

ENGINEERING YOUR SUCCESS.

PARKER AUTOMATION CONTROLLER

PAC Installation Guide



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Parker

IMPORTANT USER INFORMATION

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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.

IMPORTANT USER INFORMATION

Regulatory Statements



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.

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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 smartphones.

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.

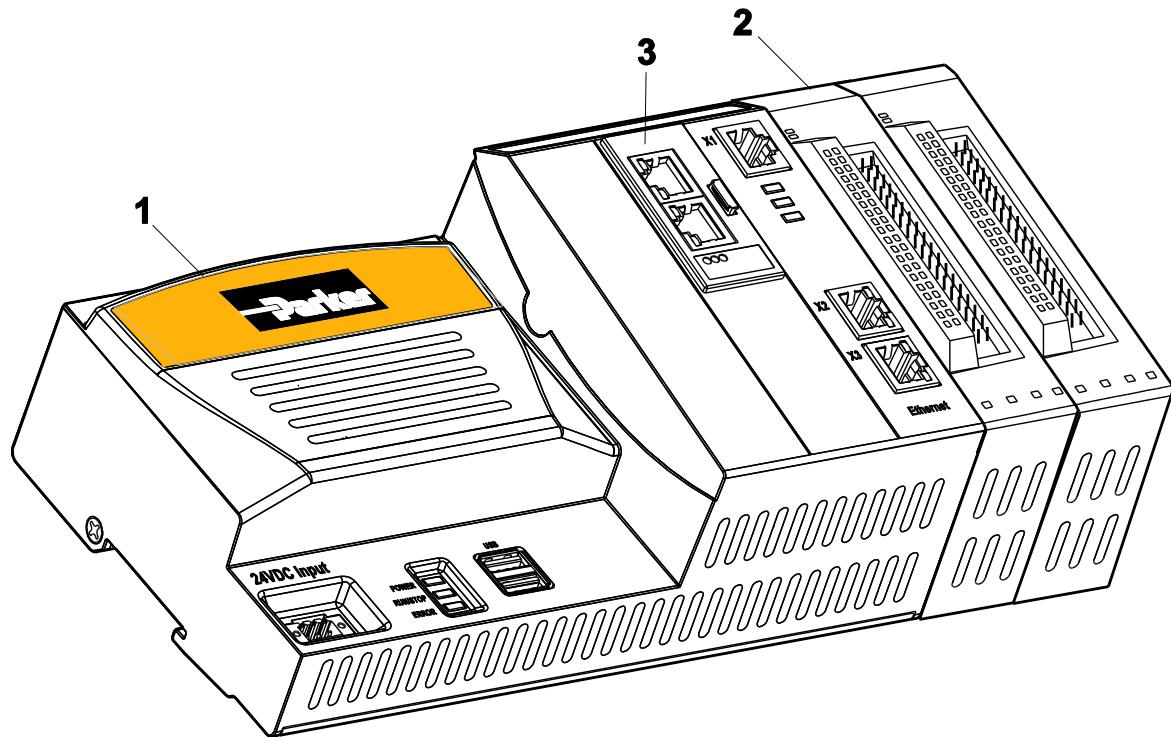
Motion and 3D Coordinated Motion: The PAC offers two levels of motion control software utilizing IEE1388 distributed clocks —one for simple motion and another for advanced CNC. An external EtherCAT connector provides communications to up to 32 axes of EtherCAT motor drives.

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.

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

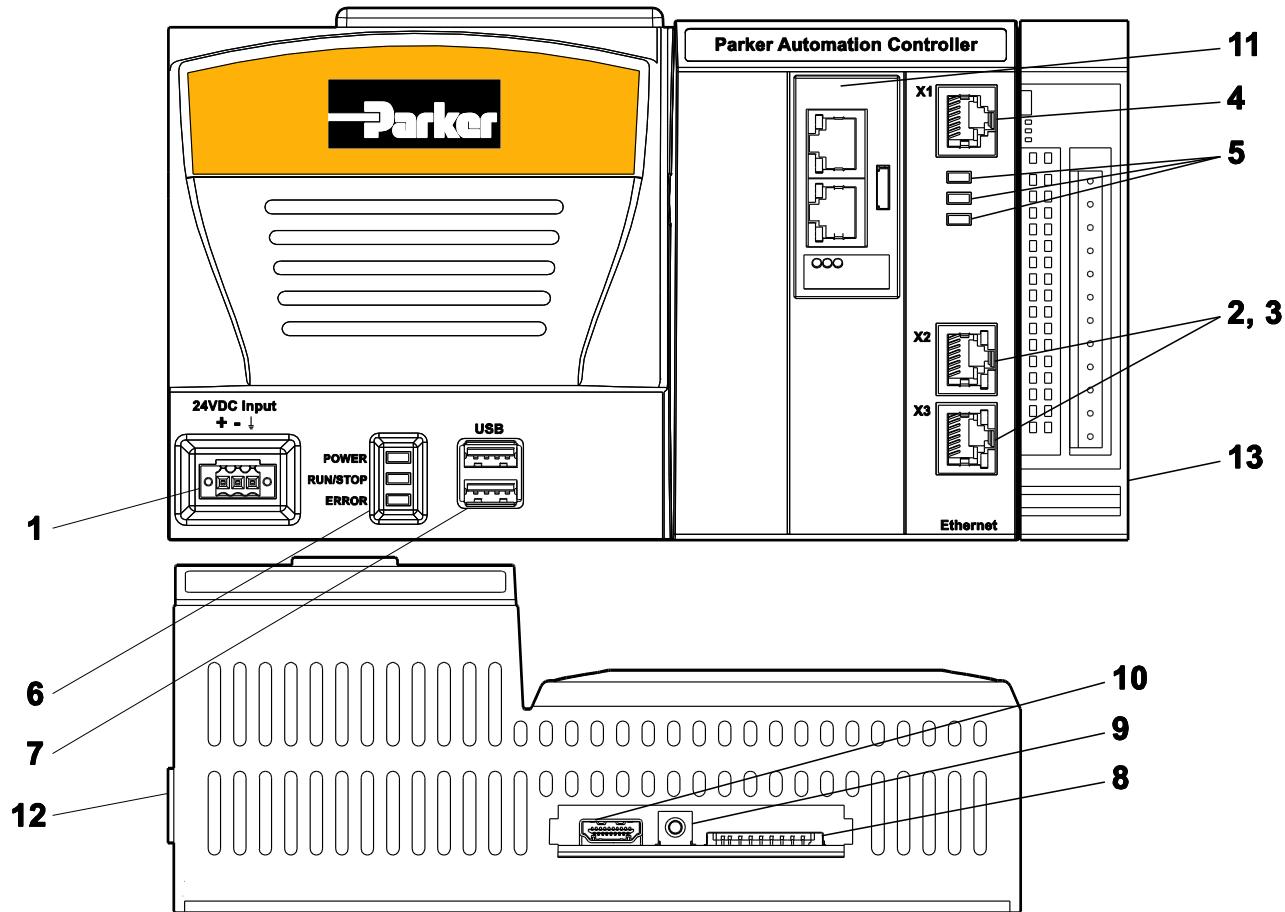


PAC and PACIO Modules

| 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 |

PRODUCT OVERVIEW

PAC Features

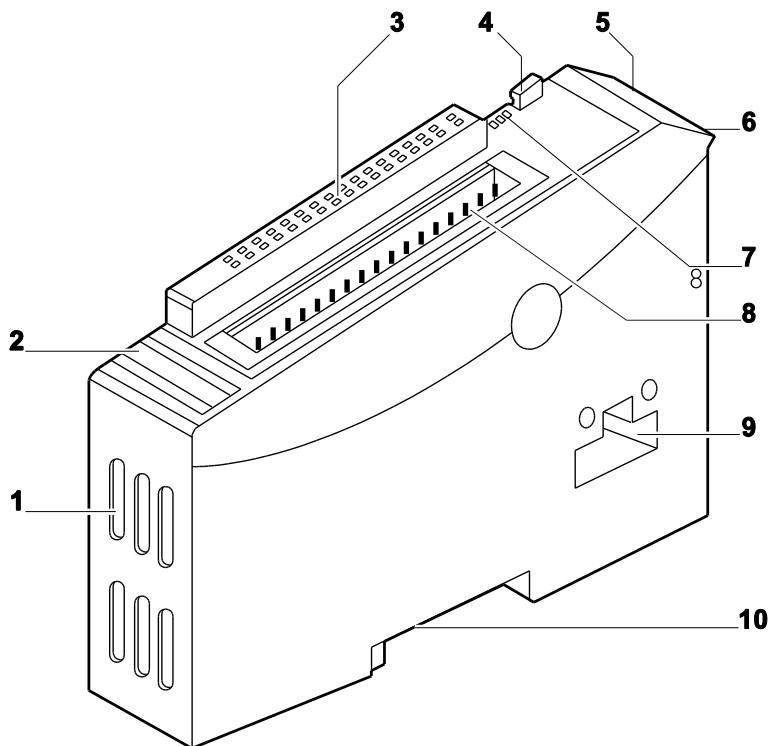


PAC Features

| 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 factory reset, I/P address reset, and clearing of the "ERROR" LED. |
| 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 μ s. 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 for project downloads. Both ports are ESD protected and have over-current shutdown at loads greater than 500mA.

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.

Button

The PAC features a button that provides different functionality depending on how long it is pressed. The button allows you to perform a system reset, I/P address reset, or a restore to factory settings. See “Reset 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 |

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.

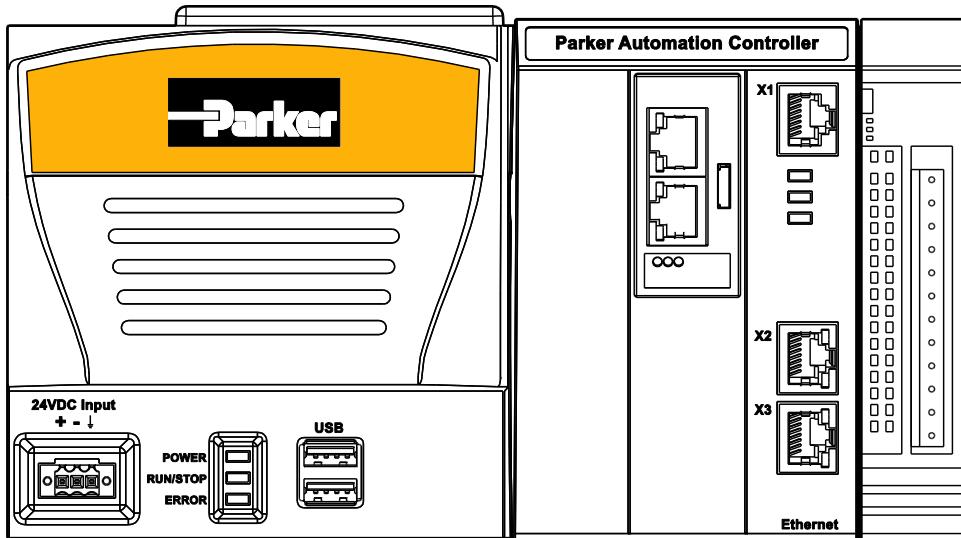


Important: A Limited Power Source (LPS) power supply or circuit according to IEC 60950-1, or an NEC Class 2 power source must be used to provide power to the PAC. NEC Class 2 circuits are considered to be safe from a fire ignition standpoint and provide acceptable protection against electric shock.

- 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 (°C) ambient, still-air locations. This means that when installed, the ambient air surrounding the Controller is not expected to exceed 50°C. 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 °C or more.

INSTALLATION

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

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

Since elevated operating temperatures can have an adverse affect 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

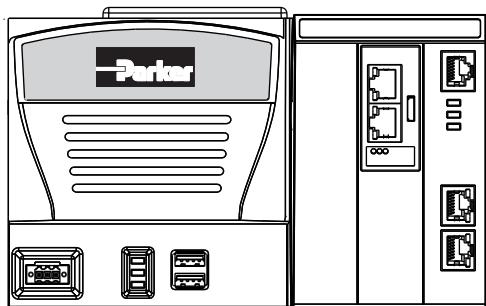
Select an enclosure that is large enough to allow free airflow in and around the Controller.

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.

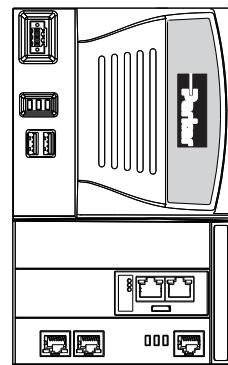
Consider additional clearance above the PAC to allow access to the SD card for insertion and removal.

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.

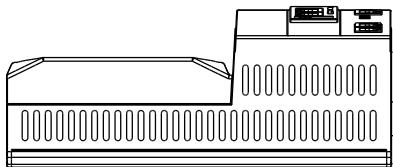
 Correct (Vertical)



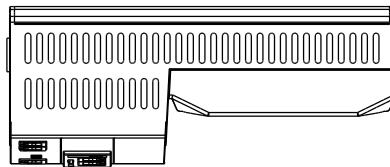
 Incorrect (Sideways)



 Incorrect (Horizontal)



 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

INSTALLATION

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.

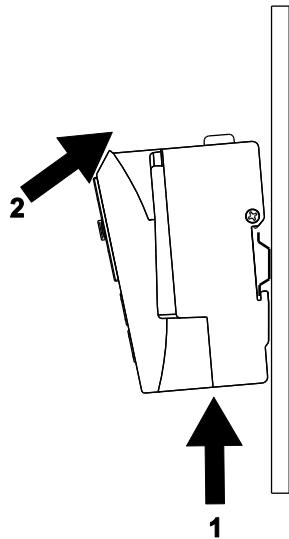
Calculate the overall length of DIN rail required for the installation base on the following component widths. Be sure to include extra length for adding additional modules in the future and a clearance allowance for removing modules.

- 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:

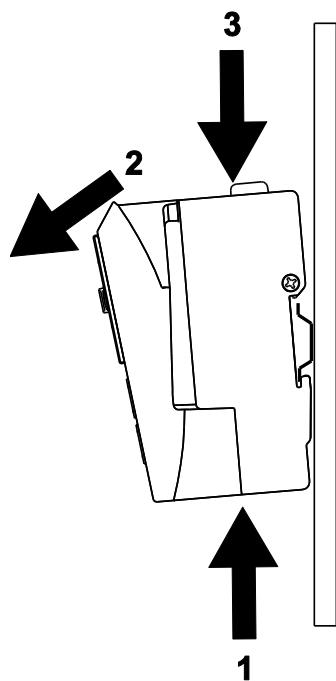
1. Push the module up against the mounting rail from below, allowing the metal spring to snap in between the mounting rail and mounting area.
2. Push the module against the mounting wall until it snaps into place.



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



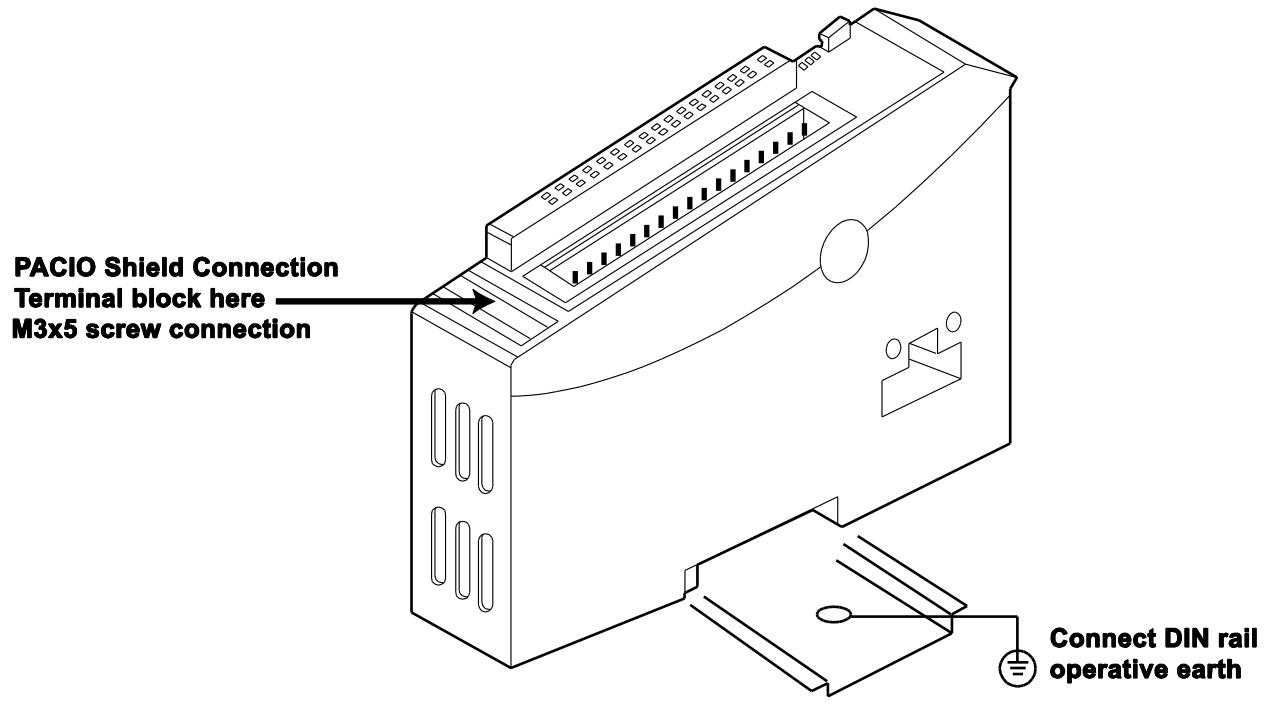
WARNING: Always attach or remove PACIO Modules with the system in a powered-down state. Damage to the modules or unintended I/O functionality might occur.

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.



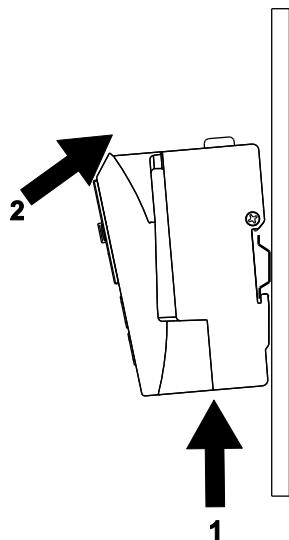
PACIO Module on DIN Rail

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.

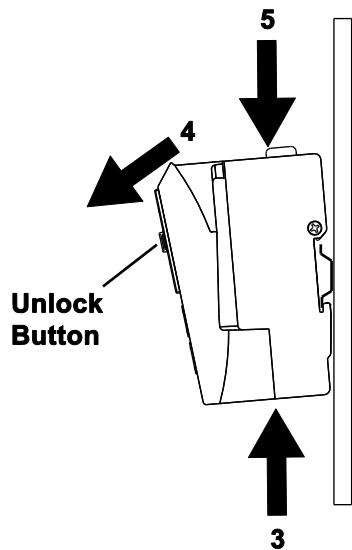


Rail mounting of single Module

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:

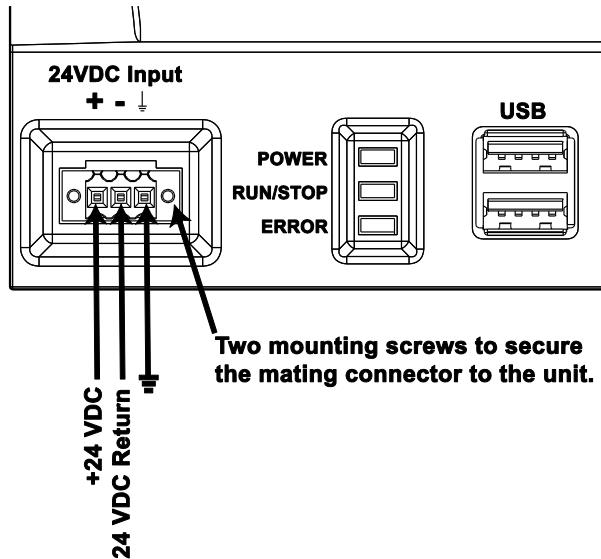
- 24VDC @ 1.2A, SELV Limited Energy, or a total of 29 Watts
- Wire gage for connection to the Controller: 0.20 - 1.0 mm² (IEC) / 26 – 16 AWG (UL), stripped to <10mm in length, solid or stranded wire

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.

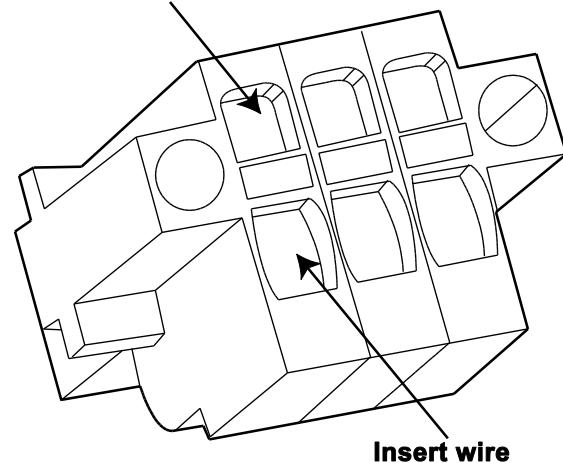


Input Power Connection Diagram

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.

Push with a screwdriver



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) |
| | Oversupply 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, noncondensing IEC 68-2-3, 68-2-3 |
| | Oversupply | 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:

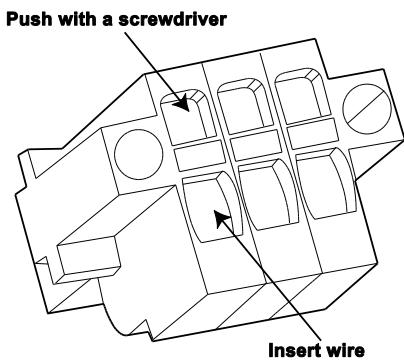
- Shielded data or communication signals
- Shielded analog signals
- Unshielded digital I/O lines
- Unshielded DC voltages < 60 V
- Unshielded AC voltages < 25 V

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 without 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 129.
- PACIO Modules that require 24VDC field power have a corresponding "POWER" LED indicator located on the Module.
- Some PACIO Modules have undervoltage monitoring, and can report this status to the control unit.



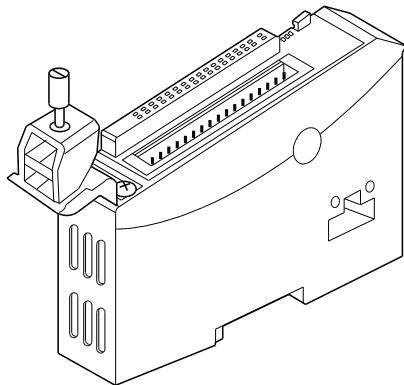
TIP: A rapid shut-down of all PACIO outputs can be performed by externally switching-off of the I/O supply voltage L+.



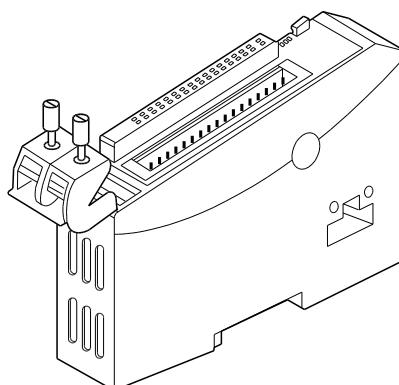
TIP: If you need to monitor the presence of the PACIO power supply in the control program, connect the 24VDC L+ input power to a PACIO digital input to represent the status of the field 24VDC power.

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 130). 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 | Blue Red Green White Off | Project is downloading from USB No programs running Programs running Reset button is pressed | |
| Error | yes | Red Off | System error No system error. | |

Configuring the Network and System Settings

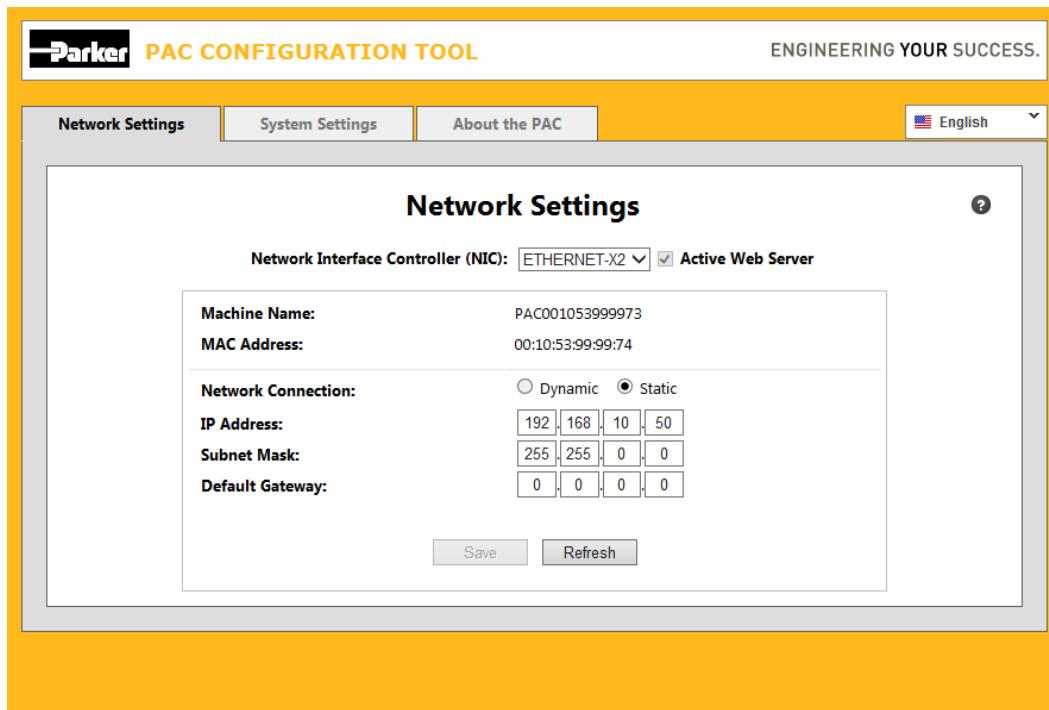
Upon powering the system for the first time, use the PAC Configuration Tool to configure the initial system parameters. After commissioning the machine, these parameters need to be changed.

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>

SYSTEM START-UP AND CONFIGURATION

5. You should see the following:



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

Tab 1 –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 – About Page

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

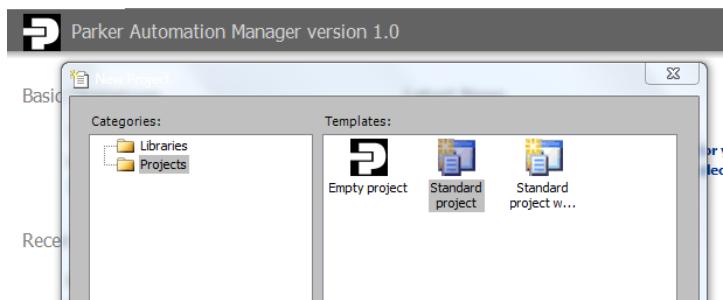
The Parker Automation Manager software package is used to configure the PAC as the EtherCAT master and to program the PAC with the IEC611-31 language. The Parker Automation Manager software can be downloaded from parkermotion.com under the PAC product page or in the Support and Downloads page.

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

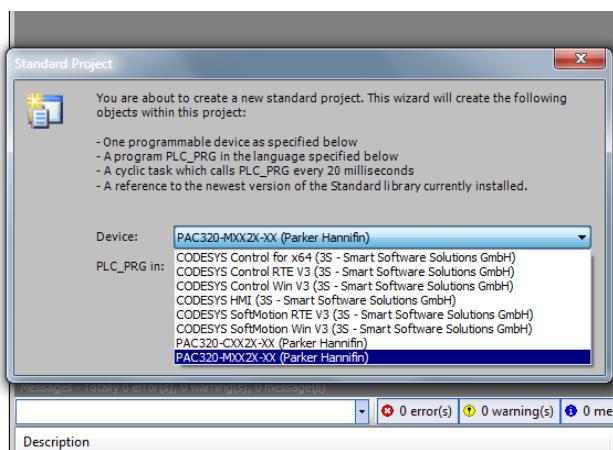
Creating a new PAC project

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**.

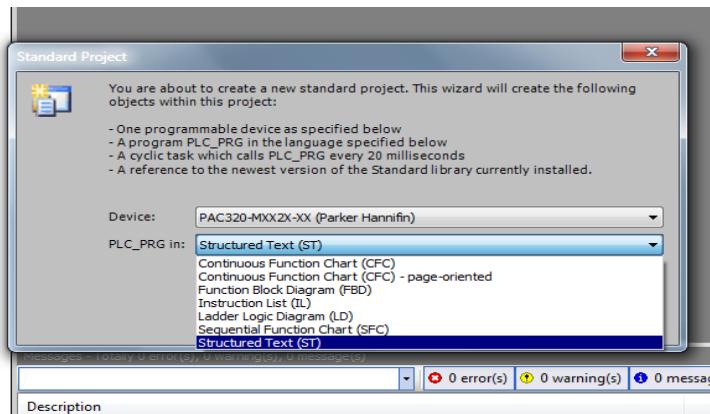


4. Choose the appropriate PAC320 device in the pull down menu depending on your version of the PAC320. If you have a PAC with motion (PAC320-M...) then choose PAC320-MXX2X-XX. If you have a PAC with CNC motion (PAC320-C...) then choose PAC320-CXX2X-XX.
5. Choose **Add Device**. This will add the PAC320 to your device tree.

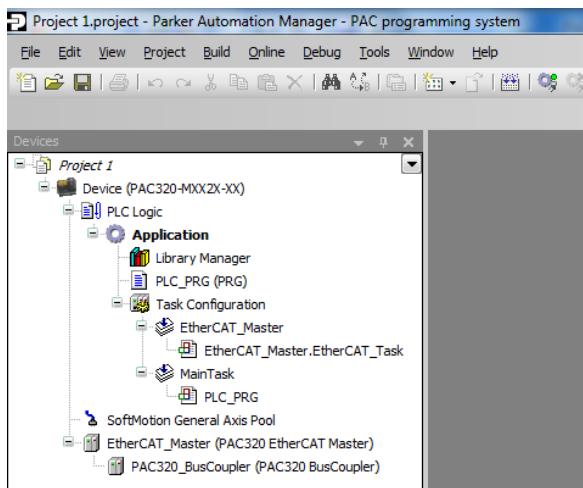


SYSTEM START-UP AND CONFIGURATION

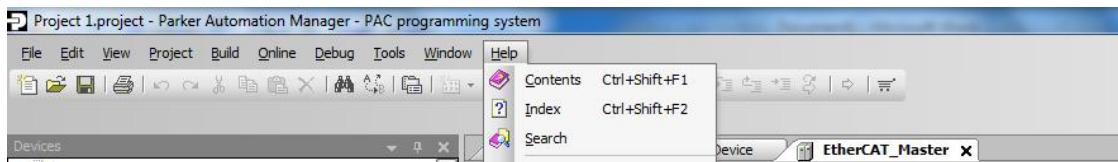
6. Choose the PLC_PRG language you would like to use in your project. Choose OK.



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



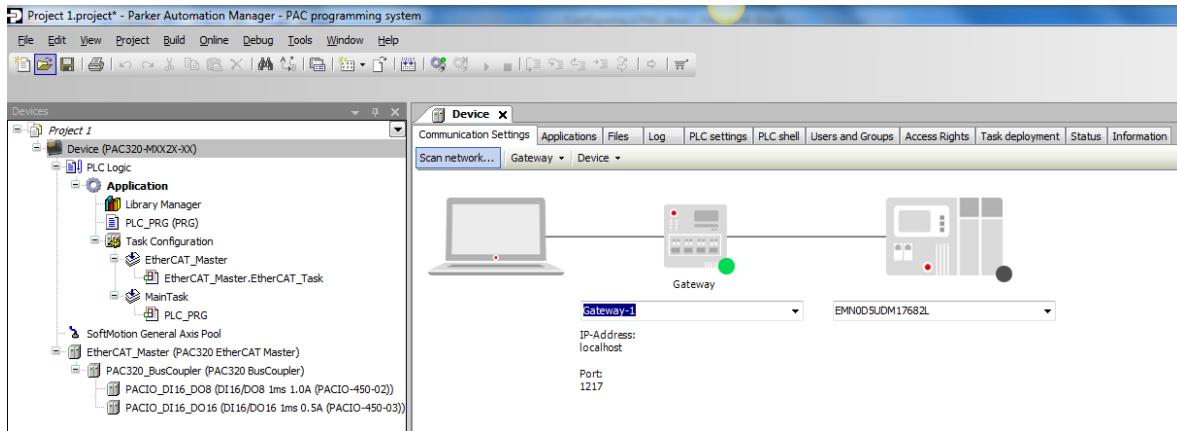
8. The Help menu in Parker Automation Manager is a great resource with documentation to help you start programming your project.



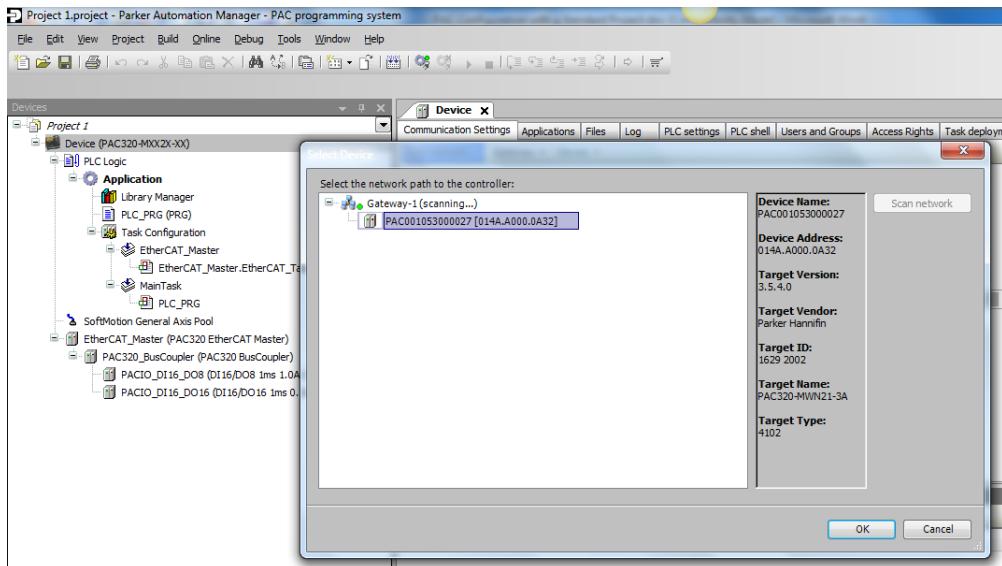
Connection to the PAC

The following section will step you through the process to connect Parker Automation Manager 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.

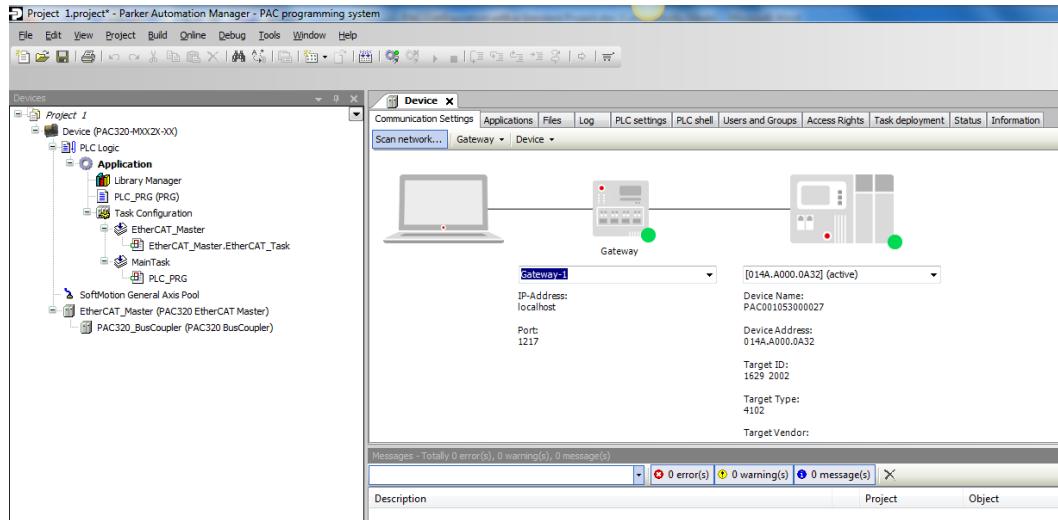


2. After the scanning process finds the PAC, select the PAC and click OK.



SYSTEM START-UP AND CONFIGURATION

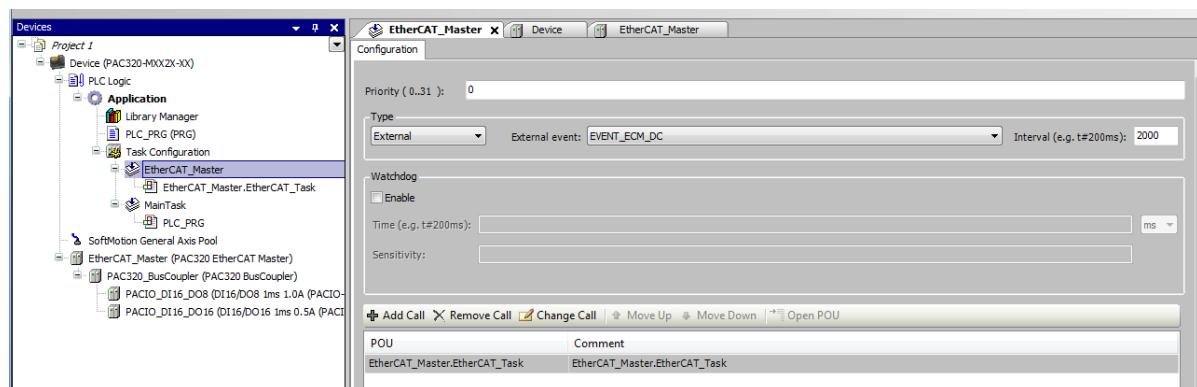
3. The Green dot on the device indicates that the device was found and you are now connected to the PAC.



Configure the EtherCAT_Master Task

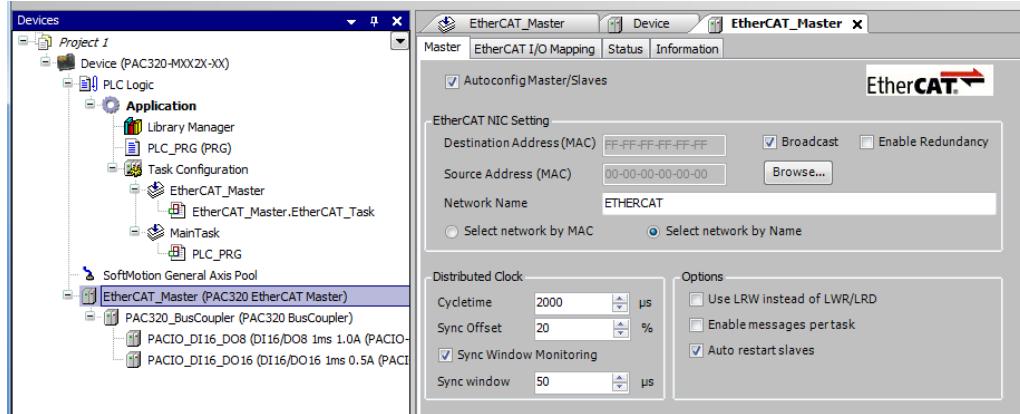
For projects that require real-time synchronization via distributed clocks (i.e., servo drive applications), use the following steps to configure the PAC as an EtherCAT master. This assumes that your EtherCAT slave also supports distributed clocks functionality. If your PAC will only be used with the 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. Set the Interval to match your desired interval (2000) in this example.



Configure EtherCAT_Master Node

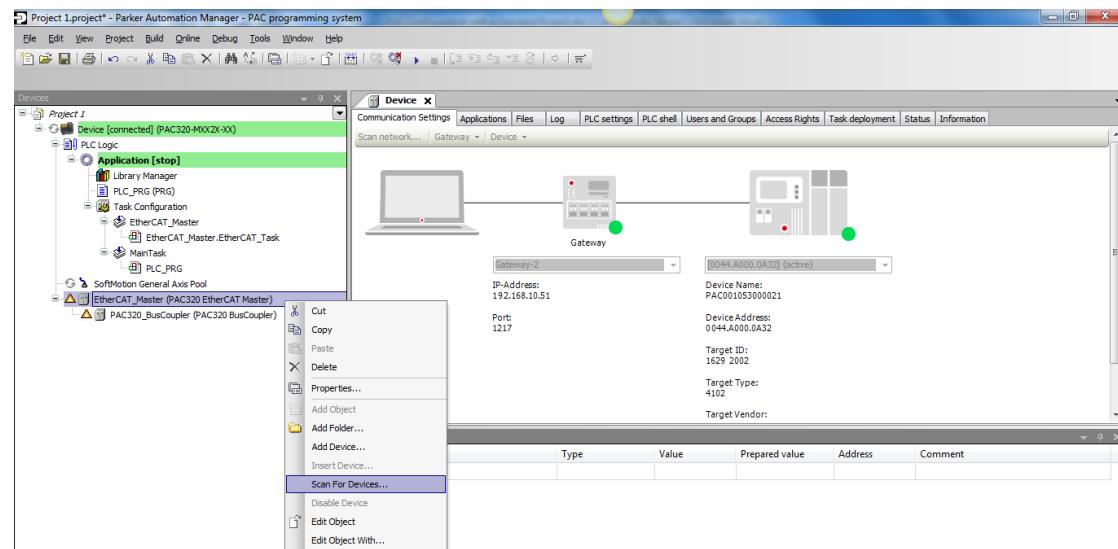
1. In the Devices tree, double click the EtherCAT_Master node to bring up the EtherCAT_Master Configuration dialog.
2. Ensure that the Autoconfig Master/Slave checkbox is checked.
3. Change the Distributed Clock Cycletime to the EtherCAT cycle time that you wish to achieve.
4. Check the Sync Window Monitoring checkbox and set the Sync window to 50.



Configuration of the PACIO

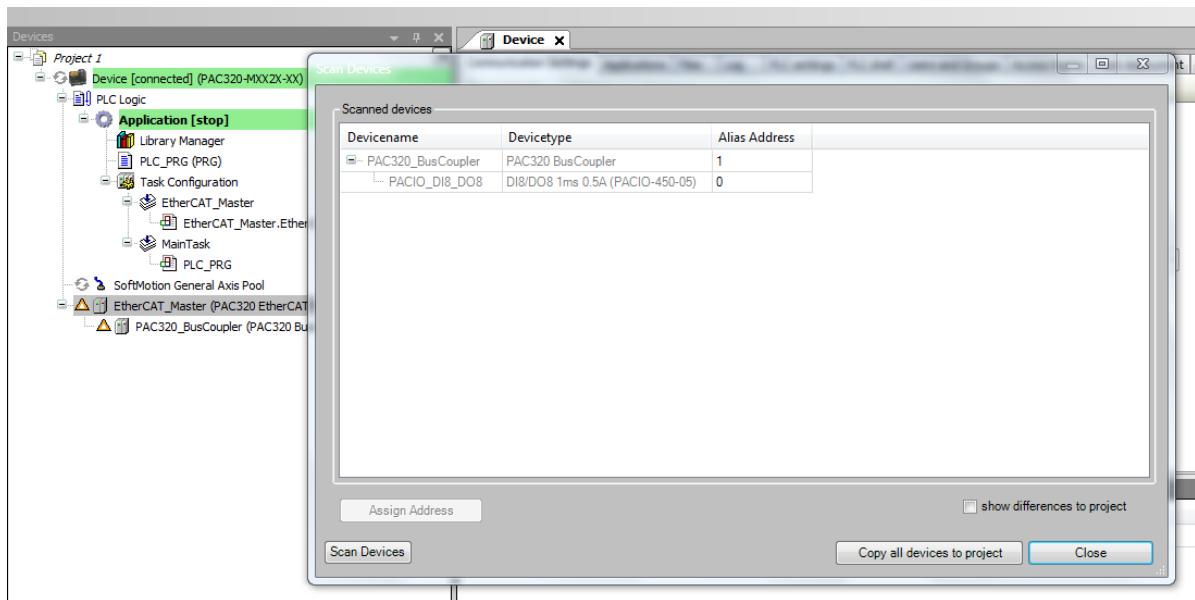
Online Method

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...".

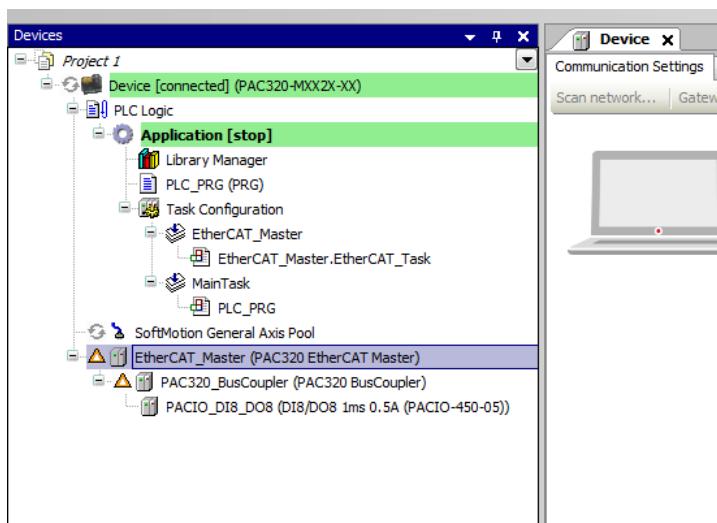


SYSTEM START-UP AND CONFIGURATION

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.



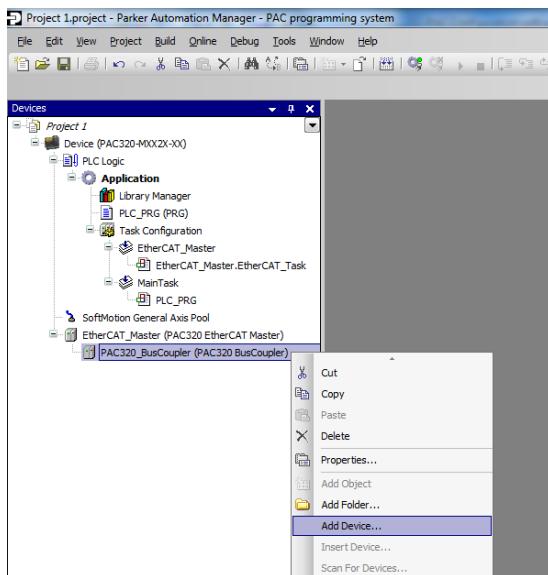
4. When the list is complete, click the "Copy all devices to project" and the PACIO will show up on your device tree under the PAC320_BusCoupler.



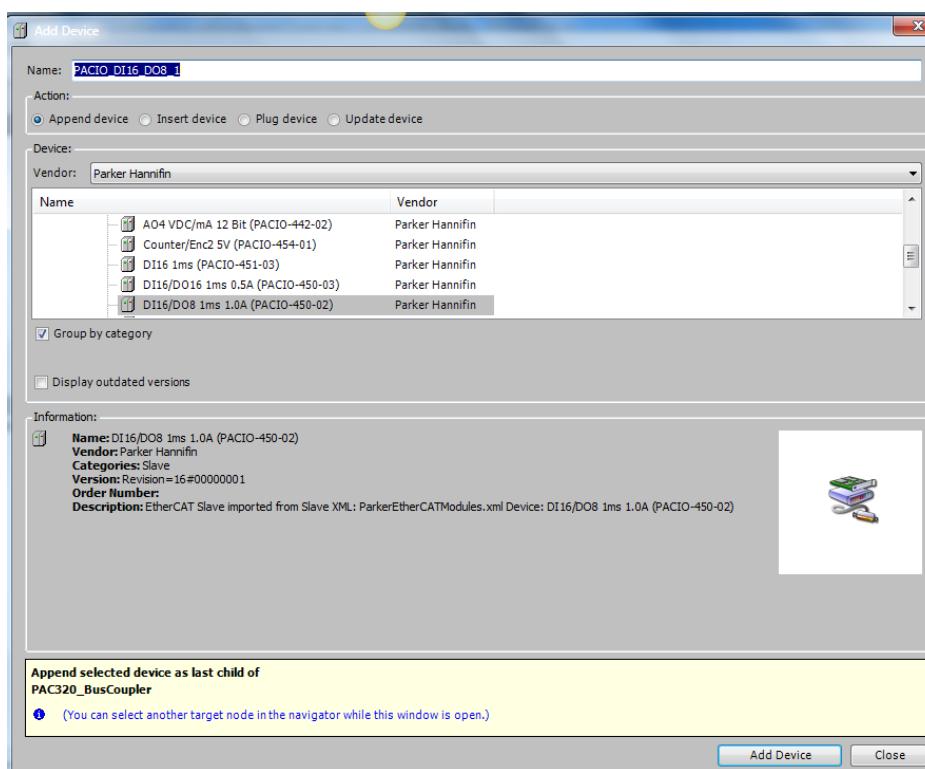
Offline Method

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”.

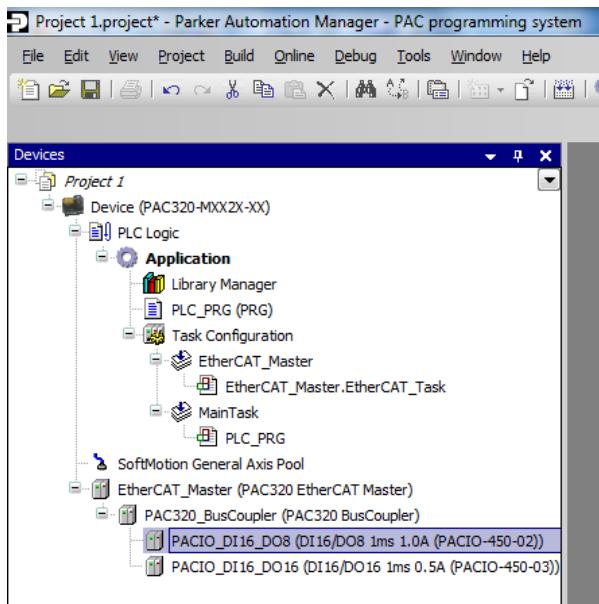


2. Find Parker Hannifin as the Vendor and select the appropriate PACIO slave module that corresponds to the PACIO hardware on your system. Then click “Add Device.”



SYSTEM START-UP AND CONFIGURATION

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 points.

PACIO_DI16_D016

- Slave
- Process Data
- EtherCAT I/O Mapping**
- Status
- Information

Channels

| Variable | Mapping | Channel | Address | Type | Unit | Description |
|-----------|---------|-----------------|---------|------|------|-----------------|
| MyOutput | | DigitalOutput0 | %QX0.0 | BIT | | DigitalOutput0 |
| MyOutput1 | ... | DigitalOutput1 | %QX0.1 | BIT | | DigitalOutput1 |
| | | DigitalOutput2 | %QX0.2 | BIT | | DigitalOutput2 |
| | | DigitalOutput3 | %QX0.3 | BIT | | DigitalOutput3 |
| | | DigitalOutput4 | %QX0.4 | BIT | | DigitalOutput4 |
| | | DigitalOutput5 | %QX0.5 | BIT | | DigitalOutput5 |
| | | DigitalOutput6 | %QX0.6 | BIT | | DigitalOutput6 |
| | | DigitalOutput7 | %QX0.7 | BIT | | DigitalOutput7 |
| | | DigitalOutput8 | %QX1.0 | BIT | | DigitalOutput8 |
| | | DigitalOutput9 | %QX1.1 | BIT | | DigitalOutput9 |
| | | DigitalOutput10 | %QX1.2 | BIT | | DigitalOutput10 |
| | | DigitalOutput11 | %QX1.3 | BIT | | DigitalOutput11 |
| | | DigitalOutput12 | %QX1.4 | BIT | | DigitalOutput12 |
| | | DigitalOutput13 | %QX1.5 | BIT | | DigitalOutput13 |
| | | DigitalOutput14 | %QX1.6 | BIT | | DigitalOutput14 |
| | | DigitalOutput15 | %QX1.7 | BIT | | DigitalOutput15 |
| MyInput | | DigitalInput0 | %IX0.0 | BIT | | DigitalInput0 |

DigitalOutput1 Always update variables

IEC Objects

| Variable | Mapping | Type |
|-----------------|---------|----------|
| PACIO_DI16_D016 | | ETCSlave |

= Create new variable = Map to existing variable

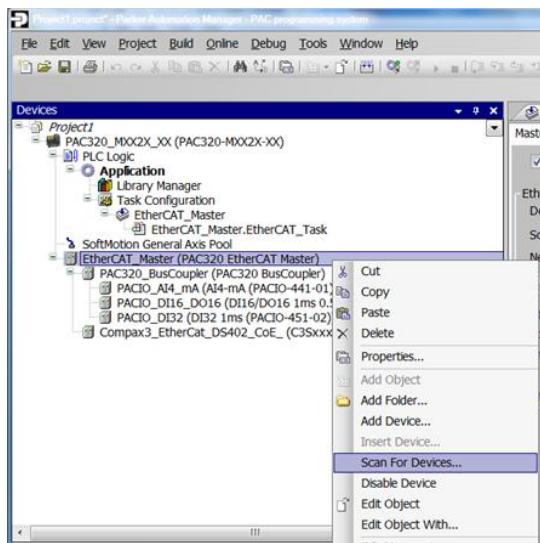
- Double click in the Variable column for the desired IO point and create a name for this point.
 *Note: Variables created this way are global for the project.

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

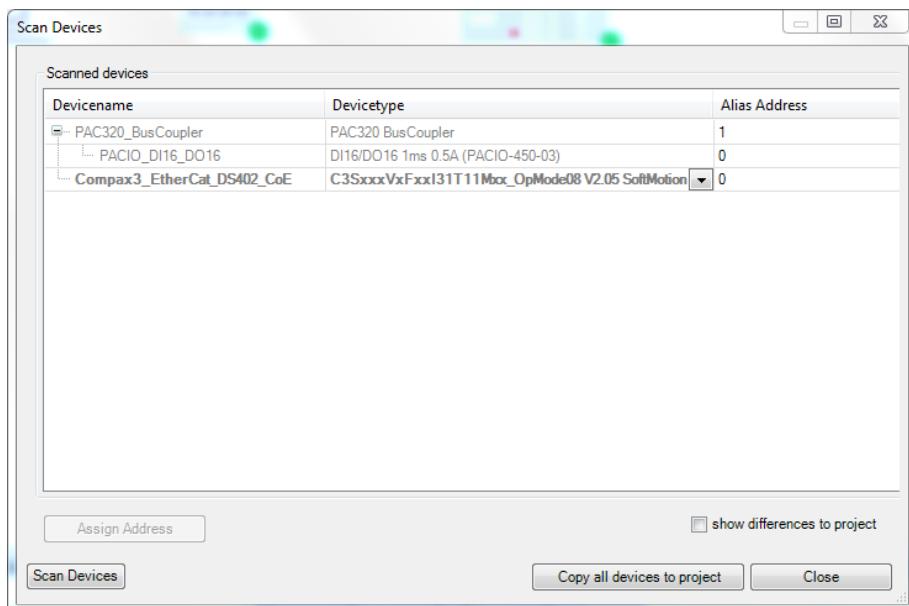
Add the Compax3 as an EtherCAT slave

Online Method

1. Double-click the PAC320_MXX2X_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.

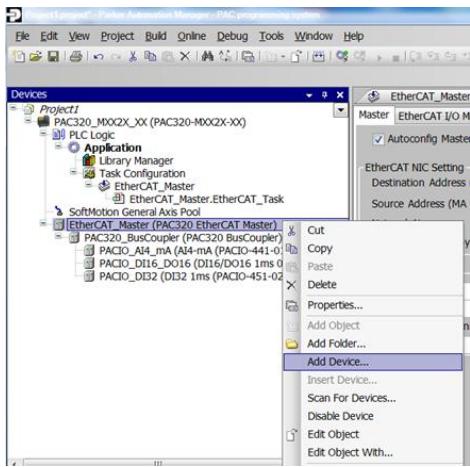


4. The dialog sets the default name "Compax3_EtherCAT_DS402_CoE_". The Compax3 is now added as a slave to the PAC in the project.

Add the Compax3 as an EtherCAT slave

Offline Method

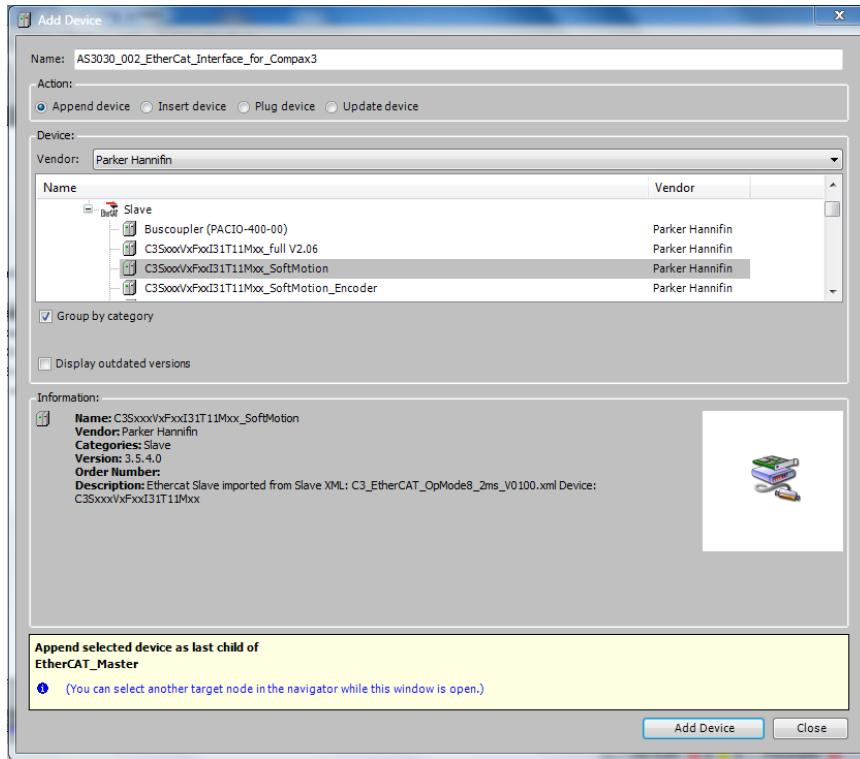
1. In the Devices tree, right-click the EtherCAT Master node.
2. Select Add Devices... This opens the Add Devices... dialog.



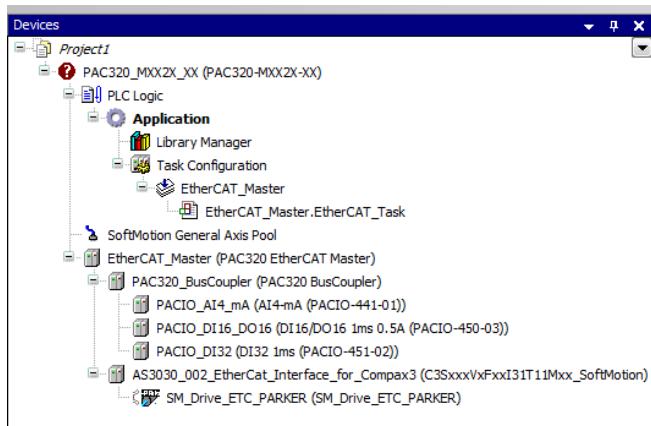
3. In the Add Devices... dialog, select Append device for the Action and Parker Hannifin for the Vendor.
4. Select C3SxxxVxFxxI31T11Mxx_SoftMotion.
5. The dialog sets the default name "AS3030_002_EtherCat_Interface_for_Compax3". You can change the name as appropriate for your application.

SYSTEM START-UP AND CONFIGURATION

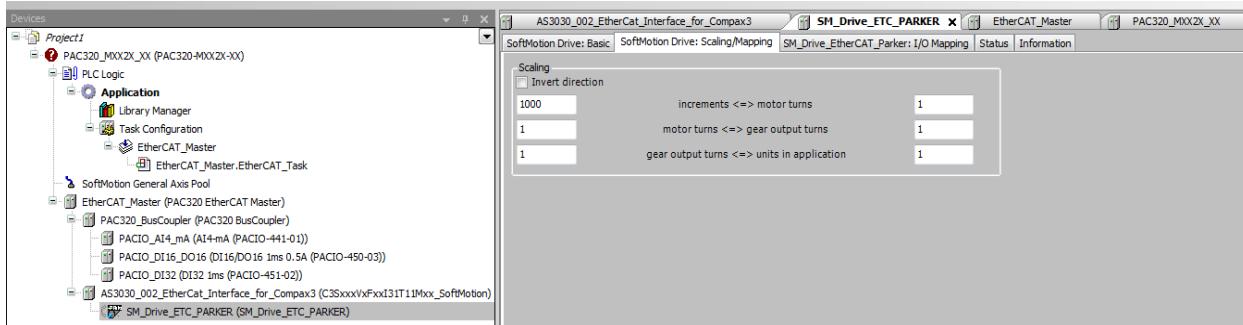
6. Click Add Device.



7. In the Devices tree, the C3SxxxVxFxxI31T11Mxx_SoftMotion node is added under the EtherCAT_Master node.



- 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. The Scaling/Mapping tab relates drive units to motor revolution, motor revolutions to gearbox output revolutions and gearbox output to user units.



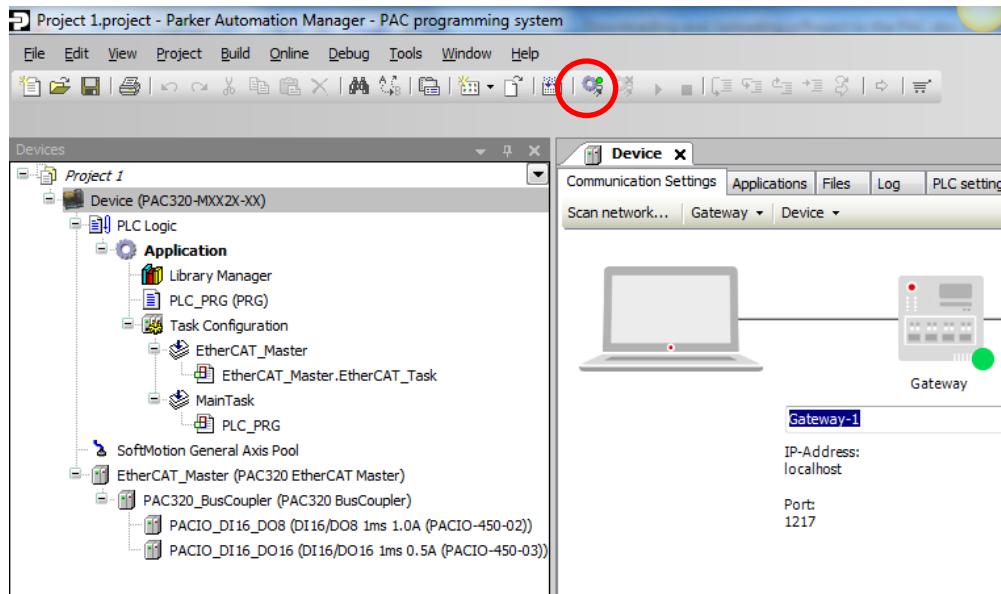
Your Compax3 is now configured as an EtherCAT Slave with the PAC.

Downloading and Uploading a Project to the PAC

Downloading Project Execution Code

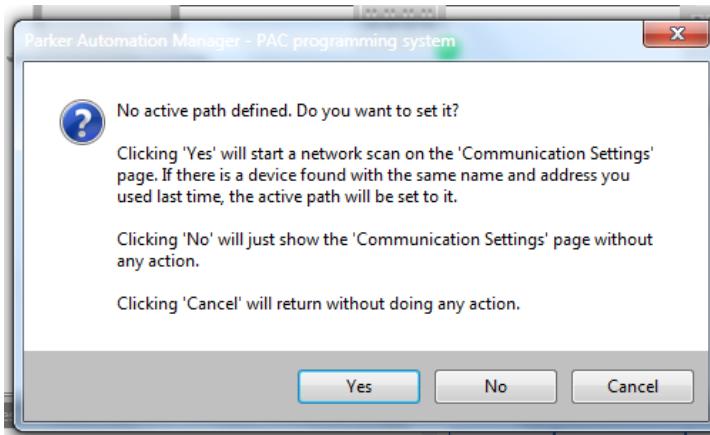
After you have completed your project and it is ready to download to the PAC, use the following instructions to help with this process.

- To download the project execution code, select the Login icon on the Toolbar.

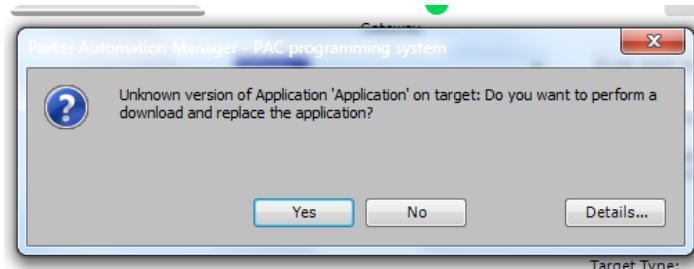


SYSTEM START-UP AND CONFIGURATION

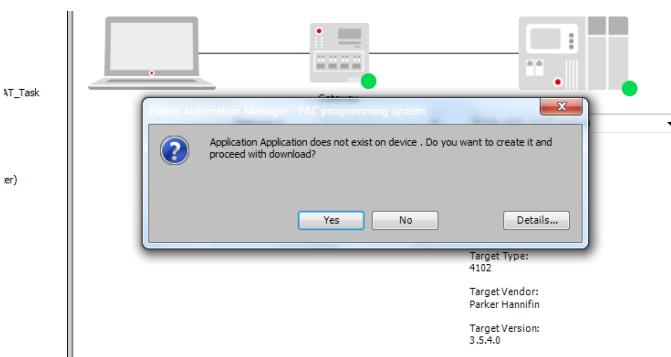
2. You may be prompted to find an active path. To have the PAC automatically, scan, select Yes. To open the Communications Settings Page, select No and then proceed to scan the network for the PAC.



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



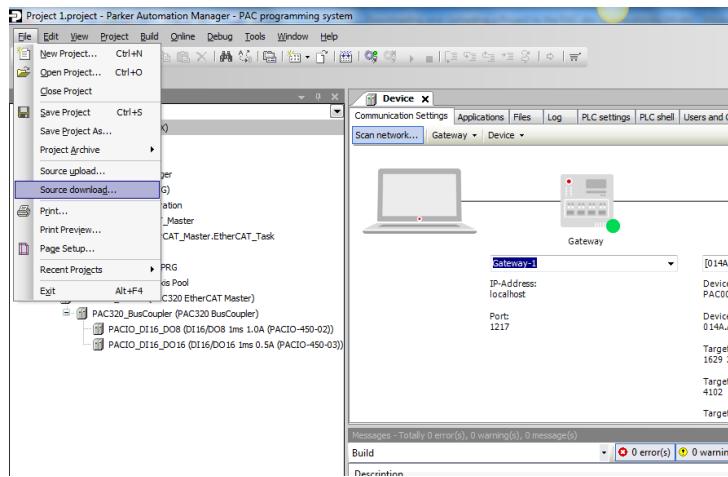
4. If you are downloading the project the first time to a PAC without a project, it may prompt you with a pop up window asking if you want to download the application, click Yes. The project is now downloaded to the PAC.



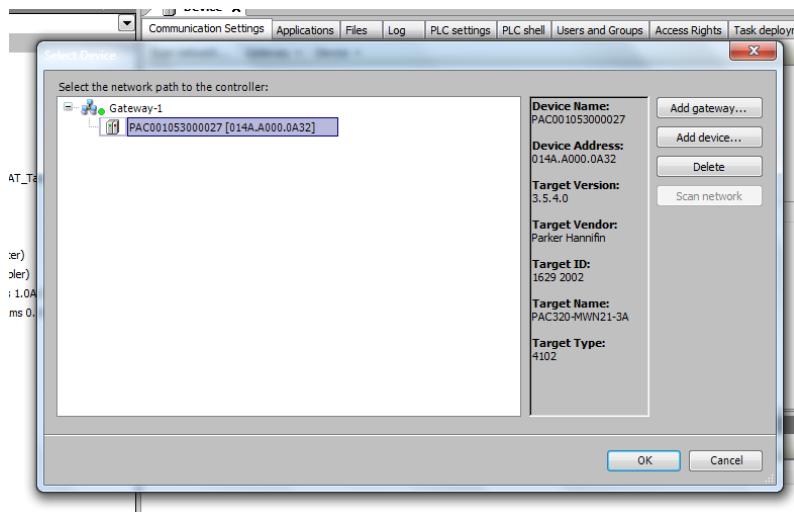
Downloading Project Source Code

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**.



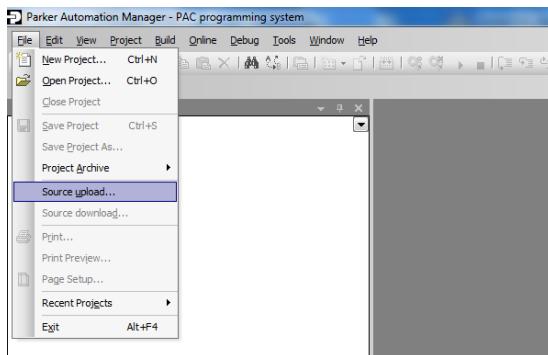
2. Select **PAC320** under the **Gateway** as the device to download the project. If the PAC does not show up under the **Gateway**, select **Scan Network** to locate the PAC. Select **OK** to download the project.



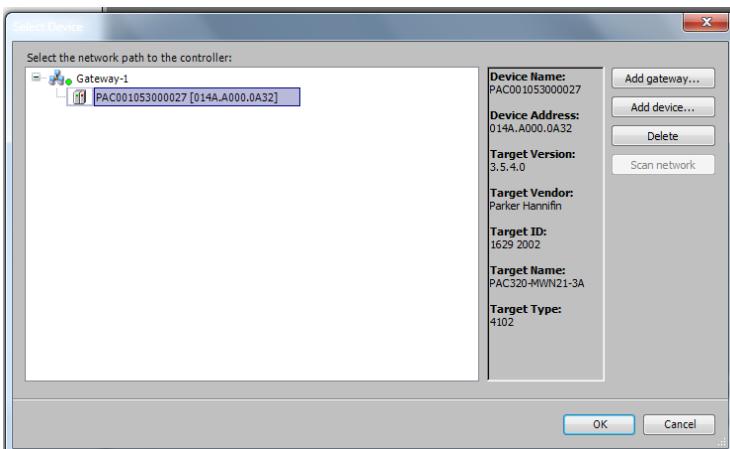
Uploading Project Source Code

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

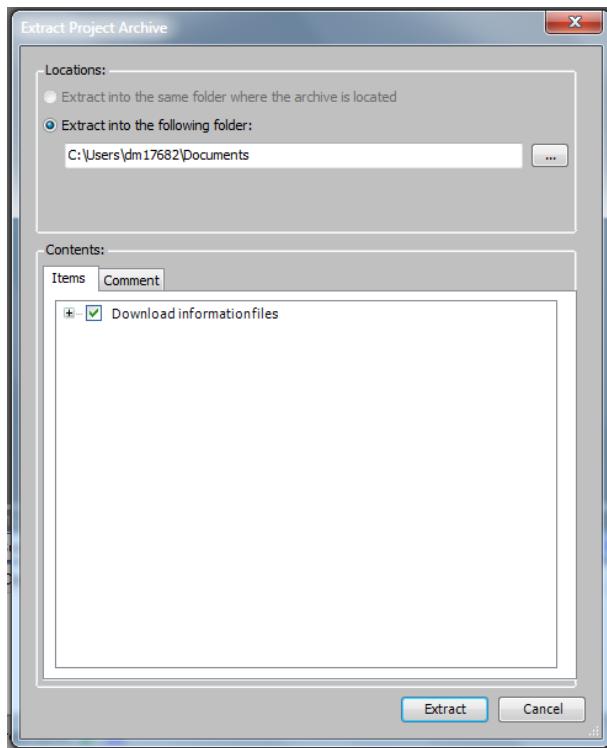
1. In Parker Automation Manager select **File**→**Source Upload**.



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

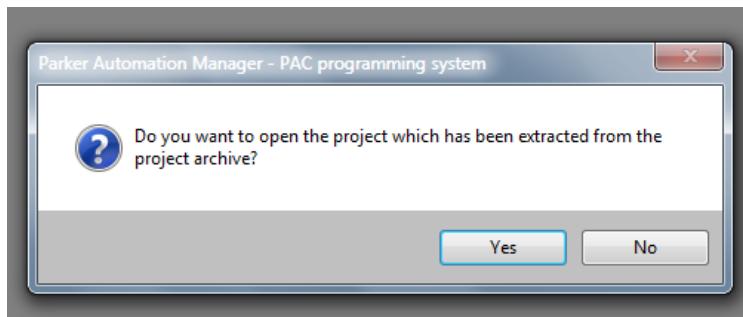


3. Choose the folder location on your computer where you would like to extract and save the source files. Then click on Extract.



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.

CHAPTER 4:

PACIO Modules



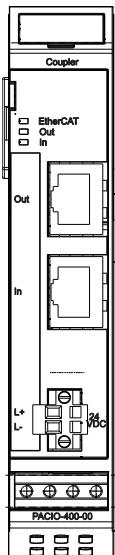
PACIO Module Overview

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/D08 1A | PACIO-450-02 |
| PACIO DI16/D016 1ms/0.5A | PACIO-450-03 |
| PACIO DI8/D08 1ms/0.5A | PACIO-450-05 |
| PACIO DI16/D016 1ms/0.5A LS | PACIO-450-13 |
| PACIO DI32 1ms | PACIO-451-02 |
| PACIO DI16 1ms | PACIO-451-03 |
| PACIO D016 0.5A | PACIO-452-01 |
| PACIO D08 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 |

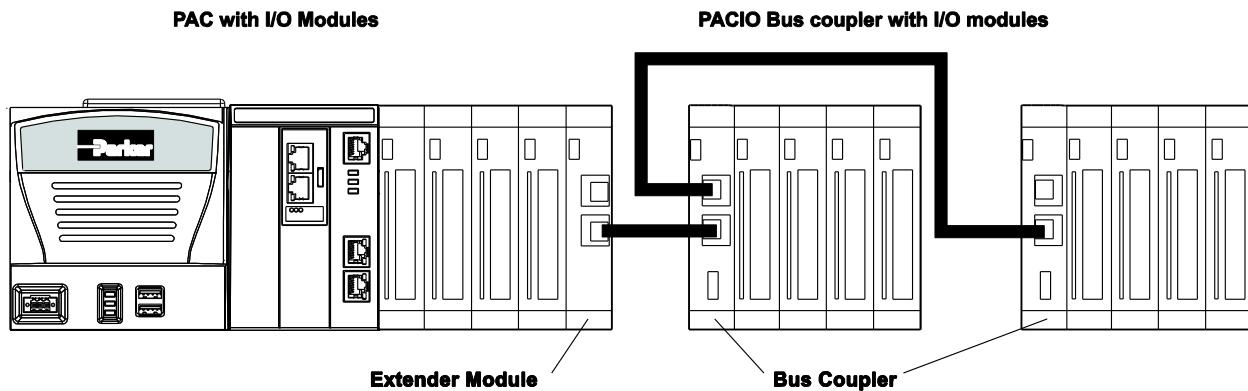


Diagram that shows how to use the Extender Module with the Bus Coupler for additional PACIO modules.

NOTE: For the best emission results, connect the shielding of the EtherCAT cable to Earth ground (see PACIO Shield Connection Terminal Block on page 130).

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) |

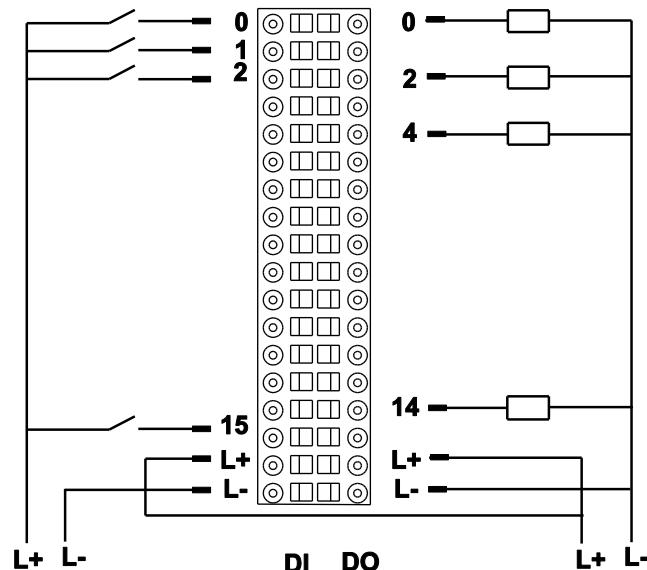
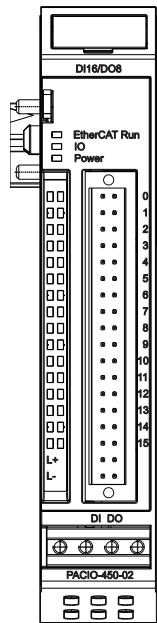
Status LEDs

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



I/O Connection

Front view of PACIO DI16/DO8 1A Module

| Out | Pin | Out | Pin |
|-----|-----|-----|-----|
| 0 | 0 | 4 | 8 |
| 1 | 2 | 5 | 10 |
| 2 | 4 | 6 | 12 |
| 3 | 6 | 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

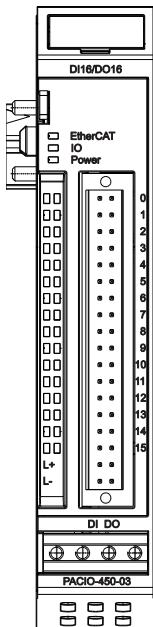
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

| "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 |

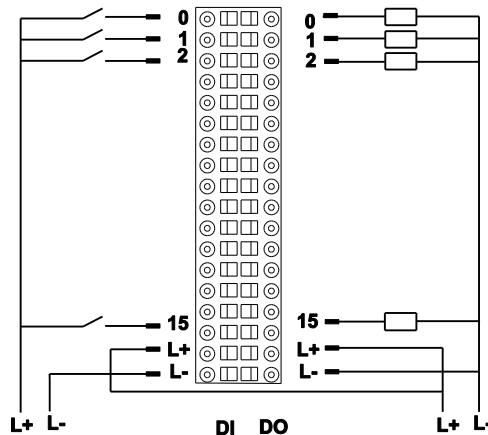


CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

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 I/O/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 |

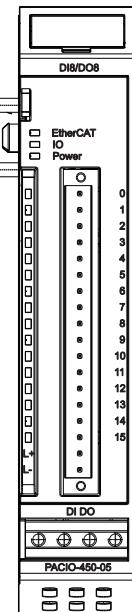
| “Power” LED | | |
|-------------|----------------|----------------------|
| State | LED Flash Code | Explanation |
| On | Green, on | 24 VDC supply ok |
| Off | Off | 24 VDC supply not ok |

| “Channel” LEDs | | |
|----------------|-----------|---|
| State | LED Code | Explanation |
| On | Green, on | Input signal Low (TRUE) / output enabled |
| Off | Off | Input signal High (FALSE) / output disabled |

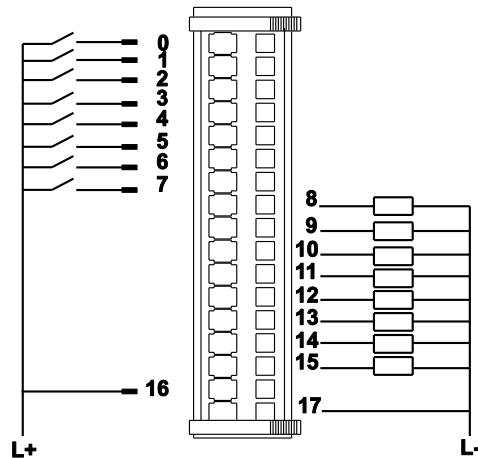


CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

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

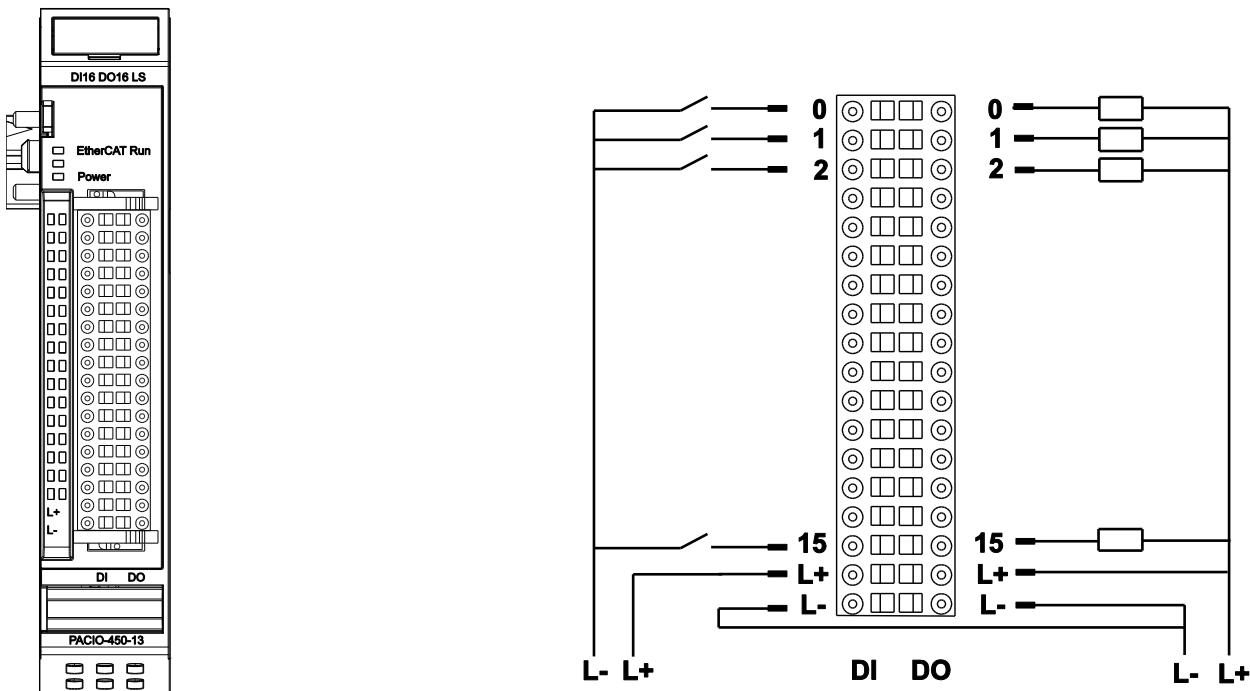
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

| “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 I/O/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 |

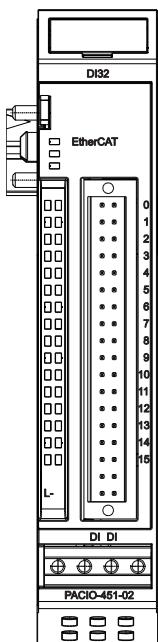
| “Power” LED | | |
|-------------|----------------|----------------------|
| State | LED Flash Code | Explanation |
| On | Green, on | 24 VDC supply ok |
| Off | Off | 24 VDC supply not ok |

| “Channel” LEDs | | |
|----------------|-----------|---|
| State | LED Code | Explanation |
| On | Green, on | Input signal Low (TRUE) / output enabled |
| Off | Off | Input signal High (FALSE) / output disabled |

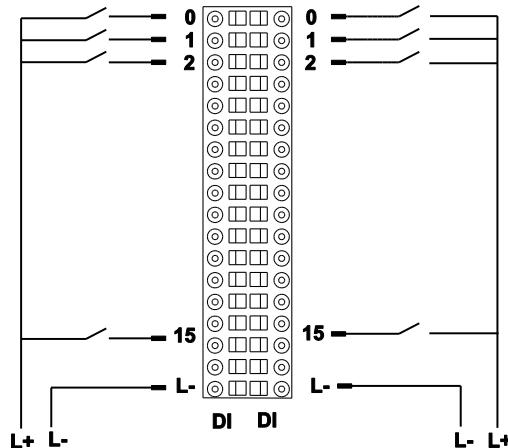


CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

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 I/O/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 |
|---------------|-----------|--------------------------|
| DigitallInput | BOOL | Digital input [n=0...31] |

Terminals

| Power Supply to Module I/Os | |
|-----------------------------|-----|
| L- | 0 V |

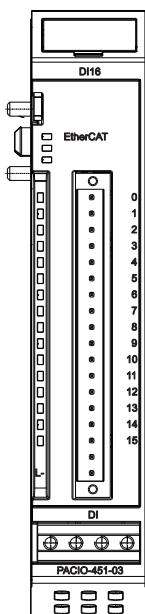
Status LEDs

The “EtherCAT Run” LED indicates the state of the Module’s EtherCAT ASIC.

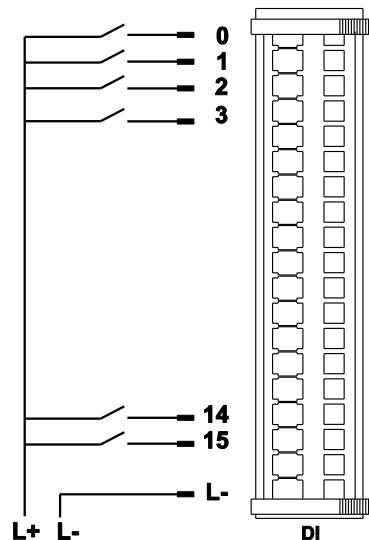
| “EtherCAT Run” LED | | |
|--------------------|----------------|---|
| State | LED Flash Code | Explanation |
| Init | Off | Initializing, no data exchange |
| Pre-Op | Off/green, 1:1 | Pre-operational, no data exchange |
| Safe-Op | Off/green, 3:1 | Safe operation, inputs readable |
| Op | Green, 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 |
|---------------|-----------|--------------------------|
| Digitallnputn | BOOL | Digital input (n=0...15) |

Terminals

| Power supply to Module I/Os | |
|-----------------------------|-----|
| L- | 0 V |

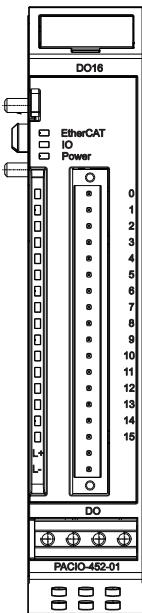
Status LEDs

The “EtherCAT Run” LED indicates the state of the Module’s EtherCAT ASIC.

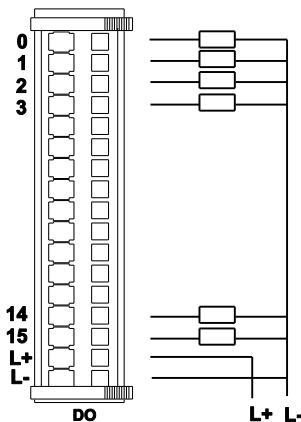
| “EtherCAT Run” LED | | |
|--------------------|----------------|---|
| State | LED Flash Code | Explanation |
| Init | Off | Initializing, no data exchange |
| Pre-Op | Off/green, 1:1 | Pre-operational, no data exchange |
| Safe-Op | Off/green, 3:1 | Safe operation, inputs readable |
| Op | Green, 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 I/O/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

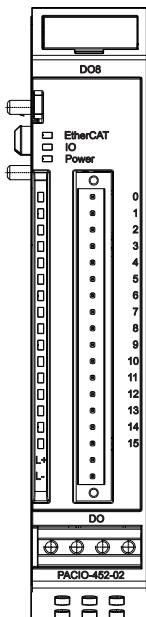
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

| “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 |

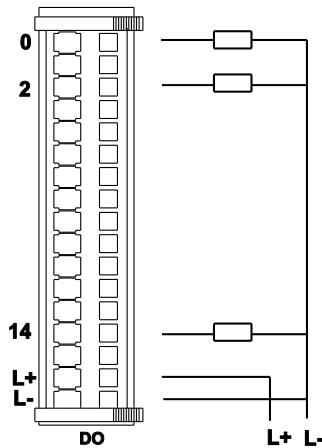


CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

PACIO DO8 1A



Front view of PACIO DO8 1A Module



I/O connection

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

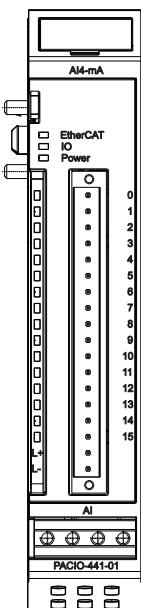
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

| “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 |

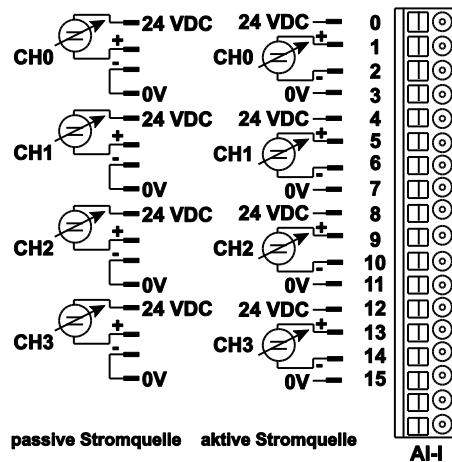


CAUTION: The output drivers have a thermal fuse to automatically turn off any short-circuited outputs. If a short circuit occurs, remove the fault and allow the output to cool down and reset before reenergizing the system.

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 28.

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 | Undervoltage (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 (0xFFFF) of the current input module is $0.5V/23.4\ \Omega = 21.3675mA$. The status is shown by the channel LED.

Measuring range *



* The measurement range is provided by the module, i.e. the maximal output value is HEX FB80.

Mode 0 .. 20 mA



Mode 4 .. 20 mA



Conversion Output value -> Current [mA]:

$$\text{Current [mA]} = \text{Output value} / 3066,336$$

Conversion Current [mA] -> Output value:

$$\text{Output value} = \text{Roundoff} (\text{Current [mA]} * 191,646) * 16$$

Measuring values, Variable values, Status

Analog Values Current

| Measuring | | Variable Values | | Measuring | | Variable Values | |
|-----------|---------|-----------------|----|-----------|-------------|-----------------|-------------|
| mA | Decimal | Hexadecimal | mA | Decimal | Hexadecimal | mA | 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 | | 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.

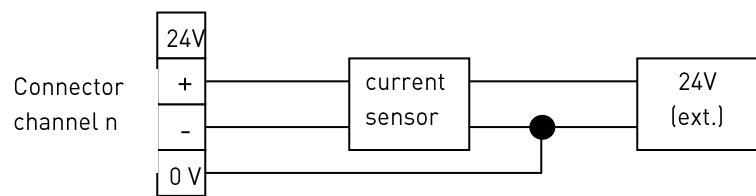
Quality of Analog Values

The Module inputs connect to both active and passive current sensors. See Figure "I/O ConnectionsPACIO Module Overview" on page 62 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:

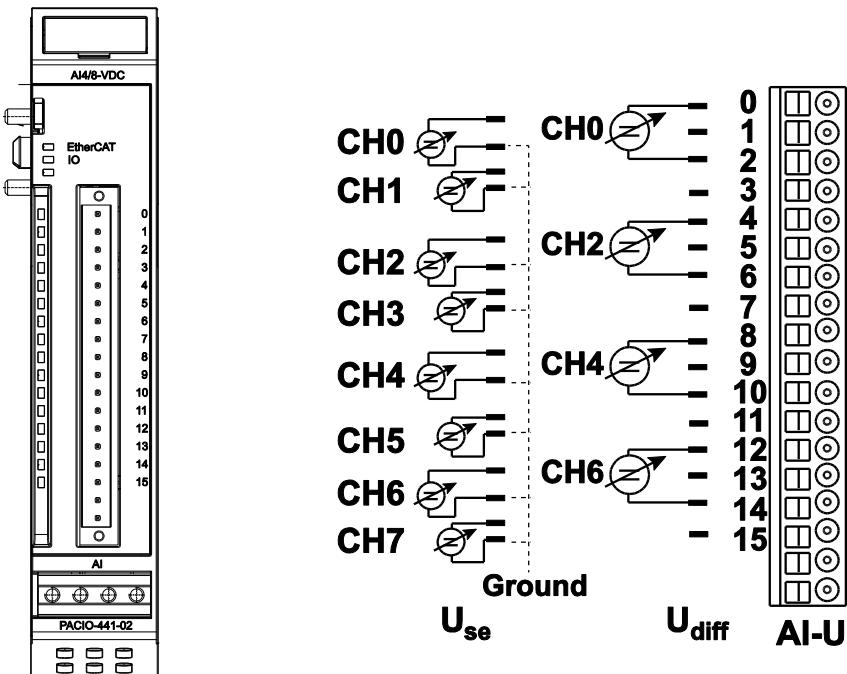
- Use the power supplied by the module if at all possible.
- If power to the current sensors is supplied by an external source, connect the 0V terminal of that power source to the 0V terminal of the module.



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 I/O/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 28.

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 | | Hexadecimal |
| | 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 | 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.

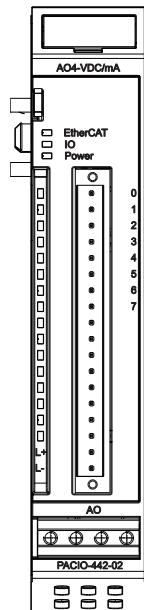
Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The Module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of Analog Values

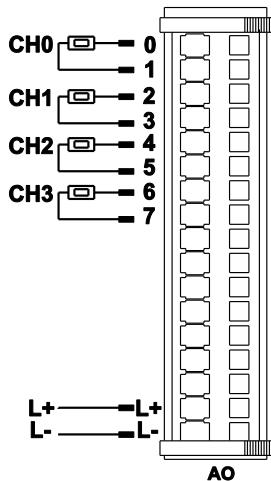
Best results are obtained by:

- 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 I/O/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 ... 0xFFFF 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 | 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 A04-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

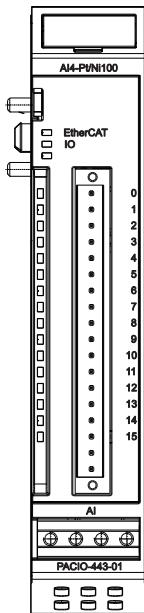
Apart from the Module error messages, the set of messages below contains details about the current state of the PACIO AO4-VDC/mA 12 Bit Module. These messages are automatically reset when the state concerned has returned to normal. They are combined into a single "Specific_Error" state of the Module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

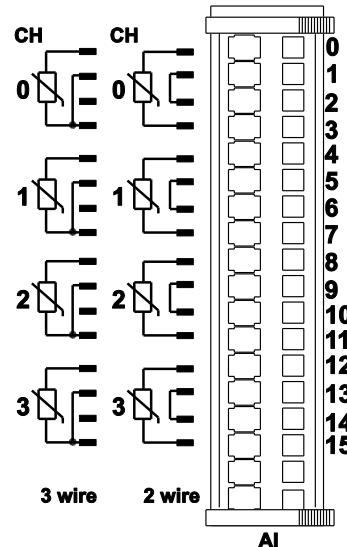
Conversion Time

The PACIO AO4-VDC/mA 12 Bit Module has a set cycle time of $320\mu\text{s}$ 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 | < \pm 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 I/O/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 I/O/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/Ni1000 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 |

| "10" 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 |

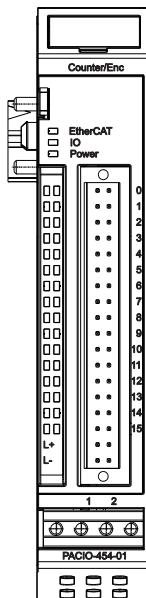
NOTE: If you are aiming for a high sampling frequency, the PAC should do the filtering (averaging) because it will normally have much more processing power.

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.

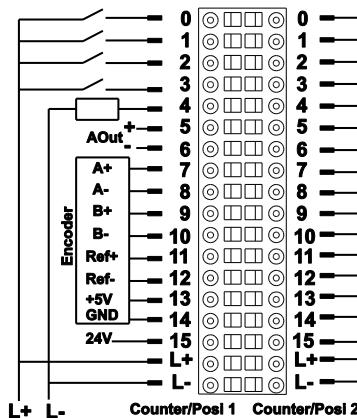
Quality of Analog Values

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-BusLoad | 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 |
| OutputsOnErrorHandler_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 107.)

Counter 1

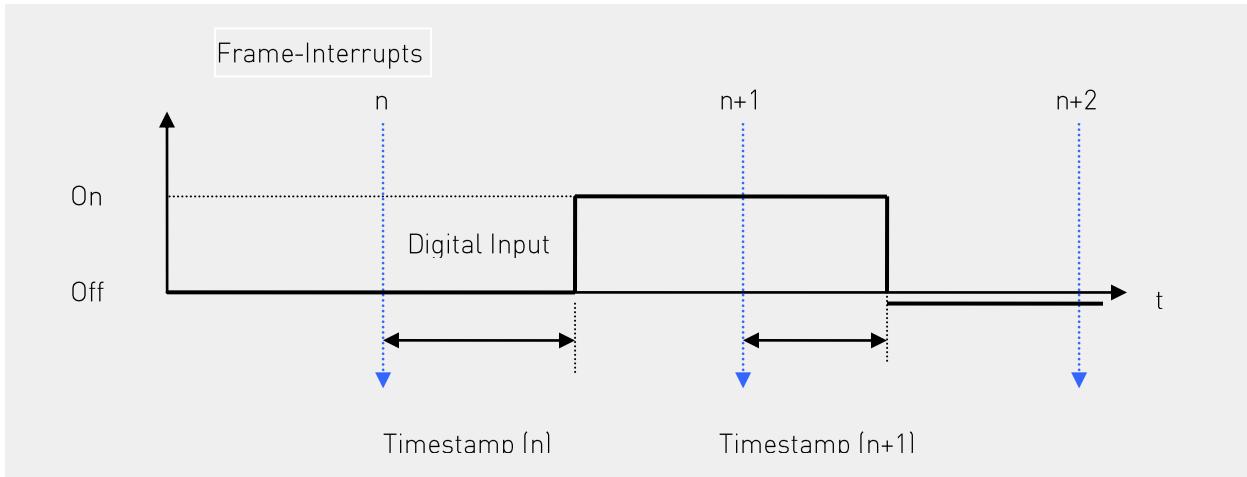
| Variable | Data type | Explanation |
|--------------|-----------|---|
| Input_0_0_TS | UINT | Time stamp for Digital Input 0 (Hardware Triggered) |
| Input_0_1_TS | UINT | Time stamp for Digital Input 1 (Software Polled) |
| Input_0_2_TS | UINT | Time stamp for Digital Input 2 (Software Polled) |
|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

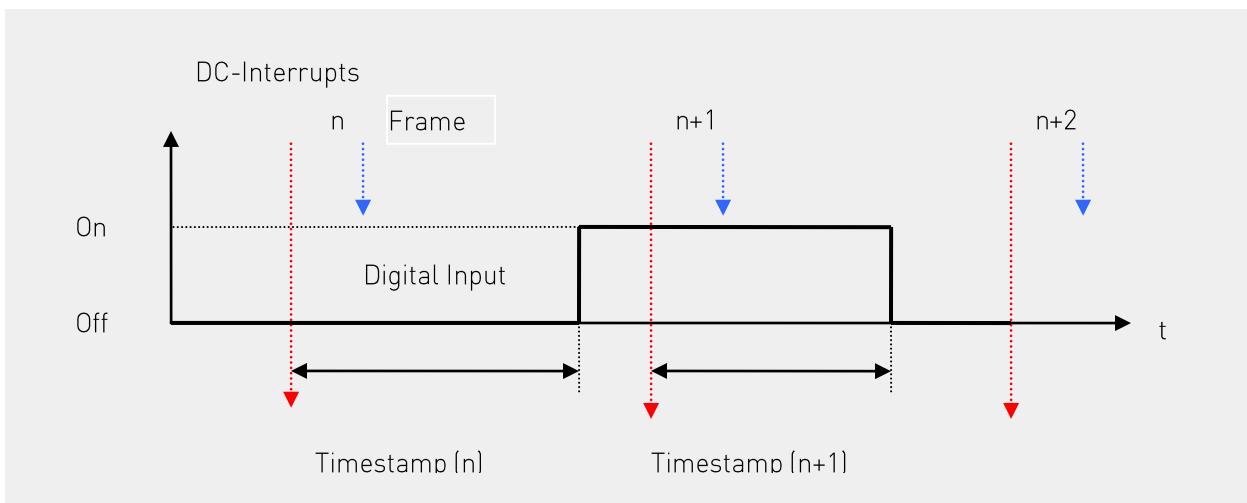
NOTE: The time stamp is metered between frame- or DC-interrupts and signal changes on the input in μ s. The value of the time stamp becomes 0xFFFF, when no signal change takes place between two frame- or DC-interrupts.

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.

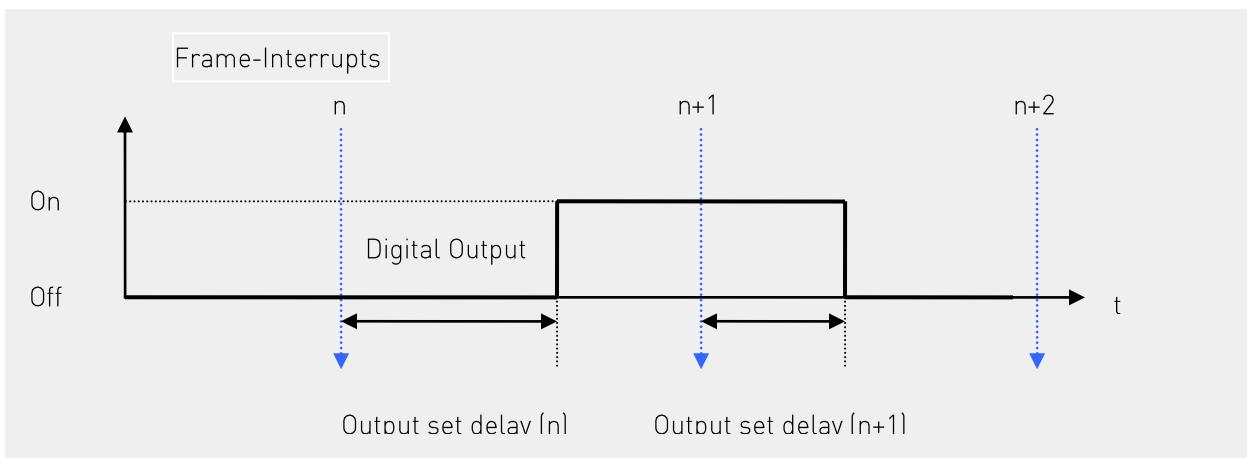
Counter 1

| Variable | Data type | Explanation |
|----------------|-----------|-----------------------------|
| Output_0_0_Del | UINT | Output set delay in μ s |

Counter 2

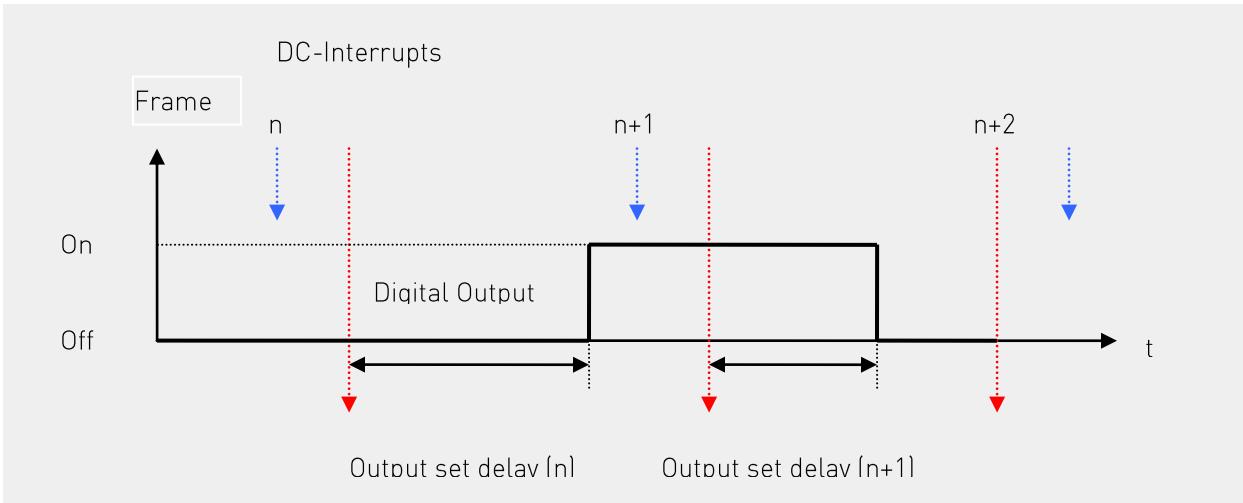
| Variable | Data type | Explanation |
|----------------|-----------|-----------------------------|
| Output_1_0_Del | UINT | Output set delay in μ s |

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 96.

| 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:=di.MaxValue ;           (*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 -2,147,483,647 to +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:= 4,294,976,294;                 (*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.

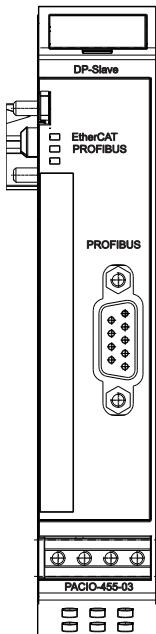
```
Term2_Input_0_0;          (*Status of Input 0*)
Term2_Input_0_1;          (*Status of Input 1*)
Term2_Input_0_2;          (*Status of Input 2*)
Term2_Input_0_3;          (*Status of Input 3*)
```

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 96.

```
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 | PACIOPBSLave.GSD |
| WxHxD | 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 28.

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 124.

| 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 module4 Byte_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
- PACIOPBSlave.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 PACIOPBSlave.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".

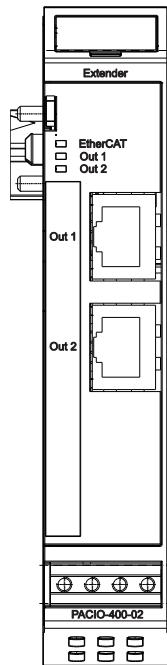
Example:

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
```

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. 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.

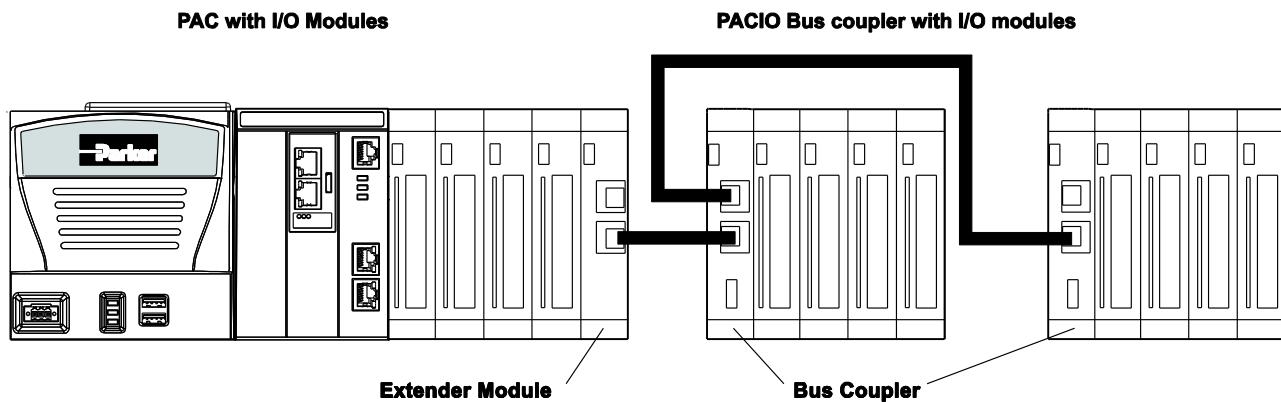


Diagram of how to use the Extender Module with the Bus Coupler for additional PACIO modules

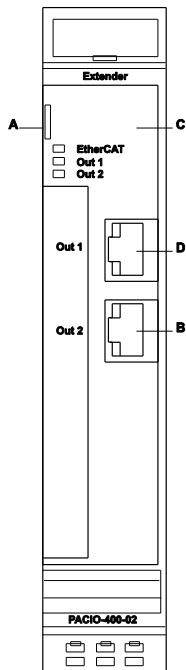


CAUTION: Always use the appropriate XML file to review for the EtherCAT configuration.

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.

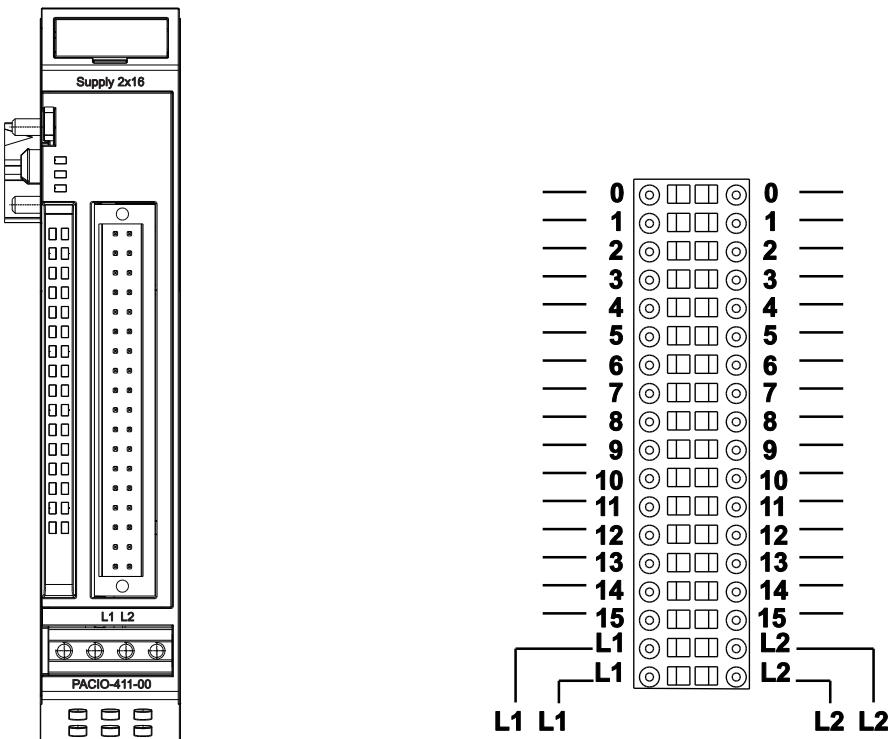
PACIO MODULES

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

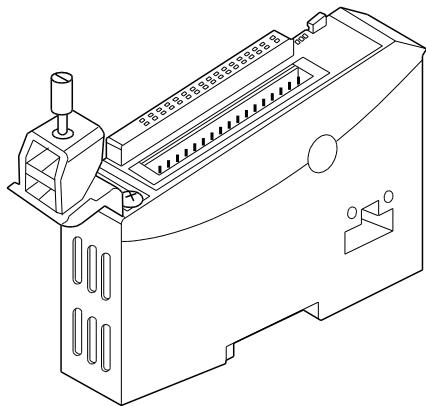
The PACIO Power Distribution 2 x 16 Module has two separate potential lines. The Module distributes the potential (optional 0 VDC or 24 VDC) attached at the pins L1 or L2 on the pins 0 to 15 of the same row.

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

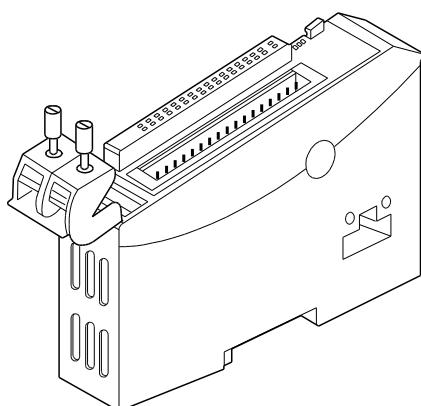
STATUS LEDS

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

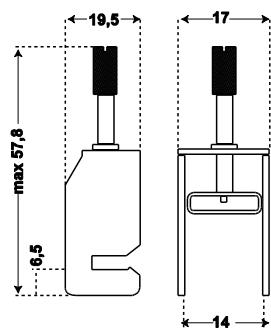
PACIO Shield Connection Terminal Block



PACIO Shield 14 mm



PACIO Shield 2x8mm



14mm Clamp

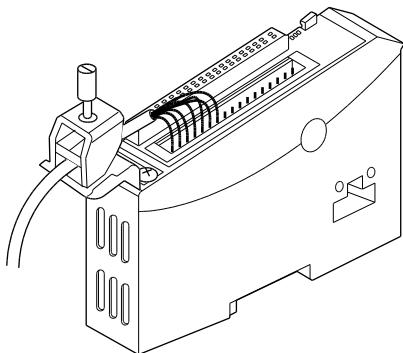
The PACIO Shield Connection Terminal Block consists of the shield clamp, the clamp holder, two screws M3x5, two washers, and two spring washers.

| 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.”

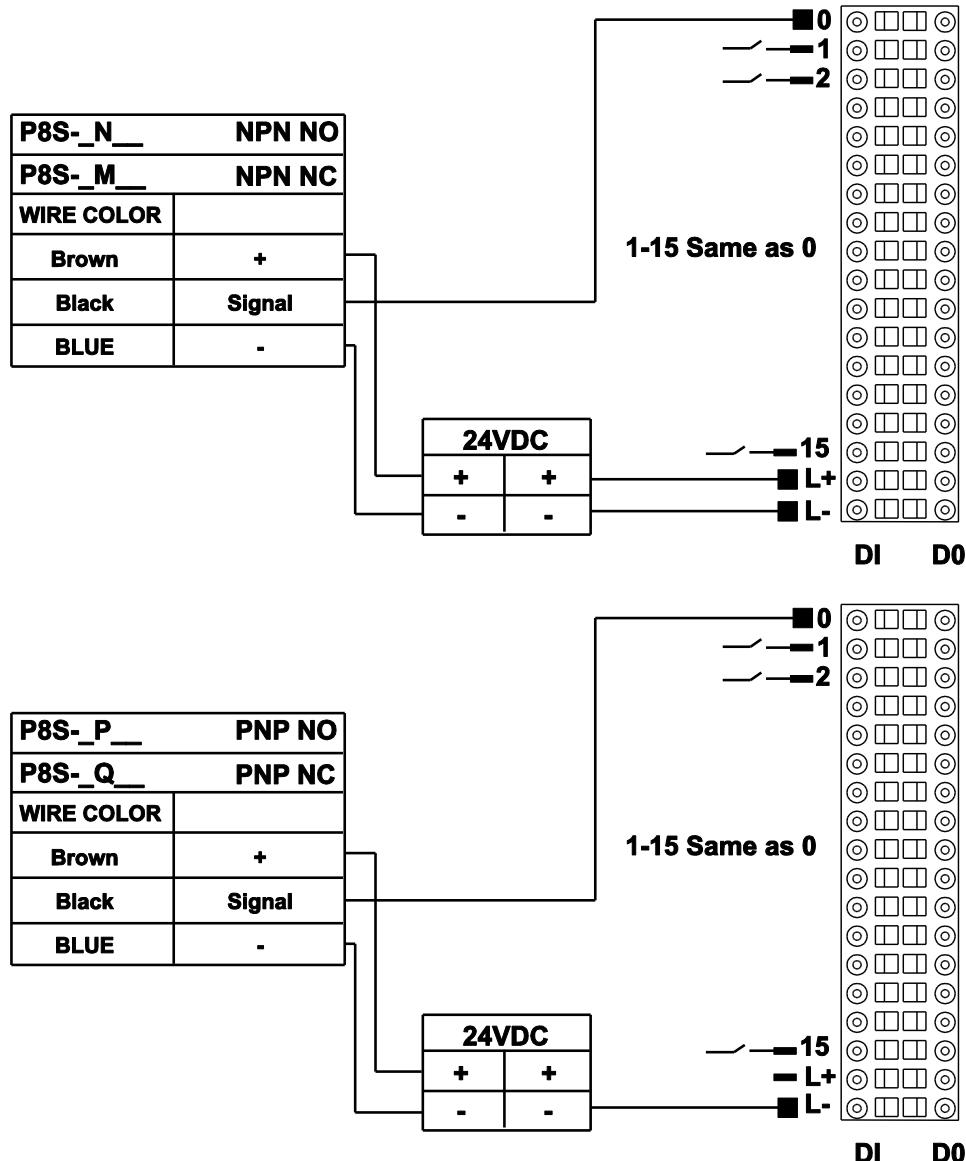


CAUTION: Do not use the Shield Connection Terminal as a strain relief. A strong pull on the I/O cable can possibly unseat the PACIO Module from the DIN rail and damage adjacent modules and E-Bus communications.

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



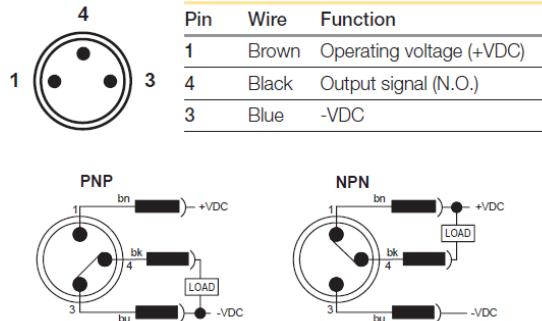
The above connections apply to both the P8S and P8S Mini-Global Sensors, shown on the next two pages.

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 60 947-2
 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)

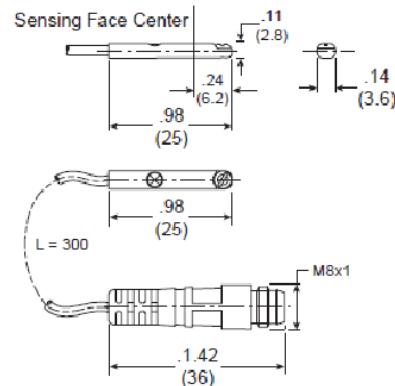


| -XX | PART# | NPN/PNP | N.O. / N.C. | CABLE |
|-------------|-----------|---------|-------------|------------------|
| 003-3743-01 | P8S-GNSHX | NPN | N.O. | 0.2M with M8 |
| | P8S-GNCHX | NPN | N.O. | 0.2M with M8 |
| 003-3743-02 | P8S-GPSHX | PNP | N.O. | 0.2M with M8 |
| | P8S-GPCHX | PNP | N.O. | 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

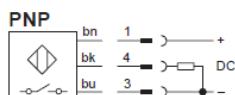
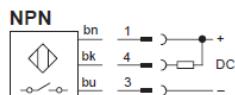
OPERATING VOLTAGE..... 10-30VDC
 CONTINUOUS CURRENT..... <70mA
 RESPONSE SENSITIVITY..... <48 GAUSS
 SWITCHING FREQUENCY..... 1000HZ
 POWER CONSUMPTION..... <8mA WITHOUT LOAD
 VOLTAGE DROP <2.5 VDC
 RIPPLE..... 10% OPERATING VOLTAGE
 HYSTERESIS..... <15 GAUSS
 REPEATABILITY..... +/- 0.1MM
 EMC..... EN 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 0.09mm²
 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 |

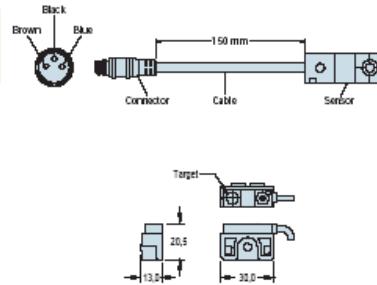
PAC with 400XR series

Home or **Limit Sensor**

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.

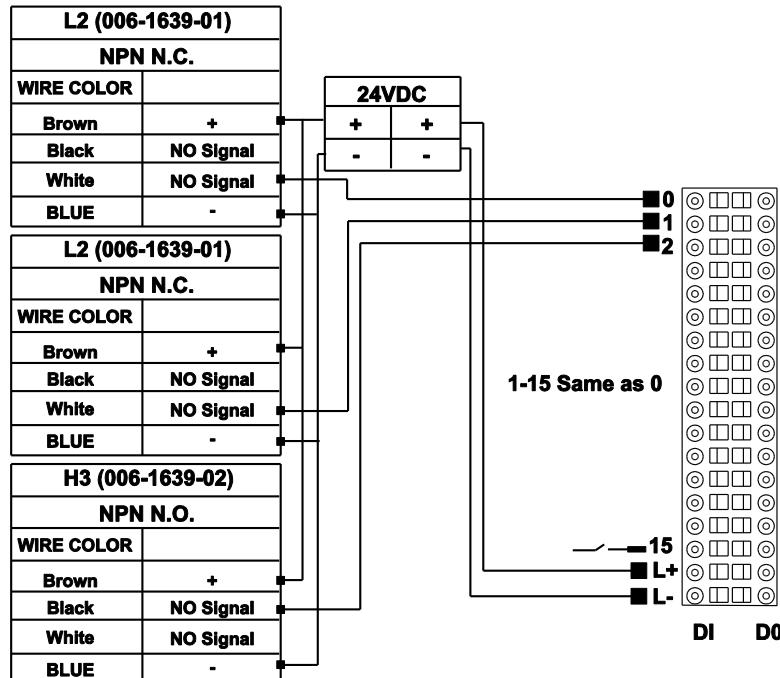
- NPN (Sinking) or PNP (Sourcing)
- Normally Closed (N.C.) or Normally Open (N.O.)
- Flying Leads or Locking Connector

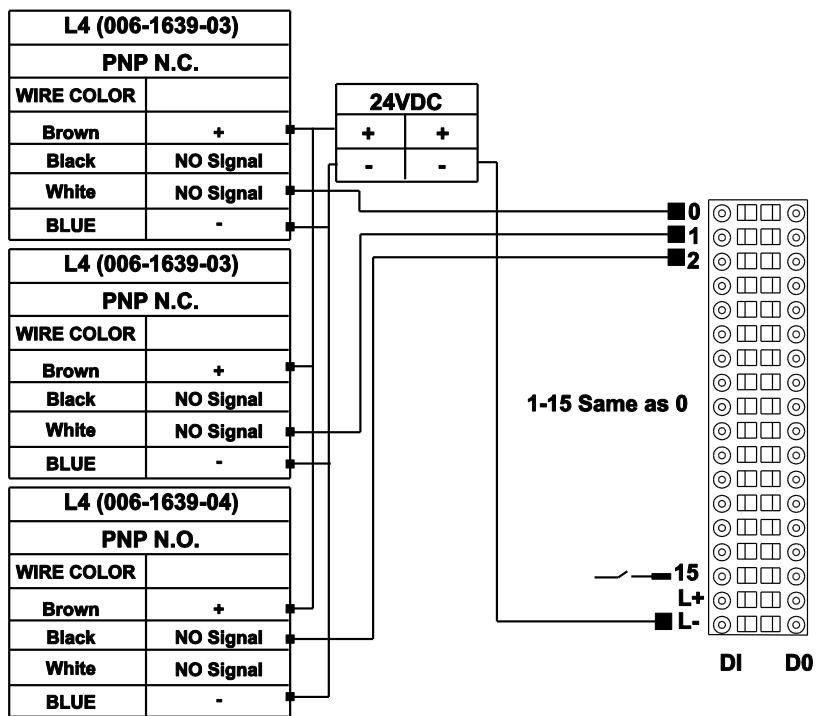
Input Power 5-30VDC, 20mA
 Output 100mA max
 Wire Color (+) Supply: Brown
 Code (-) Supply: Blue
 NO Output: Black
 NC Output: White



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

** Sensor triggers (targets) ordered separately.





PAC with 400LXR

Home Sensor

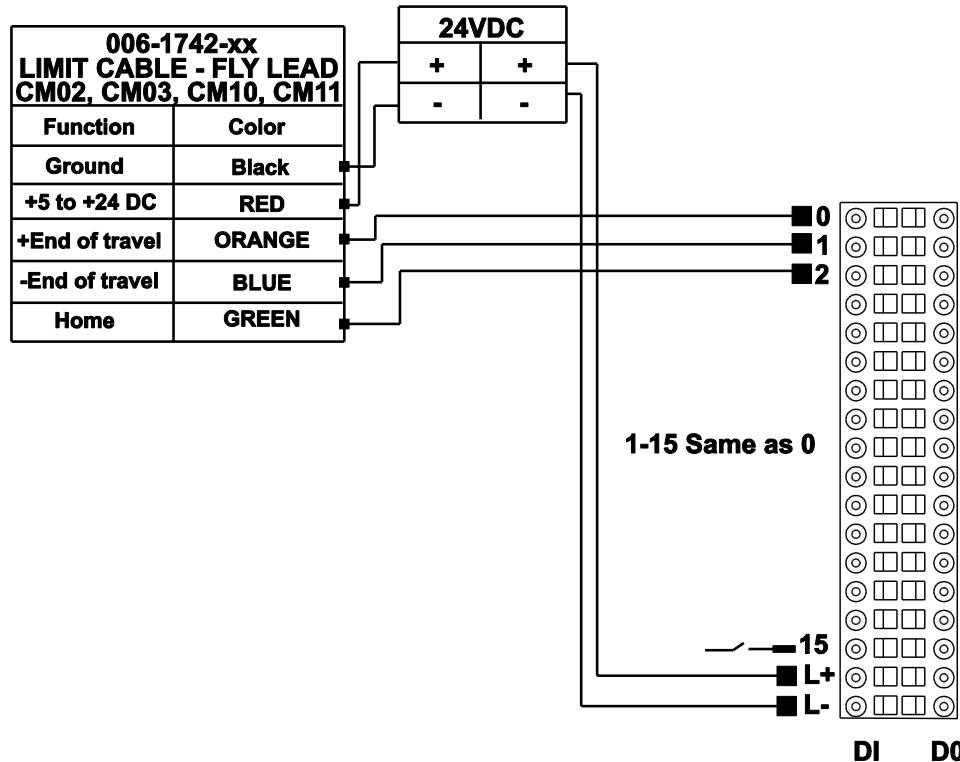
| | |
|-------------------------------|----|
| None-Free Travel (only) | H1 |
| N.C. Current Sinking | H2 |
| N.O. Current Sinking | H3 |
| N.C. Current Sourcing | H4 |
| N.O. Current Sourcing | H5 |

Limit 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 |

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 |

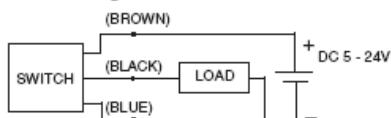


PAC with SMH sensors

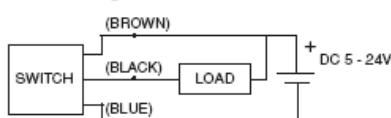
Hall Effect Sensors

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.

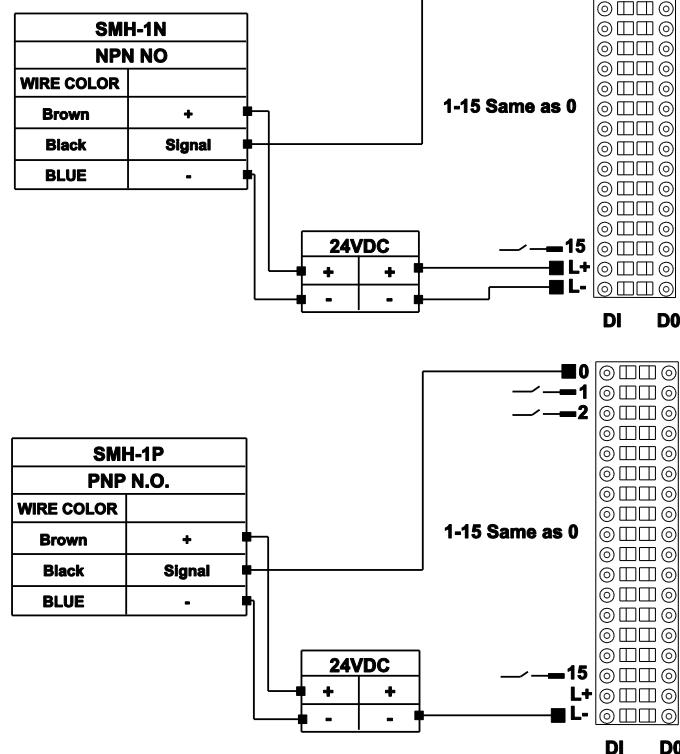
ZETA6104 controls use NPN sensors for Home and End-of-Travel.

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

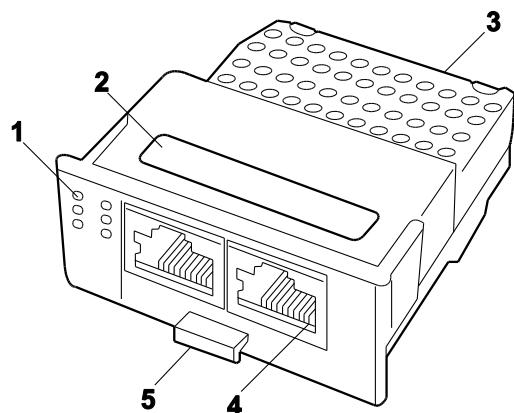


CHAPTER 5:

Communications Modules (Optional)

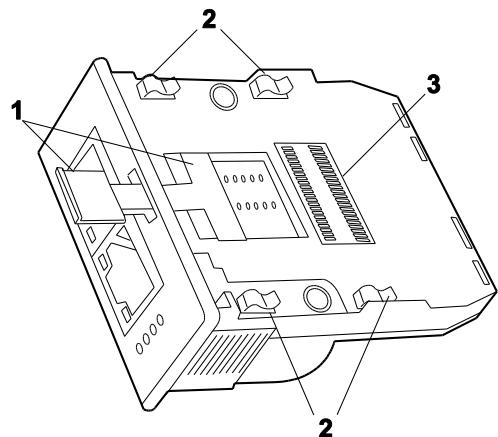
Overview

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 |

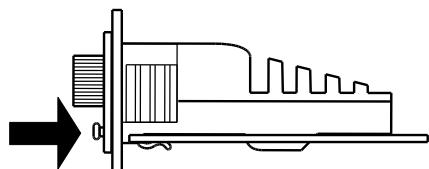
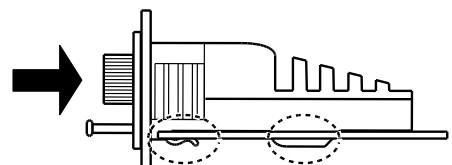
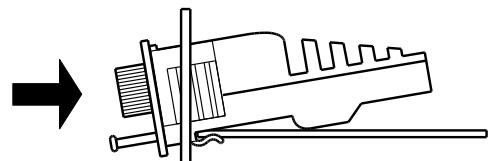
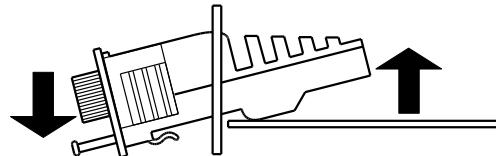
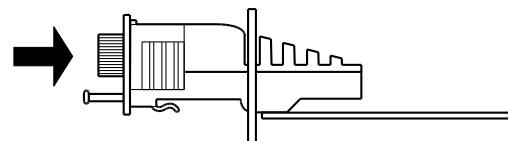
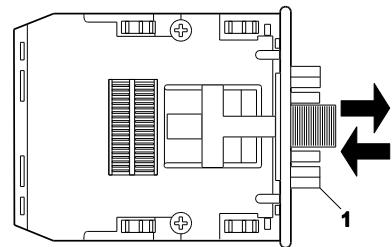


Bottom view of Communication Module

| 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 |

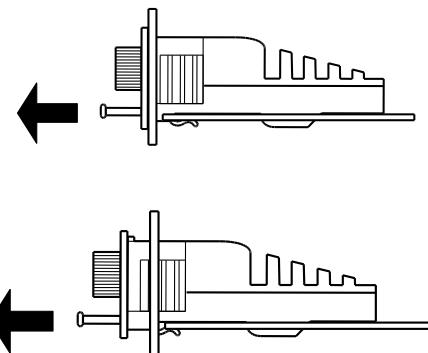
Installation

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 Parker.... and select Add Device.
 17. Set Vendors to 'All Vendors', expand 'PROFINET IO', expand PROFINET IO Device.
 18. Select the NetX PN Device then choose Add Device and select Close.
 19. Right-click NetX PN Device and choose Add Device.
 20. Choose 1 Byte Digital Input and Add Device.
 21. Choose 1 Byte Digital Input and Add Device then Close.
 22. Double-click the 1[Byte]_Digital[Input] branch and to the right, select the PNIODev-Module I/O Mapping tab.
 23. Expand the '+' in the variable column and double-click in that same column; the entry for Bit0. Create the variable name 'S7_Bit_0'.
 24. Double-click the 1[Word]_Digital[Input] branch and to the right, select the PNIODev-Module I/O Mapping tab.
 25. Expand the '+' in the variable column and double-click in that same column, the entry for Bit0. Create the variable name 'Word_Bit_0'.
 26. 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:
 - o IP Address: 192.168.01
 - o Subnet Mask: 255.255.255.0
 - o Default Gateway: 0.0.0.0
 - o Station Name: NetXDevice

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-DAB0**.
13. Drag this to Slot 2.
14. Set the IP to 172.25.8.66.
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. 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 PNS.
9. Select NJ 100 XX RE/PNS and drag it to the PROFINET network branch you just created.
10. Assign the IP by double-clicking the item and making the assignment via the Ethernet button.
11. Assign the IP to 172.25.8.68.
12. Click OK.

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. <ul style="list-style-type: none"> ■ 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. <ul style="list-style-type: none"> ■ 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. |
| Blue | A project is being downloaded via USB. |
| 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:

- Memory allocation failures
- No applications have been successfully loaded upon startup
- A call to the Get PLC Status function returns an error
- I/O system errors occur when copying files from the USB stick drive
- The Shell Execute command fails when starting the PAC runtime
- The GPIO driver call fails
- An error occurs when restoring the backup NK.bin
- The registry write fails
- An error occurs when copying the default project to the \project folder on the SD card
- The SMB bus driver call fails
- An error occurs when initializing the retentive memory chip

TROUBLESHOOTING

- 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
- PAC license file cannot be found (or copied)
- PAC Configuration files cannot be edited

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: [Format new table]

- 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 RJ45 LED indicators
- 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.

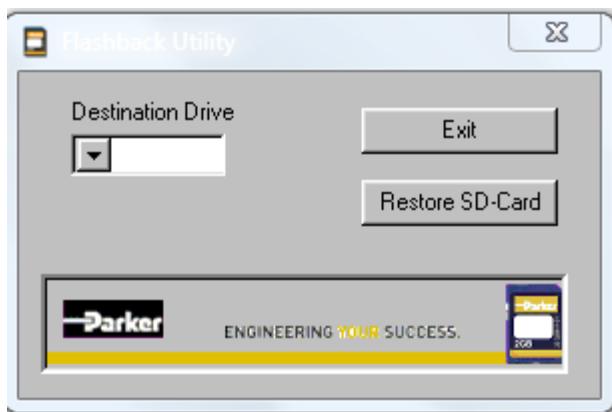
Flashback Utility

The Flashback Utility is a tool for restoring or upgrading the PAC's firmware and operating 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 supplier 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.

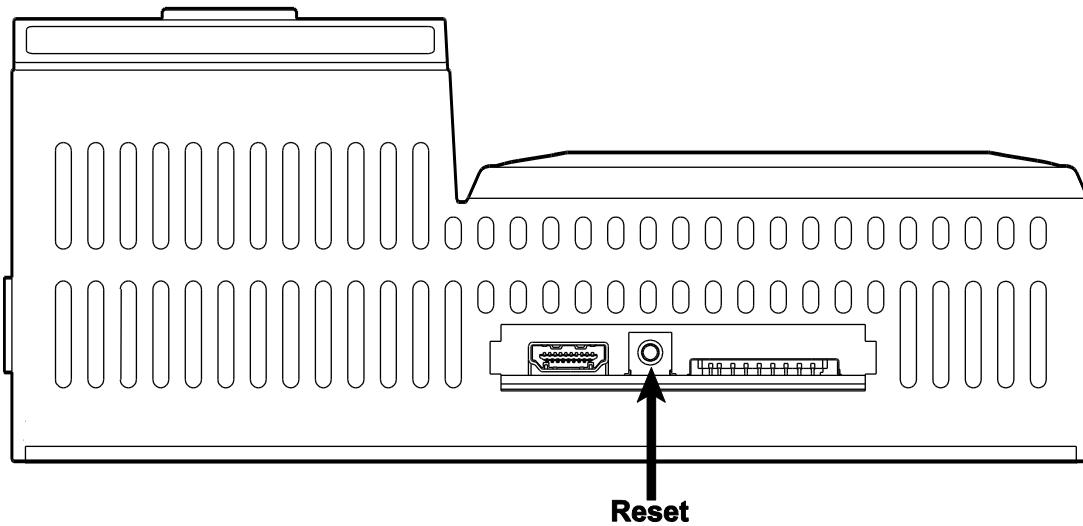


4. Select the destination drive of the SD card.
5. Click Restore SD-Card.
6. A dialog box will appear warning that all files will be deleted. Select Yes.
7. After the process is complete, properly eject the SD card from the computer.

Reset Button

Reset the Controller

Should it become necessary to restore the PAC Controller back to the state in which it shipped from the factory, use the Reset button located on the top of the Controller next to the SD card to clear the error LED, reset the IP address, and/or reset the entire system. To access the button, remove the SD Card Cover located on the top of the Controller. The Reset button is located next to the SD Card:



| Reset Button Function Overview | | |
|--------------------------------|---|--|
| Button held for | - less than 5 seconds | The ERROR LED will be reset |
| | - more than 5 seconds, but less than 30 seconds | The Controller IP Address will be reset |
| | - more than 30 seconds | The system will restore its factory settings |

More details regarding the Reset Button functions:

Resetting both auxiliary IP addresses back to factory default setting

Both Controller IP addresses will be reset via a five (5) second hold of the reset button (this can happen in RUN or STOP mode).

- After the button has been held for five seconds, the ERROR LED will slowly flash as a signal that the five seconds have passed, but no action will occur before the button has been released.
- If the button is released between seconds 5-29, then the IP addresses will be reset to the factory setting and the RUN/STOP (flashing White) and the red ERROR LEDs turn on and flash simultaneously, for a minimum of five seconds.
- After five seconds, the Controller will automatically reboot.

TROUBLESHOOTING

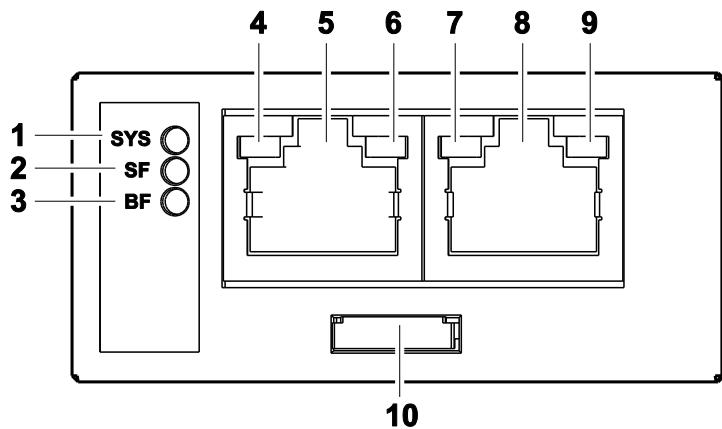
Resetting the Controller back to the factory settings

The button should be pressed and held for 30 seconds to reset the Controller completely back to factory settings. The Controller will revert back to the OS stored in the Factory nk.bin directory, IP address will be reset to factory setting, the non-volatile memory will be cleared, persistent registry is deleted (resides on the SD card), and all programs will be erased from the SD card. In other words, the SD card and the Controller will revert to the state that it was in as it shipped from the factory.

- Press and hold the Reset button for thirty (30) seconds. During this period the RUN/STOP LED will be flashing White and the ERROR LED will be flashing Red.
- After the 30 second flashing sequence and while the controller is performing the reset, the RUN/STOP LED will be solid Red, ERROR LED will be flashing Red.
- After the reset is complete, the controller will automatically reboot.

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 |
| BF Number in the device drawing (3) | Off | Off | No error |
| | Duo LED red/green | | |
| | Red | On | No configuration; or low speed physical link; or no physical link |
| LINK / RJ45 CH0 (4) & CH1 (7) | Red | Flashing cyclic at 2 Hz | No data exchange |
| | Off | Off | No error |
| | LED green | | |
| RX/TX / RJ45 CH0 (6) & CH1 (9) | Green | On | A connection to Ethernet exists |
| | Off | Off | The device has no connection to Ethernet |
| LINK / RJ45 CH0 (4) & CH1 (7) | 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.

TROUBLESHOOTING

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 41.

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.

Technical Assistance from Parker Hannifin

| Contact Information for Technical Assistance | |
|---|--|
| Contact your local automation technology center (ATC) or distributor. | |
| North America | Europe |
| Parker Hannifin | Parker Hannifin |
| Electromechanical Automation North America | Electromechanical Automation Europe |
| 5500 Business Park Drive | Robert-Bosch-Strasse 22 |
| Rohnert Park, CA 94928 | 77656 Offenburg (Germany) |
| Telephone: (707) 584-7558 | Telephone: +49 (0781) 509-0 |
| Fax: (707) 584-8029 | Fax: +49 (0781) 509-98176 |
| Email: emn_support@parker.com | Email: Em-motion@parker.com |
| Internet: http://www.parkermotion.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 | <ul style="list-style-type: none"> ■ Intel N2600 CPU, 1.6GHz, Dual Core, 64-bit ■ 1MB L2 Cache |
| Memory | <ul style="list-style-type: none"> ■ Up to 1 GB DDR3 SDRAM (minimum) ■ 1066 MHz, PC3-8500 ■ 204-pin SODIMM Socket |
| BIOS | Insyde H2O |
| Storage | 2GB (minimum) Secure Digital Card (SD) |
| Ports | <ul style="list-style-type: none"> ■ Two RJ45 10/100/1000BaseT Ethernet ■ One RJ45 100Mbit/s EtherCAT supporting IEEE1588 Distributed Clocks ■ Two USB 2.0 Host Type A |
| Dimensions HxWxL | <p>Without optional communications module:</p> <ul style="list-style-type: none"> ■ 3.27" H x 4.93" W x 8.02" L [83.1mm x 125.22mm x 203.71mm] <p>With optional communications module:</p> <ul style="list-style-type: none"> ■ 3.53" H x 4.93" W x 8.02" L [89.66mm x 125.22mm x 203.71mm] |
| Weight | <p>Without optional communications module:</p> <ul style="list-style-type: none"> ■ 1.45 lbs (0.66 kgs) <p>With optional communications module:</p> <ul style="list-style-type: none"> ■ 1.65 lbs (0.75 kgs) |

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 |

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:

