channel 0 (equivalent applies to other channels).

Conversion Time

The analog signals are converted one by one down every channel. Disabling one or several channels will shorten the entire analog-to-digital conversion cycle.

'Filter' in this case means to compute an average when the set filter time is over.

Analog value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analog value conversion plus transmitting the values into the EtherCAT data area.

Number of Channels	Cycle Time in ms
1	32
2	65
3	97
4	129

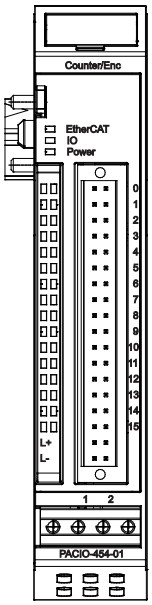
NOTE: If you are aiming for a high sampling frequency, the PAC should do the filtering (averaging) because it will normally have much more processing power.

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The Module described in this section will accept the above times as the ideal EtherCAT cycle setup.

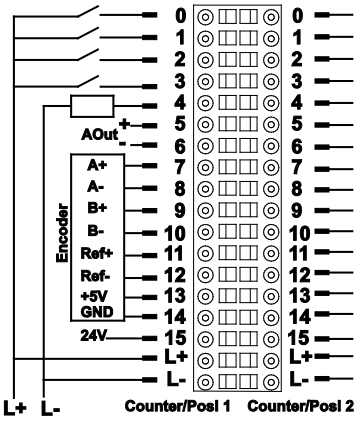
Quality of Analog Values

Best results are obtained by connecting the shield of the signal cables to operative earth.

PACIO Counter/Enc



Front view of the PACIO Counter/Enc Module



Pinouts for Counter/Enc

The PACIO Counter/Enc Module has two identical channels. Each channel has terminals for one encoder, four digital inputs, one digital output, and one analog output.

Technical Data	PACIO Counter/Enc
Part Number	PACIO-454-01
Encoder	2x A, B, Ref
Encoder type	5V (RS422) Differential
Count rate	Maximum 400 kHz
Digital inputs	8
Input delay	1ms
Input Signal level	Off: -3V ... 5V On: 15V ... 30V (EN 61131-2, type 1) Typical sink current 5mA per input at 24V PNP
Digital outputs	2
Maximum current	2A per output PNP
Analog outputs	2
Voltage	-10V...+10V
Resolution	12 bit
Fieldbus	EtherCAT 100 Mbit/s
EtherCAT-File	ParkerEtherCATModules.xml
Dimensions (WxHxD)	25x120x90 mm

Mounting	35mm DIN-Rail
Controller	ASIC ET1200
E-Bus Load	300mA
Connector IO/Power	Plug 36-pole (43-026592-01)
Power	24V DC -20% +25%
Galvanic separation	Separated from one another and versus the bus
Storage temperature	-25 °C...+70 °C
Operating temperature	0°C...+55°C
Relative humidity	5%...95% without dewing
Protection	IP20
Interference immunity	Zone B

Terminals

Pin	Signal	Explanation
0	In_0	Digital Input 0
1	In_1	Digital Input_1
2	In_2	Digital Input 2
3	In_3	Digital Input 3
4	Out_0	Digital Output
5	A_Out+	Analog Output +
6	A_Out-	Analog Output -
7..12	A+	Encoder signal A+
8	A-	Encoder signal A-
9	B+	Encoder signal B+
10	B-	Encoder signal B-
11	Ref+	Encoder Reference +
12	Ref-	Encoder Reference -
13	5 VDC	Encoder supply 5V (0.2A fuse)
14	0 VDC	Encoder supply 0V
15	n. c.	Not recommended for use
16	24 VDC	24 VDC supply
17	0 VDC	0 VDC Supply

The PACIO Counter/Enc Module has two identical channels with the same connections listed in the above table.

The Controller and I/O modules have been tested to comply with international electromagnetic and emission standards. To reduce radiated emissions, ensure that there is a good earth connection to the PAC, which can be accomplished by attaching the DIN rail to a suitable Earth ground and also utilizing Pin-3 on the Controller DC power input connector. This connection must be made with the shortest

possible, heavy gage wire or braided cable. Low-resistance (<0.5 ohms) continuity should be verified with an ohmmeter for proper grounding. In addition, all communication cables should be shielded and grounded, preferably only on one end. For information on operative earth shielding of analog wire, see the section “Earth Grounding Guidelines.”

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply.

“EtherCAT Run” LED		
State	**LED Flash Code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“IO” LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-Bus LED = Off
	Red, 2x	Low voltage
	Red, 3x	Watchdog internal
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
“Power” LED		
State	**LED Flash Code**	**Explanation**
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok

Status LEDs of the IOs

The Status LEDs of the several IOs indicate the state of the individual I/Os.

Status LEDs of I/Os			
LED	**Voltage**	**Color**	**Explanation**
0..3	24V	Green	Digital Inputs
4	24V	Green	Digital Outputs
7, 9, 11	5V	Green	Encoder signals A, B, Ref

Function

The PACIO Counter/Enc Module has two identical channels. Each channel has terminals for one encoder, four digital inputs, one digital output, and one analog output.

The documentation organizes the variables into structured groups:

- Module Control/Module Status for controlling and monitoring the entire module.
- Options/Control/Status/Errors for controlling and monitoring the Counter 1 & 2 resp. 2.
- Set Values/Current Values for determining the Counter values of Counter 1 & 2 resp. 2.
- Digital Outputs/Digital Inputs/Input Change Time Stamp/Output Delay for monitoring the state of the digital IOs of Counter 1 & 2 resp. 2.

Principle of Control and Status

If a control bit is set (=TRUE), the module will operate the corresponding function due to the rising edge of the bit. The Module indicates the execution of the function by setting the corresponding status bit (=TRUE). When the control bit is reset (=FALSE), the Module will also reset the status bit (=FALSE).

NOTE: In the following example, the functions of the counter Module are described for Counter 1. Counter 2 has corresponding functions.

Frame- or DC-Synchronous Mode

Dependent on whether Distributed Clocks (DC) are used or not, the Module adjusts itself independently on the suitable mode of operation. The Module is pre-set to Frame synchronous mode. With the receipt of the first DC telegram, the Module is changed over to DC-synchronous mode and maintains this mode of operation until the module is powered down.

Frame-Synchronous Mode

The EtherCAT master sends EtherCAT frames with the output data for the Module. With the arrival of such frame the output data are taken over and processed by the Module. The Module places its input data into the EtherCAT frame, so that the master can receive it.

DC-Synchronous Mode

If the Module is adjusted to DC-synchronous mode, it produces interrupts according to the rules of the DC. The EtherCAT master also sends EtherCAT frames with the output data for the Module. With the arrival of these frames, the output data of the Module are taken over and processed only if a DC interrupt has occurred. With the DC interrupt, the Module places its input data into a buffer, from which they are transported with the next EtherCAT Frame to the master.

With this method, time-synchronous functions for digital inputs and digital outputs for several Modules in one EtherCAT network are possible.

Controlling and Watching the Entire Module

Module control is carried out with the variables from the group "Module Control." The status of the settings having been carried out becomes shown in the variables of the group "Module Status".

Module Control

The Module reports faults with different "Module Status" bits. These bits are stored. They can be reset only if the fault is not there anymore. To reset the "Module Status" bits, send a rising edge to "ResetError".

Variable	Data type	Explanation
ResetError	BOOL	rising edge → error confirmation

Module Status

To reset, use the ResetError in the "Module Control" above.

Variable	Data type	Explanation
LowSupplyVoltage	BOOL	Low voltage
Watchdog	BOOL	Module internal Watchdog
EtherCAT_Error	BOOL	Configuration error or Timeout

Controlling/Watching Counter

- The setting of the functions of the counter is carried out with the variables from the group "Counter Options."
- The Module control is carried out with the variables from the group "Counter Control."
- The status of the settings is indicated in the variables of the group "Counter Status."

NOTE: The use of the PACIO Counter/Enc Module in a variety of different applications is possible by use of variables from the Counter Options, Counter Control, and Counter Status groups.

Counter Options

The Module offers different options for the operation of Counters. The options are set in the Module with the help of the control bit "SetOptions_1" (see also "Counter Control") and then remain valid until the next setting procedure.

1. Set the variables for the desired configuration.
2. Set "SetOptions_1=FALSE" and then set "SetOptions_1=TRUE".

The Module indicates the execution with "OptionsSet_1=TRUE". When "SetOptions_1" becomes FALSE again, the Module responds with "OptionsSet_1=FALSE". This indicates that the Module is ready for the next setting procedure.

Variable	Data type	Value	Explanation	
Enable_Compare_1	BOOL	0	Deactivate compare function	
		1	Activate compare function	
SelectEncoder_1	BOOL	0	A, B, Ref with detection of direction	
		1	Event counter at A	B=0 down
				B=1 up
SetResolution_1	BOOL		Only if SelectEncoder=1 (Event counter)	
		0	Rising and falling edges	
		1	Only rising edges	
ControlOutput_1	BOOL	0	Output_0_0 is a regular digital output	
		1	Output_0_0 is controlled by the compare function.	
OnErrorForceOutputsOff_1	BOOL	0	In case of Module error, all digital and analog outputs continue to update.	
		1	In case of Module error, all digital and analog outputs are forced to 0.	

Counter Control

Enabling and disabling of counting and referencing are determined by the state of the control variables.

Set and Reset functions are activated by setting the appropriate variable.

The execution is indicated in the corresponding status variable.

If the control variable is reset, the counter Module also resets the corresponding status variable.

Variable	Data type	Value	Explanation
SetOptions_1	BOOL	0/1	Activate "Counter 1 Options"
ResetReferenced_1	BOOL	0/1	Reset of status bit "Referenced_1"
ResetCompared_1	BOOL	0/1	Reset of status bit "Compared_1"
ResetCaptured_1	BOOL	0/1	Reset of status bit "Captured_1"
EnableCounter_1	BOOL	0	Disable counter
		1	Enable counter
EnableReferencing_1	BOOL	0	Disable Referencing
		1	Enable Referencing
SetCounter_1	BOOL	0/1	Set counter to preset value
SetCompare_1	BOOL	0/1	Set compare value register
SetPreset_1	BOOL	0/1	Set preset value register
SetMax_1	BOOL	0/1	Set maximum value register

Counter Status

The status variables indicate the status of the counter.

Variable	Data type	Explanation
Counting_1	BOOL	Counter is enabled
Referenced_1	BOOL	Reference function was executed Reset by ResetReferenced_1
Clockwise_1	BOOL	Counter counts up
Compared_1	BOOL	Compare function was executed Reset by ResetCompared_1
Captured_1	BOOL	Capture function was executed Reset by ResetCaptured_1
CounterSet_1	BOOL	Counter is set to preset value
CompareSet_1	BOOL	Compare value is set
PresetSet_1	BOOL	Preset value is set
MaxSet_1	BOOL	Maximum value is set
OptionsSet_1	BOOL	Options of counter 1 are set
OutputsOnErrorOff_1	BOOL	Outputs will be switched off in case of error

Counter Errors

These variables are provided for the indication of error states:

Variable	Data type	Explanation
OutputsForcedOff_1	BOOL	Outputs have been forced to 0 because of a Module error
Err_Reserved_1_x	BOOL	reserved error bits

Counter Values of Counter

Counter Set Values

The counter can be preset with different set values.

That is done by help of the variable "SetValue_1". After setting the following control bits, the contents of "SetValue_1" will be copied in the corresponding register.

Variable	Data Type	Explanation
SetCounter_1	BOOL	Copy "SetValue_1" to the current counter value
SetCompare_1	BOOL	Copy "SetValue_1" to the compare value register
SetPreset_1	BOOL	Copy "SetValue_1" to the preset value register
SetMax_1	BOOL	Copy "SetValue_1" to the maximum value register

The current set values can be read in the variable "SelectedValue" from the "Counter current values" group. Use the variable "Select_1",to determine which value you want to see in the variable "SelectedValue"(see section "Counter Actual Values").

Variable	Data type	Explanation	
Select_1	UINT	Sets the value displayed in the variable "SelectedValue_1":	
		0	none
		1	Compare value
		2	Preset value
		3	Max value
		4	Hardware Captured value
		5	Counter pulses/second
		6	Revolutions per minute
		128	Version info
SetValue_1	DINT	Value to be set (when using SetCounter_1, SetCompare_1, SetPreset_1, or SetMax_1	

Counter Actual Values

These variables display the current counter value and the current set values. The set values are represented in the variable "SelectedValue_1" (Determined by Select_1).

Variable	Data type	Explanation	
Counter_1	DINT	Current value of counter 1	
Selected_1	UINT	Selection of the value displayed in the variable SelectedValue_1. (Value of Select_1 read from the Module)	
		0	none
		1	Compare value
		2	Preset value
		3	Max value
		4	Captured value
		5	Counter pulses/second
		6	Revolutions per minute
		128	Version info
SelectedValue	DINT	Selected current value of counter 1	

Version information:

Byte	3	2	1	0
Explanation	Version #	Release	Level	Type code
Example	0x2	0x00	0x00	0x53
	2	0	0	S

Digital Inputs and Outputs

Counter Digital Inputs

The variables indicate the status of the digital inputs.

Counter 1 Digital Inputs

Variable	Data type	Explanation
Input_0_0	BOOL	Digital Input 0
Input_0_1	BOOL	Digital Input 1 – Capture Input
Input_0_2	BOOL	Digital Input 2
Input_0_3	BOOL	Digital Input 3
In_Output_0_0	BOOL	Status of Digital Output 0 (Reads the status)

Counter 2 Digital Inputs

Variable	Data type	Explanation
Input_1_0	BOOL	Digital Input 0
Input_1_1	BOOL	Digital Input 1 – Capture Input
Input_1_2	BOOL	Digital Input 2
Input_1_3	BOOL	Digital Input 3
In_Output_1_0	BOOL	Status of Digital Output 0 (Reads the status)

Counter Input Edge Timestamp

The variables indicate the time at which the status of the digital input has changed. The time at which the measurement starts depends on the mode of operation. (See also Frame- or DC-Synchronous Mode on page 111.)

Counter 1

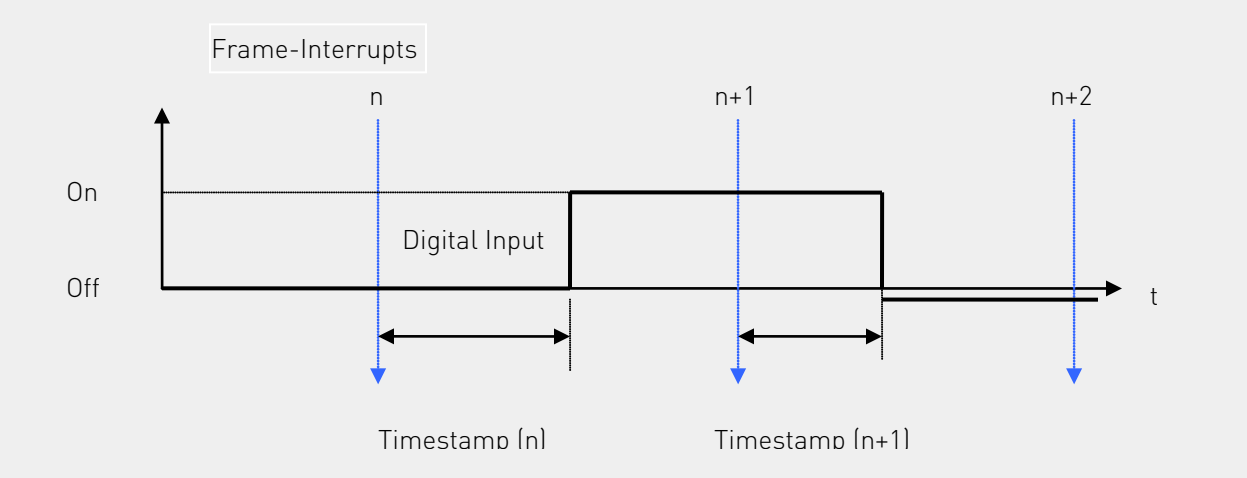
Variable	Data type	Explanation
Input_0_0_TS	UINT	Time stamp for Digital Input 0 (Hardware Triggered)
Input_0_1_TS	UINT	Time stamp for Digital Input 1 (Software Polled)
Input_0_2_TS	UINT	Time stamp for Digital Input 2 (Software Polled)
Input_0_3_TS	UINT	Time stamp for Digital Input 3 (Software Polled)

Counter 2

Variable	Data type	Explanation
Input_1_0_TS	UINT	Time stamp for Digital Input 0 (Hardware Triggered)
Input_1_1_TS	UINT	Time stamp for Digital Input 1 (Software Polled)
Input_1_2_TS	UINT	Time stamp for Digital Input 2 (Software Polled)
Input_1_3_TS	UINT	Time stamp for Digital Input 3 (Software Polled)

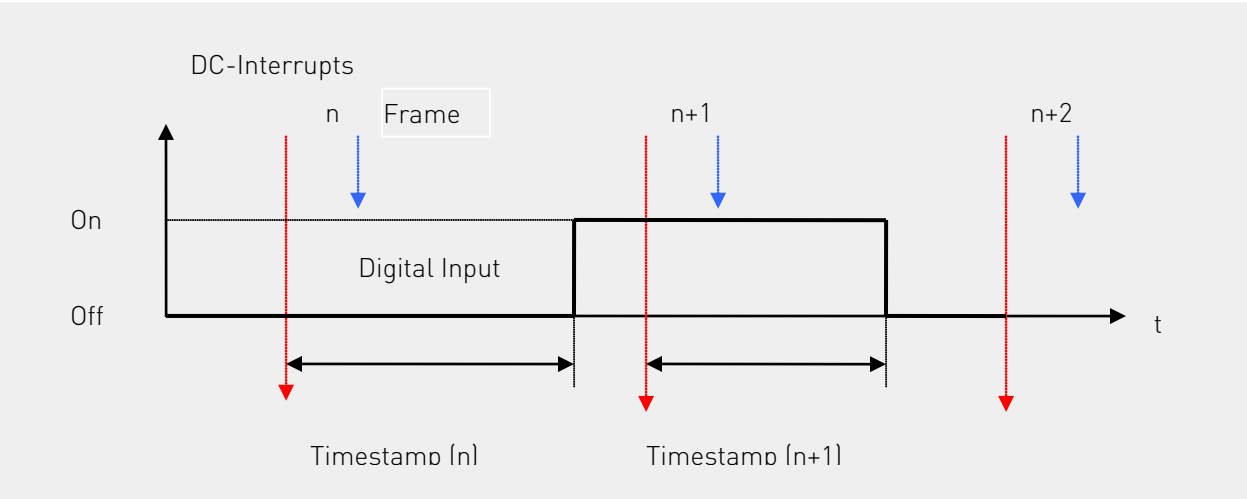
NOTE: The time stamp is metered between frame- or DC-interrupts and signal changes on the input in µs. The value of the time stamp becomes 0xFFFF, when no signal change takes place between two frame- or DC-interrupts.

In frame-synchronous mode: The time from the last frame-interrupt to the status change of the input is stored in the time stamp and sent in the following frame to the EtherCAT master.



Frame	Digital Input	
	Variable	Timestamp
n+1	TRUE	Timestamp (n)
n+2	FALSE	Timestamp (n+1)

In DC-synchronous mode: The time from the last DC-interrupt to the status change of the input is stored in the time stamp and sent in the following frame to the EtherCAT master.



Frame	Digital Input	
	Variable	Timestamp
n+1	TRUE	Timestamp (n)
n+2	FALSE	Timestamp (n+1)

Digital Outputs

These variables indicate the status of the digital outputs:

Counter 1

Variable	Data type	Explanation
Output_0_0	BOOL	Digital Output 0 (Sets the output)

Counter 2

Variable	Data type	Explanation
Output_1_0	BOOL	Digital Output 0 (Sets the output)

Output Set Delay

This variable defines the time when the output is set.

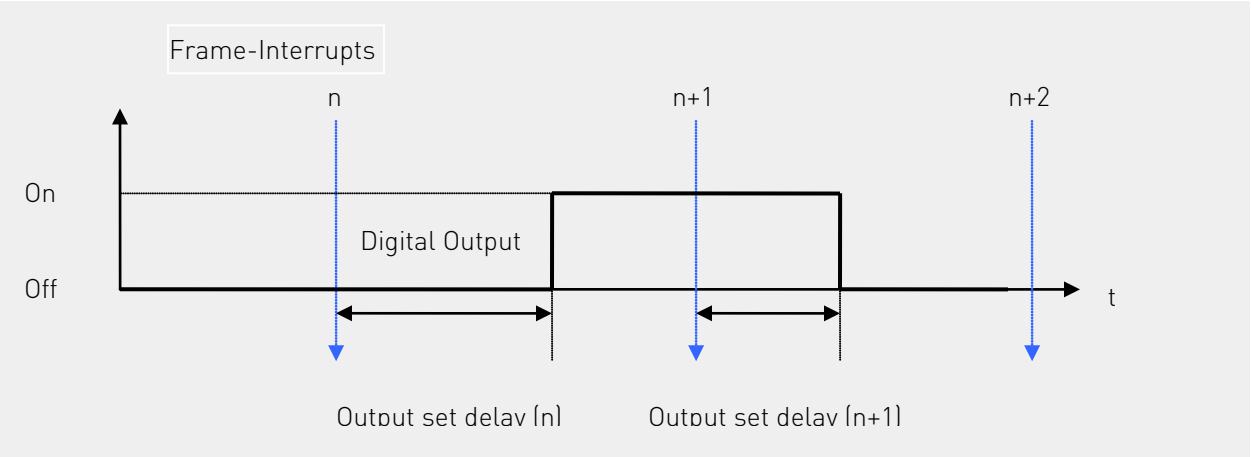
Counter 1

Variable	Data type	Explanation
Output_0_0_Del	UINT	Output set delay in µs

Counter 2

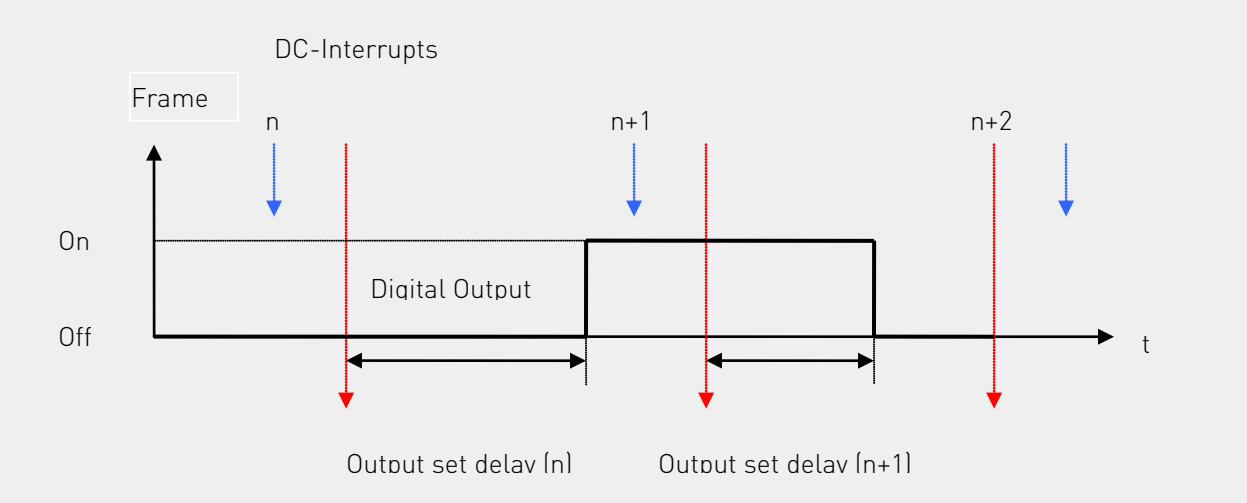
Variable	Data type	Explanation
Output_1_0_Del	UINT	Output set delay in µs

In frame-synchronous mode:



Frame	Digital Output	
	Variable	Output Set Delay
n	TRUE	Output set delay (n)
n+1	FALSE	Output set delay (n+1)

In DC-synchronous mode:



Frame	Digital Output	
	Variable	Output Set Delay
n	TRUE	Output set delay (n)
n+1	FALSE	Output set delay (n+1)

Analog Outputs

These variables define the Voltage of the analog outputs. For information on Output values, see Analog Voltage Values on page 100.

Variable	Data type	Explanation
AnalogOutput_1	UINT	Analog Output 1
AnalogOutut_2	UINT	Analog Output 2

Examples

Enable Counter

The counter is active, when the variable "EnableCounter_1" is TRUE.

```
Term2_EnableCounter_1:=TRUE;          (*Release of the counter*)
Term2_Counting_1;                     (*TRUE, if counter is enabled*)
Term2_Clockwise_1;                    (*Count direction, TRUE, when up*)
```

Counter Set/Clear

Copying the contents of "SetValue_1" into the current value is executed by a rising edge to "SetCounter_1". Execution is indicated by "CounterSet_1=TRUE". If "SetCounter_1" is reset (FALSE) again, "CounterSet_1" also becomes FALSE again.

```
Term2_SetValue_1:=diCounterValue;     (*Copy a number into the source var*)
                                      (* 0 = Clear*) and
Term2_SetCounter_1:=TRUE;             (*copy to the counter current value*)
Term2_CounterSet_1;                   (*TRUE, if set*)
```

Set Compare Value

Configuration settings set in "Counter 1 Options" are activated by the rising edge of the control bit "SetOptions_1". The successful take-over of the options is confirmed with the status bit "OptionsSet_1". For example, set compare function.

```
PROGRAM Initialization
VAR
   bInit: BOOL := TRUE;
   Step: USINT;
END_VAR
-------------------------------------------------------------------------------
IF bInit THEN
   CASE Step OF
(*Select options, activate them by a rising edge to "Set_Options"*)
   0:    Term2_EnableCounter_1:=TRUE;    (*Release counter*)
         Term2_EnableCompare_1:=TRUE;    (*Activate compare function*)
         Term2_ControlOutput_1:=TRUE;    (*Compare function controls Output*)
         Term2_SetValue_1:=10000;        (*Set value = 10000..*)
         Term2_SetCompare_1:=TRUE;       (*..use as compare value*)
         Term2_SetOptions_1:=TRUE;       (*Activate selected options*)
         Step:= 1;
(* Wait for confirmations "OptionsSet" and "CompareSet"*)
   1:    IF Term2_OptionsSet_1 AND Term2_CompareSet_1 THEN
               Step:= 2;
         END_IF
(* Set "Set_Options" and "SetCompare" in the starting position*)
   2:    Term2_SetOptions_1:=FALSE;
         Term2_SetCompare_1:=FALSE;
```

```
            Step:=0;
            bInit:=FALSE;
        END_CASE
    END_IF
```

Set Preset Value

Copying the value of "SetValue_1" into the preset value is executed by "PresetSet_1=TRUE". If "SetPreset_1" is reset (FALSE) again, "PresetSet_1" also becomes FALSE again.

```
Term2_SetValue_1:=diPresetValue;      (*Copy a number into the source var*)
Term2_SetPreset_1:=TRUE;              (*Copy to the preset value*)
Term2_PresetSet_1;                    (*TRUE, if set*)
```

Set Maximum Value

Copying the value of "SetValue_1" into the preset value is executed by "MaxSet_1=TRUE". If "SetMax_1" is reset (FALSE) again, "MaxSet_1" also becomes FALSE again.

```
Term2_SetValue_1:=diMaxValue ;        (*Copy a number into the source var*)
Term2_SetMax_1:=TRUE;                 (*Copy to the maximum value *)
Term2_MaxSet_1;                       (*TRUE, if set*)
```

Set Counter Range

The counter range is controlled by the variable SetMax_1 and SetMax_2. The default value for SetMax_1 and SetMax_2 is 2,147,483,647 and this sets the counter range from 0 to 2,147,483,647. To set the counter range from -2,147,483,647to +2,147,483,647, change the SetMax_1 or SetMax_2 value to 4,294,976,294.

```
MaxSet_1:= 2,147,483,647;             (*Sets range from 0 to 2,147,483,647*)
MaxSet_1:= 4,294,967,294;             (*Sets range from -2,147,483,647 to 2,147,483,647*)
```

Digital Output

The digital output can be controlled by the variable "Output_0_0" or the compare function, determined by the variable "ControlOutput_1". The current status of the output is read from the Module and displayed in "In_Output_0_0". See also Counter Options.

```
Term2_ControlOutput_1:=FALSE;         (*Term2_Output_0_0 controls output*)
Term2_ControlOutput_1:=TRUE;          (*Compare function controls output*)
Term2_In_Output_0_0;                  (*Status of the output*)
```

Operating as A-B-Ref-Counter or Event Counter

The counter can be operated as an A, B, Ref –Counter/Encoder or as an event counter. The selection is made by the variable "SelectEncoder_1". See also Counter Options.

```
Term2_SelectEncoder_1:=FALSE;          (*A, B, Ref *)
Term2_SelectEncoder_1:=TRUE;           (*Event counter at A*)
                                       (*B=FALSE:down, B=TRUE:up*)
```

Single-end Multiple Counting

This option is valid in the event counter mode only. The counter can count edges (all rising and falling edges, i.e. Quadrature Encoder) or pulses (only the rising edges). The selection is made by the variable "SetResolution_1". See also Counter Options.

```
Term2_SetResolution_1:=FALSE;          (*all edges*)
Term2_SetResolution_1:=TRUE;           (*Pulses*)
```

Referencing

The counter can be set to a preset value when a pulse occurs at the Ref input. The preset value can be 0, but also any other 32-bit number, using SetValue_1 and SetPreset_1.

Task: An encoder with 500 Pulses provides 2000 increments per turn in the all edges mode (Quadrature). Every Ref pulse shall set the counter to the preset value 2000. It shall be counted down to 0 within 1 turn. The counting direction is determined by the turning direction of the encoder.

```
PROGRAM Referencing
VAR
   bInit: BOOL := TRUE;
   StepInit: USINT;
   bInitReady: BOOL;
   Step: USINT;
END_VAR
-------------------------------------------------------------------------------
(*1. Initializing: Enabling of the counter and setting of the preset value*)
IF bInit THEN
   CASE StepInit OF
(*Selecting the options and setting them by a rising edge v. "Set_Options"*)
   0:    Term2_EnableCounter_1:=TRUE;
         Term2_SetValue_1:=2000;
         Term2_SetPreset_1:=TRUE;
         Term2_SetOptions_1:=TRUE;
         StepInit:=1;
```

```
(* Wait for confirmations "OptionsSet" and "PresetSet"*)
   1:    IF Term2_OptionsSet_1 AND Term2_PresetSet_1 THEN
               StepInit:=2;
         END_IF
(* Reset "Set_Options" and "Set_Preset"*)
   2:    Term2_SetOptions_1:=FALSE;
         Term2_SetPreset_1:=FALSE;
         StepInit:=0;
         bInit:=FALSE;
         bInitReady:=TRUE;
   END_CASE
END_IF

(*2. Controlling the referencing*)
IF bInitReady THEN
   CASE Step OF
   (*Switch on the referencing mode*)
   0:    Term2_EnableReferencing_1:=TRUE;
         Step:=1;
   (* Wait for a referencing pulse*)
   1:    IF Term2_Referenced_1 THEN
               Step:=2;
         END_IF
   (* Reset of the referencing message*)
   2:    Term2_ResetReferenced_1:=TRUE;
         Step:=3;
   3:    IF NOT Term2_Referenced_1 THEN
   (* Reset "ResetReferenced_1"*)
         Term2_ResetReferenced_1:=FALSE;
   (*Switch off the referencing mode *)
               Term2_EnableReferencing_1:=FALSE;
               Step:=0; (*Next turn the same procedure.*)
         END_IF
   END_CASE
END_IF
```

Capture

A falling edge at the Digital Input 1 can be used as trigger in order to save the current counter value (capture). Status bit "Captured_1" =TRUE when a capture event has occurred. You have to reset "Captured_1" by "ResetCaptured_1" so the next capture event can be indicated.

```
Term2_Input_0_1;          (*Status of Input 1*)
Term2_Select_1:=4;        (*Copy capture register to Term2_SelectedValue_1*)
Term2_Selected_1;         (* =4, if capture value in Term2_SelectedValue_1*)
Term2_SelectedValue_1;    (*Here you can read the capture value*)
Term2_Captured_1;         (*A capture event has occurred if TRUE *)
Term2_ResetCaptured_1;    (*Reset of Term2_Captured_1*)
```

Digital Inputs (Input_0_x)

The status of the digital inputs is indicated in the variables "Input_0_x". The current counter value is saved in the capture register when a falling edge appears at Input_0_1.

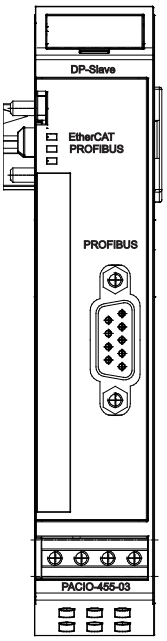
```
Term2_Input_0_0;          (*Status of Input 0*)
Term2_Input_0_1;          (*Status of Input 1*)
Term2_Input_0_2;          (*Status of Input 2*)
Term2_Input_0_3;          (*Status of Input 3*)
```

Analog Outputs

The output values of the analog outputs are written into the variables "AnalogOutput _x". For Output values, See "Analog Voltage Values" on page 100.

```
Term2_ AnalogOutput_1:= 16#7FFF;      (* Set AnalogOutput_1 to +10V *)
Term2_ AnalogOutput_2:= 16#8000;      (* Set AnalogOutput_2 to -10V *)
```

PACIO PROFIBUS-DP-Slave



Pin	Signal	Explanation
1	Shield	Shield/functional ground
2	M24	not connected
3	RxD/TxD-P	Receive/Transmit data – plus (B wire)
4	CNTR-P	Repeater control signal (direction control), RTS signal
5	DGND	Data ground (reference potential for VP)
6	VP	Supply voltage - plus (P5V)
7	P24	not connected
8	RxD/TxD-N	Receive/Transmit data – minus (A wire)
9	CNTR-N	Repeater control signal (direction control)

Pinouts for PROFIBUS

Front view of PACIO PROFIBUS-DP-Slave Module

The PACIO PROFIBUS-DP-Slave Module is an EtherCAT/PROFIBUS-DP gateway. It accomplishes the data transfer between an EtherCAT system and a PROFIBUS-DP system.

Technical data	PACIO PROFIBUS-DP-Slave
Part number	PACIO-455-03
Fieldbus1 (System)	EtherCAT 100 Mbit/s
EtherCAT-File	ParkerEtherCATModules.xml
Fieldbus2	PROFIBUS-DP-Slave
Implementation type	SPC3
Connector PROFIBUS	D-SUB Plug 9-pole, male (not part of the Module)
Baud rate	Maximum 12 Mbit/s
Detection	Automatically
Addressing	via EtherCAT-Variable
GSD-File	Park6943.GSD
W x H x D	25x120x90 mm
Mounting	35mm DIN top hat rail
Controller	ASIC ET1200
Power supply	from EtherCAT-Coupler via E-Bus-plug
E-Bus load	210mA
Galvanic separation	Separated from one another and versus the bus
Storage temperature	-25 °C...+70 °C

Operating temperature	0°C...+55°C
Relative humidity	5%...95% without dewing
Protection	IP20
Interference immunity	Zone B

Terminals

The Module needs no separate 24V connector. Power is supplied to the Module through the E-Bus connector. For information on operative earth shielding of analog wire, see “Adding PACIO Modules” on page 26.

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "PROFIBUS" indicates the state of the Module regarding PROFIBUS.

“EtherCAT Run” LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“PROFIBUS” LED		
State	**LED Flash Code**	**Explanation**
Ok	Green, on	No error
Error	Red, flashing	Connection fault
Start, Defect	Red, on	Module is not initialized

Function

The Module PROFIBUS-DP-Slave is an EtherCAT/PROFIBUS-DP gateway. It accomplishes the data transfer between an EtherCAT system and a PROFIBUS-DP system.

Data

Utilizable data will be found in four groups of input variables and four groups of output variables. For more information, see “Configuring the Data Modules” on page 128.

Variable	**Data type**	**Number**	**Explanation**
InByteM1_0 .. _15	USINT	16	Input data module1 Byte_0..Byte_15
InByteM2_0 .. _31	USINT	32	Input data module2 Byte_0..Byte_31
InByteM3_0 .. _47	USINT	48	Input data module3 Byte_0..Byte_47
InByteM4_0 .. _63	USINT	64	Input data module4Byte_0..Byte_63
OutByteM1_0 .. _15	USINT	16	Output data module1 Byte_0..Byte_15

OutByteM2_0 .. _31	USINT	32	Output data module2 Byte_0..Byte_31
OutByteM3_0 .. _47	USINT	48	Output data module3 Byte_0..Byte_47
OutByteM4_0 .. _63	USINT	64	Output data module4 Byte_0..Byte_63

Module Control

The Module provides no operational options but a PROFIBUS-address, which is set by the EtherCAT-master. The Module indicates errors by different "Module state" bits. These error bits are stored. To reset the error bits, set control bit "ResetError" to a rising edge.

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge → accepts the PROFIBUS address
ResetError	BOOL	Rising edge → acknowledges error

SPC3 Address

The PROFIBUS-DP-Slave address is set by the following variable. The assumption of the address is released with the rising edge of SetOption. The execution is indicated with OptionSet. The PROFIBUS DP slave address also can be changed at runtime.

Variable	Data type	Explanation
Address	USINT	PROFIBUS-DP-Slave address

Module State

The following Module states are indicated below. To reset the messages, see "Module Control" above.

Variable	Data type	Explanation
Shortcut	BOOL	not used
Undervoltage	BOOL	not used
Watchdog	BOOL	Internal watchdog of Module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	not used
OptionsSet	BOOL	Sent by Module to acknowledge SetOptions

Module-Specific Messages

Apart from the Module error messages, there is a set of messages containing details about the current state of the Module.

Variable	Data type	Explanation
ProfibusRunning	BOOL	PROFIBUS runs

Configuring the Data Modules

For the configuration of the EtherCAT and the PROFIBUS, the appropriate configuration files are needed.

These are:

- ParkerEtherCATModules.xml for EtherCAT
- Park6943.GSD for PROFIBUS

Number and size of the data Modules are configurable. The relationship of input data and output data is always thereby 1:1. Select the desired data Modules in the respective Configurator tools.

NOTE: Make sure that configuring on the EtherCAT side and the PROFIBUS side must be implemented identically.

PROFIBUS

To configure the PROFIBUS you need Park6943.GSD. This is to be imported into the PROFIBUS-master configurator.

Four Modules with a maximum data area length of 160 bytes for each direction can be selected. The individual Modules are consistent for itself. The Module provides the following Module-specific diagnosis data "Ext_Diag_Data".

Octet	Value	Meaning
1..4	...	Standard diagnosis
5	0x43	Standard diagnosis: Module Id.# 6943
6	0x69	
7	3	3 (1+2) Byte extended Diagnose
8	0	EtherCAT is running
	6	EtherCAT Error
9	0x11	Revision 1
	0x12	Revision 2 (with DP-address change)

EtherCAT

For EtherCAT configuration, import the file ParkerEtherCATModules.xml into the PAC320 master configurator. See also Chapter 4: System Set-up and Configuration.

NOTE: Online-configuration (Scan Boxes = Reading of the configuration data from the connected EtherCAT devices) is not possible because of the large amount of data.

For the configuration of the EtherCAT, appropriate PDOs are available.

Index	Input variable	Index	Output variable
0x1601	Module Control	0x1A01	Module Status
0x1602	Module Specific Messages	0x1A02	SPC3address_Adress
0x1603	Profibusdata_InByteM1_0 . _15	0x1A03	Profibusdata_OutByteM1_0 . _15
0x1604	Profibusdata_InByteM2_0 . _31	0x1A04	Profibusdata_OutByteM2_0 . _31
0x1605	Profibusdata_InByteM3_0 . _47	0x1A05	Profibusdata_OutByteM3_0 . _47
0x1606	Profibusdata_InByteM4_0 . _63	0x1A06	Profibusdata_OutByteM4_0 . _63

Selection of the PROFIBUS Address

The PROFIBUS address is written into the variable "Address" of the PLC program and transmitted as PDO 1602 to the PROFIBUS-DP-Slave Module.

With the setting of the bit "SetOptions", the assumption of the address in the Module becomes released. The Module acknowledges the assumption of the address by setting of "OptionsSet".

After receipt of a valid PROFIBUS address, the Module initializes the PROFIBUS. If a master accesses the Module over the PROFIBUS and transfers a valid configuration, the professional bus is functional. This is indicated by the bit "ProfibusRunning".

Only then data exchange EtherCAT <- -> PROFIBUS is possible.

Since revision 2, the address change at runtime is possible. The connection with the PROFIBUS master will be cut for a short time, but the master will rebuild the connection to the new address by its GAP update. The status of the connection is shown in "ProfibusRunning".

Example:

Setting of usiDP_Address as DP-Slave address

```
 (* Start (Single action) *)
Term2_Address:=usiDP_Adresse;          (* Copying the DP-Slave address *)
Term2_SetOptions_Byte.0:=TRUE;         (* Start of the address setting *)

(* Controlling*)
IF Term2_SetOptions_Byte.0=TRUE THEN
   IF Term2_Shortcut_Byte.7=TRUE THEN (* Wait for confirmation *)
         Term2_SetOptions_Byte.0=FALSE; (* Reset*)
   END_IF
END_IF
```

PROFIBUS example with Siemens S7

This document outlines the procedure for configuring ProfiBus communication from PAC to a Siemens S7 processor capable of communicating this protocol. This particular configuration demonstrates this using the Siemens CPU 315-2 PN/DP 6ES7 315-2EH13-0AB0 / V2.6 processor and STEP 7 v5.4 SP5 software.

STEP 7 Software

1. Open the STEP 7 software, select 'File', 'New' and enter a name for the project.

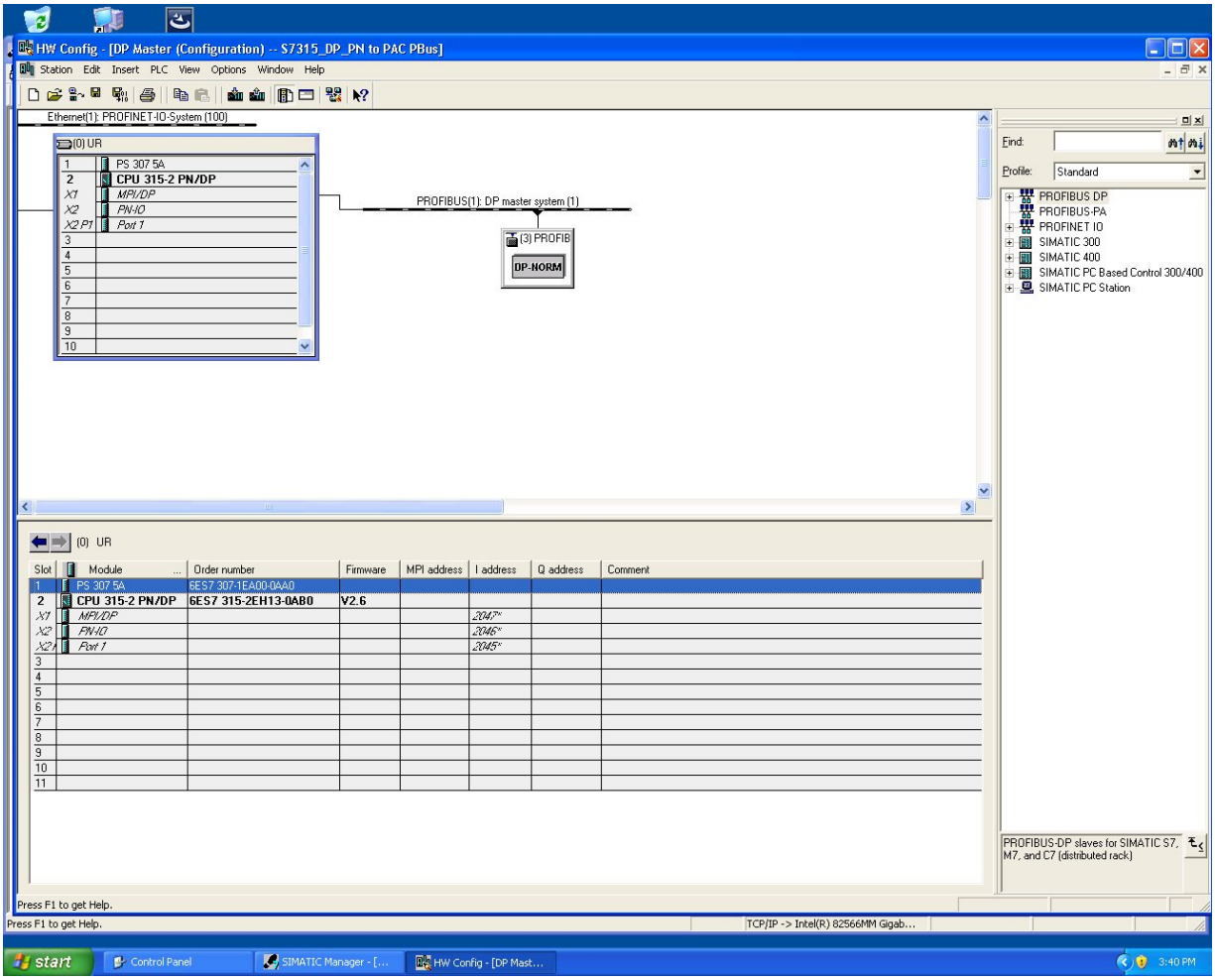
2. Right-click on the name and select 'Insert New Object'. Choose 'SIMATIC 300 Station'.

Note: You may rename the default names used for portions of this project.

3. In the left pane, left-click on the newly added branch. In the right pane, double click on 'Hardware'.

4. In the new windows opened, open the branches in the right pane to find the Simatic 300 / Rack 300 / Rail and add it to the project by double-clicking it. You will now have a grid to configure your processor.

5. Configure the processor to match your particular type/model. Configuration for the type used in this project is shown below.

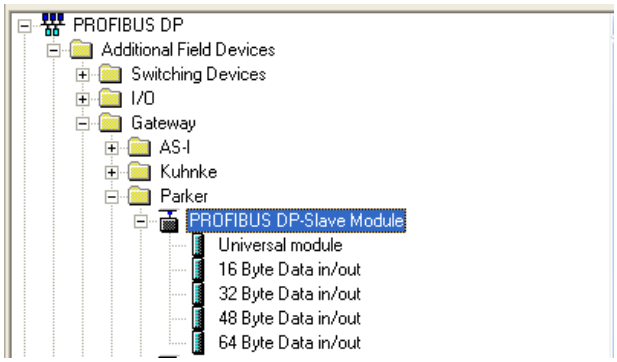


6. Select the X1 Port. Configure the X1 port to Address 2.

7. From the X1 port, Right-click and add the ProfiBus DP Master System to the project.

8. Double-click the ProfiBus network properties and set the Master System # to 1.

9. You will need to add the Parker GSD file for ProfiBus communication. Use the Option 'Install GSD File' to load this.

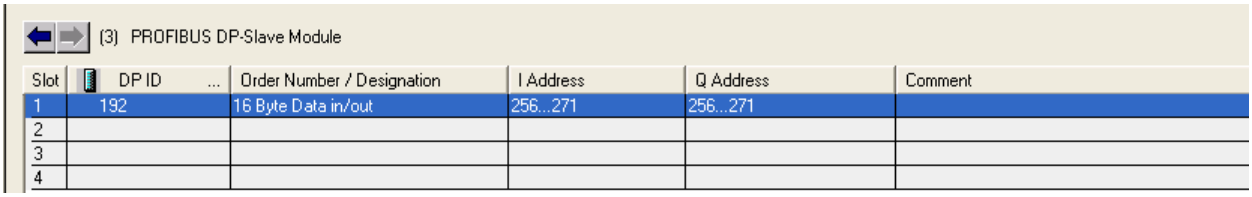


10. Right click on the ProfiBus network and insert the loaded GSD file.

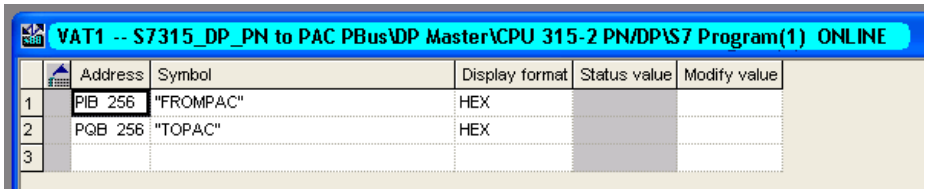
11. Double-click and configure the ProfiBus node of this component to be station # 3.

12. In the right pane expand the ProfiBus Module to display the 16 Byte Data In/Out branch and add this to the project.

13. Configure as shown below:



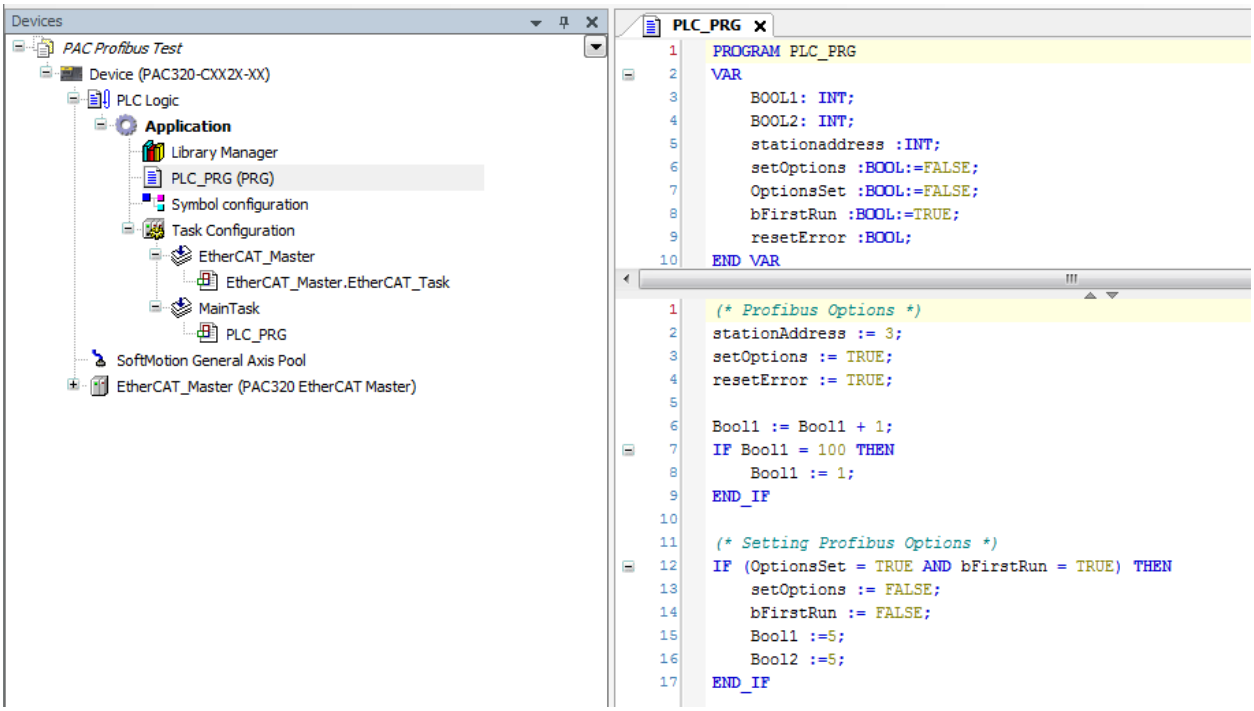
14. Create a Variable Table and reference the following variables:



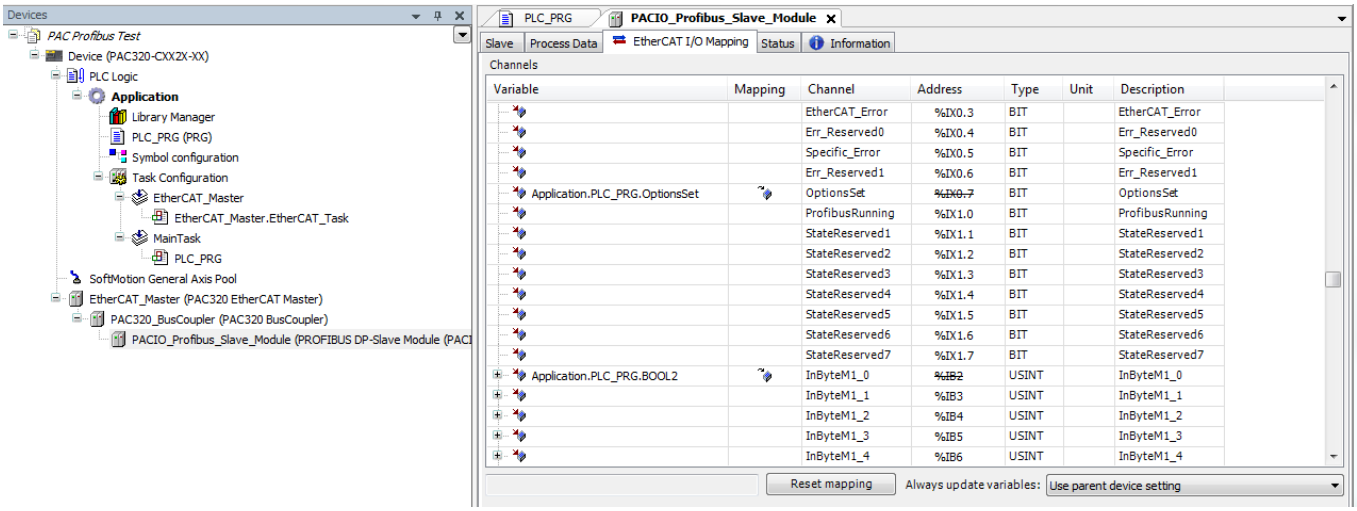
15. Save the project and download it to the processor.

PAC Software

1. In this example, PAC has been configured with the device 'PACIO ProfiBus Slave Module' as shown. You will now add the following program code to the project and reference it with an associated task:



2. After adding the device and code to the project, you will configure the IO map as displayed:

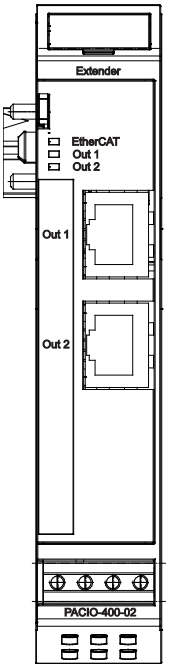


Application.PLC_PRG.OptionsSet		OptionsSet	~~%IX0.7~~	BIT		OptionsSet
		ProfibusRunning	%IX1.0	BIT		ProfibusRunning
		StateReserved1	%IX1.1	BIT		StateReserved1
		StateReserved2	%IX1.2	BIT		StateReserved2
		StateReserved3	%IX1.3	BIT		StateReserved3
		StateReserved4	%IX1.4	BIT		StateReserved4
		StateReserved5	%IX1.5	BIT		StateReserved5
		StateReserved6	%IX1.6	BIT		StateReserved6
		StateReserved7	%IX1.7	BIT		StateReserved7
Application.PLC_PRG.BOOL2		InByteM1_0	~~%IB2~~	USINT		InByteM1_0
		InByteM1_1	%IB3	USINT		InByteM1_1
		InByteM1_2	%IB4	USINT		InByteM1_2
		InByteM1_3	%IB5	USINT		InByteM1_3
		InByteM1_4	%IB6	USINT		InByteM1_4
		InByteM1_5	%IB7	USINT		InByteM1_5
		InByteM1_6	%IB8	USINT		InByteM1_6
		InByteM1_7	%IB9	USINT		InByteM1_7

3. Download the project to the PAC and enter RUN mode.

4. You should now be able to monitor data being produced by the PAC by monitoring data in the STEP 7 software.

PACIO Extender 2 Port



Front view of the PACIO Extender 2 Port Module

The purpose of the PACIO Extender 2 Port Module is the extension of a PACIO block.

Technical Data	PACIO Extender 2 Port
Part number	PACIO-400-02
Controller	ASIC ET1200
Baud rate	100Mbit/s
Cable	CAT5
Cable length	Maximum 100m (328 feet)
EtherCAT connection	2 x RJ45
Power supply	via E-Bus
E-Bus load	160mA for Out1 / 210 mA for Out1+Out2

Terminals

Supply to the Module: via E-Bus

EtherCAT		
OUT1	RJ45-Socket	Output port (to the next EtherCAT-device)
OUT2	RJ45-Socket	Output port (to the next EtherCAT-device)

Status LEDs

The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The "Out2" and "Out1" LEDs indicate the physical state of the Ethernet ports to which they are allocated.

"EtherCAT Run" LED		
State	**LED Flash Code**	**Explanation**
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 3:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"In" LED, "Out" LED		
State	**LED Flash Code**	**Explanation**
No connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Exchanging telegrams

Function

The Extender Module changes the transmitting physics of LVDS (E-Bus) on a twisted pair. The Module is usually arranged at the end of the block (but this not required). In addition, the Extender Module can be used in an arbitrary place behind the bus coupler. Thus EtherCAT Slaves can also be connected in star topology. Standard hubs and switches are not recommended to be used for the EtherCAT network. If you need to have a star topology, it is recommended to use the Extender module.

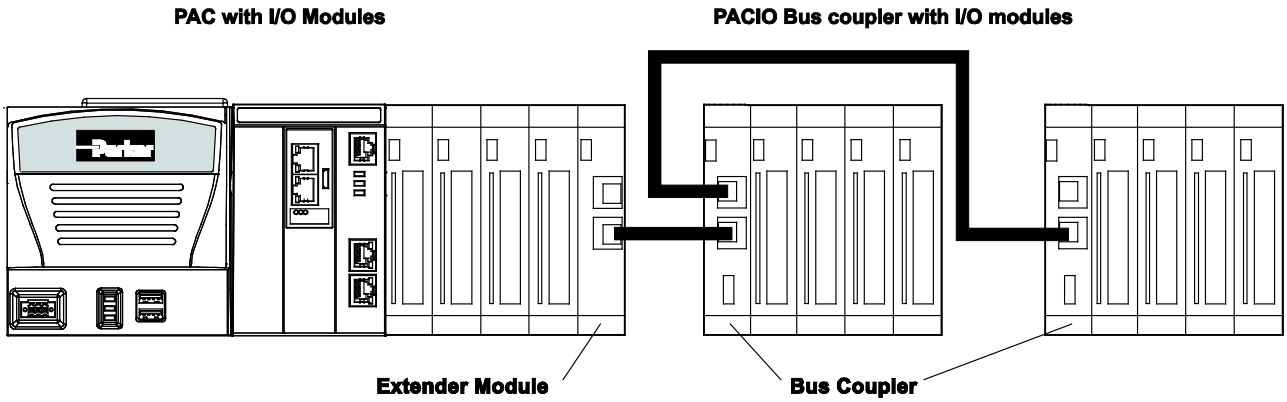
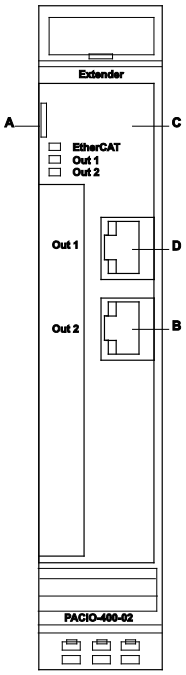


Diagram of how to use the Extender Module with the Bus Coupler for additional PACIO modules

CAUTION: Always use the appropriate XML file to review for the EtherCAT configuration.

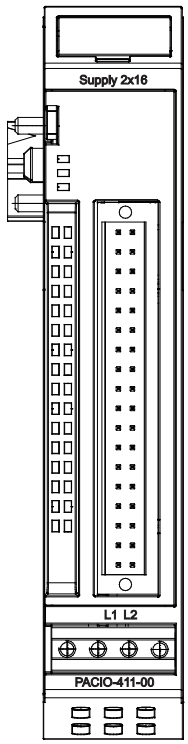
The Extender 2-port Module has four ports. The name 2-port Module was chosen because of the two standard, 100 base TX (OUT1, OUT2) RJ45 connections. Another two ports are covered by the E-Bus.

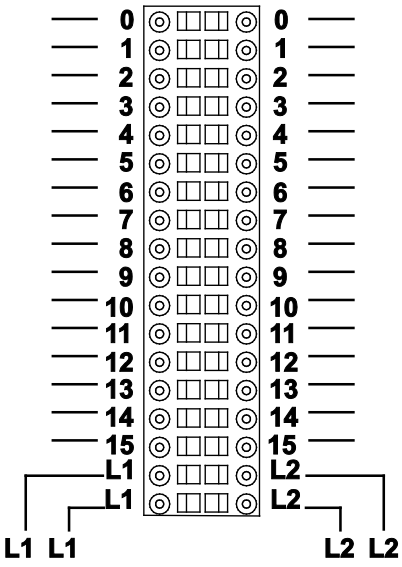
The sequence in which the connections are operated is important to the configuration (which way the EtherCAT frame runs).



Port	Connection	Sequence
Port A	E-Bus In	1
Port B	Out 2	3
Port C	E-Bus Out	4
Port D	Out 1	2

PACIO Power Distribution 2 x 16





Front view of PACIO Power Distribution 2 x 16 Module *Connections*

The PACIO Power Distribution 2 x 16 Module includes 2-wire or 3-wire terminals for digital I/O Modules.

Technical data	PACIO Power Distribution 2 x 16
Part number	PACIO-411-00
Connector potential	Plug 36-pole (43-026592-01)
E-Bus load	none

TERMINALS

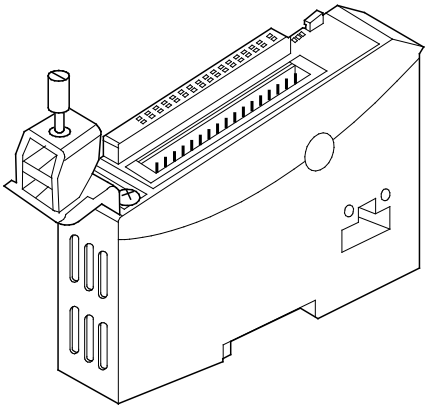
The PACIO Power Distribution 2 x 16 Module has two separate potential lines. The Module distributes the potential (optional 0 VDC or 24 VDC) attached at the pins L1 or L2 on the pins 0 to 15 of the same row.

The E-Bus is passed on from the previous Module to the next Module.

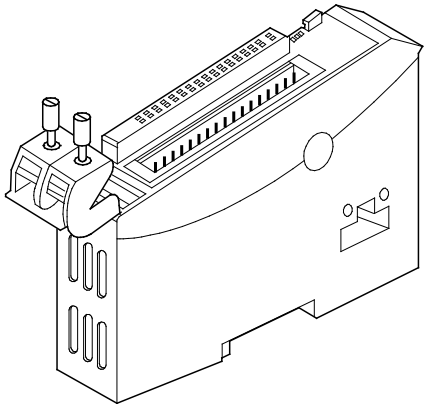
STATUS LEDS

The PACIO Power Distribution 2 x 16 Module has no Status LEDs.

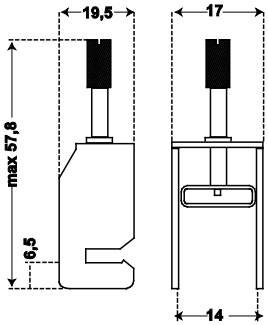
PACIO Shield Connection Terminal Block



PACIO Shield 14 mm



PACIO Shield 2x8mm



14mm Clamp

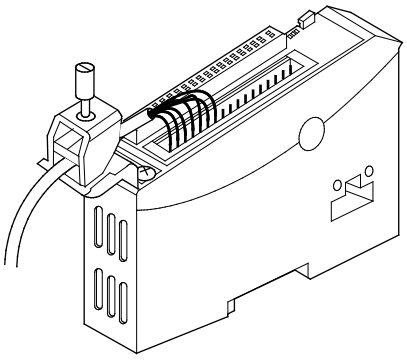
The PACIO Shield Connection Terminal Block consists of the shield clamp, the clamp holder, two screws M3x5, two washers, and two spring washers.

Technical Data	PACIO Shield Connection Terminal Block 2x8mm
Part number	PACIO-412-01
Shield clamp 8mm	2 pieces

Technical Data	PACIO Shield Connection Terminal Block 14mm
Part number	PACIO-412-02
Shield clamp 14mm	1 piece

Installation

Fasten the clamp holder by using the washers and spring washers on the housing of the PACIO Module. Use the tapped holes on the front side. They are provided for it.



Shield Terminal Block Example

Function

The shield connection terminal block makes it easy to apply the cable shield directly to any PACIO Module. These shield connections are useful in grounding the I/O wiring cable shields to Earth ground for EMI noise suppression.

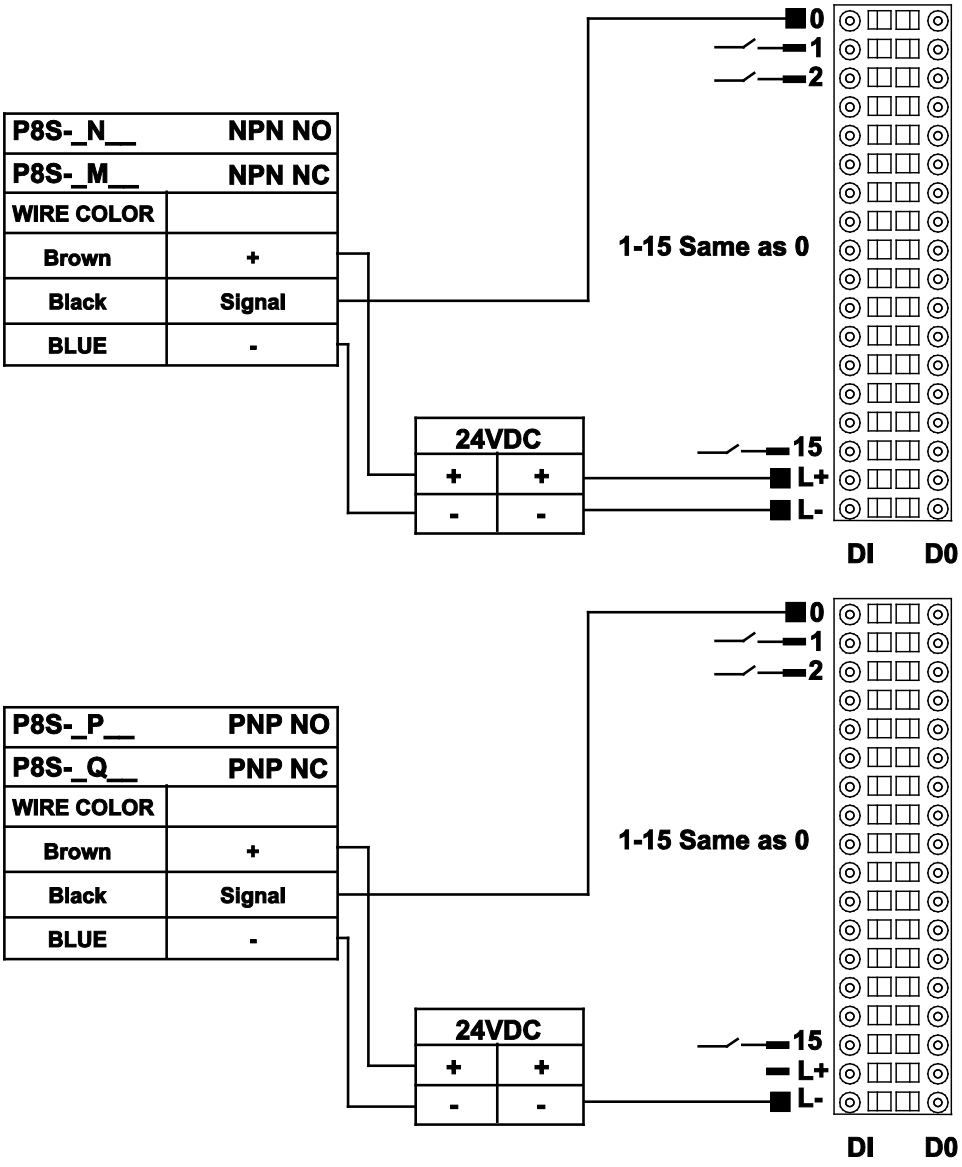
CAUTION: Ensure that the mounting rail has a suitable earth connection. For more information, see the chapter "Installation Guidelines."

CAUTION: Do not use the Shield Connection Terminal as a strain relief. A strong pull on the I/O cable can possibly unseat the PACIO Module from the DIN rail and damage adjacent modules and E-Bus communications.

PACIO Connections to Parker Sensors

This section shows wiring diagrams for common Parker Sensor to PACIO Modules. Typically you should wire your home and limit sensors to your EtherCAT drive. But if your application requires these sensors to be connected to the PAC, use the following diagrams.

PAC with P8S sensors

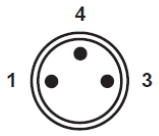


The above connections apply to both the P8S and P8S Mini-Global Sensors, shown on the next two pages.

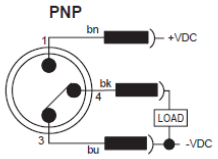
P8S Global Drop-In Solid State Sensors

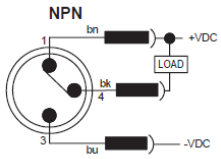
Type	Electronic
Output Function	Normally Open
Switching Output	PNP/NPN
Operating Voltage	10 - 30VDC
Continuous Current	200 mA max.*
Response Sensitivity	2.8 mT min.
Switching Frequency	5 KHz
Power Consumption	10 mA max.
Voltage Drop	2 VDC max.
Ripple	10% of Operating Voltage
Hysteresis	1.5 mm max.
Repeatability	0.1 mm max.
EMC	EN 60 947-5-2
Short-circuit Protection	Yes
Power-up Pulse Suppression	Yes
Reverse Polarity Protection	Yes
Enclosure Rating	IP 67
Shock and Vibration Stress	30g, 11 ms, 10 to 55 Hz, 1 mm
Operating Temperature Range	-25°C to +75°C (-13°F to 167°F)
Housing Material	PA 12, Black
Connector Cable	PVC
Connector	PUR cable w/8 or 12 mm conn.

Flying lead or 8 mm connector (shown)



Pin	Wire	Function
1	Brown	Operating voltage (+VDC)
4	Black	Output signal (N.O.)
3	Blue	-VDC



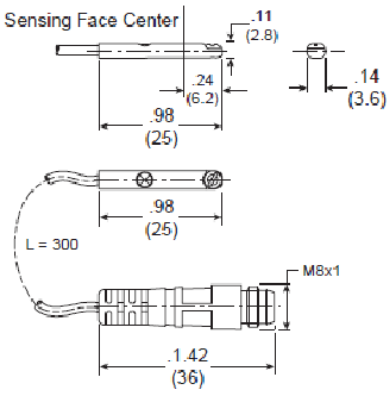


-XX	PART#	NPN/PNP	N.O. / N.C.	CABLE
003-3743-01	P8S-GNSHX	NPN	N.O.	0.2M with M8
	P8S-GNCHX	NPN	N.O.	0.2M with M8
003-3743-02	P8S-GPSHX	PNP	N.O.	0.2M with M8
	P8S-GPCHX	PNP	N.O.	0.2M with M8
003-3743-03	P8S-GMSHX	NPN	N.C.	0.2M with M8
	P8S-GMCHX	NPN	N.C.	0.2M with M8
003-3743-04	P8S-GQSHX	PNP	N.C.	0.2M with M8
	P8S-GQCHX	PNP	N.C.	0.2M with M8
003-3743-05	P8S-GNFLX	NPN	N.O.	3.0M FLY LEADS
	P8S-GNFAX	NPN	N.O.	3.0M FLY LEADS
003-3743-06	P8S-GPFLX	PNP	N.O.	3.0M FLY LEADS
	P8S-GPFAX	PNP	N.O.	3.0M FLY LEADS
003-3743-07	P8S-GMFLX	NPN	N.C.	3.0M FLY LEADS
	P8S-GMFAX	NPN	N.C.	3.0M FLY LEADS
003-3743-08	P8S-GQFLX	PNP	N.C.	3.0M FLY LEADS
	P8S-GQFAX	PNP	N.C.	3.0M FLY LEADS
003-3743-13	P8S-TMA0X	N/A	N/A	MOUNTING BRACKET

PART#	Description
003-2918-01	Extension Cable, 5m cable, M8 connector, flying lead, PVC jacket
003-2918-02	Extension Cable, 10m cable, M8 connector, flying lead, PVC jacket
003-2918-03	Extension Cable, 20m cable, M8 connector, flying lead, PVC jacket

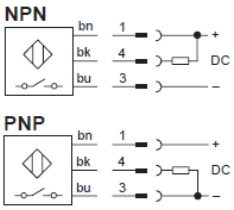
P8S Mini-Global Drop-In Solid State Sensors

OPERATING VOLTAGE..... 10-30VDC
CONTINUOUS CURRENT..... <70mA
RESPONSE SENSITIVITY..... <48 GAUSS
SWITCHING FREQUENCY..... 1000HZ
POWER CONSUMPTION.....<8mA WITHOUT LOAD
VOLTAGE DROP .....<2.5 VDC
RIPPLE.....10% OPERATING VOLTAGE
HYSTERESIS.....<15 GAUSS
REPEATABILITLITY.....+/- 0.1MM
EMC.....EN 60 947-5-2
SHORT CIRCUIT PROTECTION.....YES
POWER UP PULSE SUPPRESSION.....NO
REVERSE POLARITY PROTECTION....YES
ENCLOSURE RATING.....IP67
OPERATING TEMP.....-25°C TO +75°C
CONNECTOR CABLE.....PUR 3 X 0.09mm^2
CONNECTOR.....PUR CABLE W 8MM CONNECTOR



Wiring connection

Pin	Wire	Function
1	Brown	+VDC
4	Black	NO
3	Blue	- VDC



-XX	PART#	NPN/PNP	N.O. / N.C.	CABLE
003-4475-01	P8S-MQFLX	PNP	N.C.	3.0M FLY LEADS
	P8S-MQFLY	PNP	N.C.	3.0M FLY LEADS
003-4475-02	P8S-MQSHX	PNP	N.C.	0.3M with M8
	P8S-MQCHY	PNP	N.C.	0.3M with M8
003-4475-03	P8S-MMFLX	NPN	N.C.	3.0M FLY LEADS
	P8S-MMFLY	NPN	N.C.	3.0M FLY LEADS
003-4475-04	P8S-MMSHX	NPN	N.C.	0.3M with M8
	P8S-MMCHY	NPN	N.C.	0.3M with M8
003-4475-05	P8S-MPFLX	PNP	N.O.	3.0M FLY LEADS
	P8S-MPFLY	PNP	N.O.	3.0M FLY LEADS

003-4475-06	P8S-MPSHX	PNP	N.O.	0.3M with M8
	P8S-MPCHY	PNP	N.O.	0.3M with M8
003-4475-07	P8S-MNFLX	NPN	N.O.	3.0M FLY LEADS
	P8S-MNFLY	NPN	N.O.	3.0M FLY LEADS
003-4475-08	P8S-MNSHX	NPN	N.O.	0.3M with M8
	P8S-MNCHY	NPN	N.O.	0.3M with M8

PAC with 400XR series

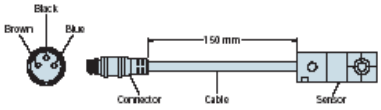
Home H_ or Limit Sensor L_

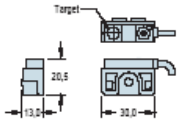
End of Travel and Home Sensors for the 400XR series are available in a variety of styles. The sensors can be ordered as part of the table or as separate components with the associated mounting hardware or in an enclosed sensor pack. A 5 meter "hi-flex" extension cable (Part No. 003-2918-01) is available for use with the 401XR thru 406XR models having the locking connector option.

Input Power	5-30VDC, 20mA
Output	100mA max
Wire Color Code	(+) Supply: Brown (-) Supply: Blue NO Output: Black NC Output: White

- NPN (Sinking) or PNP (Sourcing)
- Normally Closed (N.C.) or Normally Open (N.O.)
- Flying Leads or Locking Connector

Order Code	Part No.** (Includes Mounting Bracket)	Switch Type	Logic	Cable Length	Connector Option
H2 or L2	006-1639-01	N.C.	Sinking	2,0 m	Flying Leads
H3 or L3	006-1639-02	N.O.	Sinking	2,0 m	Flying Leads
H4 or L4	006-1639-03	N.C.	Sourcing	2,0 m	Flying Leads
H5 or L5	006-1639-04	N.O.	Sourcing	2,0 m	Flying Leads
H6 or L6	006-1639-09	N.C.	Sinking	150 mm	Locking Connector
H7 or L7	006-1639-08	N.O.	Sinking	150 mm	Locking Connector
H8 or L8	006-1639-11	N.C.	Sourcing	150 mm	Locking Connector
H9 or L9	006-1639-10	N.O.	Sourcing	150 mm	Locking Connector

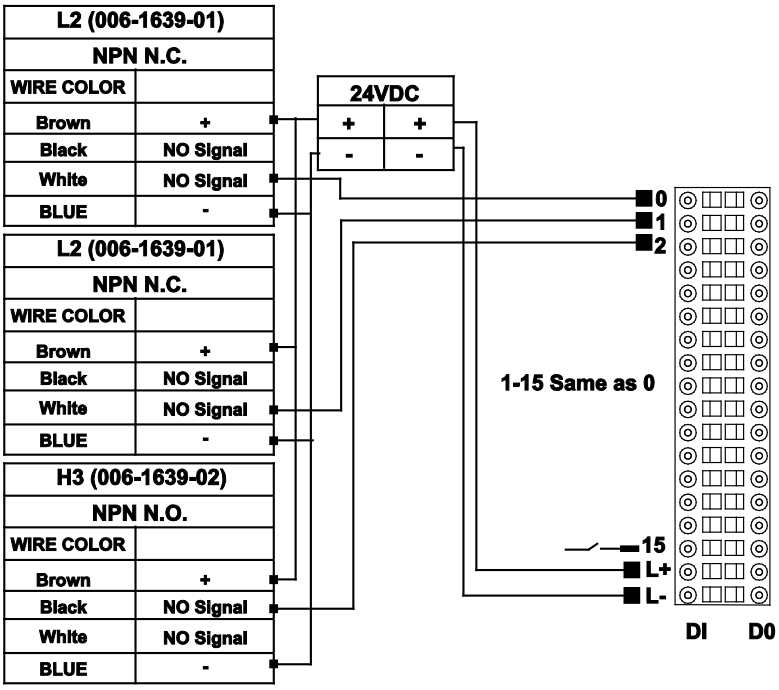


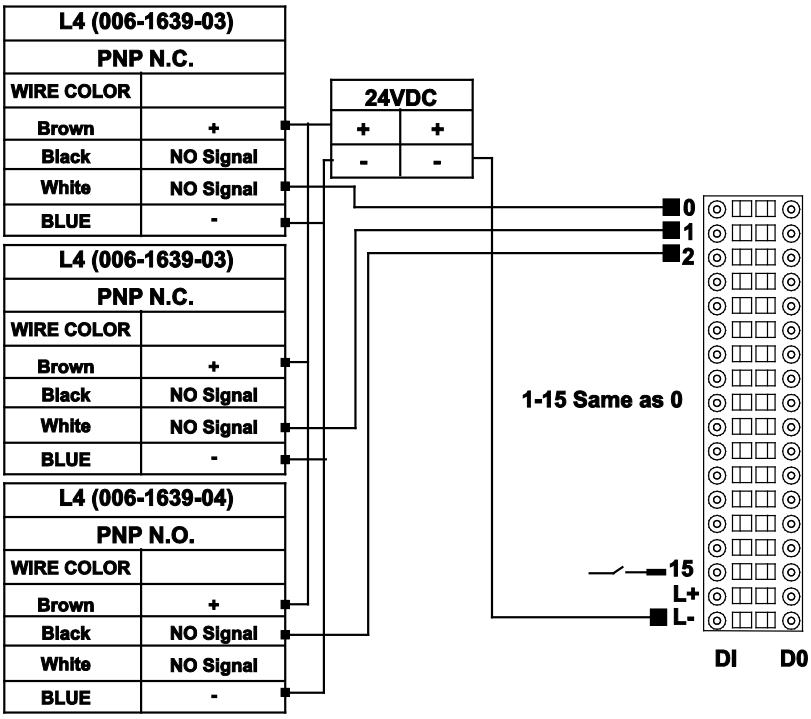


Sensor / Bracket Detail

* Applies to 401XR thru 406XR models. 412XR models have limits and homes internally mounted with a connector termination.

**Sensor triggers (targets) ordered separately.




L4 (006-1639-03)
PNP N.C.
WIRE COLOR
Brown +
Black NO Signal
White NO Signal
BLUE -
L4 (006-1639-03)
PNP N.C.
WIRE COLOR
Brown +
Black NO Signal
White NO Signal
BLUE -
L4 (006-1639-04)
PNP N.O.
WIRE COLOR
Brown +
Black NO Signal
White NO Signal
BLUE -
24VDC
+ +
- -
0
1
2
1-15 Same as 0
15
L+
L-
DI D0

PAC with 400LXR

Home Sensor

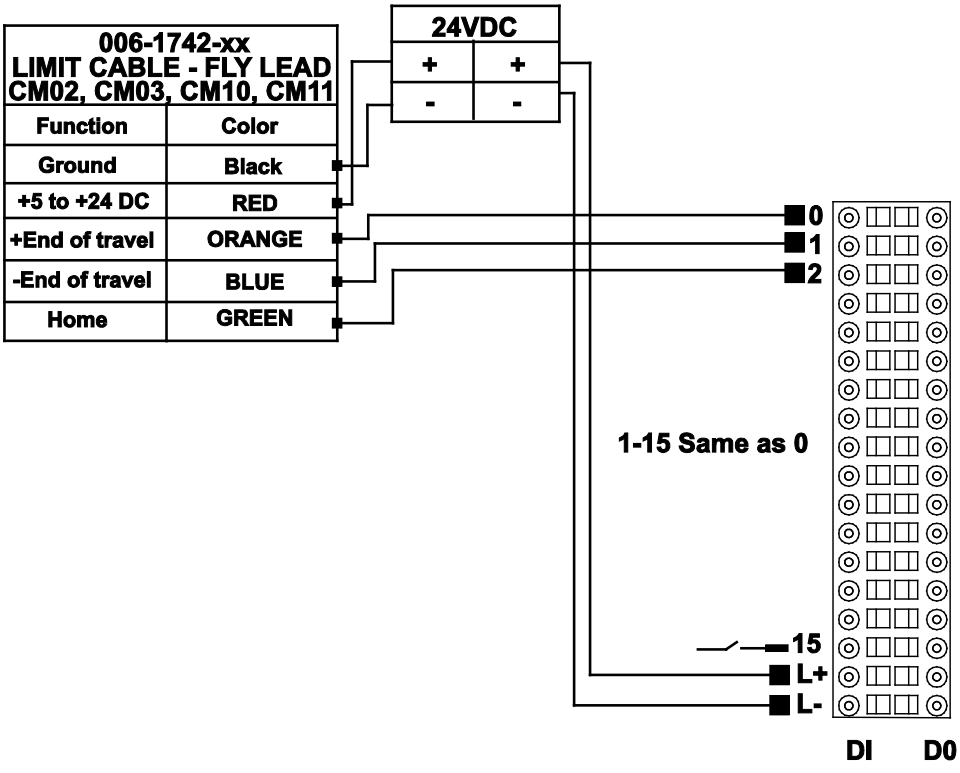
None-Free Travel (only)	H1
N.C. Current Sinking	H2
N.O. Current Sinking	H3
N.C. Current Sourcing	H4
N.O. Current Sourcing	H5

Limit Sensor

None-Free Travel (only)	L1
N.C. Current Sinking	L2
N.O. Current Sinking	L3
N.C. Current Sourcing	L4
N.O. Current Sourcing	L5

Limit and Home Sensor Specifications

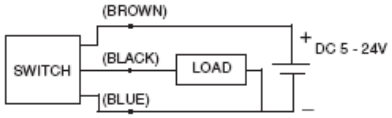
Description	Specification
Input Power	+5 to +24 VDC 60 mA (20 mA per sensor)
Output	Output form is selectable with product: Normally Closed Current Sinking Normally Open Current Sinking Normally Closed Current Sourcing Normally Open Current Sourcing All types Sink or Source maximum of 50 mA
Repeatability	Limits: +/- 10 microns (unidirectional) Home: See Z channel specifications



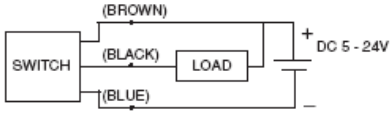
Hall Effect Sensors

Two types of Hall effect sensors are available for use with ET Series and ER Series actuators. The normally open sensor is typically used for mid-position sensing, such as homing applications. The normally closed sensor is generally used to indicate over-travel at the end of the stroke, and is used in a safety circuit to prevent damage to components caused by over-travel.

PNP Wiring Connection



NPN Wiring Connection



Note: End of travel sensors do not reduce available stroke.

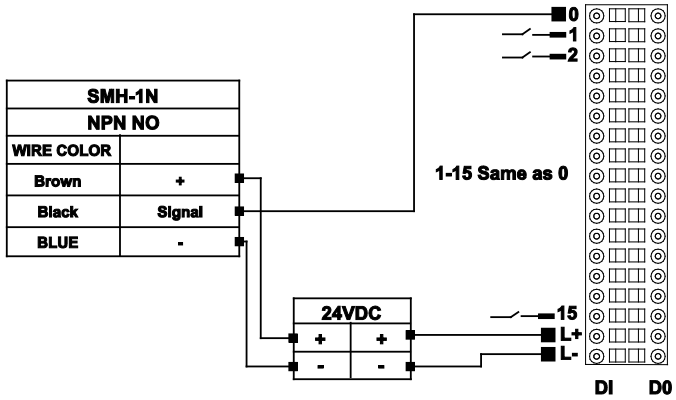
ZETA6104 controls use NPN sensors for Home and End-of-Travel.

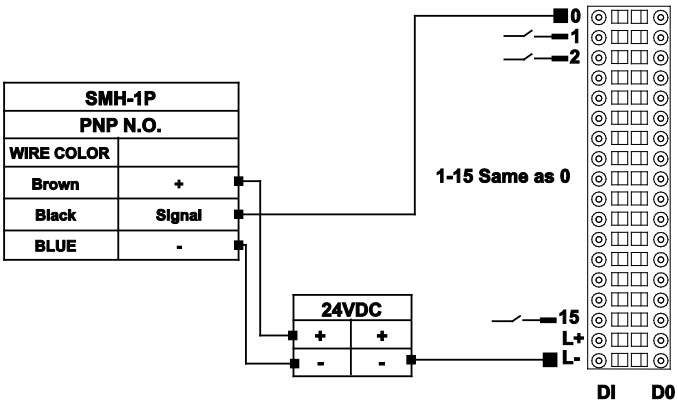
Specifications

Type:	Solid State Type (PNP or NPN)
Switching Logic:	Normally Open or Normally Closed
Supply Voltage Range:	5 - 24 VDC
Max. Switch Current:	150 mA
Current Consumption:	7 mA at 12 VDC, 14 mA at 24 VDC
Switching Response:	500 Hz Maximum
Residual Voltage:	0.8 V Maximum (150 mA)
Leakage Current:	10 uA Maximum
Insulation Resistance:	100 M Ohm min.
Min. Current for LED:	1mA
Operating Temperature:	-10° to 85°C (14° to 185°F)**
Lead Termination	1500 mm (60 in) or 150 mm (6 in) with connector
Industrial Protection:	IP67
Shock Resistance:	50 g's, 490 m/sec^2

Basic Connection Diagram (PNP and NPN)

- Brown: DC Voltage (5-24 VDC)
- Black: Limit Input
- Blue: Ground





CHAPTER 5:
Communication Interfaces (Optional)

Ethernet/IP Overview

The PAC can be ordered with and optional Ethernet/IP option. With this option the PAC can be configured to act as an Adapter and can produce (broadcast) tags that can be consumed (received) by a Rockwell ControlLogix® or CompactLogix™ PLC.

To produce tags, create a project using Parker Automation Manager

1. Open the Parker Automation Manager software, select 'File', 'New Project' and 'Standard project'. Choose OK.

2. Select the appropriate Device for use with the PAC. (PAC320-MXX2X-XX or PAC320-CXX2X-XX or PAC320-PXX2X-XX) and select Structured Text (ST) for the 'PLC_PRG ' option.

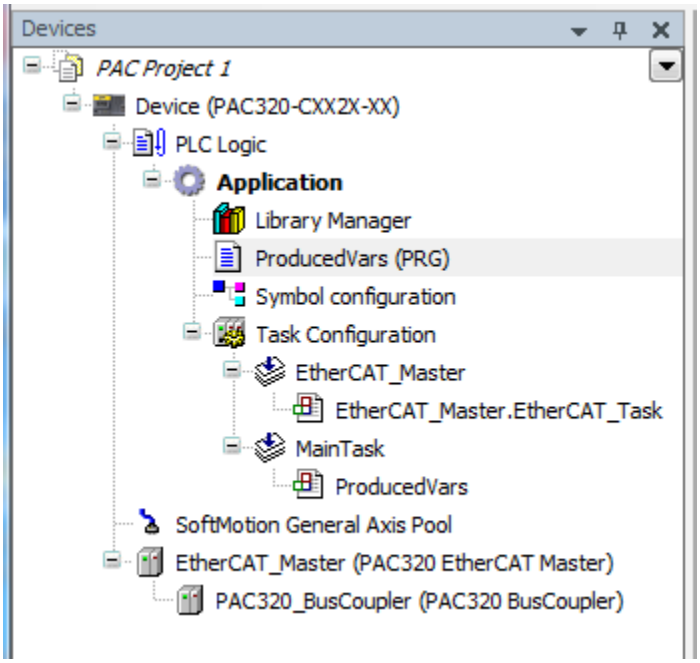
3. Choose OK

4. Right-click on 'PLC_PRG' (PRG) and select Properties.

5. Rename 'PLC_PRG' to 'ProducedVars'

Note: Tags being produced to be made available to the PLC MUST be in an object such as a Persistent Variables list, Global Variable List or POU and MUST be named 'ProducedVars'. Additionally, your PAM project can have only one object named 'ProducedVars'.

6. You will also need to rename the reference to 'PLC_PRG' in the Main Task Branch. Rename this to ProducedVars.



7. Double-click ProducedVars (PRG) in the tree.

8. Enter the following text into the Declarations section of this POU.

```
PROGRAM ProducedVars
```

```
VAR
    ControlLogix: DINT;
END_VAR
```

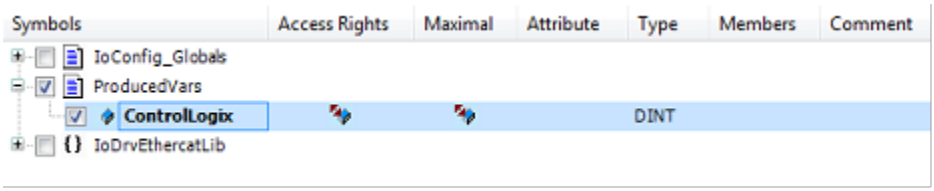
9. Enter the following text into the Program section of this POU.

```
IF ControlLogix < 200 THEN
    ControlLogix : = ControlLogix + 1;
ELSE
    ControlLogix : = 0;
END_IF
```

10. Double-click on Symbol configuration to open the symbol configuration worksheet.

11. At this point, you will select 'Build' from the upper menu bar. Choose 'Build'.

12. You will see a branch titled 'ProducedVars'. Expand that location and select the ControlLogix variable listed as shown below. In order to expose a tag, the check box needs to be checked for each of these tags.



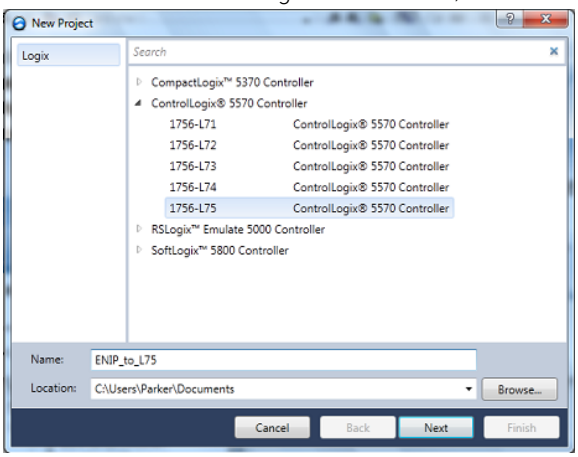
13. Provided you have no errors, select 'File', 'Save Project As…' and name the project 'My Project'.

14. Download your project to the PAC controller.

Studio 5000 Configuration

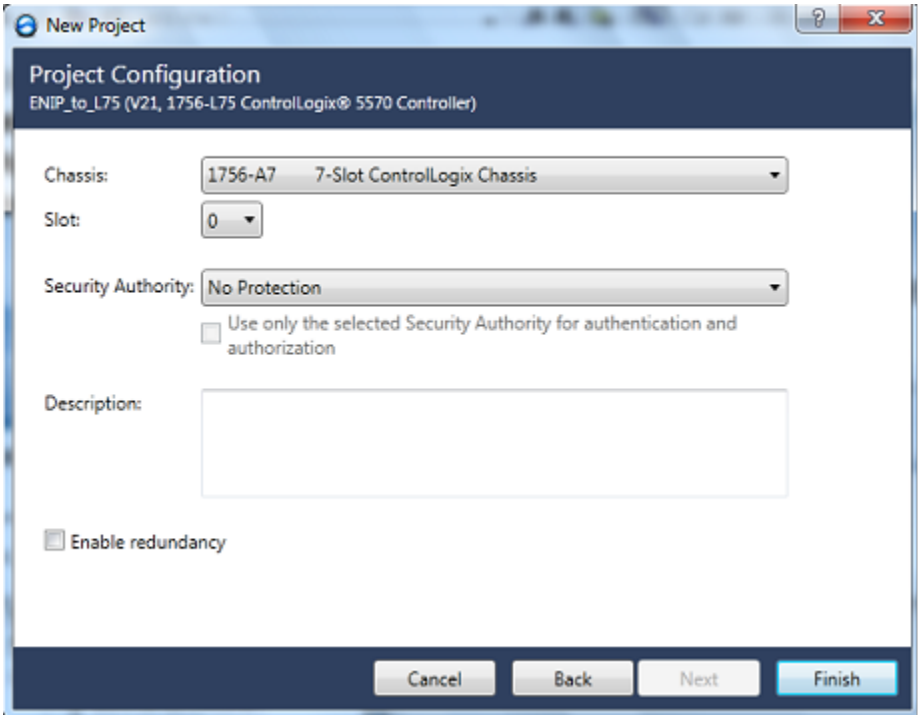
1. Open Studio 5000 Software, select "New Project" and enter a name for the project. (Example: ENIP_to_L75)

2. Under the ControlLogix 5570 Series, select 1756-L75. Configure a new controller as displayed below:



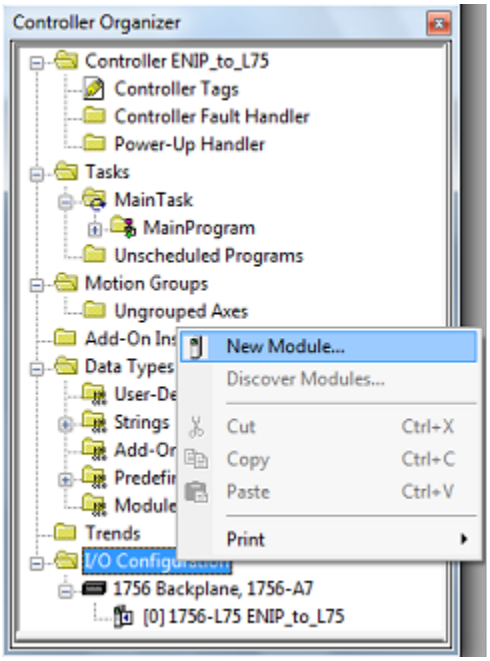
3. Select "Next"

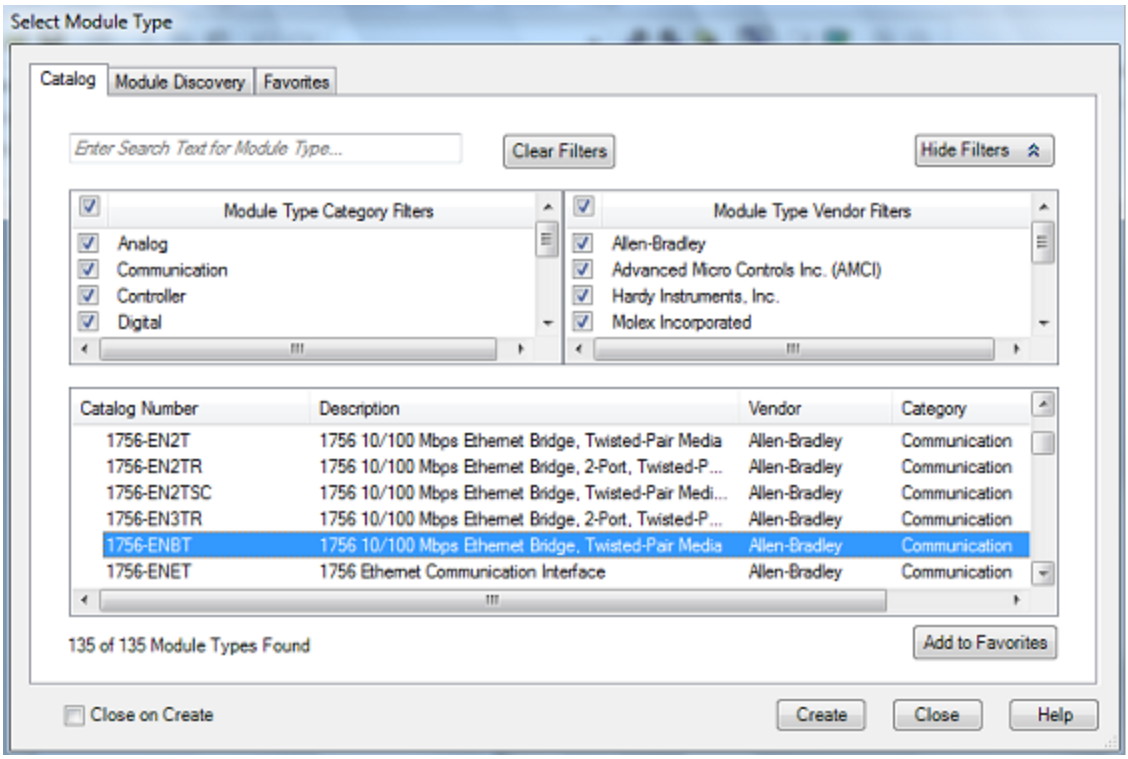
4. Enter Chassis size. For this particular example, a 7-slot chassis is chosen and the processor is located in Slot 0.



5. Choose "Finish"

6. In the tree, right-click on I/O Configuration and choose New Module. Choose as shown. This will represent the network module you are communicating with from the PLC. For this example, you will select the 1756-ENBT module.

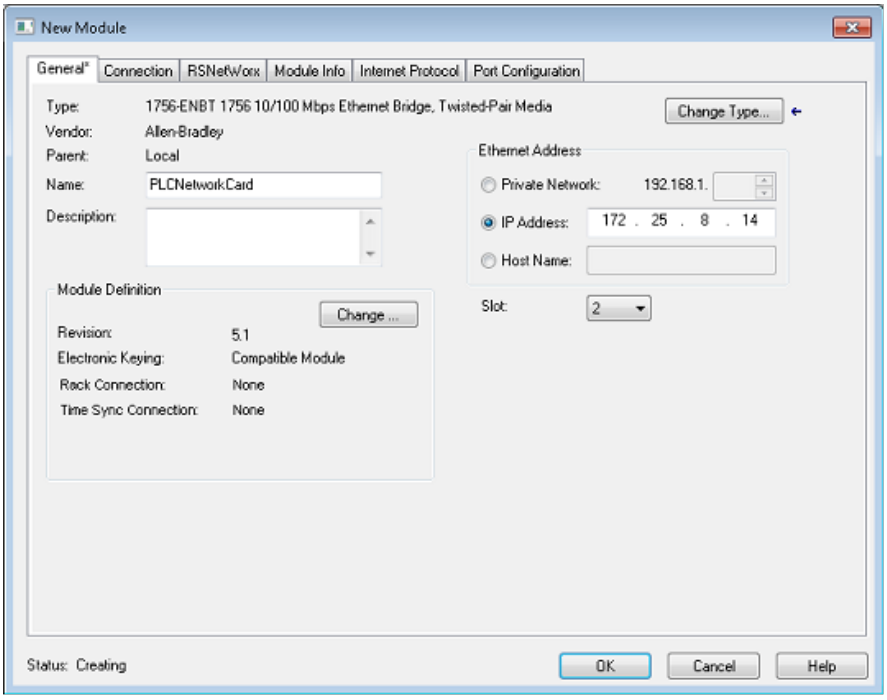




Note: If the module you are looking for is not listed, reference the Rockwell Automation web site(rockwellautomation.com) for information on how to install additional .eds file.

7. Choose "Create"

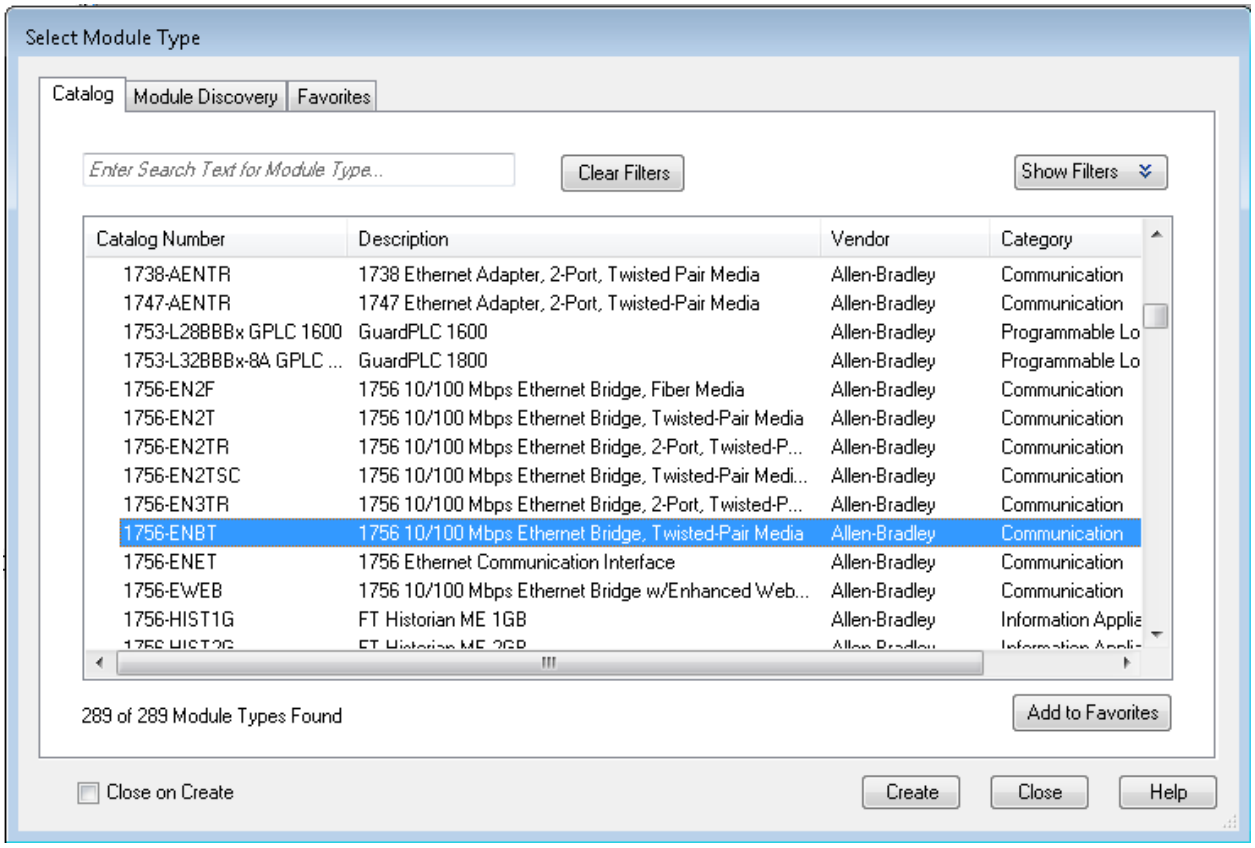
8. Configure the menu that displays as shown. Enter the IP address for this module. It is also important that you configure the correct slot number that the module occupies



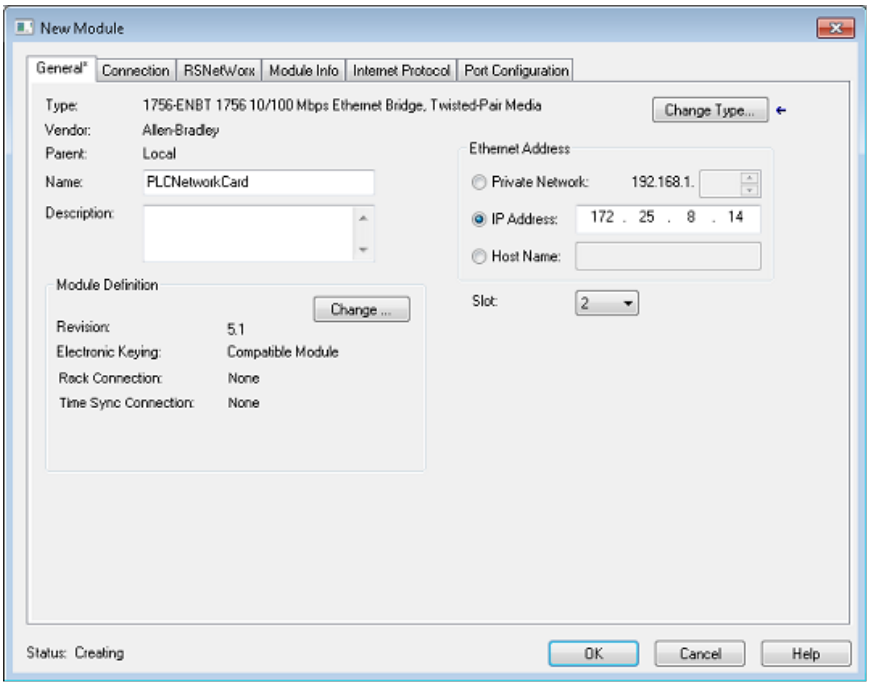
9. Choose "OK"

10. Right-click on what you just added, [2] 1756-ENBT, and select New Module.

11. Select new module as shown:



12. Configure the new module as shown below. This represents the PAC unit you will be communicating with. What is important here is to configure the IP Address of the PAC unit and to enter a name for the network interface to the PAC, in this case "PACNetworkCard." Also, you MUST set the Rack Connection option to "None."

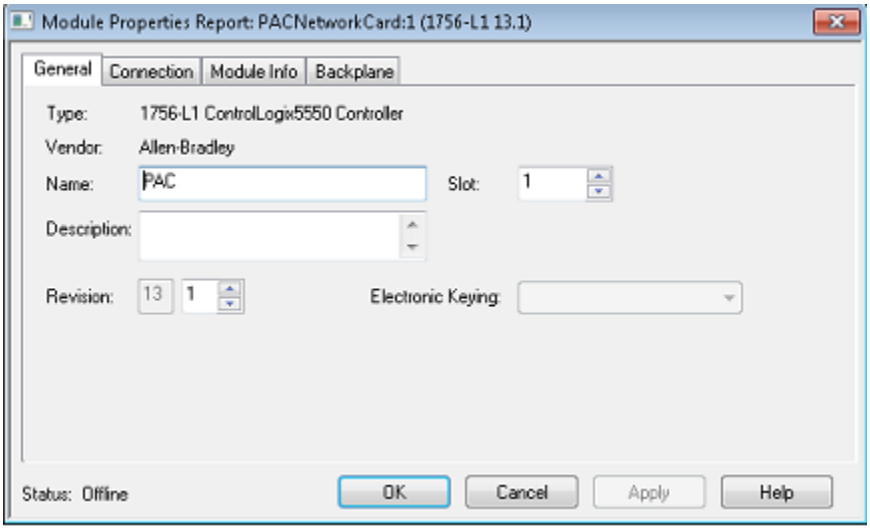


13. Choose "OK" and close the Module selection screen.

14. Right-click on what you just added, 1756-ENBT PACNetworkCard and select the 1756-L1 catalog number.

15. Choose "Create"

16. The only thing that must be entered is the name representing the PAC unit. Enter "PAC"

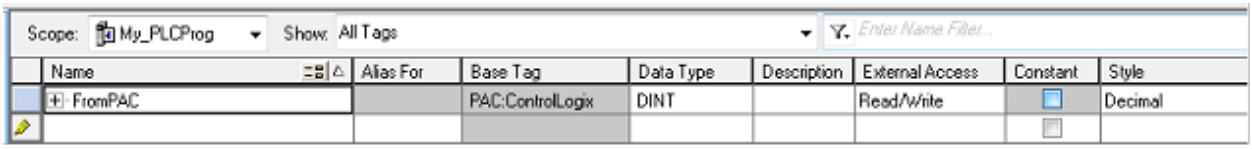


17. Choose "OK"

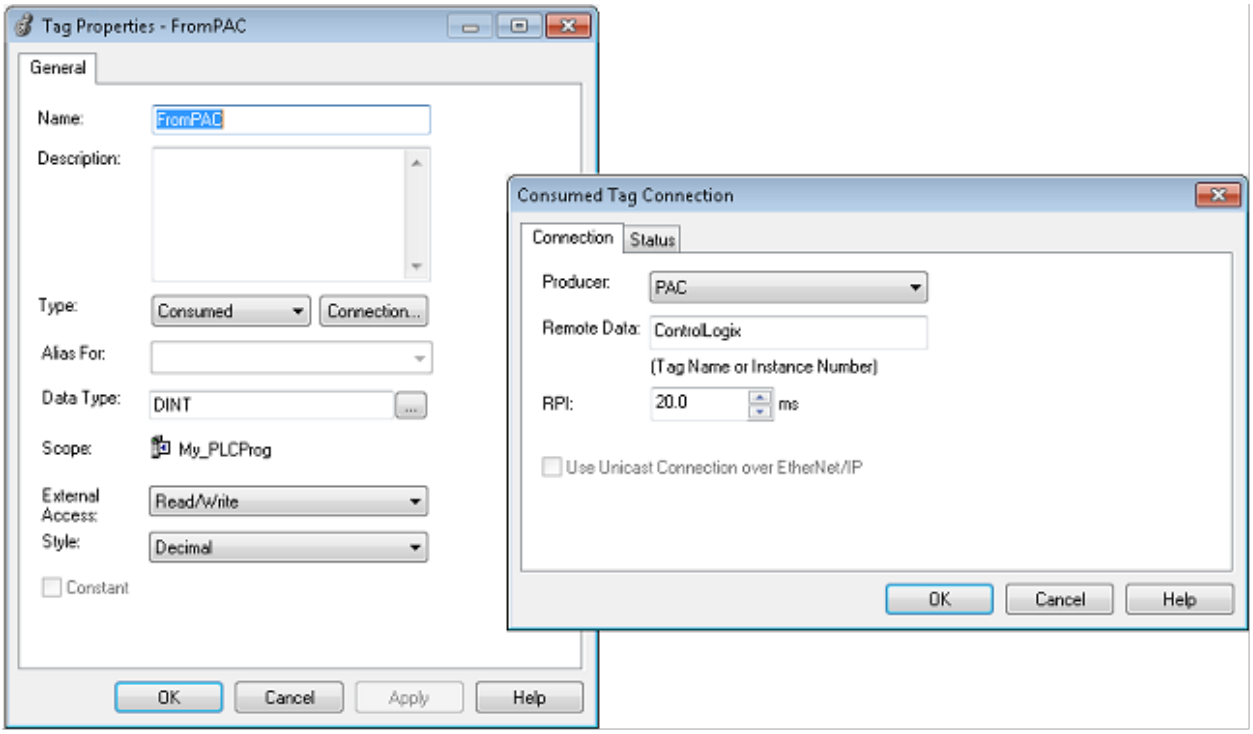
18. Near the top of the tree, double click "Controller Tags" and choose "Edit Tag" tab.

19. Double-click in an empty space under "Tag Name"

20. Create a tag called "FromPAC" and hit enter

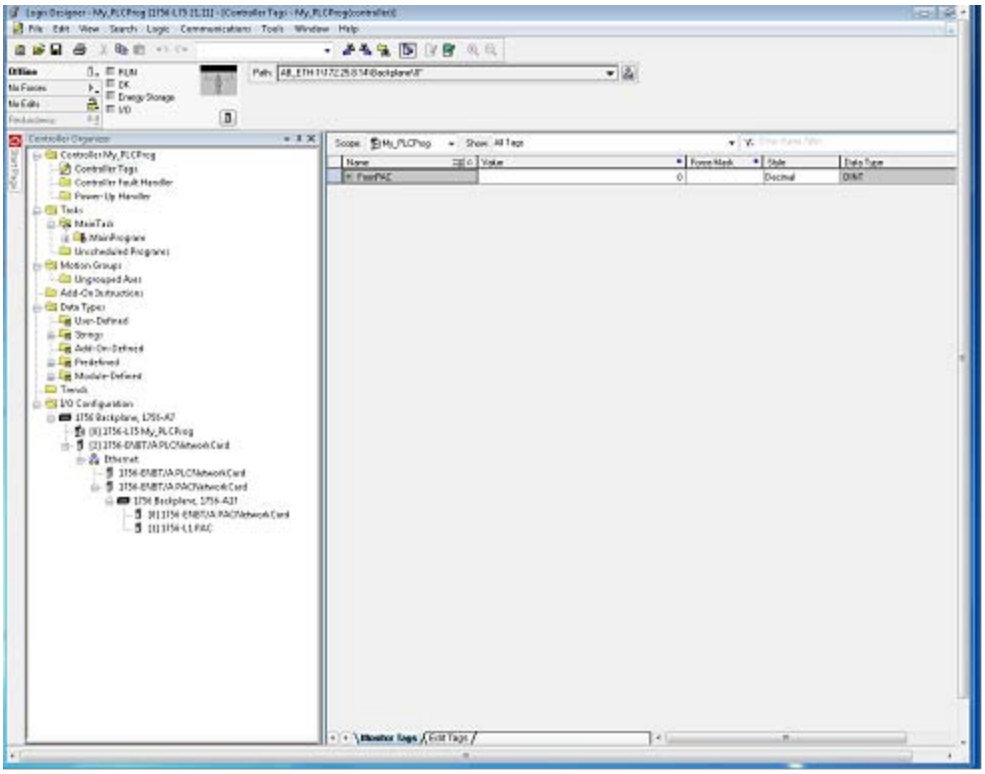


21. Right-click that tag and choose "Edit Tag Properties" and enter the following:



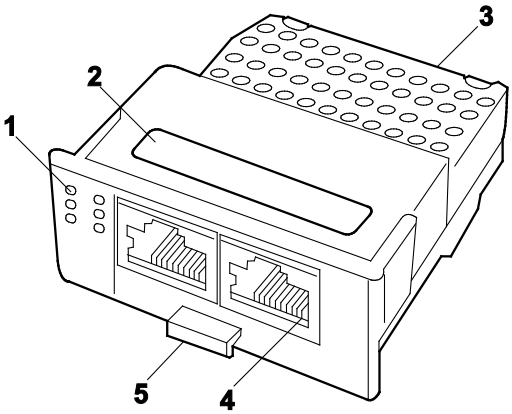
22. Select the Connection tab and configure as shown in the right graphic above.

23. Save the project, download to the controller and enter Run mode with your devices. Select the Monitor tab to view the data.



PROFINET Overview

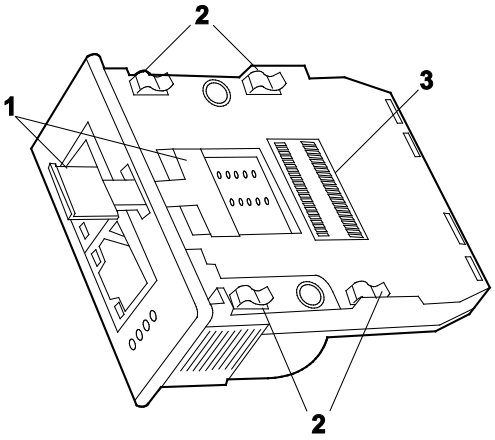
The illustrations below show top and bottom views of the optional Communication Module for the PAC.



Top view of Communication Module

Number	Description
1	Status LEDs
2	Device label
3	Ventilation posts

4	Network interfaces
5	Sliding latch



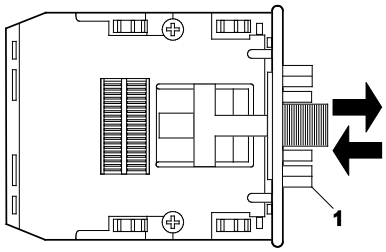
Bottom view of Communication Module

Number	Feature Name	Description
1	Sliding latch	Locks the Communication Module into the PAC. Used to remove and insert the Module into the Controller.
2	Brackets	Affixes the Communication Module to the carrier board of the PAC. Also provides an Earth ground connection for EMI shielding.
3	Connector	Interfaces with the PAC

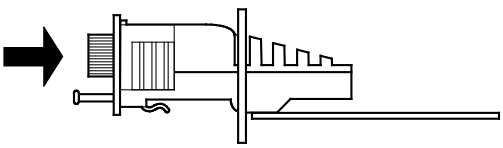
Installation

1. First, remove power from the PAC Controller.

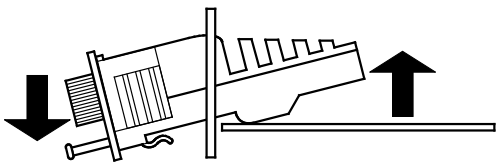
2. Set the sliding latch located on the underside of the Communication Module to the mounting position. Pull the handle of the sliding latch half way out of the module. Mounting position 1 is reached when the latch is approximately at the center position of the guiding rails.



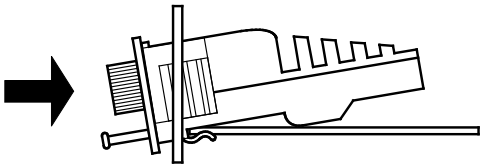
3. Insert the module approximately half way into the cutout opening on the face of the Controller.



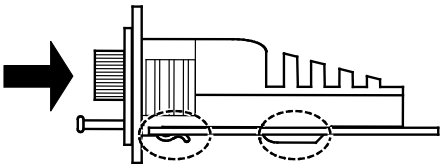
4. Tilt the module slightly downwards and push it further into the Controller.



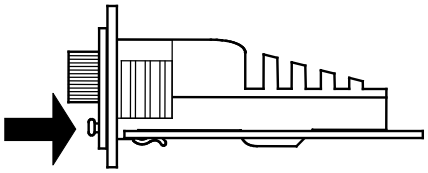
5. Push the module further into the unit until it engages into the internal board cutouts.



6. Push the Module further into the Controller until the final position is reached and the module cannot be further inserted.

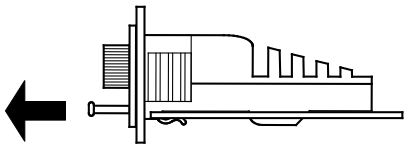


7. To lock the Module into the Controller, push the handle of the sliding latch fully into the Module.

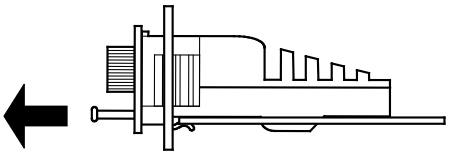


Removal

1. Remove power from the PAC Controller.
2. To unlock the Communications Module, pull the handle of the sliding latch out of the module.



3. While holding on to the handle of the sliding latch, pull the Module fully out of the housing of the Controller. A little strength may be required to overcome the resistance of the brackets clamping onto the internal carrier board.



Configuration of PROFINET Communications Module

This section describes a step-by-step instruction on connectivity of a PAC to a Siemens S7 controller communicating PROFINET by way of the PROFINET communication module.

Hardware:

- PAC320 with PROFINET Module
- Siemens CPU315-2 PN/DP

Software:

- Parker Automation Manager
- Siemens S7 315-2 PN/DP

Parker Automation Manager Configuration

1. Open **Parker Automation Manager** and select **File / New Project.**
2. Select the **Empty Project** template and choose **OK.**
3. Select **File / Save Project As**... and give the name '**PROFINET Communication Tutorial'.**
4. Right-click on the new name in the tree and select **Add Device.**
5. On the menu that appears, select the pulldown next to **Vendor** and choose **'Parker Hannifin'.**
6. Select 'Parker...'(PAC320 Controller) and **Add Device**, then **Close.**
7. Right-click on **Application**, select **Add Object** and choose **POU.**
8. Name the POU **PLC_PRG**, create this to be a **Program** and use the **Ladder Logic Diagram (LD).**
9. Choose **'Add'.**

10. Right-click on **Task Configuration.**
11. Choose **'Add Object'** and **'Task'.**
12. Name this task **'MainTask'.**
13. Choose **'Add'.**
14. Right-click on **MainTask,** choose **Add Object** and select **Program Call.**
15. Select the **'...'** and choose **PLC_PRG** found in the **Application** branch then select **Add.**
16. Right-click on **PAC320-xxxx-xx....** and select **Add Device.**
17. Set Vendors to **'All Vendors',** expand **'PROFINET IO',** expand **PROFINET IO Device.**
18. Select the **NetX PN Device**
19. **Change the name in the dialog box from 'NetX_PN_Device' to 'PAC_PROFINET' and** then choose **Add Device** and select **Close.**
20. Right-click **PAC_PROFINET in the device tree** and choose **Add Device.**
21. Choose **1 Byte Digital Input** and **Add Device.**
22. Choose **1 Word Digital Input** and **Add Device** then **Close.**
23. Double-click the **1_Byte_Digital_Input** branch and to the right, select the **PNIODev-Module I/O Mapping** tab.
24. Expand the '+' in the variable column and double-click in that same column; the entry for Bit0. Create the variable name **'S7_Bit_0'.**
25. Double-click the **1_Word_Digital_Input** branch and to the right, select the PNIODev-Module I/O Mapping tab.
26. Expand the '+' in the variable column and double-click in that same column, the entry for Bit0. Create the variable name **'Word_Bit_0'.**
27. Double-click on **PLC_PRG** and enter the following text into the worksheet:

```
PROGRAM PLC_PRG
VAR
    SInBitA: BOOL;
END_VAR.
```

1. Select the graphical ladder portion of the worksheet. Right-clicking in this area *below* the variables you entered will allow you to enter rungs of logic. (You will see the number 1 displayed in this worksheet area) Choose **Insert Contact**, select the **'???'** above the contact and then select the **'...'**. Choose **SInBitA** then close the menu.
2. Right-click on the rightmost rectangle to the right of the contact you entered and select **Insert Coil**
3. Select the **'???'** above the coil, **'...'** and expand the **IoConfig_Globals_Mapping** branch. Select **'S7_Bit_0'** from the list

4. Using the same method, create another rung below the first.
5. Right-click in the ladder worksheet area and choose **Insert Contact**, select the **'???'** above the contact and then select the **'...'**. Open the **IODrvEthercatLib** section of the menu and choose **SInBitA** then close the menu.
6. Right-click on the rightmost rectangle to the right of the contact you entered and select **Insert Coil.**
7. Select the **'???'** above the coil, **'...'** and expand the **IoConfig_Globals_Mapping** branch. Select **'Word_Bit_0'** from the list.
8. Double-click the NetX_PN_Device portion of the tree.
9. Select the PNIO identification tab and enter the following values:

- IP Address: 192.168.0.1
- Subnet Mask: 255.255.255.0
- Default Gateway: 0.0.0.0
- Station Name: PAC

Siemens S7 Configuration

This section describes configuration of the Siemens S7 controller. This document uses the Siemens model CPU315-2 PN/DP controller. Consult the appropriate documentation for communication with other controllers.

1. Open Simatic Manager.
2. Select **File/New.**
3. Enter the project name **'PLC_Project_001'.**
4. Click **OK.**
5. Right-click in right window and click **Insert 'New Object'.**
6. Click **'Simatic 300 Station'.**
7. Double-click **'Hardware'**.
8. Right-click in left window and choose **'Insert Object'**, choose **Simatic 300, Rack 300, Rail**
9. Select **PS 307 5A.**
10. Open **Simatic 300 branch.**
11. Open **CPU 315-2 PN/DP.**
12. Open **6ES7-315 2Eh13-0AB0.**
13. Drag this to Slot 2.
14. Set the IP to 192.168.0.66.
15. Set the Mask to 255.255.255.0.
16. Click **OK.**

PROFINET Settings

This section is the primary requirement for appending PROFINET communication to existing systems.

Note: Acquire the PROFINET related CoDeSys GSD file for use with CoDeSys product. The file is called GSDML-V2.1-3S - Smart Software Solutions GmbH-CoDeSys PLC-20120822.xml and by default, it is installed at this file location:

C:\Program Files(x86)\Parker Hannifin\ParkerAutomationManager\Communication Interface Files\Profinet GSD Files.

Load this and any additional GSD files for supporting hardware by choosing 'Options' 'Install GSD File'.

1. Select PROFINET IO.
2. Right-click on the PN-IO (X2 Port) of the PLC grid in the upper left.
3. Click Insert 'PROFINET IO System'.
4. (You will see a network branch appear in the graphical display. This will allow you to add the PAC. PROFINET device to the configuration).
5. In the right window listing devices, select the 'PROFINET IO' branch.
6. Select Additional Field Devices.
7. Select IO.
8. Select PAC.
9. Select PAC PN Device and drag it to the PROFINET network branch you just created.
10. Double click the new node.
11. Set the Device Name to "PAC"
12. Select "Ethernet"
13. Assign the IP to 192.168.0.1 (note: The IP Address and the Station Name has to match the IP Address and Device Name on the PROFINET Network within the Siemens Step 7 Software.
14. Click OK.
15. Click OK
16. Expand the PAC PN Device node from the tree on the right
17. Drag 1 Byte Digital Input to Slot 1 on the green grid on the left
18. Drag 1 Word Digital Input to Slot 2 on the green grid on the left.
19. Save the project.

CHAPTER 6:
Troubleshooting

Troubleshooting Overview

The PAC Controller features LEDs on the front panel of the Controller and PACIO Modules which provide quick identification of the device status. After installation, if your Controller does not function properly, use the guidelines and procedures in this chapter to troubleshoot. These guidelines also apply to troubleshooting a malfunction during normal operation of the Controller.

First Troubleshooting Steps

The first step in troubleshooting is to check the power-status LED on the front panel of the Controller. The table below describes the normal operational states of the Power LED and troubleshooting actions.

Power LED	What It Means
Off	The PAC detects no power source. ■ Verify that the power source meets the requirements. ■ Check for disconnected power cable, blown fuses, and so forth.
Green/Blue	Normal operation
Red	24V is present, but an internal power rail has malfunctioned. ■ Contact Parker Hannifin Technical Assistance.

General Troubleshooting Procedures

Use the following list as a guideline for troubleshooting. The remaining sections of this chapter provide procedures for each of the guidelines in the list.

1. Check the status-indicator LEDs for power.
2. Check the Run/Stop and Error LEDs to determine where the PAC is in the Boot/Runtime sequence (see table below).
3. Check the FAQs at www.parkermotion.com.

LED Status Indicators

General Status LEDs

General Troubleshooting	
None of the LEDs are illuminated	Check wiring, fuses, and input power.
Power LED does not turn blue	Check wiring, fuses, and input power.
Power LED is Red	Internal power supply is not functioning.
Error LED is Red	Refer to the Error LED information (information below)
Program is not running	Check the Run/Stop LED status (table below).
Power LED is Blue	End State Status: Run/stop is red, green or off, error is off.
No end state is achieved	Check the LED sequence table to determine where it stops.
Power LED does not illuminate	Check wiring, fuses, and input power.

System Status LEDs

Run/Stop LED

During the Boot process:	
Off (Error LED is Off as well)	The BIOS has not yet loaded.
White (Along with Error LED turning Red)	The BIOS is loading.
Flashing Red (Along with Error LED turning off)	The BIOS has handed control to the Bootloader on the SD card.
Flashing Yellow (Error LED is Off)	The Bootloader has finished loading the Runtime image into RAM and the Operating System is starting.
Flashing White (Error LED is Off)	The Operating System is loaded and the Runtime System is starting.

During Runtime:	
Red	No program is running.
Green	Programs are running.
White	The button is pressed.

Error LED

During the Boot process (Run/Stop LED is White):	
Off	A bootable device has been detected and control is handed off to the Bootloader on the SD card.
On	A bootable device has not yet been detected.

During Runtime:	
Off	The runtime system has not detected an error.
On	An error has been detected by the runtime system.

PAC Error LED

The PAC Error LED may turn solid red due to any of the following conditions listed below. To determine the exact failure, refer to the log files that are accessible with the Configuration Tool in the About Tab (see page 43, About the PAC). The two files that contain the error logs are: PAC Runtime Config Log File and Retentive Memory Log File.

If the Error LED turns on, the follow these steps to try and resolve the issue:

- Power Cycle the PAC
- Reload the project to the PAC
- Restore the SD using the Flashback Utility (see page 160)
- Contact Technical Support with specific information about the error

Here is a list of possible recoverable errors:

- Memory allocation failures
- No applications have been successfully loaded upon startup

- The *.app file is missing
- I/O system errors occur when copying files from the USB stick drive
- An error occurs when restoring the backup NK.bin
- An error occurs when copying the default project to the \project folder on the SD card
- An error occurs when initializing the retentive memory chip
- The retentive memory chip signals an error
- An error occurs when copying files to the SD card root directory
- The model number is invalid or missing

EtherCAT Connection

There are a variety of reasons for problems with the EtherCAT connection:

- The PAC does not find the EtherCAT slave
- There is a device conflict
- The cable is not connected
- There is no XML file

Troubleshoot the following:

- EtherCAT Network state
- Link activity for the Fieldbus LED
- Link activity for the E-Bus

EtherCAT Status LEDs

There are three LEDs located directly below the EtherCAT connector X1.

ECAT Run:

- Off – The EtherCAT network is off-line.
- On – The EtherCAT network is running.

E-Bus Link/Act:

- Off – The E-Bus does not have a link.
- On – The E-Bus link is detected.
- Blinking - The E-Bus link is detected and there is activity.

X1 Link/Act:

- Off – The EtherCAT fieldbus does not have a link.
- On – The EtherCAT fieldbus link is detected.

- Blinking - The EtherCAT fieldbus link is detected and there is activity.

Ethernet Connection

Perform the following steps to resolve Ethernet network problems:

1. Verify that you are using the correct type of cable
2. Ethernet Status LEDs

Ethernet Status LEDs

The Ethernet status LEDs are located on the Ethernet connector. If there is not Link activity, ensure that the cables are securely connected.

The top-right LED on connectors X2 and X3 indicates the connection speed:

The color of the LED signifies the speed of the connection.

- Off – 10 Mb/s
- Green – 100 Mb/s
- Orange – 1000 Mb/s

The bottom-right LED on connector X2 and X3 indicates link and activity status:

- Off – No link
- On – Link is detected
- Blinking – Link is detected and there is activity

If the PAC is unable to connect to the Ethernet Connection, perform the following:

- Verify the IP address
- Attempt to connect the PAC through a browser with the PAC Configuration Tool
- Ping the IP address through the command prompt
- Verify the cable connections
- Verify the RJ485 LED indicators
- Press the push button to log the IP address to the SD card. Using an SD card reader, open the "IP _Address_Info.txt" file to verify the IP address of the PAC.
- Examine the .INI file to determine the last IP address that was set
- Examine the Config Tool Log to verify the last IP address change

USB Troubleshooting

Verify the USB stick/drive is securely attached to the unit. Also, I/O system errors may occur when there is an issue copying files from the USB drive.

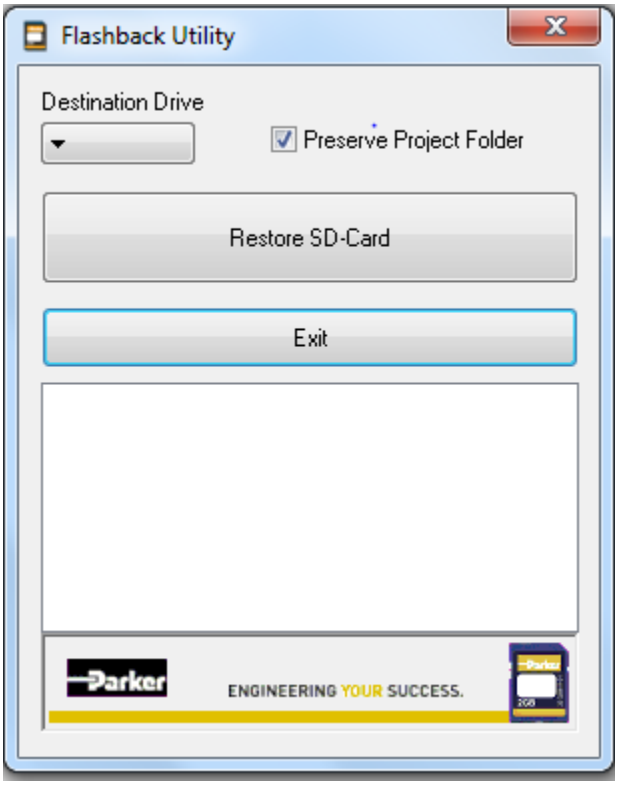
Flashback Utility

The Flashback Utility is a tool for restoring or upgrading the PAC's firmware and operating system onto the SD card. The Flashback utility can be found on-line via the PAC product page: parkermotion.com/globalpac. Before you run the utility, you need a computer that has a native or external SD card reader/writer. You can use the flashback utility when:

- A new version of the PAC firmware is available
- The user wishes to create a backup copy of the SD image
- The factory supplied SD cards becomes corrupt or unusable

Complete the following steps to restore your SD card with the Flashback Utility:

1. Save the Flashback_PAC.exe executable on your computer from www.parkermotion.com/globalpac.
2. Insert the SD card into SD card reader/writer.
3. Run the Flashback_PAC.exe program.



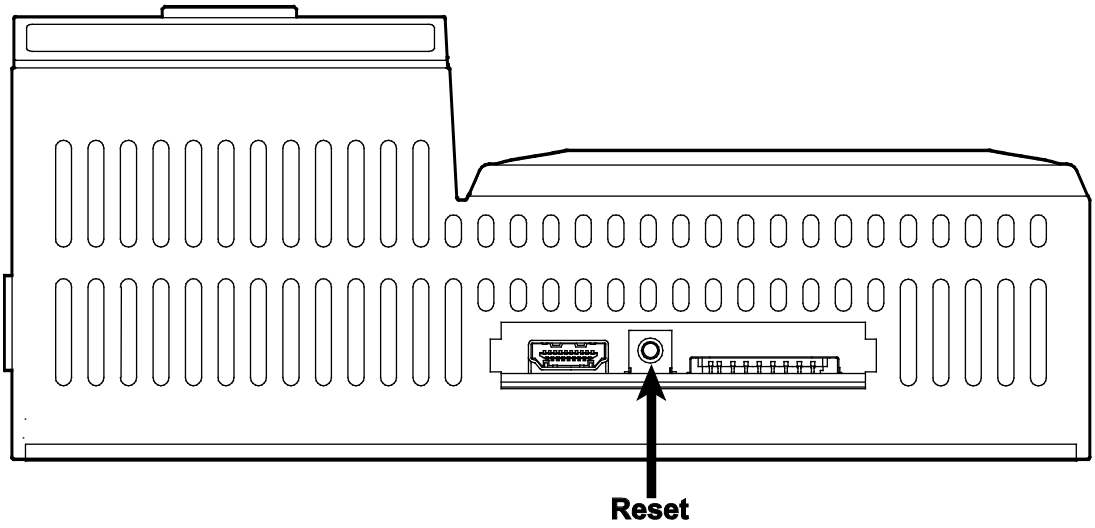
4. Select the destination drive of the SD card.
5. If you would like to preserve your project, leave the boxed checked. If you would like to erase your project too, uncheck the box.
6. Click Restore SD-Card.

7. A dialog box will appear warning that all files will be deleted. Select Yes.
8. After the process is complete, properly eject the SD card from the computer.

Push Button

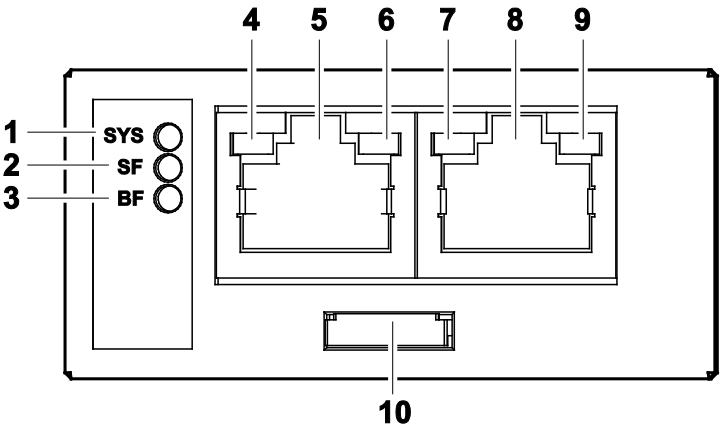
Log IP Address

If you do not know the IP Address of the PAC, you can use the Push Button to log the IP Address. If you press and hold the button, it will record a time stamp and IP Address of both X2 and X3 Ethernet ports. A log file named "IP _Address_Info.txt" will be created on the root directory of the SD card. The Push button is located next to the SD Card:



PROFINET Module

The PROFINET module has multiple LEDs to help monitor the status of the communication. Refer to the diagrams below for troubleshooting purposes:



Number	Feature Name
1	System LED (SYS)
2	System Error LED (SF)
3	Bus Error LED (BF)
4	LINK LED for channel 0
5	Interface channel 0
6	Receive/Transmit LED (RX/TX) for channel 0
7	LINK LED for channel 1
8	Interface channel 1
9	Receive/Transmit LED (RX/TX) for channel 1
10	Sliding latch

LED	Color	State	Meaning
SF Number in the device drawing (2)	Duo LED red/green		
	Red	On	Watchdog timeout; channel. Generic or extended diagnosis present; system error
	Red	Flashing cyclic at 2 Hz (3 sec.)	DCP signal service is initiated via the bus
	Off	Off	No error
BF Number in the device drawing (3)	Duo LED red/green		
	Red	On	No configuration; or low speed physical link; or no physical link
	Red	Flashing cyclic at 2 Hz	No data exchange
	Off	Off	No error
LINK / RJ45 CH0 (4) & CH1 (7)	LED green		
	Green	On	A connection to Ethernet exists
	Off	Off	The device has no connection to Ethernet
RX/TX / RJ45 CH0 (6) & CH1 (9)	LED yellow		
	Yellow	Flashing	The device sends/receives Ethernet frames

If the PAC cannot find the PROFINET slave module, be sure to double check the mechanical installation instructions in Chapter 6.

If the PROFINET Master cannot communicate with the PAC:

1. Check if the Slave is set up correctly. Refer to the configuration section of Chapter 6.
2. Check if the Master is set up correctly. Refer to the documentation of the master.
3. Check if the configuration of the Master and Slave match. To configure the Controller, a GSDML file (device description file) is required. The settings in the used Controller must comply with the settings in the Device to establish communication. Important parameters are Station Name, Vendor ID, Device ID, and Input and Output Data Bytes.
4. Double check the cabling between the Master and Slave. Try a different cable.

Secure Digital (SD) Card

The PAC comes with a Secure Digital (SD) Card from the factory. It is highly recommended that you only use SD cards purchased from Parker. Replacement SD cards can be purchased from Parker using part number 33-026611-01.

When you order a PAC, the SD card comes from the factory loaded with the Operating System and other necessary files to run the PAC. When you save your project with Parker Automation Manager, it will also be stored on the SD card. Do not remove or modify any files on the SD card unless instructed to in the documentation. This card is used as a removable drive and provides non-volatile memory storage. Although this card is removable, it must be inserted in the controller at power up and cannot be removed while the PAC is powered on.

The SD card is not recommended to be written to during run time. This could corrupt the SD card and cause failures on the next power cycle. If you need to log or store data, we recommend using the USB port.

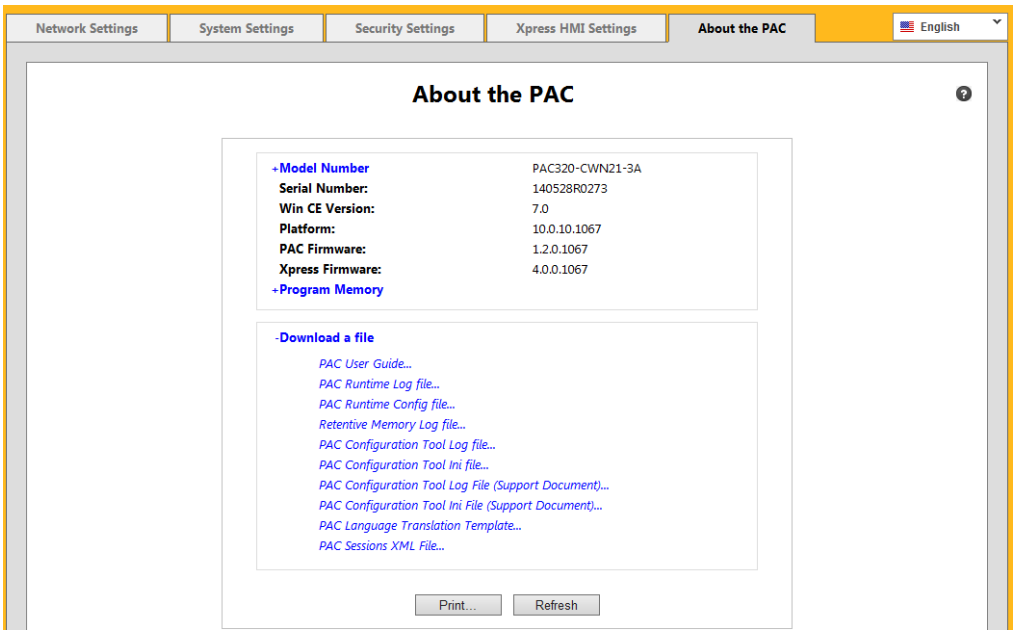
If you are having difficulties powering up the PAC (the Error LED is Red), it could be associated with the SD Card. The SD Card has been specially formatted for the PAC. Make sure you are using a Parker SD card and it has all of the necessary files on the card. You can use the Flashback Utility to restore the SD card back to factory settings that includes the proper format. Refer to the Flashback Utility section of this installation guide for more details on how to use this feature. It may be necessary to try a replacement SD card if you continue to have power up issues that are associated with the faulty card.

Note: SD Cards over 4 GB are not compatible.

Log Files

Log files are extremely useful for debugging and/or for other support purposes. Log files are automatically created and periodically written to by the web server. The files are stored in the "\Windows\Parker\Logs\" directory. Log files are created on an as needed basis; that is, they are created only when the need to write something to the log is requested. These log files can be downloaded from the Configuration Tool under the "About" tab (see the screen shot below). For more information about how to access the Configuration Tool, see "Configuring the Network and System Settings" on page 39.

The most important files to help with troubleshooting will be the PAC Runtime Log File, Retentive Memory Log file, and PAC Configuration Tool Log file. These log files include time stamped actions to help the user track the history of PAC since the last power cycle. To learn more about the log files, click on the Help (?) link in the upper right hand corner of the "About" screen.



I/O Modules

Refer to Chapter 5 for troubleshooting the individual PACIO Modules.

HDMI Connector

The function of this connector is not enabled and is intended for factory use only.

Real Time Clock (RTC)

The Real Time Clock (RTC) or time-of-day clock in the PAC Controller is a timer used to keep the local time and date for use by the Runtime software. The RTC is based on a free running timer located on the PAC processor board when either 24DC system power is applied to the PAC Controller or battery supplied power when DC input power is not available.

When 24VDC power is applied to the PAC Controller input connector, no current drain is required from the RTC battery. Conversely, if the 24VDC power is removed for periods of time such as during shipping or if the Controller is shut down over nights and weekends, small amounts of battery current consumption will be required. The battery life expectancy is dependent on how long DC power is provided to the PAC; the longer that DC power is applied to the PAC over a period of time, the less battery drain will be required to power the RTC circuit. Current consumption calculations indicate that if DC power is never applied to the PAC, the battery powered RTC should keep time for at least 5 years. If DC power is applied to the PAC about 50% of the time, then the RTC should keep time for more than an estimated 9 years. Note that elevated temperatures can also have a negative effect on battery life.

Should the PAC lose its time and date time keeping after an extended period, the battery needs to be replaced. The Controller can be returned to the factory to have the battery replaced as a repair order, or the battery can be simply replaced by the customer. The replacement battery is an industry standard CR2032 lithium coin cell and is easily obtainable. To replace, simply remove the cover from the PAC Controller, locate the battery on the top side of the processor board, and slide the old battery from the holder. Observe the correct battery orientation (PLUS [+] down) when inserting the new battery. Follow local ordinances to properly dispose of the old battery. Reattach the plastic cover and reconnect the Controller to the PACIO modules on the DIN rail. Be sure to use the PAC Configuration Tool to set the correct time and date before recommissioning the system.

Technical Assistance from Parker Hannifin

Contact Information for Technical Assistance	
Contact your local automation technology center (ATC) or distributor.	
North America Parker Hannifin Electromechanical Automation North America 5500 Business Park Drive Rohnert Park, CA 94928 Telephone: (707) 584-7558 Fax: (707) 584-8029 Email: emn_support@parker.com Internet: http://www.parkermotion.com	Europe Parker Hannifin Electromechanical Automation Europe Robert-Bosch-Strasse 22 77656 Offenburg (Germany) Telephone: +49 (0781) 509-0 Fax: +49 (0781) 509-98176 Email: Em-motion@parker.com Internet: www.parker-automation.com

APPENDIX A:
PAC System Specifications

Controller Specifications

Environmental Specifications

Environmental Specifications Table

Category	Specifications
Operating Temperature	32 to 122°F (0 to 50°C) Ambient (air temperature surrounding the Controller), Indoor Use Only
Storage Temperature	-13 to 158°F (-25 to +70°C)
Relative Humidity	0% to 95% non-condensing
Altitude	10,000 Feet
Shock Rating	10g peak; 11ms (operating)
	30g peak; 11ms (non-operating)
Operating Vibration	10-500Hz: 2 grms random
Environmental Design	IP20, Intended to be installed in a suitable fire enclosure. Pollution Degree 2
RoHS	RoHS Compliant

Electrical Specifications

Electrical Specifications Table

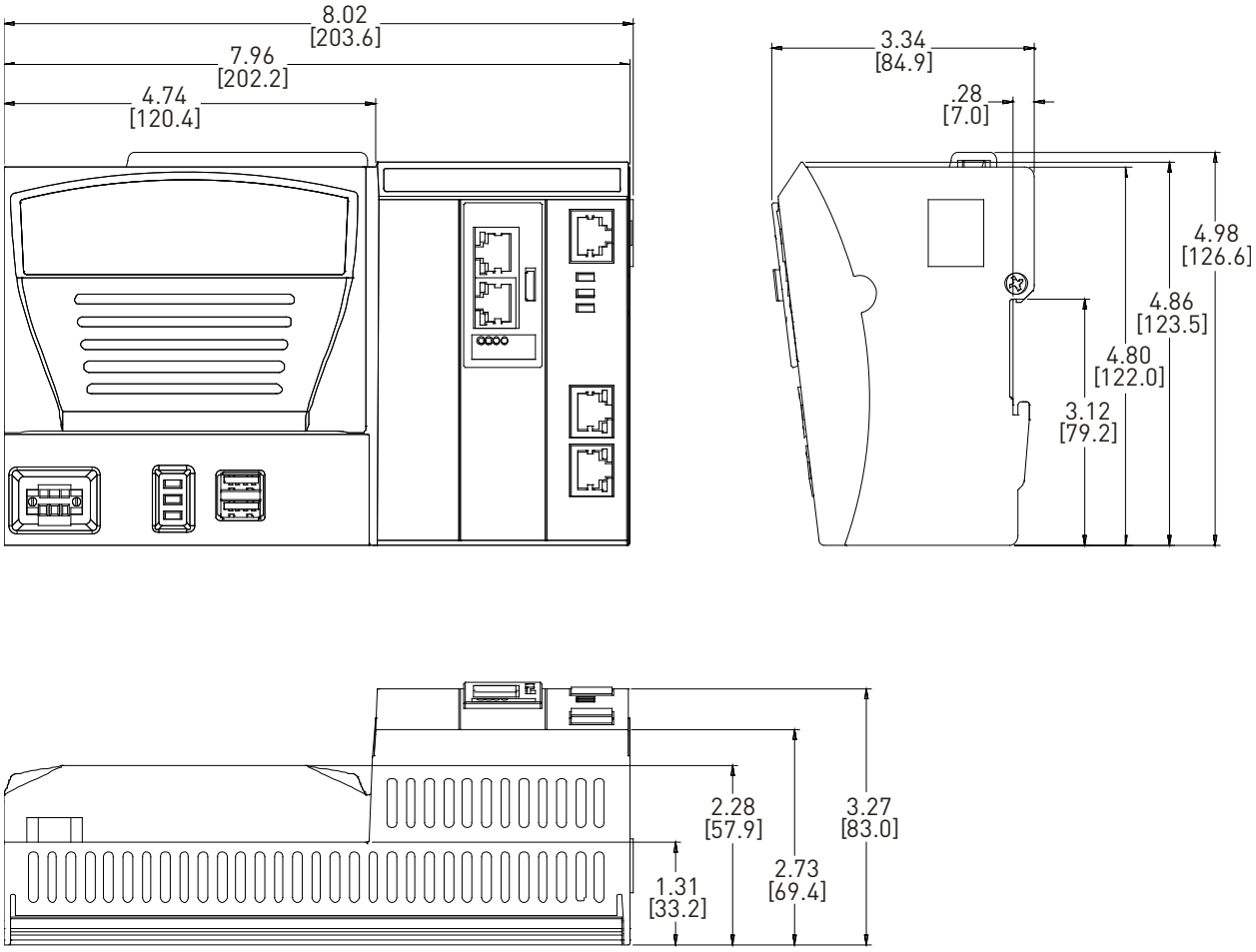
Category	Specifications
Input voltage	24 VDC (-15%/+25%), SELV Limited Energy, 1.2 A, 29W. Power must be provided by a Class 2 power source. Overvoltage Category 1
Fuse	Littelfuse Nano SMF Slow Blow Type; Part number R454002
Heat Dissipation	Without optional communications module: 5.0 watts maximum With optional communications module: 5.8 watts maximum
Maximum Number of PACIO Modules	Up to 20 Modules connected to the Controller or, Maximum 5VDC @ 3A E-Bus load. More than 20 modules can be added to the PAC320 by using the Extender Module and Bus Coupler Module. See the PACIO Bus Coupler section of the User Guide.

Physical Specifications

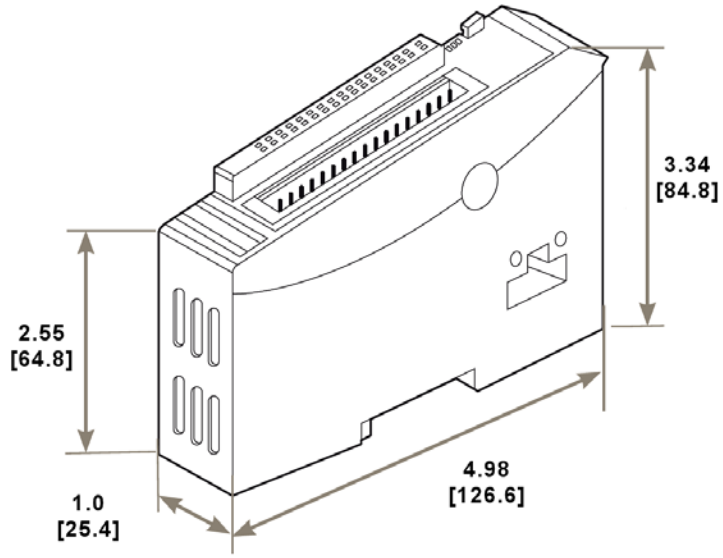
Physical Specifications Table

Category	Specification
CPU	■ Intel N2600 CPU, 1.6GHz, Dual Core, 64-bit ■ 1MB L2 Cache
Memory	■ Up to 1 GB DDR3 SDRAM (minimum) ■ 1066 MHz, PC3-8500 ■ 204-pin SODIMM Socket
BIOS	Insyde H_2O
Storage	2GB (minimum) Secure Digital Card (SD)
Ports	■ Two RJ45 10/100/1000BaseT Ethernet ■ One RJ45 100Mbit/s EtherCAT supporting IEEE1588 Distributed Clocks ■ Two USB 2.0 Host Type A
Dimensions H x W x L	Without optional communications module: ■ 3.27"H x 4.93"W x 8.02"L (83.1mm x 125.22mm x 203.71mm) With optional communications module: ■ 3.53"H x 4.93"W x 8.02"L (89.66mm x 125.22mm x 203.71mm)
Weight	Without optional communications module: ■ 1.45 lbs (0.66 kgs) With optional communications module: ■ 1.65 lbs (0.75 kgs)

PAC Controller Dimensions – inches (mm)



PACIO Dimensions – inches (mm)



Agency Approvals

The PAC Controller was tested in accordance with the product family standard for Electrical Equipment for Measurement, Control and Laboratory use. EN 61326-1:2006 + CRG:2011 / IEC 61326-1:2005 Immunity requirements for equipment used in Industrial Locations. Harmonic Current Emissions EN 61000-3-2:2006 + A2:2009 / IEC 61000-3-2:2009, Voltage Fluctuations and Flicker EN 61000-3-3:2008 / IEC 61000-3-3:2008.

European Community Approvals Table

Test	Specification
Harmonic Current Emissions	EN 61000-3-2:2006 + A2:2009 IEC 61000-3-2:2009
Voltage Fluctuations and Flicker	EN 61000-3-3:2008 IEC 61000-3-3:2008
Electrostatic Discharge Immunity	IEC 61000-4-2:2008
Radiated Electromagnetic Field Immunity	IEC 61000-4-3:2010
Electrical Fast Transient Burst Immunity	IEC 61000-4-4:2012
Surge Immunity	IEC 61000-4-5:2005
Radio Frequency Common Mode Immunity	IEC 61000-4-6:2008
Power Frequency Magnetic Field Immunity	IEC 61000-4-8:2009
Voltage Interrupts Immunity	IEC 61000-4-11:2004
Radiated & Conducted Emissions CISPR 11 Group 1, Class A	EN 55011:2009 + A1:2010 CISPR 11:2009 + A1:2010
EN61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use. Part 1 General Requirements
EN61010-2-201:2013	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use. Part 2-201 Particular Requirements for Control Equipment

Underwriters Laboratories Approvals Table

Test	Specification
UL 61010-1, 3rd Edition, 2012-04-17 UL File E243373	Electrical Equipment for Measurement, Control and Laboratory use. Part 1: General Requirements
CAN/CSA-C22.2 No. 61010-1, 3rd Edition, 2012-04	Electrical Equipment for Measurement, Control and Laboratory use. Part 1: General Requirements
UL 61010-2-201	Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 2-201: Particular requirements for control equipment
IEC 60529, Edition 2.1 + Corr. 1:2003 + Corr. 2:2007 + Corr. 3:2009	Protection Degree IP20

PACIO Technical Data

PACIO Module System Properties

Fieldbus	EtherCAT 100Mbit/s
Dimensions	25mm x 120mm x 90mm (W x H x D)
Housing mount	aluminum
Shield	connected straight to Module housing
Installation	35mm DIN rail (top-hat rail)
IO connection	spring-assisted combi plug with mechanical ejector, 4 ... 36-pin
Signal indication	LED located next to the terminal
Diagnosis	LED: bus state, Module state, broken wire/excessive current
Number of ports	up to 32 digital I/Os on every Module, up to 8 analog channels per Module
Supply voltage	24 VDC -20%/+25%
Number of I/O Modules	20 per bus coupler (total max. power consumption: 3A)
Electrical insulation	Modules electrically insulated from one another and from the bus
Storage temperature	-25°C ... + 70°C,
Operating temperature	0°C ... + 50°C
Rel. humidity	5% ... 95%, non-condensing
Protection	IP20
Susceptibility to noise	zone B to EN 61131-2, installation on an earthed top hat DIN rail in the earthed control cabinet
CE Compliant	2004/108/EC Electromagnetic Compatibility
UL	UL508
RoHS	RoHS Compliant

APPENDIX B:
Additional Information

Terms and Acronyms

The following table lists terms and acronyms used in this guide, along with their definitions.

Term	Definition
ATC	Automation Technology Center
LVDS	Low-voltage Differential Signaling
PLC	Programmable Logic Controller
VAC	Volts Alternating Current
VDC	Volts Direct Current

Controller Options

Model Number Configurations

The model number configuration of the PAC provides a good overview of the available model options. The full model configurator is as follows: