ENGINEERING YOUR SUCCESS.

PARKER AUTOMATION CONTROLLER

PACIO Reference Guide

Effective: May 2024

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Trademark Information

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

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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.

Statement of Compliance

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:

- 2014/30/EU 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.

Contents

About This Guide

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

Version History

This table describes the history of changes to this user guide.

Version History	
Date	Change Description
May 2024	Original Version A

Assumptions of Technical Experience

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

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

Product Naming

This guide describes the following products:

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

Notes, Cautions, and Warnings

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

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

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

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

CHAPTER 1:
Product Overview

Product Description

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

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

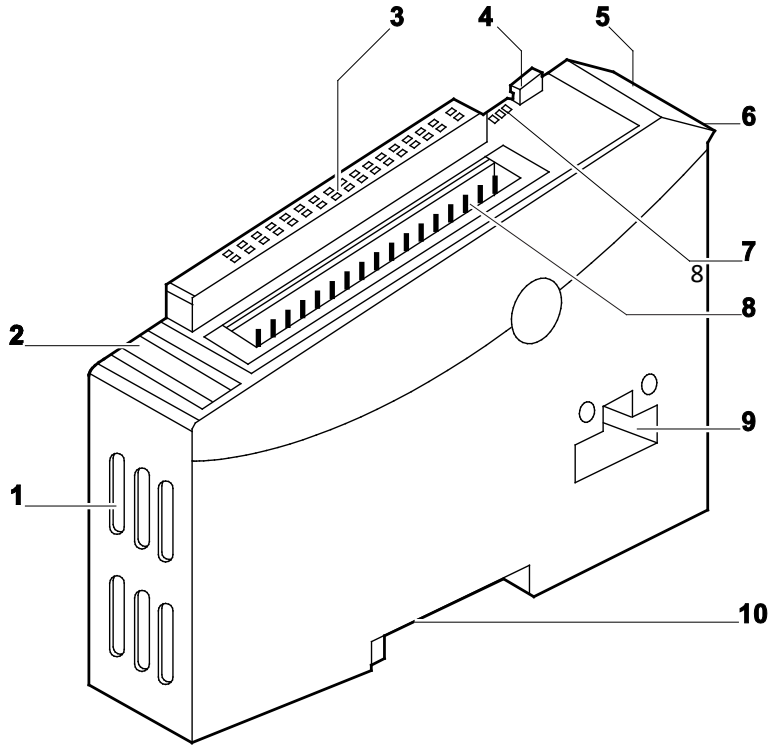
The PAC also accommodates connections to remote I/O Modules, industrial control networks, terminals, factory displays, and Internet-connected devices such as PCs, notebooks, and even smart phones.

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.

Product Features

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

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 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

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

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.

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.

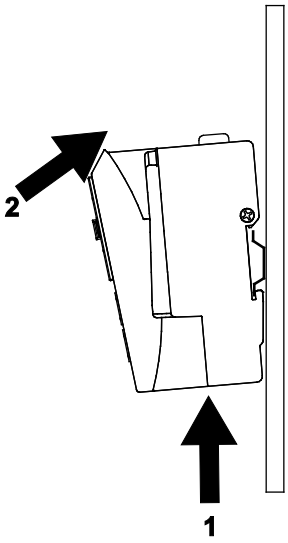
Calculate the overall length of DIN rail required for the installation base on the following component widths. Be sure to include extra length for adding additional modules in the future and a clearance allowance for removing modules.

- 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:

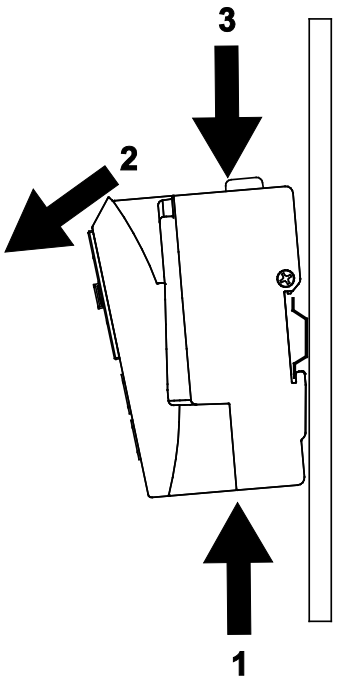
1. Push the module up against the mounting rail from below, allowing the metal spring to snap in between the mounting rail and mounting area.
2. Push the module against the mounting wall until it snaps into place.



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

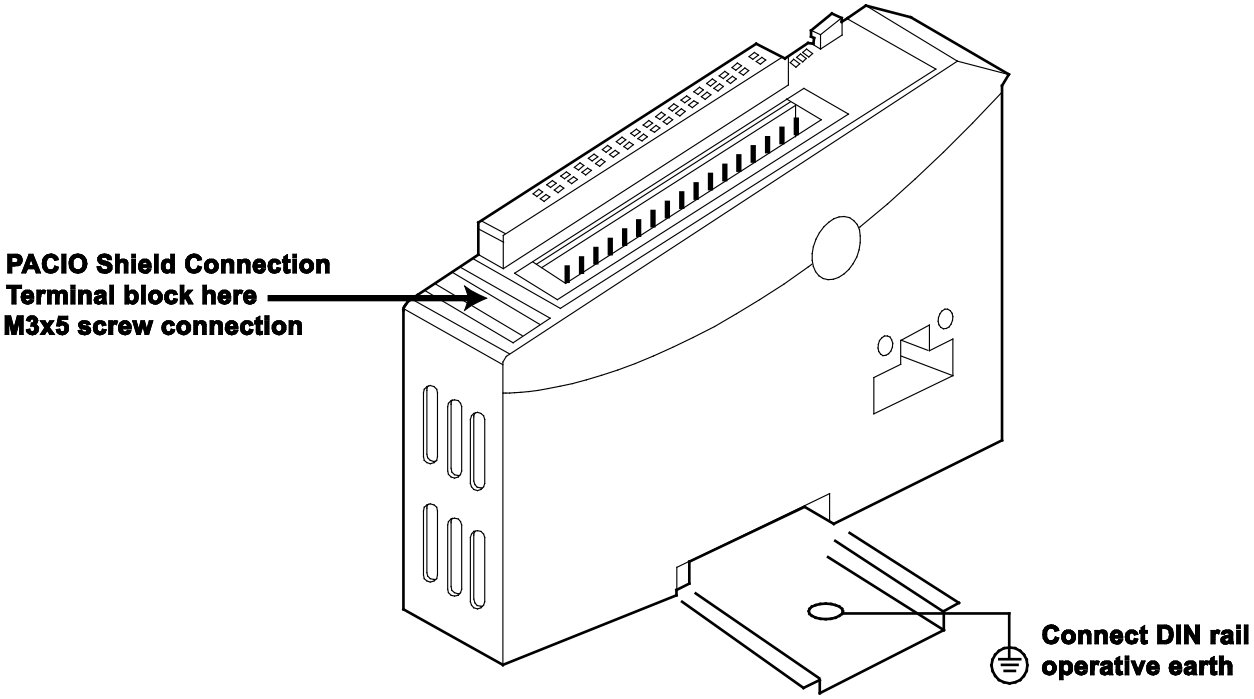
WARNING: Always attach or remove PACIO Modules with the system in a powered-down state. Damage to the modules or unintended I/O functionality might occur.

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.



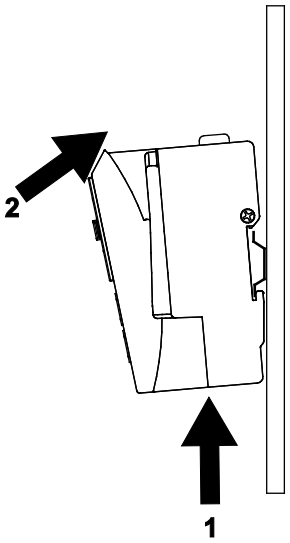
PACIO Module on DIN Rail

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.



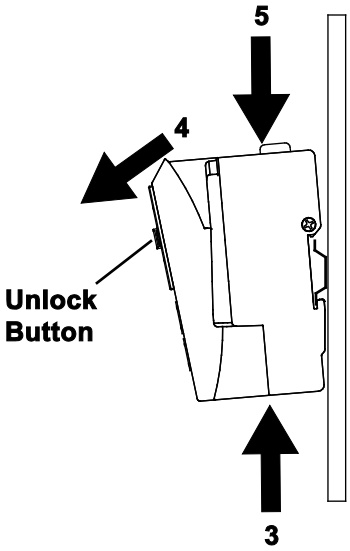
Rail mounting of single Module

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.

Note: To ensure smooth functionality of the PACIO modules, the PACIO modules must be arranged based on their e-bus load. The modules with the biggest e-bus load are to be arranged directly next to the PAC Controller. The modules with the smallest e-bus load should be the furthest from the PAC.

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

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.

Add I/O wiring to the PACIO Modules

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

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

Keep the following power circuits separate from control circuits:

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

The following control circuits can be combined:

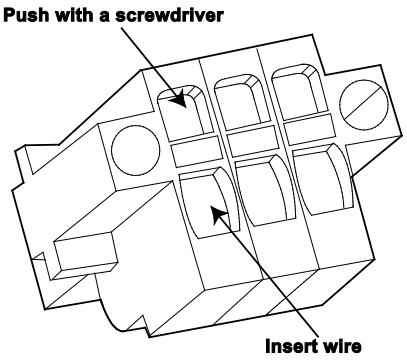
- Shielded data or communication signals
- Shielded analog signals
- Unshielded digital I/O lines
- Unshielded DC voltages < 60 V
- Unshielded AC voltages < 25 V

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

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

How to attach the wires to the tension clamp terminals:

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



Attach Wires to Tension Clamp Terminals

PACIO Power Distribution Module

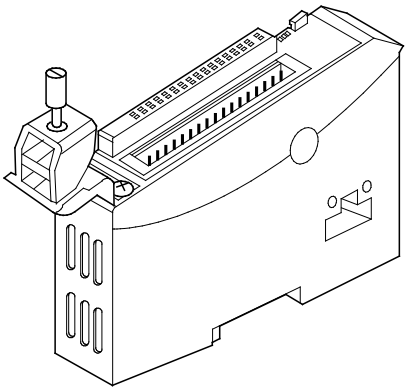
- Many PACIO Modules require 24VDC to provide power to field outputs. To ensure that there is as little cross interference as possible, do not connect the PACIO field power supply lines from one PACIO power supply port to the next. Install a central power supply point and establish a star topology using the shortest wires possible between the central point and PACIO Modules. To simplify this wiring, the use of a PACIO Power Distribution 2 x 16 Module is recommended. For more information, see page 155.
- PACIO Modules that require 24VDC field power have a corresponding “POWER” LED indicator located on the Module.
- Some PACIO Modules have under voltage monitoring, and can report this status to the control unit.

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

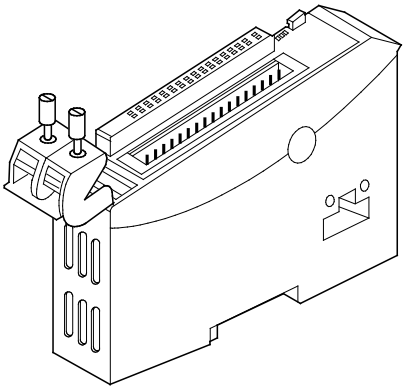
TIP: If you need to monitor the presence of the PACIO power supply in the control program, connect the 24VDC L+ input power to a PACIO digital input to represent the status of the field 24VDC power.

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

- Shielding the wiring of low voltage analog and digital I/O signals is particularly important
- Each PACIO Module contains an Earth ground bus bar for connection of an optional PACIO Shield Connection Terminal Block (see page 156). 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

CHAPTER 4:
PACIO Modules

PACIO Module Overview

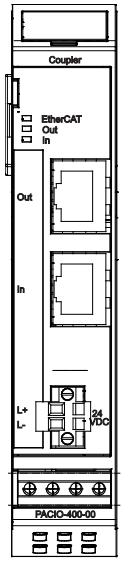
The PACIO Module family consists of a variety of Input and Output modules that are directly connected to the controller via a high speed EtherCAT network (E-Bus). These include digital or analog I/O Modules, analog temperature Modules, counters and interface Modules. Each of the PACIO Modules listed 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
Interface Modules	
PACIO Extender 2 Port	PACIO-400-02
Digital Input and Output Modules	
PACIO DI16/DO8 1A	PACIO-450-02
PACIO DI16/DO16 1ms/0.5A	PACIO-450-03
PACIO DI8/DO8 1ms/0.5A	PACIO-450-05
PACIO DI16/DO16 1ms/0.5A LS	PACIO-450-13
PACIO DI32 1ms	PACIO-451-02
PACIO DI16 1ms	PACIO-451-03
PACIO DO16 0.5A	PACIO-452-01
PACIO DO8 1A	PACIO-452-02
PACIO DO8 Relay NO 24V	PACIO-452-03
PACIO DO8 Relay NO 230VAC	PACIO-452-04
Analog Input and Output Modules	
PACIO AI4-mA 12 Bit	PACIO-441-01 (not recommended for new applications)
PACIO AI4-mA 12 Bit CoE	PACIO-441-51
PACIO AI4/8-VDC 13 Bit	PACIO-441-02 (not recommended for new applications)
PACIO AI4/8-VDC 13 Bit CoE	PACIO-441-52
PACIO AO4-VDC/mA 12 Bit	PACIO-442-02 (not recommended for new applications)
PACIO AO4-VDC/mA 16 Bit CoE	PACIO-442-52
Analog Temperature Input Modules	
PACIO AI4-Pt/Ni100 16 Bit	PACIO-443-01 (not recommended for new applications)
PACIO AI4-Pt/Ni1000 16 Bit	PACIO-443-03 (not recommended for new applications)
PACIO AI8 Thermocouple 16 Bit	PACIO-443-06 (not recommended for new applications)
PACIO AI4-Pt/Ni/Thermo 16 Bit CoE	PACIO-443-57
PACIO AI8-Pt/Ni/Thermo 16 Bit CoE	PACIO-443-58
Counter Modules	
PACIO Counter/Enc	PACIO-454-01

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-400-00 - Bus Coupler 3A



Although a bus coupler is built into 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 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

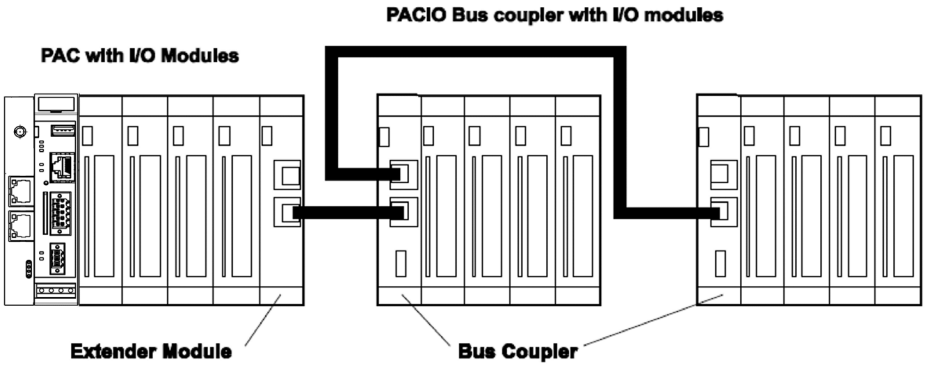


Diagram that shows how to use the Extender Module with the Bus Coupler for additional PACIO modules.

NOTE: For the best emission results, connect the shielding of the EtherCAT cable to Earth ground (see PACIO-412-01 & PACIO-412-02 Shield Connection Terminal Block on page 156).

Module State

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

Terminals

Module Power Supply	
L+	24 VDC
L-	0 V

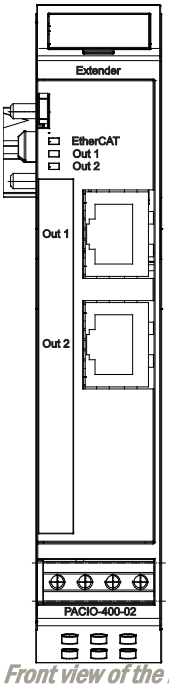
EtherCAT		
IN	RJ45 socket	input (from previous EtherCAT station)
OUT	RJ45 socket	output (to next EtherCAT station)

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, 5:1	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-400-02 - 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, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"In" LED, "Out" LED		
State	LED Flash Code	Explanation
No connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Exchanging telegrams

Function

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

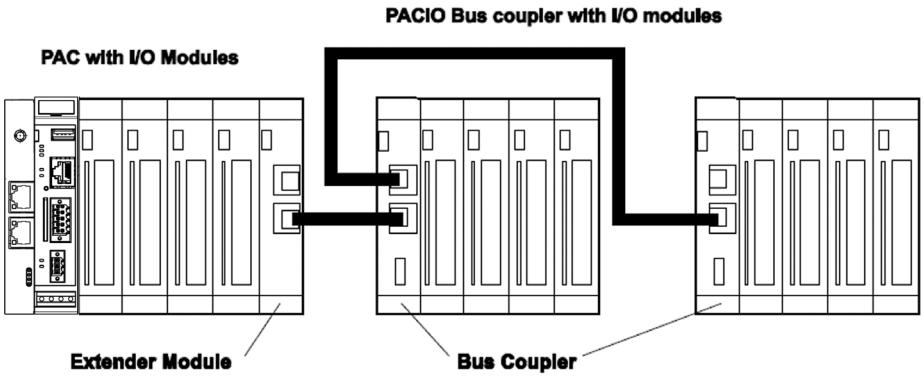
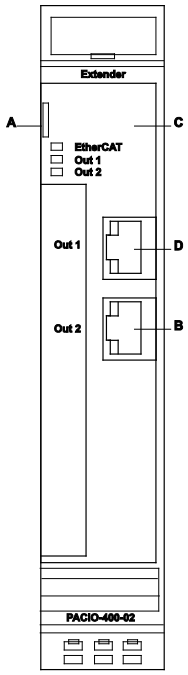


Diagram of how to use the Extender Module with the Bus Coupler for additional PACIO modules

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

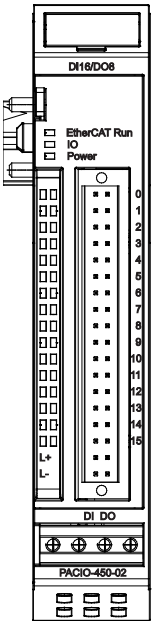
The Extender 2-port Module has four ports. The name 2-port Module was chosen because of the two standard, 100 base TX (OUT1, OUT2) RJ45 connections. Another two ports are covered by the E-Bus.

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

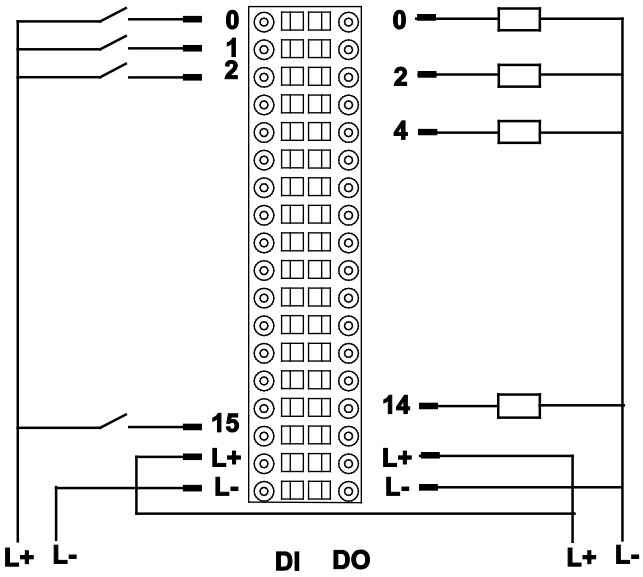


Port	Connection	Sequence
Port A	E-Bus In	1
Port B	Out 2	3
Port C	E-Bus Out	4
Port D	Out 1	2

PACIO-450-02 - DI16/DO8 1A



Front view of PACIO DI16/DO8 1A Module



I/O Connection

Out	Pin
0	0
1	2
2	4
3	6

Out	Pin
4	8
5	10
6	12
7	14

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

Technical data	PACIO DI16/DO8 1A
Part number	PACIO-450-02
Controller	ASIC ET1200
Baud Rate	100 Mbit/s
Power Supply	24 VDC -20% +25%
E-Bus Load	135mA
Connector IO/Power	Plug 36-pole (43-026592-01)
Input Specs	
Digital Inputs	16
Max Input Frequency	1000 Hz
Signal Level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw of 5 mA per input at 24V Sourcing (High Side, “PNP”)
Output Specs	
Digital Outputs	8
Maximum Current	1A per output Sourcing (High Side, “PNP”)
Total Current	Maximum 8A

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.

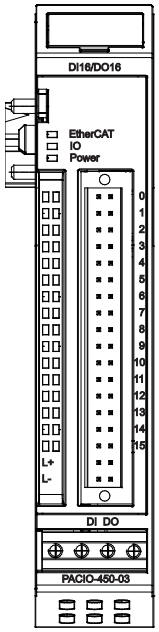
Status LEDs

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.

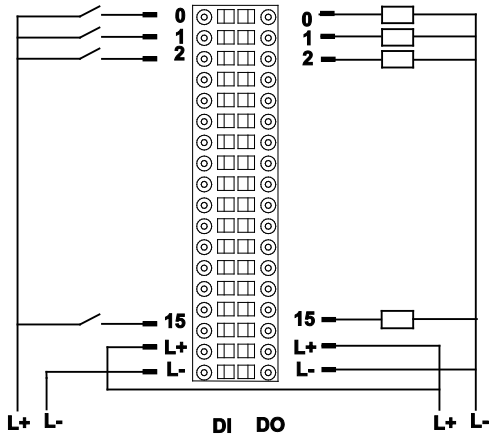
"EtherCAT Run" LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
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-450-03 - 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
Controller	ASIC ET1200
Baud Rate	100 Mbit/s
Power Supply	24 VDC -20% +25%
E-Bus Load	135mA
Connector IO/Power	Plug 36-pole (43-026592-01)
Input Specs	
Digital Inputs	16
Max Input Frequency	1000 Hz
Signal Level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw of 5 mA per input at 24V Sourcing (High Side, “PNP”)
Output Specs	
Digital Outputs	16
Maximum Current	0.5 A Sourcing (High Side, “PNP”)
Total Current	Maximum 8A

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

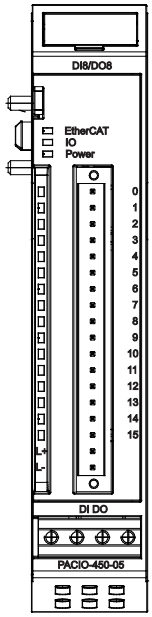
Status LEDs

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.

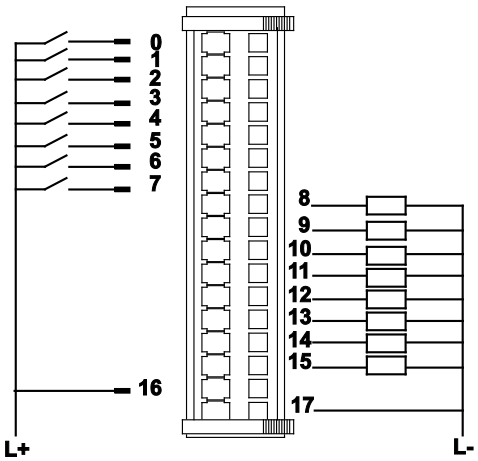
“EtherCAT Run” LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“Power” LED		
State	LED Flash Code	Explanation
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-450-05 - 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
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
Input Specs	
Digital inputs	8
Maximum Input Frequency	1000 Hz
Signal level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw 5 mA per input at 24V Sourcing (High Side, “PNP”)
Output Specs	
Digital outputs	8
Maximum current	0.5A per output Sourcing (High Side, “PNP”)
Total current	Maximum 8A

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

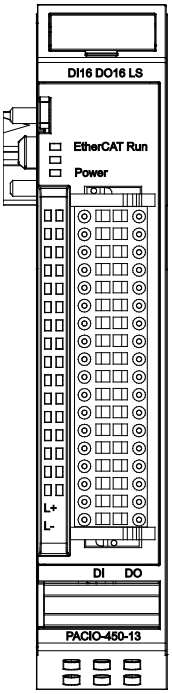
Status LEDs

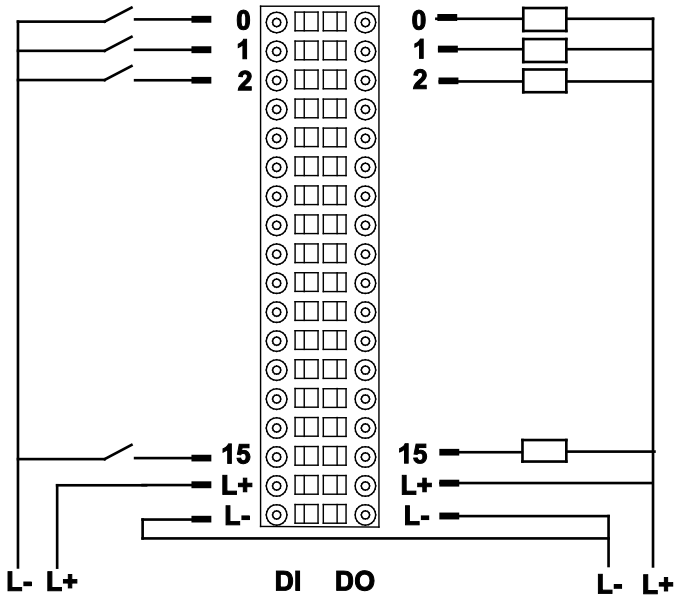
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" indicates the state of the Module's inputs and outputs. The LED labeled "Power" indicates the state of the Module's I/O power supply; the Module is not monitored for low voltage status.

"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, 5:1	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-450-13 - DI16/DO16 1ms/0.5A LS (Sinking)





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
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
Input Specs	
Digital inputs	16
Maximum Input Frequency	1000 Hz
Signal level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw of 2 mA per input at 24V Sinking (Low Side, “NPN”)
Output Specs	
Digital outputs	16
Maximum current	0.5 A per output Sinking (Low Side, “NPN”)
Total current	Maximum 8A

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

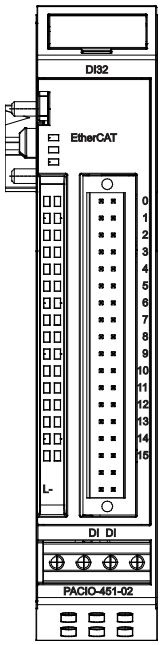
Status LEDs

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.

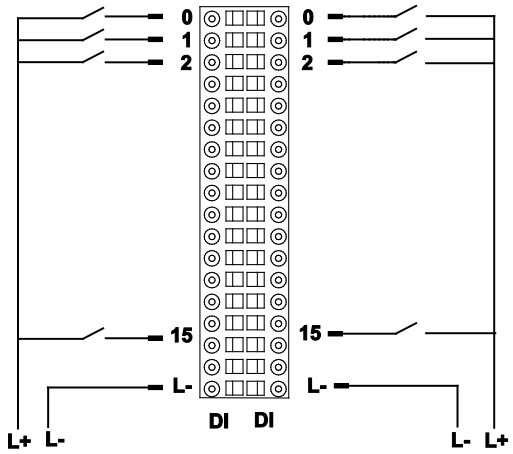
“EtherCAT Run” LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“Power” LED		
State	LED Flash Code	Explanation
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-451-02 - 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
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	85 mA
Inputs Specs	
Digital inputs	32
Maximum Input Frequency	1000 Hz
Signal level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw of 5 mA per input at 24V Sourcing (High Side, “PNP”)

Variable

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

Terminals

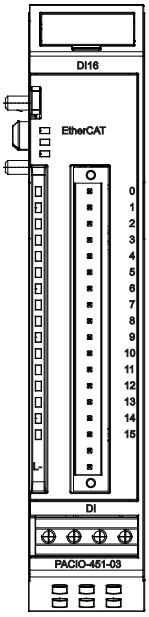
Power Supply to Module I/Os	
L-	0 V

Status LEDs

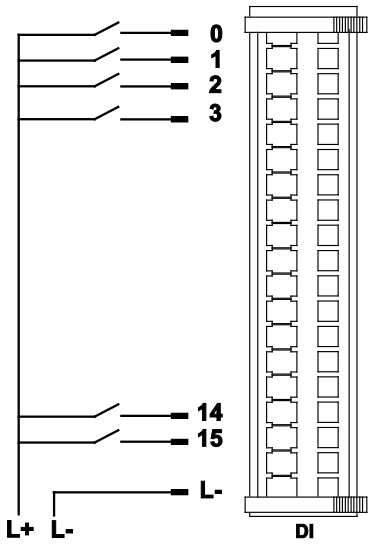
The “EtherCAT Run” LED indicates the state of the Module’s EtherCAT ASIC.

“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, 5:1	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-451-03 - 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
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
Input Specs	
Digital inputs	16
Maximum Input Frequency	1000 Hz
Signal level	Off: -3V … 5V (EN 61131-2, type 1) On: 15V … 30V Typical current draw of 5 mA per input at 24V Sourcing (High Side, “PNP”)

Variable

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

Terminals

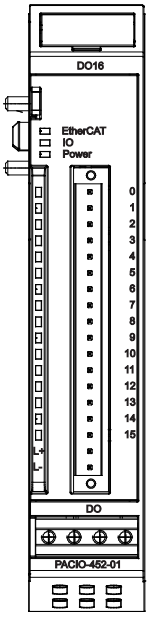
Power supply to Module I/Os	
L-	V

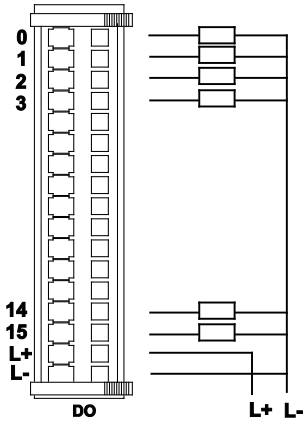
Status LEDs

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, 5:1	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-452-01 - 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
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
Output Specs	
Digital outputs	16
Maximum current	0.5A per output Sourcing (High Side, “PNP”)
Total current	Maximum 8A

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

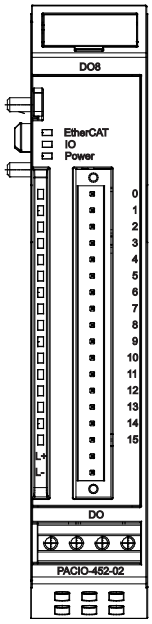
Status LEDs

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.

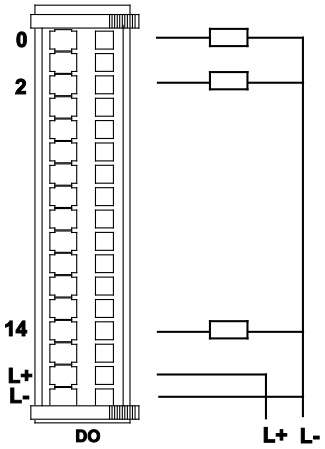
"EtherCAT Run" LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
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-452-02 - DO8 1A



Front view of PACIO DO8 1A Module



I/O connection

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

The **PACIO DO8 1A** Module features 8 digital outputs.

Technical Data	PACIO DO8 1A
Part number	PACIO-452-02
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
Output Specs	
Digital outputs	8
Maximum current	1A per output Sourcing (High Side, “PNP”)
Total current	Maximum 8A

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

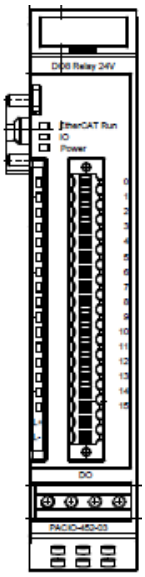
Status LEDs

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.

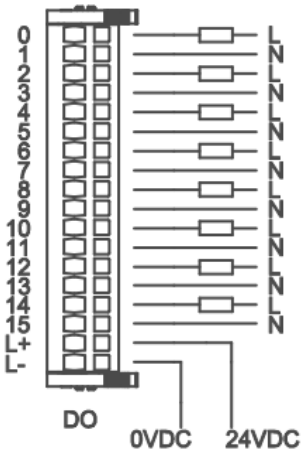
"EtherCAT Run" LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
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-452-03 – DO8 Relay NO 24V



Front view of PACIO DO8 Relay NO 24V Module



I/O connection

Output	Pin
Output 0	0
	1
Output 1	2
	3
Output 2	4
	5
Output 3	6
	7
Output 4	8
	9
Output 5	10
	11
Output 6	12
	13
Output 7	14
	15
24V	16
0V	17

The **PACIO DO8 Relay NO 24V** Module features 8 normally open relay outputs.

Technical Data	PACIO DO8 Relay NO 24V
Part number	PACIO-452-03
Digital Outputs	8 normally open relays
Max Switching Current (resistive)	5.0 A each
Max Switching Current (inductive)	2.0 A each
Min admissible load	10 mA @ 5 VDC
Min mechanical switching cycles	2×10^7
Min electrical switching cycles	3×10^5 (2A/30 VDC)
Switching Voltage	Max 24 VDC/AC
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

Module State

Variable	Data type	Explanation
VoltageOK	BOOL	Low Voltage (supplied power < 19.2V)

Terminals

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

Status LEDs

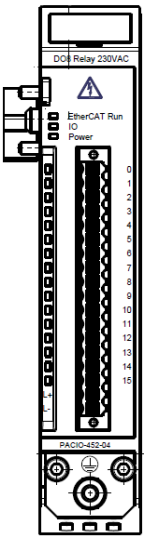
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" has no function on this module. The LED labeled "Power" indicates the state of the Module's I/O power supply.

"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, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
		No Function
"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

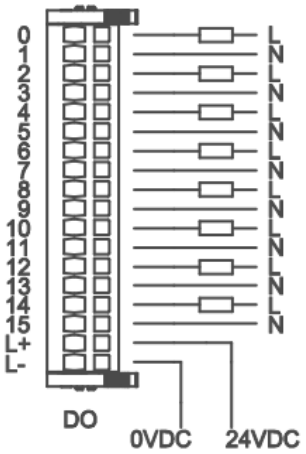
Note: In case of under voltage the switching of the relays is prevented and already energized relays will turn off.

Note: Operation of the module at the maximum limit (temperature / total current) could reduce the lifetime of the module. As a best practice, switching currents should be physically wired as far away from each other as possible. If all the outputs are in use, the highest current outputs should be placed as far away from each other as possible.

PACIO-452-04 – DO8 Relay NO 230VAC



Front view of PACIO DO8 Relay NO 230VAC Module



I/O connection

Output	Pin
Output 0	0
	1
Output 1	2
	3
Output 2	4
	5
Output 3	6
	7
Output 4	8
	9
Output 5	10
	11
Output 6	12
	13
Output 7	14
	15
24V	16
0V	17

The **PACIO DO8 Relay NO 230VAC** Module features 8 normally open relay outputs.

Technical Data	PACIO DO8 Relay NO 230VAC
Part number	PACIO-452-04
Digital Outputs	8 normally open relays
Max Switching Current (resistive)	5.0 A each
Max Switching Current (inductive)	2.0 A each
Min admissible load	10 mA @ 5 VDC
Min mechanical switching cycles	2×10^7
Min electrical switching cycles	3×10^5 (2A/30 VDC)
Switching Voltage	Max 24 VDC/230 VAC
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

Module State

Variable	Data type	Explanation
VoltageOK	BOOL	Low Voltage (supplied power < 19.2V)

Terminals

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

Status LEDs

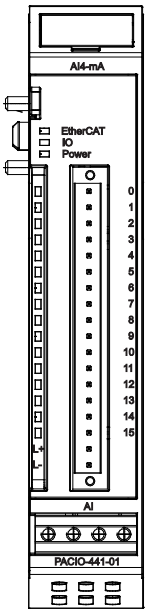
The LED labeled "EtherCAT Run" indicates the state of the EtherCAT ASIC. The LED labeled "IO" has no function on this module. The LED labeled "Power" indicates the state of the Module's I/O power supply.

"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, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
		No Function
"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

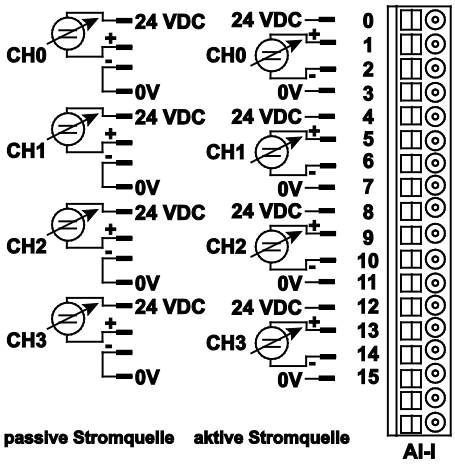
Note: In case of under voltage the switching of the relays is prevented and already energized relays will turn off.

Note: Operation of the module at the maximum limit (temperature / total current) could reduce the lifetime of the module. As a best practice, switching currents should be physically wired as far away from each other as possible. If all the outputs are in use, the highest current outputs should be placed as far away from each other as possible.

PACIO-441-01 - 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	0-20 mA 4-20 mA (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 22.

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, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Short-circuited digital output
		Inoperative if E-Bus LED = Off
	Red, 2x	Under voltage (not implemented)
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module Defective
"Power" LED		
State	LED Flash Code	Explanation
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	LED Flash Code	Explanation
On	Green, on	Channel enabled
Off	Off	Output 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…3)

Measured Value

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

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]: **Current [mA] = Output value / 3066,336**

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

Measuring values, Variable values, Status

Analog Values Current

Measuring		Variable Values	Measuring		Variable Values
mA	Decimal	Hexadecimal	mA	Decimal	Hexadecimal
0	0	0	12	36784	16#8FB0
1	3056	16#0BF0	13	39856	16#9BB0
2	6128	16#17F0	14	42928	16#A7B0
3	9184	16#23E0	15	45984	16#B3A0
4	12256	16#2FE0	16	49056	16#BFA0
5	15328	16#3BE0	17	52112	16#CB90
6	18384	16#47D0	18	55184	16#D790
7	21456	16#53D0	19	58256	16#E390
8	24528	16#5FD0	20	61312	16#EF80
9	27584	16#6BC0	20.5	62848	16#F580
10	30656	16#77C0			
11	33728	16#83C0	≥ 21.37	65520	16#FFF0

Module Control

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

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

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

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

Module Options

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

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

Module State

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

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

Module-Specific Messages

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

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

Conversion Time

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

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

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

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

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

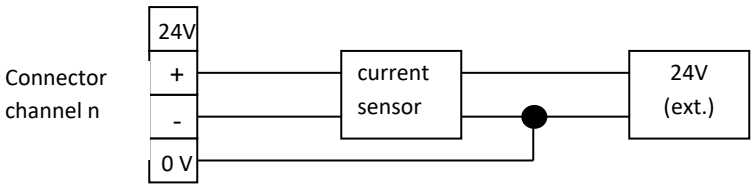
Quality of Analog Values

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

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

Active current sensors:

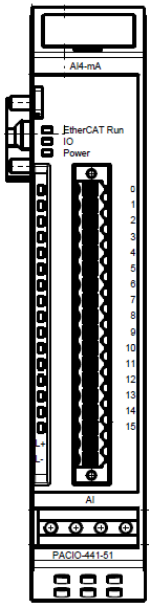
- Use the power supplied by the module if at all possible.
- If power to the current sensors is supplied by an external source, connect the 0V terminal of that power source to the 0V terminal of the module.



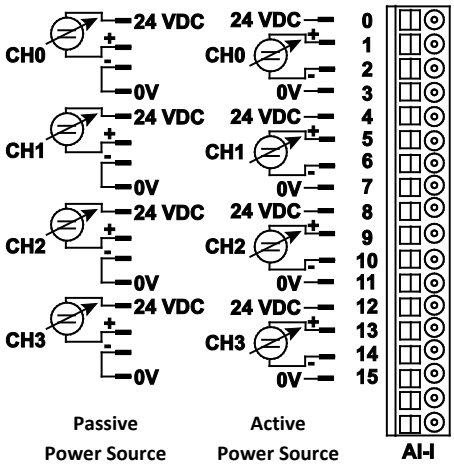
Sensor Connections

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

PACIO-441-51 - AI4-mA 12 Bit CoE



Front view of AI4-mA 12 Bit CoE Module



I/O Connection

The PACIO AI4-mA 12 Bit CoE 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).

NOTE: PACIO-441-51 AI4-mA 12 Bit CoE is the successor to PACIO-441-01 AI4-mA 12 Bit.

Before replacing a PACIO-441-01 AI4-mA 12 Bit module with a PACIO-441-51 AI4-mA 12 Bit CoE module, modify the project on the PAC using Parker Automation Manager.

Technical Data	PACIO AI4-mA 12 Bit CoE
Part number	PACIO-441-51
Analog inputs	4 single-ended
Resolution	12 bit
Measuring range	0-20 mA 4-20 mA limit 20mA
Measuring Error	< ± 0.5%, typical < ± 0.4% of final value
Input filter cutoff frequency	100 kHz
Internal Resistance	< 300 Ω
Conversion Time	235 µs (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	190mA

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 22.

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	Off	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	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	Under voltage (not implemented)
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module Defective
"Power" LED		
State	LED Flash Code	Explanation
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
"Channel" LEDs		
State	LED Flash Code	Explanation
On	Green, on	Channel enabled
Off	Off	Output disabled
Error	Red, 1x	Current >20.5 mA
	Red, 2x	Curren <3.5 mA (4...20 mA mode)

Analog Inputs

Check the following variable for the digitized input values.

Variable	Data type	Explanation
Inputn	UINT	Value measured on channel n (n= 0…3)

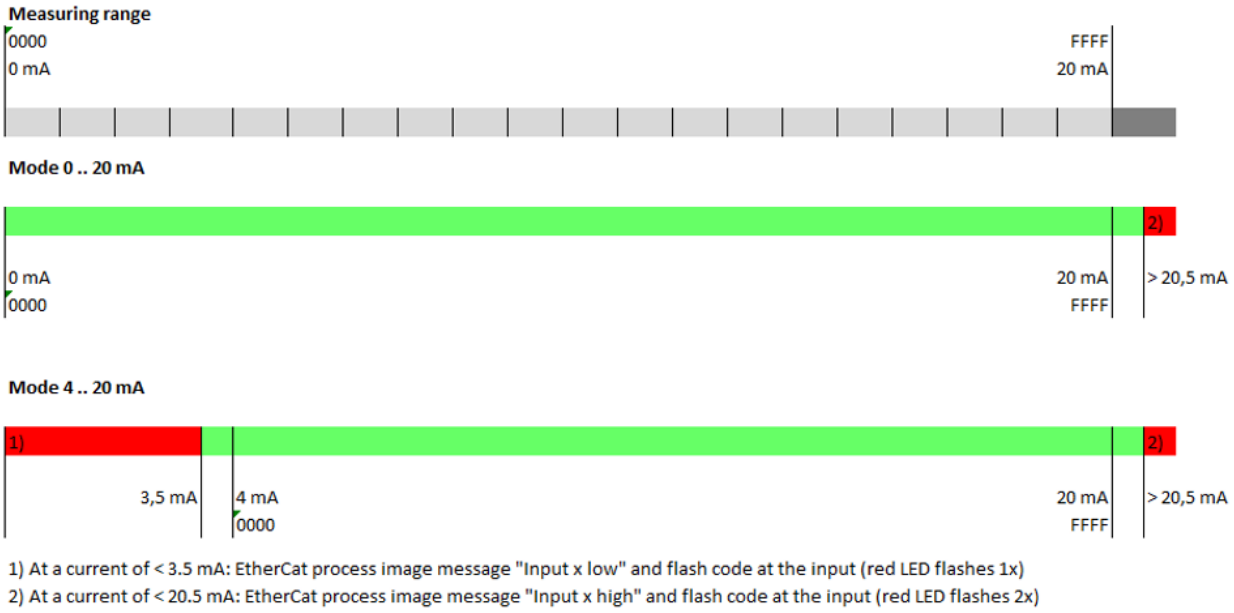
Measured Value

Table “0-20 mA current mode”

Current (mA)	Value (hex)
0	0x0
10	0x7FFF
20	0xFFFF

Table “4-20 mA current mode”

Current (mA)	Value (hex)
4	0x0
12	0x7FFF
20	0xFFFF



1) At a current of < 3.5 mA: EtherCat process image message "Input x low" and flash code at the input (red LED flashes 1x)
2) At a current of < 20.5 mA: EtherCat process image message "Input x high" and flash code at the input (red LED flashes 2x)

Measuring values, Variable values, Status

Analog Values Current

Measuring	Variable Values		Measuring	Variable Values	
mA	Decimal	Hexadecimal	mA	Decimal	Hexadecimal
0	0	0	12	36784	16#8FB0
1	3056	16#0BF0	13	39856	16#9BB0
2	6128	16#17F0	14	42928	16#A7B0
3	9184	16#23E0	15	45984	16#B3A0
4	12256	16#2FE0	16	49056	16#BFA0
5	15328	16#3BE0	17	52112	16#CB90
6	18384	16#47D0	18	55184	16#D790
7	21456	16#53D0	19	58256	16#E390
8	24528	16#5FD0	20	61312	16#EF80
9	27584	16#6BC0	20.5	62848	16#F580
10	30656	16#77C0			
11	33728	16#83C0	≥ 21.37	65520	16#FFF0

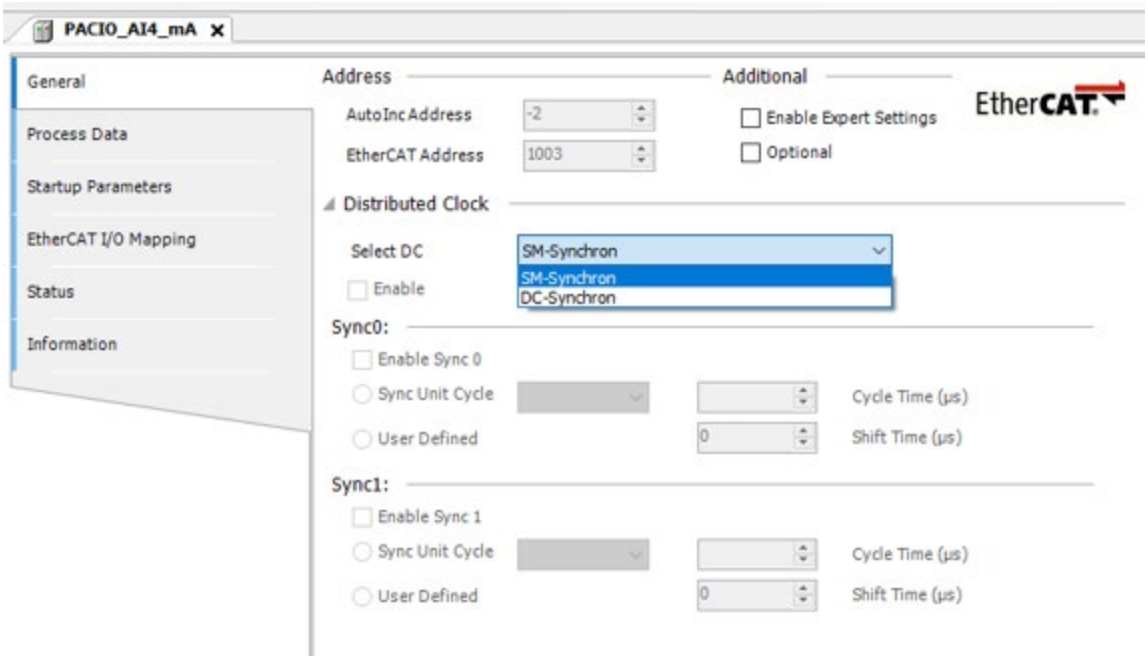
Module Control

The module provides you with various operational options:

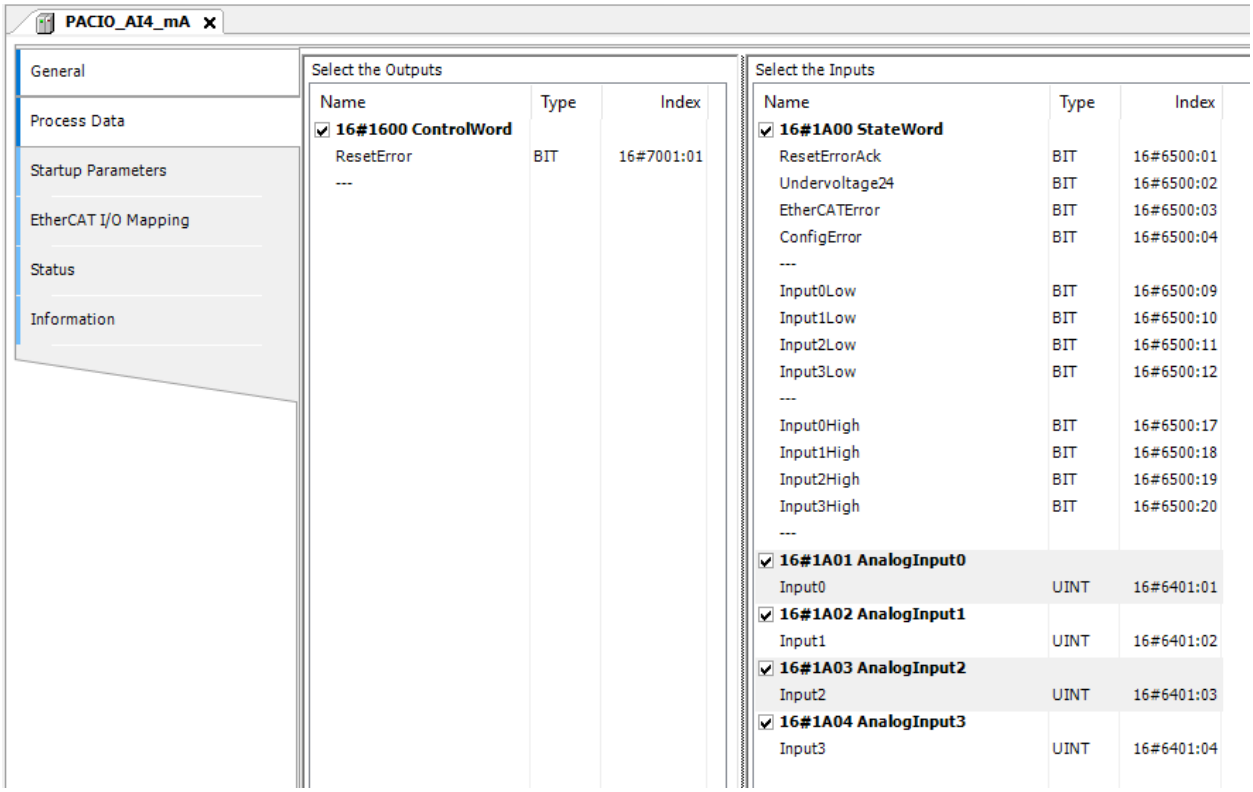
Conversion of the analog values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

SM-Synchron: This mode will synchronize the EtherCAT slave with the Sync Manager Events SM2/SM3. Sync Manager Events are trigger when a passing frame is processed.

DC-Synchron: This mode will synchronize the EtherCAT slave with the Distributed Clock sync events. The EtherCAT slave will be trigger by the SYNC0 or SYNC1 events of the Distributed Clock system. These events are synchronized with all DC Enabled EtherCAT slaves and will ensure strict timing with minimal jitter based on the EtherCAT Master task cycle. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.



The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

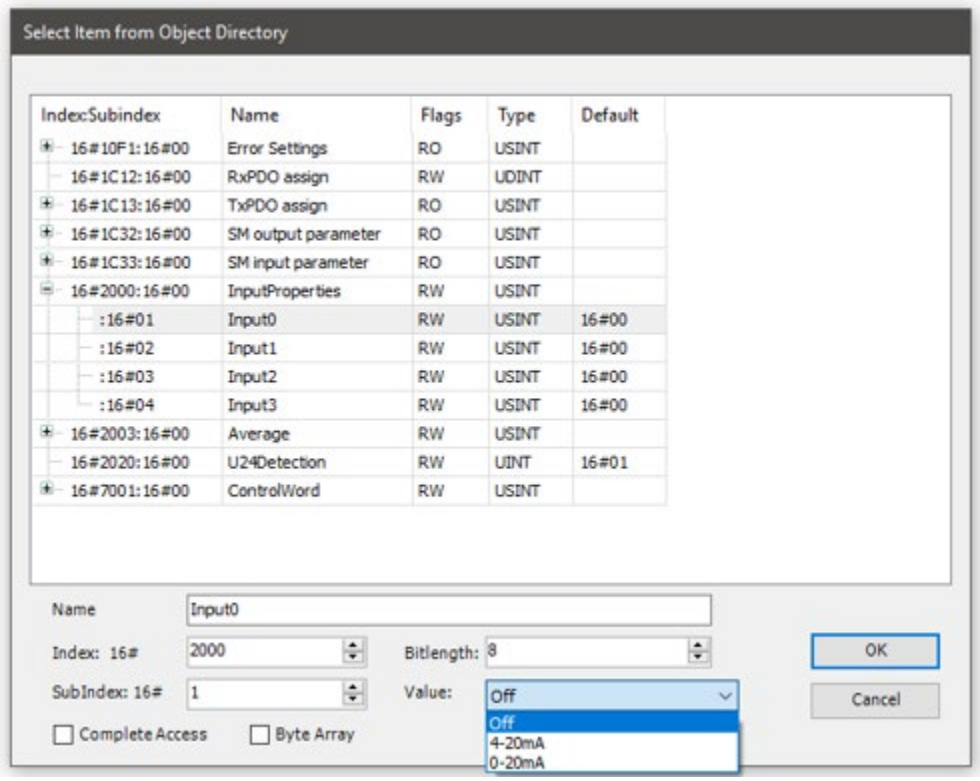


Service data objects (SDO) are available for details and settings.

You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI4-mA 12-Bit CoE (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.

You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.



Module Options

The following options are available for every channel:

Variable	Data type	Explanation
InputProperties	0	Off (default)
	5	4-20 mA
	6	0-20 mA
Average	n=1..255	Inputn = average after n cycles (default=1)

StateWord

The state word (DWORD) indicates the module state:

Bit	Name	Explanation
Shortcut	BOOL	Short circuit
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	Undervoltage24	Power to passive sensors < 19 V (no error, just info)
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7		not used
8	Input0low	Current at 4-20mA < 3.5mA
9	Input1low	Current at 4-20mA < 3.5mA
10	Input2low	Current at 4-20mA < 3.5mA
11	Input3low	Current at 4-20mA < 3.5mA
12-15		not used
16	Input0high	Current > 20.5 mA
17	Input1high	Current > 20.5 mA
18	Input2high	Current > 20.5 mA
19	Input3high	Current > 20.5 mA
20-31	-	not used

ControlWord

The control word contains a bit for acknowledging errors.

Bit	Name	Explanation
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Object Dictionary

Index	Name	Type	Default	Min Max	Access
100A	Software Version	String	1.00		RO
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4-I 12-Bit		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185339		RO
1018, 3	Revision Number	UINT32	1		RO

1018, 4	Serial Number	UINT32			RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 1	Input 0	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 3	Input 2	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 4	Input 3	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2003	Input Average	Array			
2003, 0	Number of Entries	UINT8	4		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	4		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	32		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	Undervoltage24	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13..16	-	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P

6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21..32	-	BOOL			RO P
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

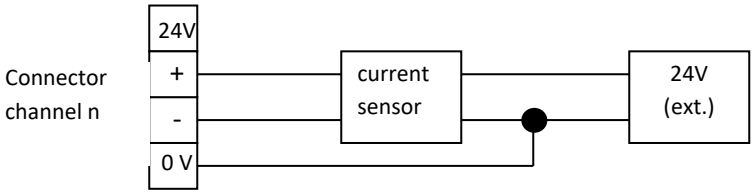
Quality of Analog Values

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

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

Active current sensors:

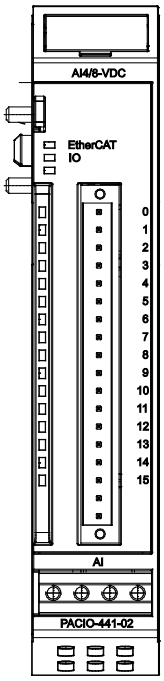
- Use the power supplied by the module if at all possible.
- If power to the current sensors is supplied by an external source, connect the 0V terminal of that power source to the 0V terminal of the module.

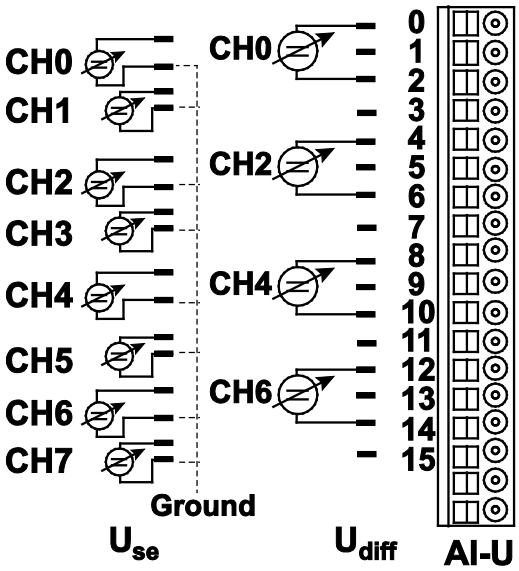


Sensor Connections

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

PACIO-441-02 - AI4/8-VDC 13 Bit





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

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

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

Terminals

The Module needs no separate 24V connector. Power is supplied to the Module through the E-Bus connector. For information on operative earth shielding of analog wire, see Adding PACIO Modules on page 22.

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, 5:1	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	UINT	Value measured on channel n (n= 0…7)

Analog Voltage Values

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

Module Control

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

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

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

Module Options

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

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

NOTE: For Differential usage, both channel n and channel n+1 must be 'On'.

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.

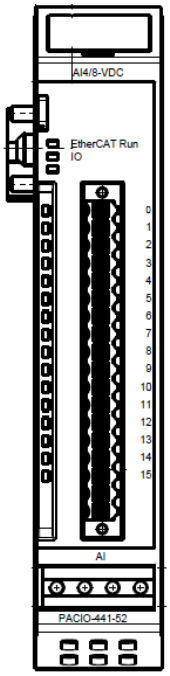
Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The Module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of Analog Values

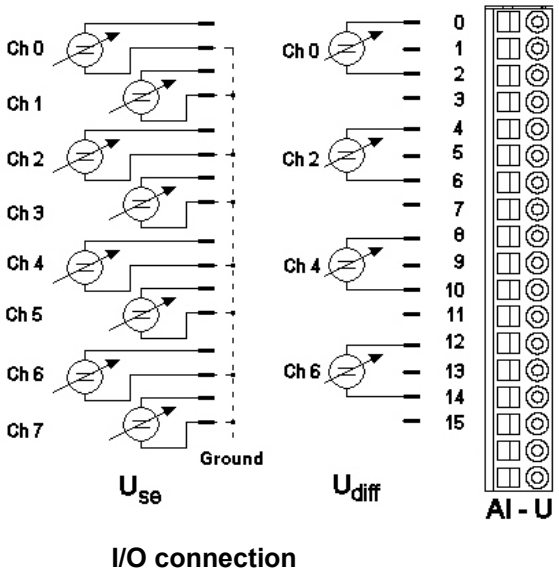
Best results are obtained by:

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

PACIO-441-52 - AI4/8-VDC 13 Bit CoE



Front view of PACIO AI4/8-VDC 13 Bit CoE Module



I/O connection

I/O connection

The **PACIO AI4/8-VDC 13 Bit CoE** 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.

NOTE: PACIO-441-52 AI4/8-VDC 13 Bit CoE is the successor to PACIO-441-02 AI4/8-VDC 13 Bit module.

Before replacing a PACIO-441-02 AI4/8-VDC 13 Bit with a PACIO-441-52 AI4/8-VDC 13 Bit CoE, modify the project on the PAC using Parker Automation Manager.

Technical data	PACIO AI4/8-VDC 13 Bit CoE
Part number	PACIO-441-52
Analog inputs	8 single-ended or 4 differential
Resolution	13 bit
Measuring range	0 -10V ± 10V ± 5V ± 2.5V
Measuring Error	< ±0.4%, typ. < ±0.2% of final value
Start A/D conversion	synchronized with DC / SM
Conversion Time	464 µs (if all channels are enabled)
Input filter cutoff frequency	typical 1 kHz
Internal resistance	> 1 MΩ
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	from coupler through E-Bus connector

E-Bus load	190 mA

Terminals

The Module does not need a 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 22.

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	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-Bus LED= Off
	Red, 4x	EtherCAT watchdog control
	Red, 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 variables for the digitized input values:

Variable	Data type	Explanation
Inputn	INT	Value of channel n (n=0…7)

Analog Voltage Values

Measuring Value			Variable Value			
±10 V	± 5 V	± 2.5 V	Bipolar		Unipolar [UINT]	
Volt	Volt	Volt	Decimal	Hexadecimal	Decimal	Hexadecimal
-10	-5	-2.5	-32768	16#8000		

-9	-4.5	-2.25	-29492	16#8CCC		
-8	-4	-2	-26215	16#9999		
-7	-3.5	-1.75	-22938	16#A666		
-6	-3	-1.5	-19661	16#B333		
-5	-2.5	-1.25	-16384	16#C000		
-4	-2	-1	-13108	16#CCCC		
-3	-1.5	-0.75	-9831	16#D999		
-2	-1	-0.5	-6574	16#E666		
-1	-0.5	-0.25	-3292	16#F324		
0	0	0	0	0	0	0
1	0.5	0.25	3276	16#0CCC	6553	16#1999
2	1	0.5	6553	16#1999	13107	16#3332
3	1.5	0.75	9830	16#2666	19660	16#4CCC
4	2	1	13106	16#3332	26214	16#6665
5	2.5	1.25	16383	16#3FFF	32767	16#7FFF
6	3	1.5	19660	16#4CCC	39320	16#9998
7	3.5	1.75	22936	16#5998	45874	16#B332
8	4	2	26213	16#6665	52427	16#CCCB
9	4.5	2.25	29490	16#7332	58981	16#E665
10	5	2.5	32767	16#7FFF	65534	16#FFFE

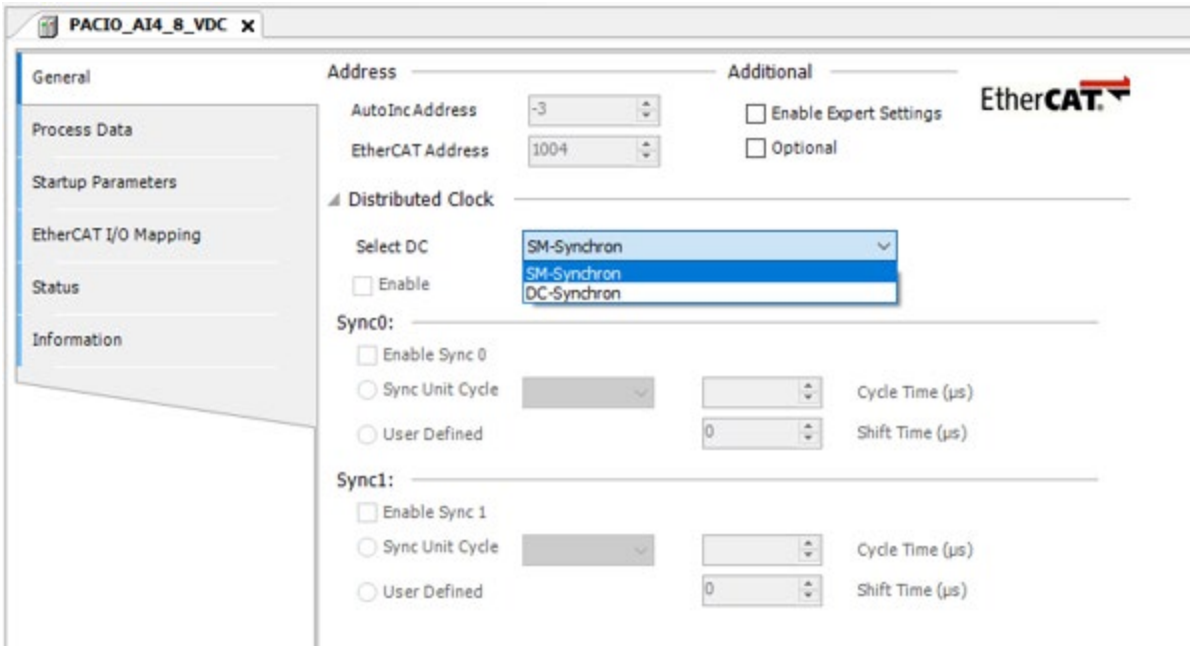
NOTE: If the inputs are not used but switched on, the measured values displayed in the I / O image are floated. To prevent this, you should deactivate the measurement channel at the start parameters or set the input to ground (short-circuit when measuring differential signals).

Module Control

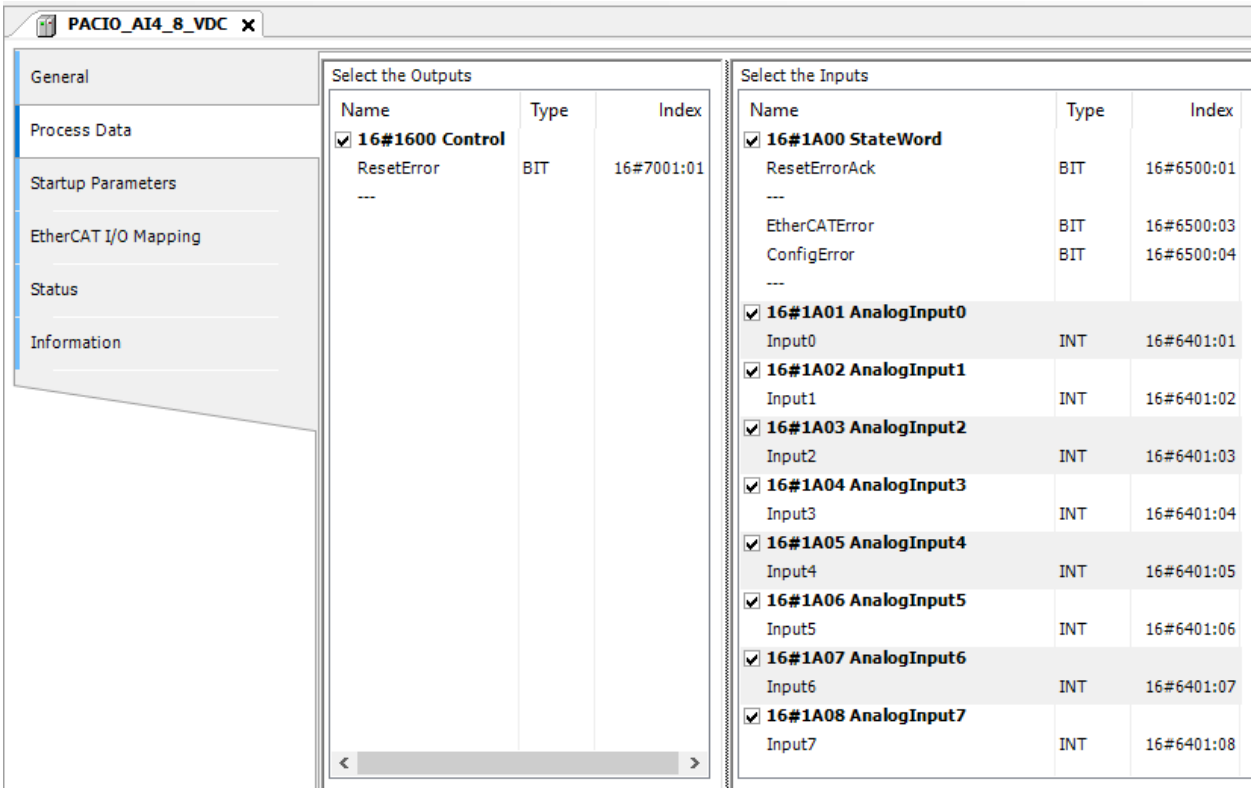
Conversion of the analog values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

SM-Synchron: This mode will synchronize the EtherCAT slave with the Sync Manager Events SM2/SM3. Sync Manager Events are trigger when a passing frame is processed.

DC-Synchron: This mode will synchronize the EtherCAT slave with the Distributed Clock sync events. The EtherCAT slave will be trigger by the SYNC0 or SYNC1 events of the Distributed Clock system. These events are synchronized with all DC Enabled EtherCAT slaves and will ensure strict timing with minimal jitter based on the EtherCAT Master task cycle. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.



The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

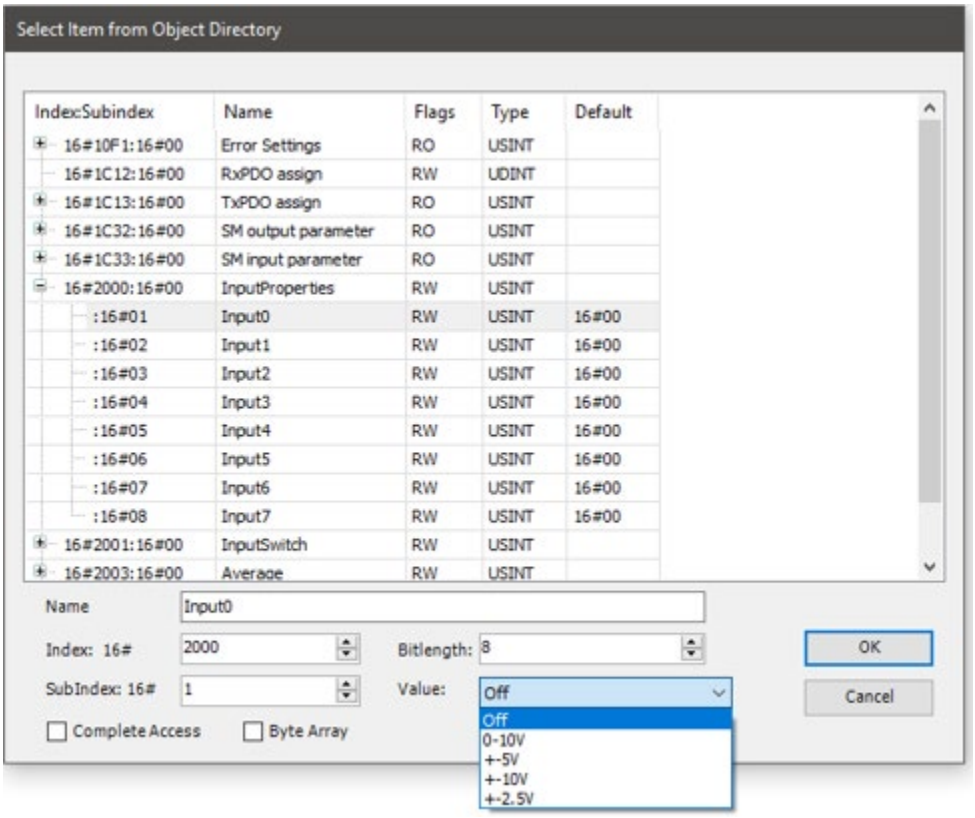


Service data objects (SDO) are available for details and settings.

You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI4/8-VDC 13 Bit CoE (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.

You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.



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.

Name	Value	Explanation
InputProperties	0	Off (default)
	1	0-10V
	2	±5 V
	3	±10 V
	4	±2,5 V
InputSwitch	0	Single-Ended (default)
	1	Differential
Average	n=1..255	Inputn= average after n cycles (default=1)

StateWord

The state word is indicative of the module state:

Bit	Name	Explanation
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1		not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-15		not used

ControlWord

The state word is indicative of the module state:

Bit	Name	Explanation
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Object Dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4/8-VDC 13 Bit CoE		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185340		RO
1018, 3	Revision Number	UINT32	2		RO
1018, 4	Serial Number	UINT32	0		RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	8		RO
2000, 1	Input 0	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 3	Input 2	UINT8	Off	Off (0),	RW

				0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	
2000, 4	Input 3	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 5	Input 4	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 6	Input 5	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 7	Input 6	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 8	Input 7	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2001	Input Switch	Array			
2001, 0	Number of Entries	UINT8	4		RO
2001, 1	Input 0_1 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 2	Input 2_3 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 3	Input 4_5 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 4	Input 6_7 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2003	Input Filter	Array			
2003, 0	Number of Entries	UINT8	8		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW

2003, 6	Input 5 Average	UINT8	1	1..255	RW
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	8		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 6	UINT16			RO P
6401, 8	Analog Input 7	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

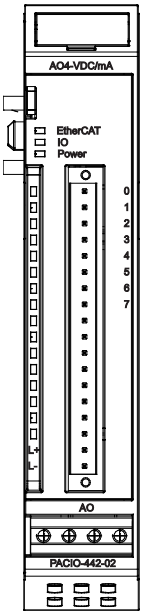
RO=read-only, RW= read/write, P=process image

Quality of Analog Values

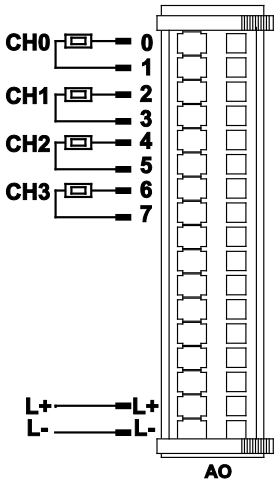
Best results are obtained by:

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

PACIO-442-02 - 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 A04-VDC/mA 12 Bit
Part number	PACIO-442-02
Analog inputs	4
Resolution	12 bit
Measuring range	0 – 10 V ± 10 V 0…20 mA ± 20 mA (Only available on modules shipped before approximately January 2017)
Output impedance	22.1 Ω each channel
Output frequency	3.125 kHz
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

NOTE: The PACIO-442-02 made minor changes in approximately January 2017. The modules can be interchangeable without changing the device description file in the control program of the EtherCAT Master.

PACIO-442-02 (before Jan 2017)	PACIO-442-02 (after Jan 2017)
Measuring range: 0.... ± 20 mA	Measuring Range: 0…+20mA In order to use the current outputs, the "Channel_n_n + 1_Unipolar" variable of the corresponding outputs must be set to True. See Analog Voltage Values
Short Circuit is detected	Short circuit is not detected, but outputs are protected against a short circuit
Data-type of the outputs: INT	Data-type of the outputs UINT. In the development environment, a data type conversion from INT to UINT is required.

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	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-Bus LED = Off
	Red, 1x	Short circuit

	Red, 2x	Low voltage
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
“Power” LED		
State	LED Flash Code	Explanation
On	Green, on	24 VDC supply ok
Off	Off	24 VDC supply not ok
“Channel” LEDs		
State	LED Flash Code	Explanation
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Short circuit
	Red, 3x	Broken wire
	Red, 5x	Excessive temperature of output drivers

Analog outputs

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

Write the output values into the following variables.

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

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

Analog Voltage/Current Values

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

Module control

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

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

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

Module Options

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

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

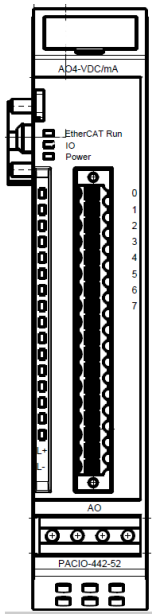
Apart from the Module error messages, the set of messages below contains details about the current state of the PACIO AO4-VDC/mA 12 Bit Module. These messages are automatically reset when the state concerned has returned to normal. They are combined into a single "Specific_Error" state of the Module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

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

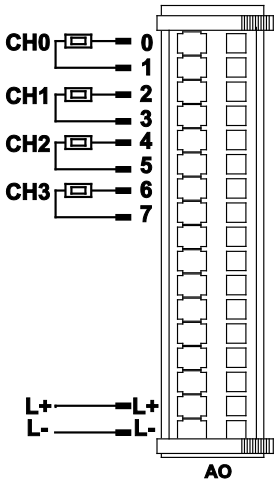
Conversion Time

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

PACIO-442-52 - AO4-VDC/mA 16 Bit CoE



Front view of PACIO AO4-VDC/mA 16 Bit CoE Module



I/O connection

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

The **PACIO AO4-VDC/mA 16 Bit CoE** Module features four analog outputs. Every channel can be separately set to the unipolar or bipolar output of voltages or currents.

NOTE: PACIO-442-52 AO4-VDC/mA 16-Bit CoE is the successor to PACIO-442-02 AO4-VDC/mA 12-Bit module.

Before replacing a PACIO-442-02 AO4-VDC/mA 12-Bit with a PACIO-442-52 AO4-VDC/mA 16-Bit CoE, modify the project on the PAC using Parker Automation Manager.

Technical Data	PACIO A04-VDC/mA 16 Bit
Part number	PACIO-442-52
Analog inputs	4
Resolution	16 bit
Measuring range	0…10 V ± 10 V 0…+20 mA 4…20 mA 0…24 mA
Output impedance	22.1 Ω each channel
Output frequency	Synchronized with Soft Motion or Distributed Clocks
Intrinsic error	±0.2%
Temperature Error	±0.005%K
Maximum External Voltage	15V
Voltage	
Short Circuit Protection	Yes. Maximum 30 mA
Load Resistance	Minimum 1 kΩ
Settling Time	0→10V: ≤22µs at 2kΩ/<200pF
Current	
Load Resistance	max. 500Ω, max. 1mH (inductive)
Settling Time	0→16V: ≤25µs at 300Ω/<1mH
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Terminals

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

Status LEDs

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

"EtherCAT Run" LED		
State	LED Flash Code	Explanation
Init	Off	Initializing, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	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

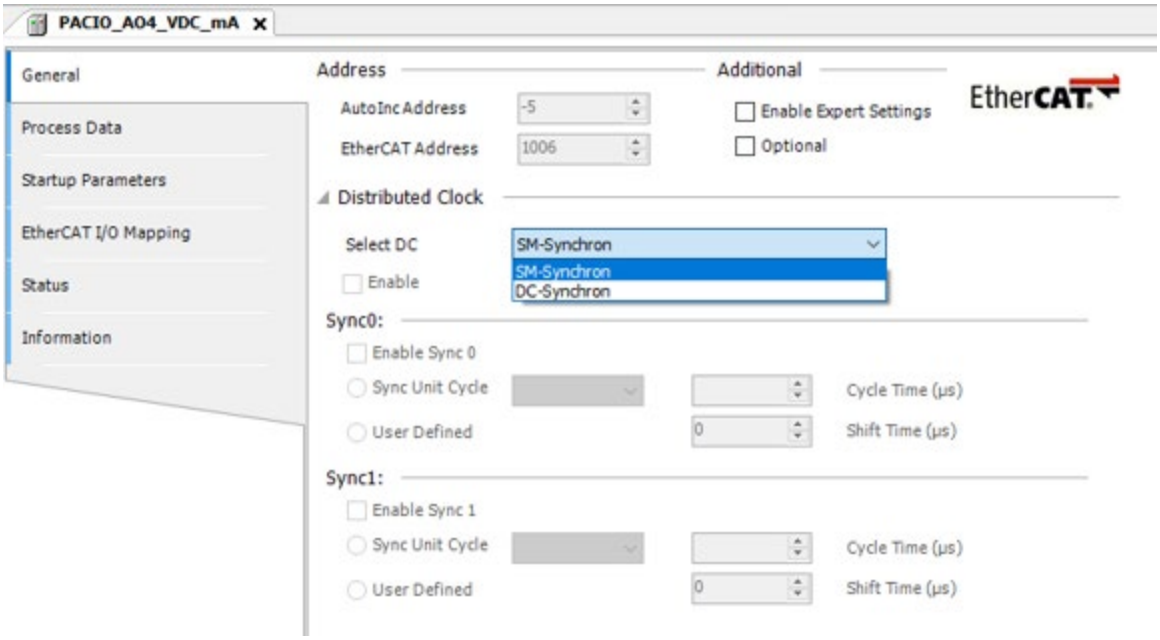
	Red, 1x	Short circuit
	Red, 2x	Low voltage
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
"Power" LED		
State	LED Flash Code	Explanation
On	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

Module control

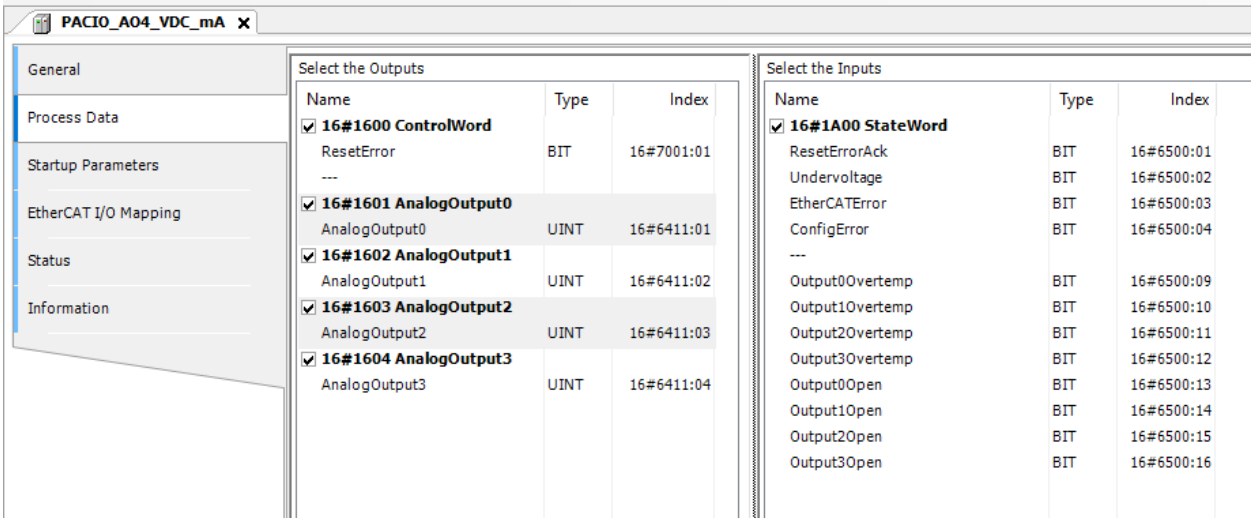
Output of the analog values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

SM-Synchron: This mode will synchronize the EtherCAT slave with the Sync Manager Events SM2/SM3. Sync Manager Events are trigger when a passing frame is processed.

DC-Synchron: This mode will synchronize the EtherCAT slave with the Distributed Clock sync events. The EtherCAT slave will be trigger by the SYNC0 or SYNC1 events of the Distributed Clock system. These events are synchronized with all DC Enabled EtherCAT slaves and will ensure strict timing with minimal jitter based on the EtherCAT Master task cycle. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.

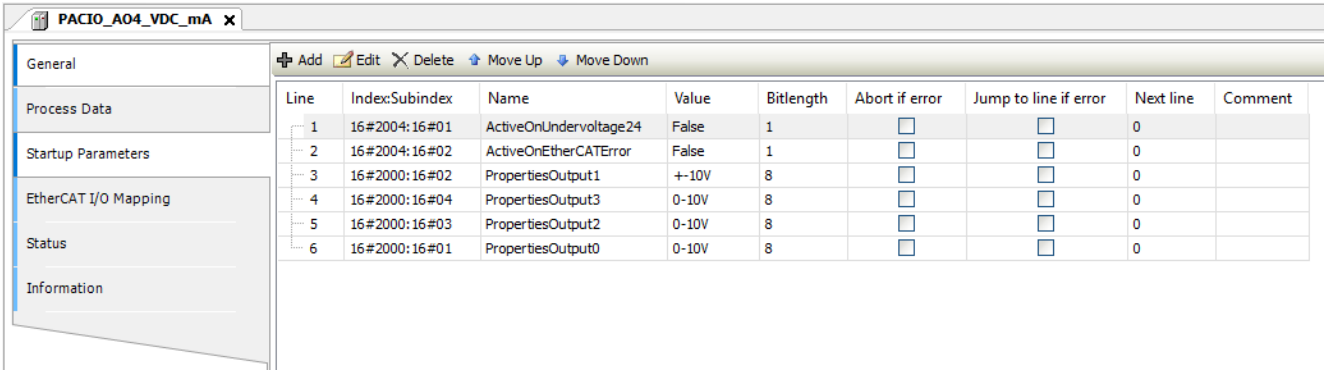


The process data objects stored as variables in the EtherCAT master's control program are used to access the output values and the module state.

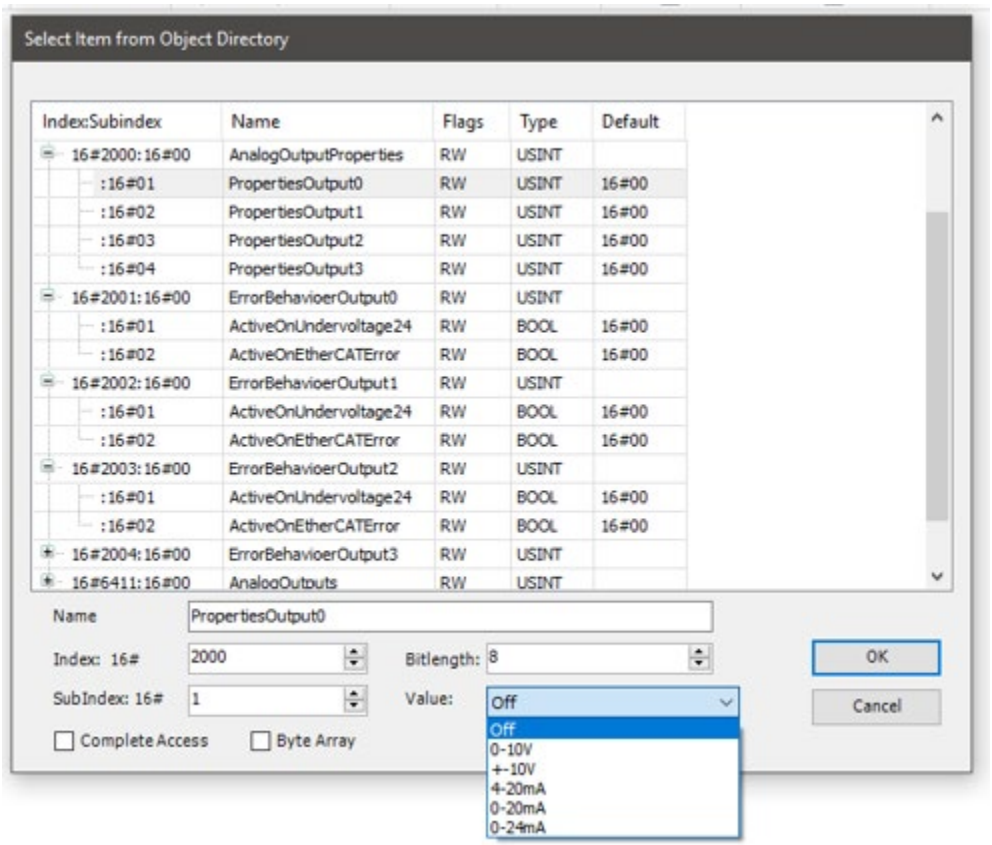


Service data objects (SDO) are available for details and settings.

You may run the configuration tool offline to change some settings of module AO4 16-Bit (such as the properties of each of the outputs). The EtherCAT master will apply the settings when starting up the module. You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.



Click/tap on "Add…", choose an object, and set the appropriate value.



Analog outputs

The AO4 module has 4 analogue outputs. Every channel can be separately set to unipolar or bipolar output of voltages or currents.

To output voltage or current readings (measured values) to the analogue outputs, verify that the associated output variables contain these values in the 2-byte two's complement format. The letter 'n' in the tables below represents the channel number (n=0…3).

Write the output values into the following variables.

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

Analog Voltage/Current Values

Measuring				Variable Value (@ 16bits)			
±10, 0..10	0..20	4..20	0..24	Bipolar [UINT]		Unipolar [UINT]	
Volt	mA	mA	mA	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	4	0	0	0	0	0
1	2	5.6	2.4	3276	16#0CCC	6553	16#1999
2	4	7.2	4.8	6553	16#1999	13107	16#3332
3	6	8.8	7.2	9830	16#2666	19660	16#4CCC
4	8	10.4	9.6	13106	16#3332	26214	16#6665
5	10	12.0	12.0	16383	16#3FFF	32767	16#7FFF
6	12	13.6	14.4	19660	16#4CCC	39320	16#9998
7	14	15.2	16.8	22936	16#5998	45874	16#B332
8	16	16.8	19.2	26213	16#6665	52427	16#CCCB
9	18	18.4	21.3	29490	16#7332	58981	16#E665
10	20	20	24	32767	16#7FFF	65534	16#FFFE

State Word

The state word is indicative of the module state:

Bit	Name	Explanation
0	ResetErrorACK	Acknowledges "Reset Error" in Module Control
1	Undervoltage24	24V supply low
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4	-	
5	-	
6	-	
7	-	
8	Output 0 Overtemp	Over-temperature detected by output driver (automatic switch-off)
9	Output 1 Overtemp	Over-temperature detected by output driver (automatic switch-off)
10	Output 2 Overtemp	Over-temperature detected by output driver (automatic switch-off)
11	Output 3 Overtemp	Over-temperature detected by output driver (automatic switch-off)
12	Output 0 Open	If there is no current in Current mode
13	Output 1 Open	If there is no current in Current mode
14	Output 2 Open	If there is no current in Current mode
15	Output 3 Open	If there is no current in Current mode

ControlWord

The control word contains a bit for acknowledging errors.

Bit	Name	Explanation
0	ResetError	0 -> errors are retained, 1 ->errors cleared after removing their cause
1-15	-	Not used

Object Dictionary

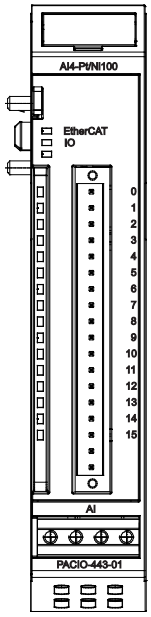
Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0xF0191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String			RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	ARRAY			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32			RO
1018, 3	Revision Number	UINT32	2		RO

1018, 4	Serial Number	UINT32	0		RO
2000	Analog Output Properties	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 2	Properties Output 1	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2000, 3	Properties Output 2	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2000, 4	Properties Output 3	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2001	ErrorBehavior Output 0	Array			
2001, 0	Number of Entries	UINT8	2		RO
2001, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2001, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
2002	ErrorBehavior Output 1	Array			
2002, 0	Number of Entries	UINT8	2		RO
2002, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2002, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
2003	ErrorBehavior Output 2	Array			
2003, 0	Number of Entries	UINT8	2		RO
2003, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2003, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
2004	ErrorBehavior Output 3	Array			
2004, 0	Number of Entries	UINT8	2		RO
2004, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2004, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
6411	Analogue Outputs	Array			
6411, 0	Number of Entries	UINT8	4		RO
6411, 1	Analogue Output 0	UINT16			RW P
6411, 2	Analogue Output 1	UINT16			RW P

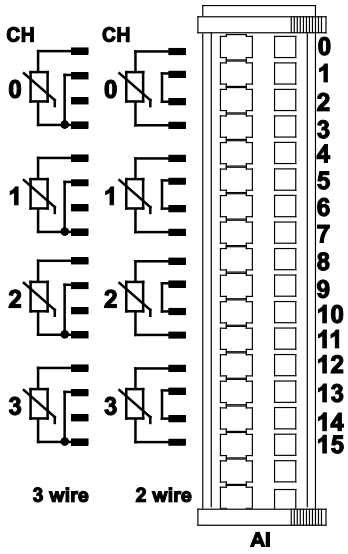
6411, 3	Analogue Output 2	UINT16			RW P
6411, 4	Analogue Output 3	UINT16			RW P
6500	State Word	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	Reset Error Ack	BOOL			RO P
6500, 2	Undervoltage24	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5	-	BOOL			RO P
6500, 6	-	BOOL			RO P
6500, 7	-	BOOL			RO P
6500, 8	-	BOOL			RO P
6500, 9	Output 0 Overtemp	BOOL			RO P
6500, 10	Output 1 Overtemp	BOOL			RO P
6500, 11	Output 2 Overtemp	BOOL			RO P
6500, 12	Output 3 Overtemp	BOOL			RO P
6500, 13	Output 0 Open	BOOL			RO P
6500, 14	Output 1 Open	BOOL			RO P
6500, 15	Output 2 Open	BOOL			RO P
6500, 16	Output 3 Open	BOOL			RO P
7001	Control Word	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

PACIO-443-01 - AI4-Pt/Ni100 16 Bit
PACIO-443-03 - 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 320 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 3200 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…320 Ω
Temperature drift	< ± 50ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.50 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Technical Data	PACIO AI4-Pt/Ni1000 16 Bit
Part number	PACIO-443-03
Analog inputs	4
Resolution	16 bit (resistance 0.1 temperature 0.1°C)
Pt100 measuring range	- 75°C…+ 570°C
Ni100 measuring range	- 60°C…+ 250°C
Resistance	700…3200 Ω
Temperature drift	< ± 60ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.12 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	150mA

Terminals

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

Status LEDs

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

“EtherCAT Run” LED		
State	LED Flash Code	Explanation
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“IO” LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control

	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
“Channel” LEDs		
State	LED Flash Code	Explanation
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Short circuit, Broken wire

Analog Inputs

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

Check the following variable for the digitized input values.

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

Module Control

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

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

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

Module Options

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

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

n		0 … 3	Channel number

Module State

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

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

Module-Specific Messages

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

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

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

Conversion Time

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

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

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

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

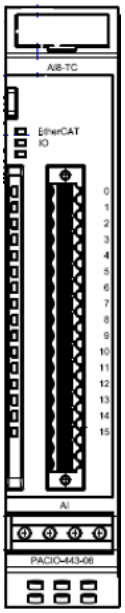
NOTE: If you are aiming for a high sampling frequency, the PAC should do the filtering (averaging) because it will normally have much more processing power.

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

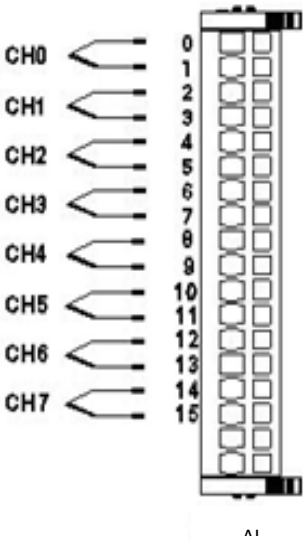
Quality of Analog Values

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

PACIO-443-06 - AI8 Thermocouple 16 Bit



Front view of PACIO AI8 Thermocouple 16 Bit



I/O connection

The **PACIO AI8 Thermocouple 16 Bit** Module has 8 analog inputs for Thermocouple sensors. It also can measure mV voltages.

Technical data	PACIO AI8 Thermocouple 16 Bit
Part number	PACIO-443-06
Analog inputs	8
Resolution	16 bit
mV Measuring range	mV: -40…+65, in 2 µV
Type K measuring range	Type K: -200°C .. +1372°C in 0.1°C
Measurement failure (25°C)	< ± 0.4% regarding range limit
less measurement failure	on demand
Cold junction compensation	Yes
Critical frequency	typical 0.33 Hz
Sampling frequency	> 3.82 Hz (if all channels are enabled)
Connector IO/Power	Plug 18-pole (43-026591-01)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Power supply	24 VDC -20% +25%
E-Bus load	170mA

Terminals

The PACIO AI8 Thermocouple 16 Bit Module does not need a separate 24V connector. Power is supplied to the Module 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" 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, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
"IO" LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-Bus pre-operational), number of process data differs from that in the Module
Defective	Red, on	Module defective
"Channel" LEDs		
State	LED Flash Code	Explanation
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Short circuit, Broken wire

Analog Inputs

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

Check the following variable for the digitized input values.

Variable	Data type	Explanation	
Channel_n	INT	Value measured on channel n (n= 0…3)	
		Default	in 1/10 °C
		mV Mode	in µV resp. 2µV

Module Control

The PACIO AI8 Thermocouple 16 Bit Module provide 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 Modules 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 AI8 Thermocouple 16 Bit Module. To set and accept options, see “Module Control” above.

Variable	Data type	Explanation	
Channel_n_SensorType	USINT	Sensor type	
		16#00	mV: not used
		16#10	mV: -40 .. +65mV, values in 2µV
		16#04	Type K: not used
		16#14	Type K: -200°C .. +1372°C in 0.1°C
Channel_n_On	BOOL	Enables channel n	
Channel_n_Filter	USINT	Set filter for channel n. The arithmetic mean is output after n+1 conversions	
n		0 … 7	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 AI8 Thermocouple 16 Bit Module. 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_Out_of_Range	BOOL	Measuring value is out of range

*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	Number of channels	Cycle Time in ms
1	32	5	167
2	65	6	198
3	97	7	230
4	129	8	262

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.

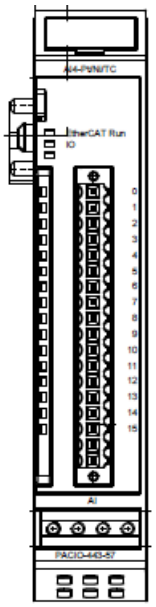
Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The Module described in this section will accept the above times as the ideal EtherCAT cycle setup.

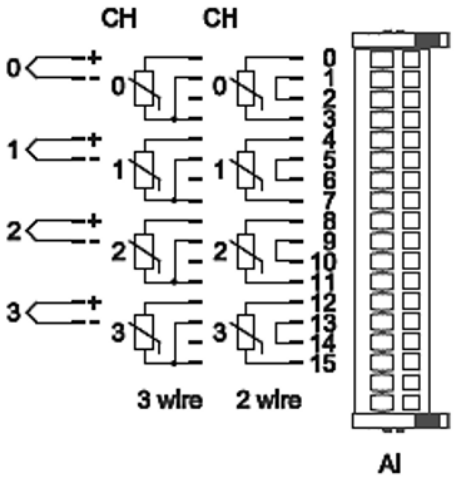
Quality of Analog Values

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-443-57 - AI4-Pt/Ni/Thermocouple CoE





Front view of PACIO AI4-Pt/Ni/Thermocouple CoE I/O Module *I/O connection*

The **PACIO AI4 Pt/Ni/Thermocouple CoE** Module has 4 analog inputs for temperature sensors. Every channel can be separately set to one of the following sensor types: millivolt, Pt100, Pt1000, Ni100, Ni1000 (DIN 43760) or thermocouple.

NOTE: PACIO-443-57 AI4-Pt/Ni/Thermocouple CoE is the successor to the following PACIO modules:

PACIO-443-01 AI4-Pt/Ni100 16 Bit
PACIO-443-03 AI4-Pt/Ni1000 16 Bit
PACIO-443-06 AI8 Thermocouple 16 Bit

Before replacing the above modules with PACIO-443-57 AI4-Pt/Ni/Thermocouple CoE, modify the project on the PAC using Parker Automation Manager.

Technical Data	PACIO AI4-Pt/Ni/Thermocouple CoE
Part Number	PACIO-443-57
Analog inputs	4
Resolution	16 bit
Input filter cutoff frequency	typical 0.33 Hz
Conversion time	50 ms (adjustable)
Measuring error	<± 0.54% (of final measuring range value)
Temperature drift	<± 50ppm (of final measuring range value)
Thermocouple	
Sensor Types	J,K, mV(internal)
Cold point compensation	Yes
Measuring range Type K	-200°C…+1372°C
Measuring range Type J	-50°C…+760°C
Measuring range mV	-40… +65mV
PT100/Ni100	
Measuring range Type Pt	-75°C…+670°C
Measuring range Type Ni	-60°C…+250°C
Measuring resistance	70…320 Ω
Measuring Current	1mA (typical)
PT1000/Ni1000 DIN43760	
Measuring range Type Pt	-75°C…+670°C
Measuring range Type Ni	-60°C…+250°C
Measuring resistance	700…3200 Ω
Measuring Current	0.1mA (typical)
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	170mA

Terminals

The PACIO AI4 Pt/Ni/Thermocouple CoE Module does not need a separate 24V connector. Power is supplied to the Module 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	Off	Initializing, no data exchange

Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“IO” LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 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, 1x	Sensor low
	Red, 2x	Sensor high

NOTE on Pt/100/Ni100 mode:

Error "input high" is not shown in the Pt100 and Ni100 modes, unless a temperature sensor is connected. Check that your wiring is correct (jumpered 2-wire or 3-wire connection) to ensure that all errors are detected/shown properly.

NOTE on thermocouple mode:

Errors *input low* and *input high* are just indicative of the temperature being out of the set range.

A short circuit (input low) is not detected in thermocouple mode (types J,K) because the thermal voltage is too small for a short circuit to be relevant to the measured result.

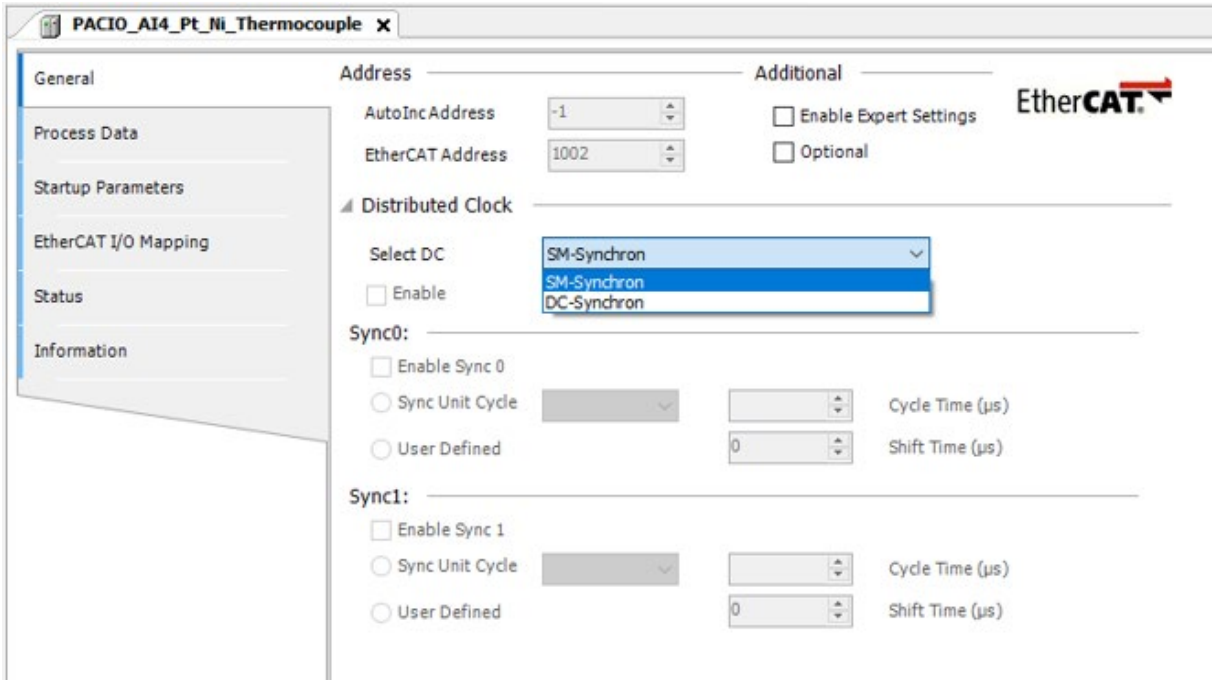
Since a broken wire is not detected, the floating module values may provoke an indication of error *input high* or *input low*.

Module Control

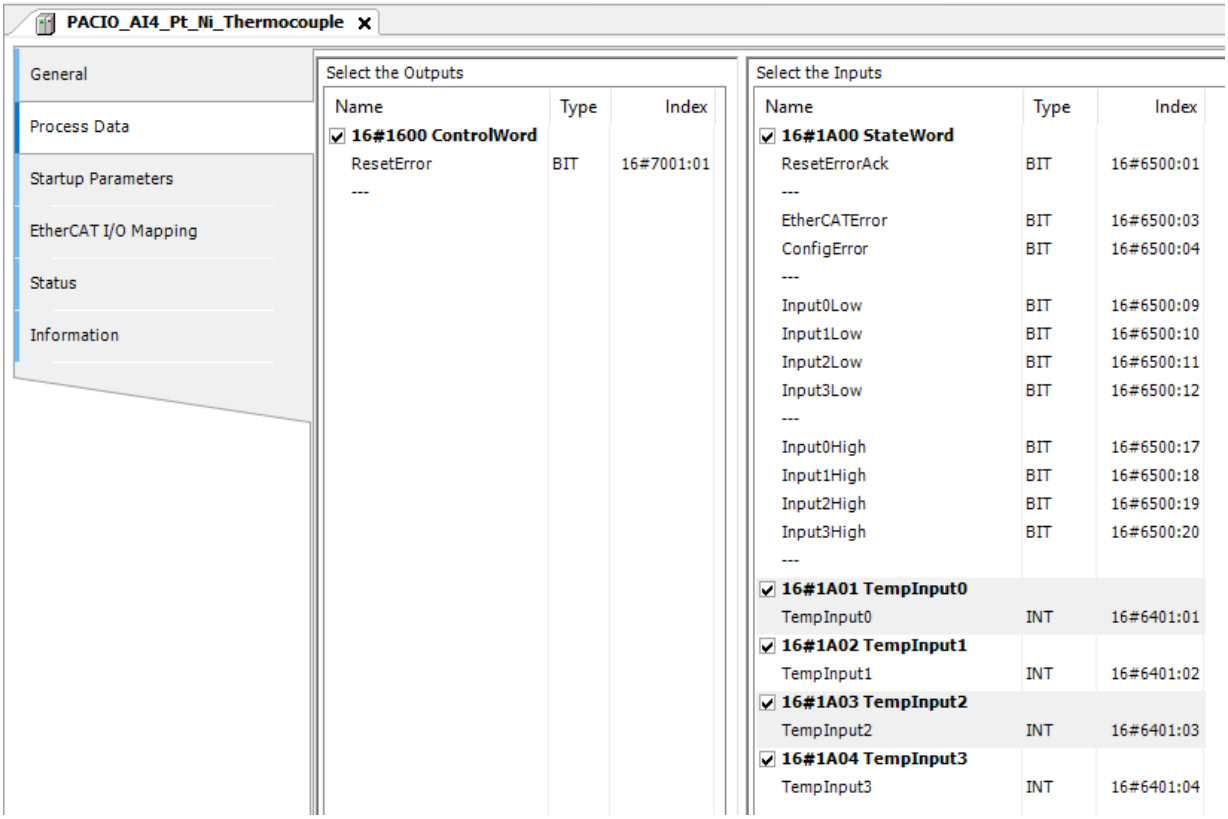
Conversion of the analog values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

SM-Synchron: This mode will synchronize the EtherCAT slave with the Sync Manager Events SM2/SM3. Sync Manager Events are trigger when a passing frame is processed.

DC-Synchron: This mode will synchronize the EtherCAT slave with the Distributed Clock sync events. The EtherCAT slave will be trigger by the SYNC0 or SYNC1 events of the Distributed Clock system. These events are synchronized with all DC Enabled EtherCAT slaves and will ensure strict timing with minimal jitter based on the EtherCAT Master task cycle. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.



The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

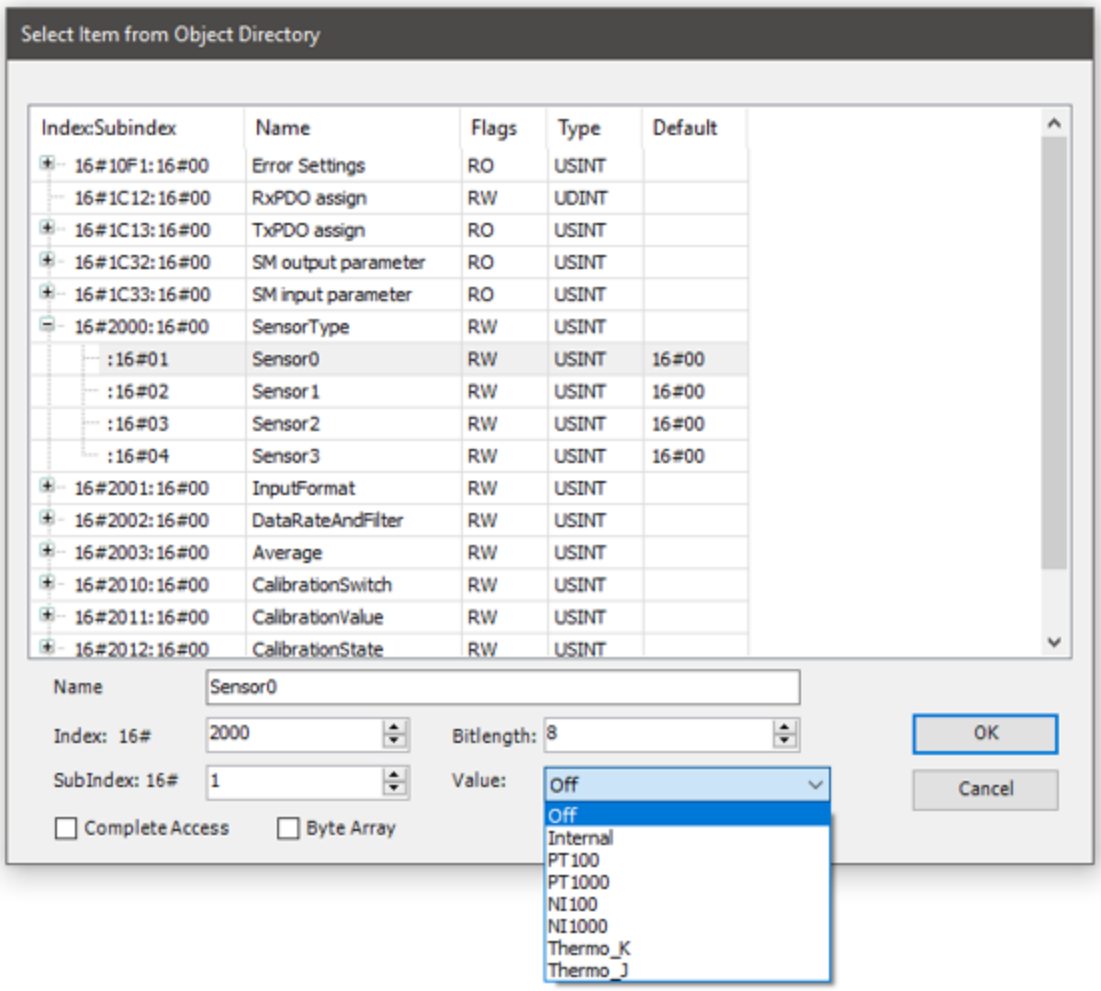


Service data objects (SDO) are available for details and settings.

You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI4-Pt/Ni/TC (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.

You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.



Module Options

The following options are available for every channel:

Variable	Data type	Explanation
SensorType	0	Off (default)
	1	Internal (mV)
	2	Pt100
	3	Pt1000
	4	Ni100
	5	Ni1000 (DIN43760)
	6	Thermo K
	7	Thermo J
InputFormat	0	0.1°C
	1	Ω / V

	2	Raw (raw data)
Data rate and filter	0	1000 readings per second
	1	600 readings per second
	2	330 readings per second
	3	175 readings per second
	4	90 readings per second
	5	45 readings per second
	6	20 readings per second
	7	20 readings per second plus 50 & 60 Hz filter
	8	20 readings per second plus 50 Hz filter
	9	20 readings per second plus +60 Hz filter
Average	n=1..255	Inputn= average after n cycles (default=1)

StateWord

The state word (DWORD) is indicative of the module state:

Bit	Name	Explanation
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	-	not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7	-	not used
8	Input0low	Incorrect range of connected reading
9	Input1low	Incorrect range of connected reading
10	Input2low	Incorrect range of connected reading
11	Input3low	Incorrect range of connected reading
12-15	-	not used
16	Input0high	Incorrect range of connected reading
17	Input1high	Incorrect range of connected reading
18	Input2high	Incorrect range of connected reading
19	Input3high	Incorrect range of connected reading
20-31	-	not used

Analog Inputs

Check the following variables for the digitized input values:

Variable	Data type	Explanation
TempInputn	INT	Value of channel n (n=0…3) in 0.1°C, Ω or 2µV

Control Word

The control word contains a bit for acknowledging errors.

Bit	Name	Explanation
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Cold Point Compensation

Cold points are automatically compensated if thermocouples are used. Temperature readings are taken immediately at the plug near the connection.

Calibration

This module does not have to be calibrated by the end user because it is calibrated after fabrication.

It can only be calibrated once because the calibration values are kept on memory.

The calibration objects (2010:n; 2011:n and 2012:n) in the Startup Parameters are intended for internal use only.

Object Dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4_Pt/Ni/Thermo		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185345		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Sensor Type	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 1	Sensor0	UINT8	Off	Off (0), Internal (1), PT100 (2), PT1000 (3), NI100 (4), NI1000 (5), Thermo_K (6), Thermo_J (7),	RW
2000, 2	Sensor1	UINT8	Off	Off, Internal, PT100,	RW

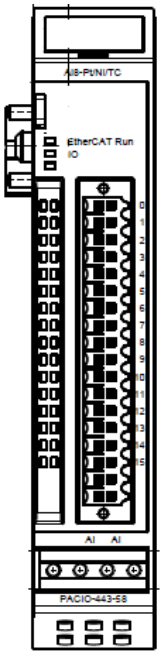
				PT1000, NI100, NI1000, Thermo_K, Thermo_J,	
2000, 3	Sensor2	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 4	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2001	Input Format	Array			
2001, 0	Number of Entries	UINT8	4		RO
2001, 1	Input0Format	UINT8	0.1°C	0.1°C (0), Ω / V (1) Raw (2)	RW
2001, 2	Input1Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 3	Input2Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 4	Input3Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2002	Data RateAndFilter	Array			
2002, 0	Number of Entries	UINT8	4		
2002, 1	Input0DataRateAnd Filter	UINT8	20 PLC	1000 PLC (0) 600 PLC (1) 330 PLC (2) 175 PLC (3) 90 PLC (4) 45 PLC (5) 20 PLC (6) 20 PLC+50&60Hz (7) 20 PLC + 50Hz (8) 20 PLC + 60Hz (9)	RO
2002, 2	Input1DataRateAndFilter	UINT8	20 PLC	1000 PLC	RO

				600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	
2002, 3	Input2DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 4	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2003	Average	Array			
2003, 0	Number of Entries	UINT8	4		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
6401	Analog input	Array			
6401, 0	Number of Entries	UINT8	4		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6500	StateWord	Array			RO P
6500, 0	Number of Entries	UINT8	32		RO P
6500, 1	ResetErrorAck	BOOL			RO P

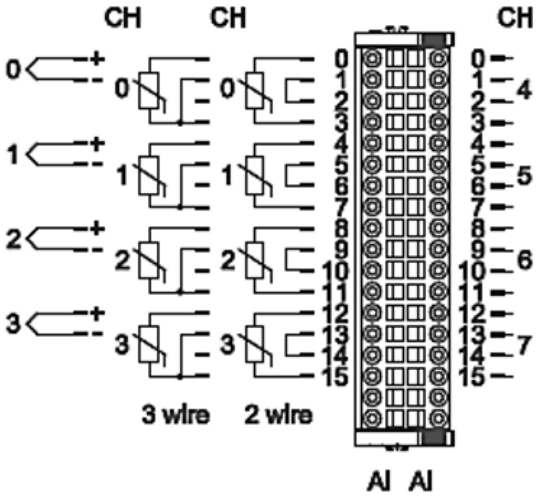
6500, 2	-	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13..16	-	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21..32	-	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

PACIO-443-58 – AI8-Pt/Ni/Thermocouple CoE



Front view of PACIO AI8-Pt/Ni/Thermocouple CoE I/O Module



I/O connection

The **PACIO AI8 Pt/Ni/Thermocouple CoE** Module has 8 analog inputs for temperature sensors. Every channel can be separately set to one of the following sensor types: millivolt, Pt100, Pt1000, Ni100, Ni1000 (DIN 43760) or thermocouple.

NOTE: PACIO-443-58 AI8-Pt/Ni/Thermocouple CoE is the successor to the following PACIO modules:

PACIO-443-01 AI4-Pt/Ni100 16 Bit
PACIO-443-03 AI4-Pt/Ni1000 16 Bit
PACIO-443-06 AI8 Thermocouple 16 Bit

Before replacing the above modules with PACIO-443-58 AI8-Pt/Ni/Thermocouple CoE, modify the project on the PAC using Parker Automation Manager.

Technical Data	PACIO AI8-Pt/Ni/Thermocouple CoE
Part Number	PACIO-443-58
Analog inputs	8
Resolution	16 bit
Input filter cutoff frequency	typical 0.33 Hz
Conversion time	50 ms (adjustable)
Measuring error	<± 0.54% (of final measuring range value)
Temperature drift	<± 50ppm (of final measuring range value)
Thermocouple	
Sensor Types	J,K, mV(internal)
Cold point compensation	Yes
Measuring range Type K	-200°C…+1372°C
Measuring range Type J	-50°C…+760°C
Measuring range mV	-40… +65mV
PT100/Ni100	
Measuring range Type Pt	-75°C…+670°C
Measuring range Type Ni	-60°C…+250°C
Measuring resistance	70…320 Ω
Measuring Current	1mA (typical)
PT1000/Ni1000 DIN43760	
Measuring range Type Pt	-75°C…+670°C
Measuring range Type Ni	-60°C…+250°C
Measuring resistance	700…3200 Ω
Measuring Current	0.1mA (typical)
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	170mA

Terminals

The PACIO AI8 Pt/Ni/Thermocouple CoE Module does 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	Off	Initializing, no data exchange

Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
“IO” LED		
State	LED Flash Code	Explanation
Ok	Green, on	No error
Error	Off	Malfunction of Module if E-Bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 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, 1x	Sensor low
	Red, 2x	Sensor high

NOTE on Pt/100/Ni100 mode:

Error "input high" is not shown in the Pt100 and Ni100 modes, unless a temperature sensor is connected. Check that your wiring is correct (jumpered 2-wire or 3-wire connection) to ensure that all errors are detected/shown properly.

NOTE on thermocouple mode:

Errors *input low* and *input high* are just indicative of the temperature being out of the set range.

A short circuit (input low) is not detected in thermocouple mode (types J,K) because the thermal voltage is too small for a short circuit to be relevant to the measured result.

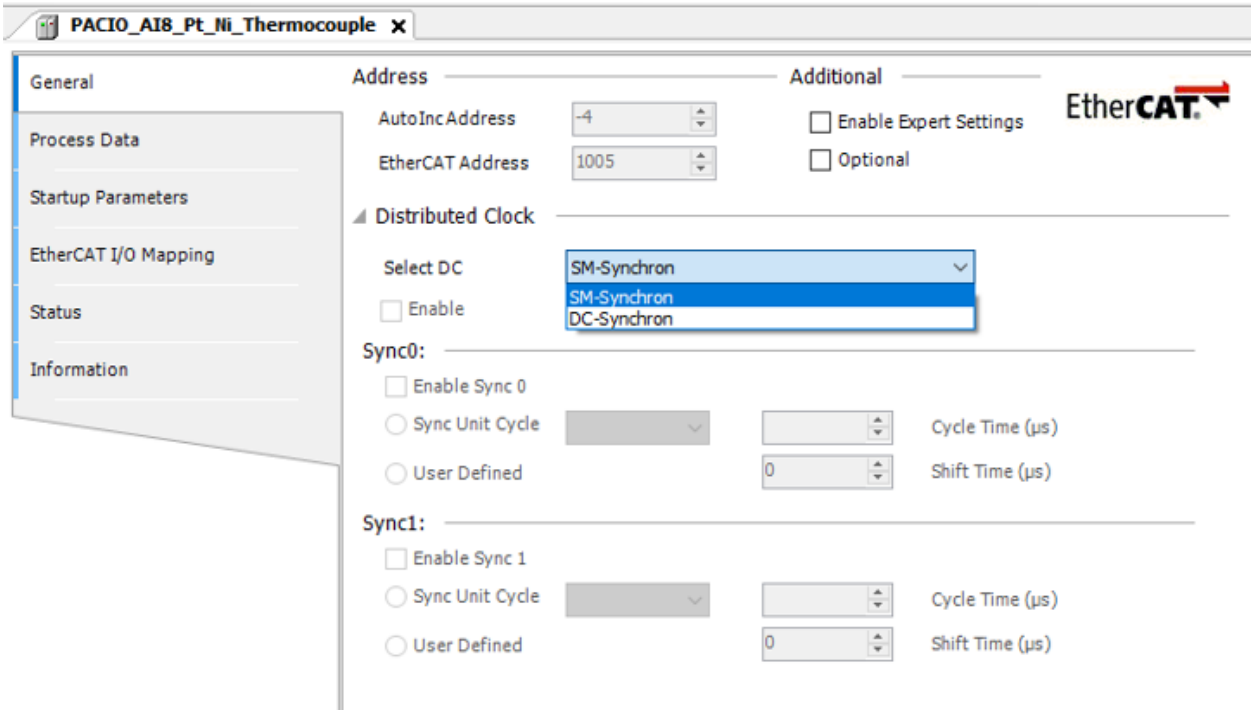
Since a broken wire is not detected, the floating module values may provoke an indication of error *input high* or *input low*.

Module Control

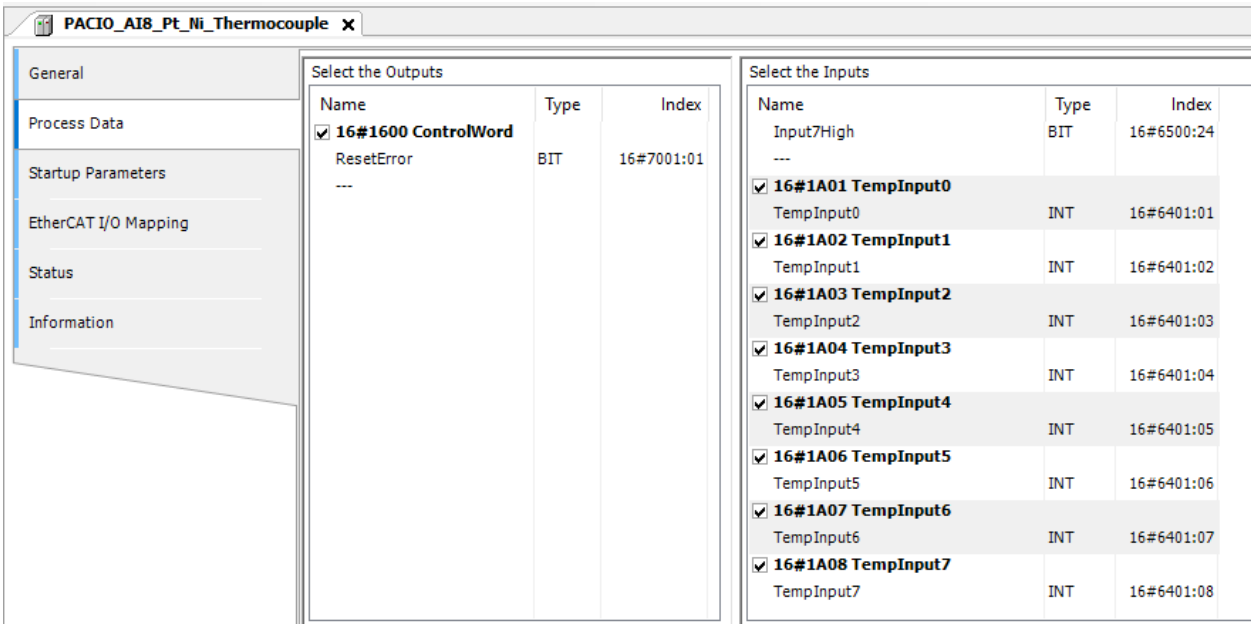
Conversion of the analog values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

SM-Synchron: This mode will synchronize the EtherCAT slave with the Sync Manager Events SM2/SM3. Sync Manager Events are trigger when a passing frame is processed.

DC-Synchron: This mode will synchronize the EtherCAT slave with the Distributed Clock sync events. The EtherCAT slave will be trigger by the SYNC0 or SYNC1 events of the Distributed Clock system. These events are synchronized with all DC Enabled EtherCAT slaves and will ensure strict timing with minimal jitter based on the EtherCAT Master task cycle. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.



The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

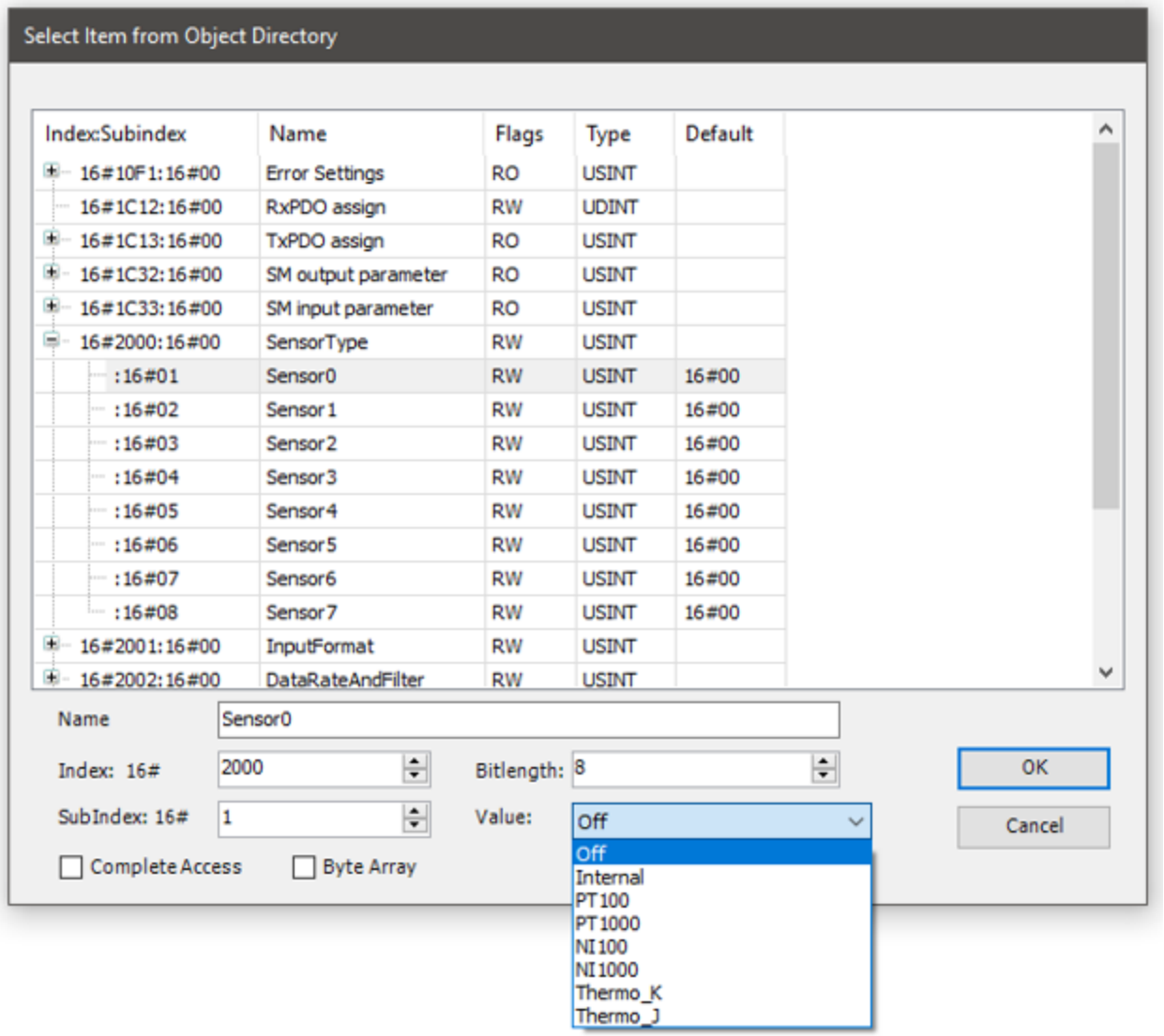


Service data objects (SDO) are available for details and settings.

You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI4-Pt/Ni/TC (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.

You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.



Module Options

The following options are available for every channel:

Variable	Data type	Explanation
SensorType	0	Off (default)
	1	Internal (mV)
	2	Pt100
	3	Pt1000
	4	Ni100
	5	Ni1000 (DIN43760)
	6	Thermo K
	7	Thermo J

InputFormat	0	0.1°C
	1	Ω / V
	2	Raw (raw data)
Data rate and filter	0	1000 readings per second
	1	600 readings per second
	2	330 readings per second
	3	175 readings per second
	4	90 readings per second
	5	45 readings per second
	6	20 readings per second
	7	20 readings per second plus 50 & 60 Hz filter
	8	20 readings per second plus 50 Hz filter
	9	20 readings per second plus +60 Hz filter
Average	n=1..255	Inputn= average after n cycles (default=1)

StateWord

The state word (DWORD) is indicative of the module state:

Bit	Name	Explanation
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	-	not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7	-	not used
8	Input0low	Incorrect range of connected reading
9	Input1low	Incorrect range of connected reading
10	Input2low	Incorrect range of connected reading
11	Input3low	Incorrect range of connected reading
12	Input4low	Incorrect range of connected reading
13	Input5low	Incorrect range of connected reading
14	Input6low	Incorrect range of connected reading
15	Input7low	Incorrect range of connected reading
16	Input0high	Incorrect range of connected reading
17	Input1high	Incorrect range of connected reading
18	Input2high	Incorrect range of connected reading
19	Input3high	Incorrect range of connected reading
20	Input4high	Incorrect range of connected reading
21	Input5high	Incorrect range of connected reading

22	Input6high	Incorrect range of connected reading
23	Input7high	Incorrect range of connected reading
24-31	-	not used

Analog Inputs

Check the following variables for the digitized input values:

Variable	Data type	Explanation
TempInputn	INT	Value of channel n (n=0…7) in 0.1°C, Ω or 2µV

Control Word

The control word contains a bit for acknowledging errors.

Bit	Name	Explanation
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Cold Point Compensation

Cold points are automatically compensated if thermocouples are used. Temperature readings are taken immediately at the plug near the connection.

Calibration

This module does not have to be calibrated by the end user because it is calibrated after fabrication.

It can only be calibrated once because the calibration values are kept in memory.

The calibration objects (2010:n; 2011:n and 2012:n) in the Startup Parameters are intended for internal use only.

Object Dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4_Pt/Ni/Thermo		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185345		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Sensor Type	Array			
2000, 0	Number of Entries	UINT8	4		RO

2000, 1	Sensor0	UINT8	Off	Off (0), Internal (1), PT100 (2), PT1000 (3), NI100 (4), NI1000 (5), Thermo_K (6), Thermo_J (7),	RW
2000, 2	Sensor1	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 3	Sensor2	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 4	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 5	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 6	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW

2000, 7	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 8	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2001	Input Format	Array			
2001, 0	Number of Entries	UINT8	4		RO
2001, 1	Input0Format	UINT8	0.1°C	0.1°C (0), Ω / V (1) Raw (2)	RW
2001, 2	Input1Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 3	Input2Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 4	Input3Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 5	Input0Format	UINT8	0.1°C	0.1°C Ω / V Raw	RW
2001, 6	Input1Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 7	Input2Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 8	Input3Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2002	Data RateAndFilter	Array			
2002, 0	Number of Entries	UINT8	4		
2002, 1	Input0DataRateAnd Filter	UINT8	20 PLC	1000 PLC (0) 600 PLC (1) 330 PLC (2)	RO

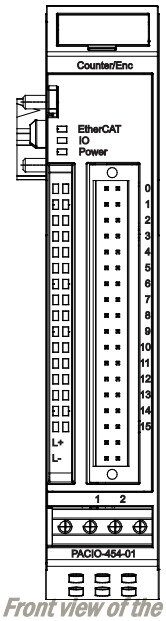
				175 PLC (3) 90 PLC (4) 45 PLC (5) 20 PLC (6) 20 PLC+50&60Hz (7) 20 PLC + 50Hz (8) 20 PLC + 60Hz (9)	
2002, 2	Input1DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 3	Input2DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 4	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 5	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 6	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC	RO

				600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	
2002, 7	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 8	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2003	Average	Array			
2003, 0	Number of Entries	UINT8	4		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW
2003, 6	Input 5 Average	UINT8	1	1..255	RW
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
6401	Analog input	Array			
6401, 0	Number of Entries	UINT8	4		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P

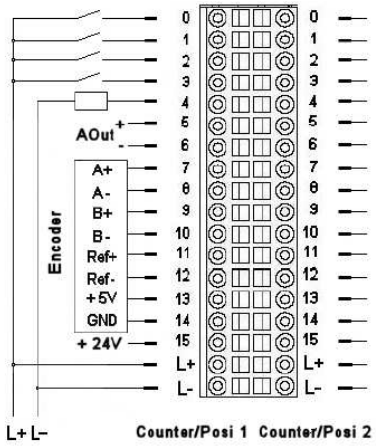
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 5	UINT16			RO P
6401, 8	Analog Input 6	UINT16			RO P
6401, 3	Analog Input 7	UINT16			RO P
6500	StateWord	Array			RO P
6500, 0	Number of Entries	UINT8	32		RO P
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	-	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13	Input 4 low	BOOL			RO P
6500, 14	Input 5 low	BOOL			RO P
6500, 15	Input 6 low	BOOL			RO P
6500, 16	Input 7 low	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21	Input 4 high	BOOL			RO P
6500, 22	Input 5 high	BOOL			RO P
6500, 23	Input 6 high	BOOL			RO P
6500, 24	Input 7 high	BOOL			RO P
6500, 25..32	-	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

PACIO-454-01 - 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 Specs	
Encoders	2
Encoder Channels	A, A-, B, B-, Ref, Ref - * *Unused encoder signals should be pulled up to +5V
Encoder type	5-24 Vdc, Quadrature RS422, Differential
Maximum Input Frequency	200 kHz
Input Specs	
Digital inputs	8
Maximum Input Frequency	1000 Hz
Input Signal level	Off: -3V … 5V On: 15V … 30V (EN 61131-2, type 1) Typical current draw of 5 mA per input at 24V Sourcing (High Side, “PNP”)
Output Specs	
Digital outputs	2
Maximum current	2A per output Sourcing (High Side, “PNP”)
Analog Output Specs	
Analog outputs	2
Voltage	±10V
Resolution	12 bit
Fieldbus	EtherCAT 100 Mbit/s
EtherCAT-File	ParkerEtherCATModules.xml
Dimensions (WxHxD)	25x120x90 mm
Mounting	35mm DIN-Rail

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

Terminals

Pin	Signal	Explanation
0	In_0	Digital Input 0
1	In_1	Digital Input_1
2	In_2	Digital Input 2
3	In_3	Digital Input 3
4	Out_0	Digital Output
5	A_Out+	Analog Output +
6	A_Out-	Analog Output -
7	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

* Unused encoder signals should be pulled up to +5V

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, 5:1	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. For more information about Distributed Clocks, see the section titled Configure EtherCAT Master Node.

Frame-Synchronous Mode

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

DC-Synchronous Mode

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

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

Controlling and Watching the Entire Module

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

Module Control

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

Variable	Data type	Explanation
ResetError	BOOL	rising edge → error confirmation

Module Status

To reset, use the ResetError in the “Module Control” above.

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

Controlling/Watching Counter

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

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

Counter Options

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

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

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

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

Counter Control

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

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

The execution is indicated in the corresponding status variable.

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

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

Counter Status

The status variables indicate the status of the counter.

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

Counter Errors

These variables are provided for the indication of error states:

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

Counter Values of Counter

Counter Set Values

The counter can be preset with different set values.

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

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

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

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

Counter Actual Values

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

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

Version information:

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

Digital Inputs and Outputs

Counter Digital Inputs

The variables indicate the status of the digital inputs.

Counter 1 Digital Inputs

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

Counter 2 Digital Inputs

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

Counter Input Edge Timestamp

The variables indicate the time at which the status of the digital input has changed. The time at which the measurement starts depends on the mode of operation. (See also Frame- or DC-Synchronous Mode on page 140.)

Counter 1

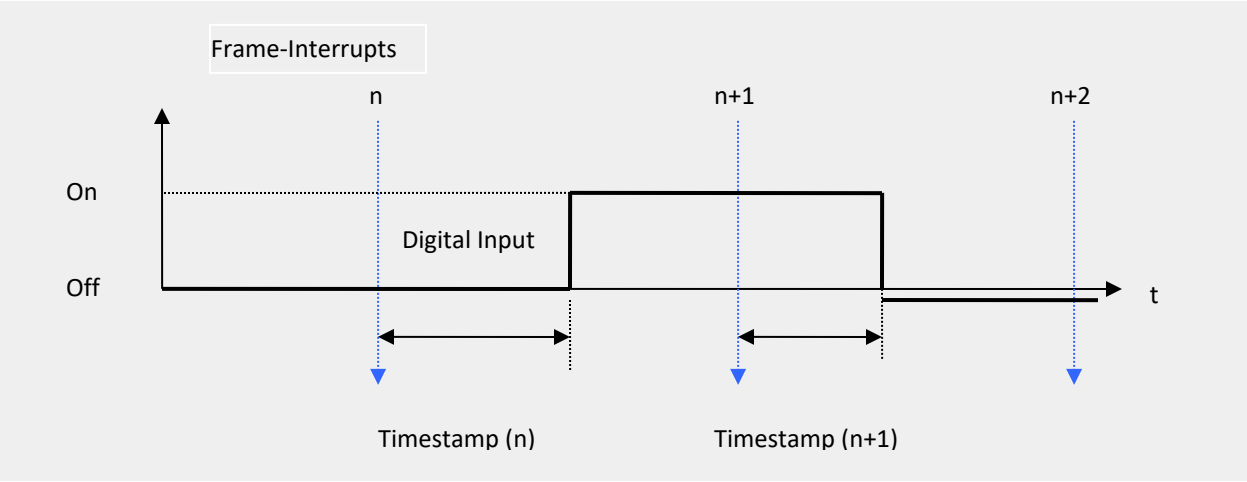
Variable	Data type	Explanation
Input_0_0_TS	UINT	Time stamp for Digital Input 0 (Hardware Triggered)
Input_0_1_TS	UINT	Time stamp for Digital Input 1 (Software Polled)
Input_0_2_TS	UINT	Time stamp for Digital Input 2 (Software Polled)
Input_0_3_TS	UINT	Time stamp for Digital Input 3 (Software Polled)

Counter 2

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

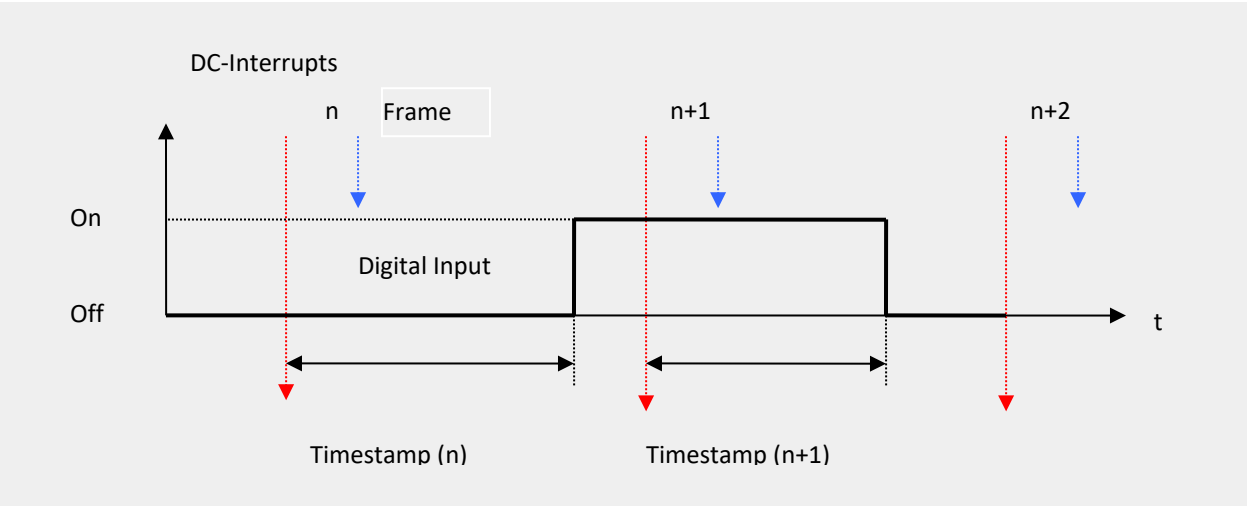
NOTE: The time stamp is metered between frame- or DC-interrupts and signal changes on the input in µs. The value of the time stamp becomes 0xFFFF, when no signal change takes place between two frame- or DC-interrupts.

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



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

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



Frame	Digital Input	
	Variable	Timestamp

n+1	TRUE	Timestamp (n)
n+2	FALSE	Timestamp (n+1)

Digital Outputs

These variables indicate the status of the digital outputs. This is not applicable when Compare function is enabled, see the Compared_1 status flag instead.

Counter 1

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

Counter 2

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

Output Set Delay

This variable defines the time when the output is set.

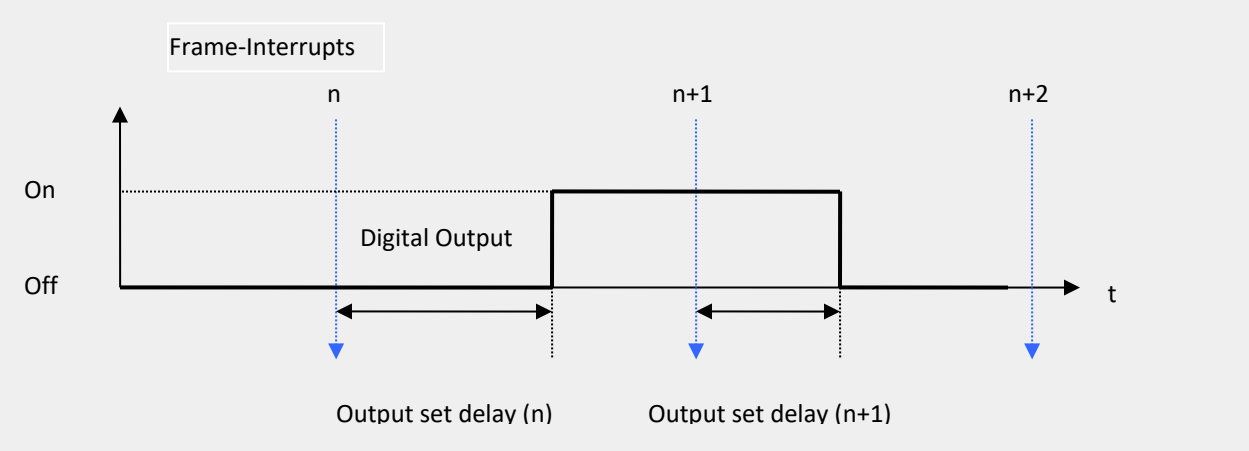
Counter 1

Variable	Data type	Explanation
Output_0_0_Del	UINT	Output set delay in µs

Counter 2

Variable	Data type	Explanation
Output_1_0_Del	UINT	Output set delay in µs

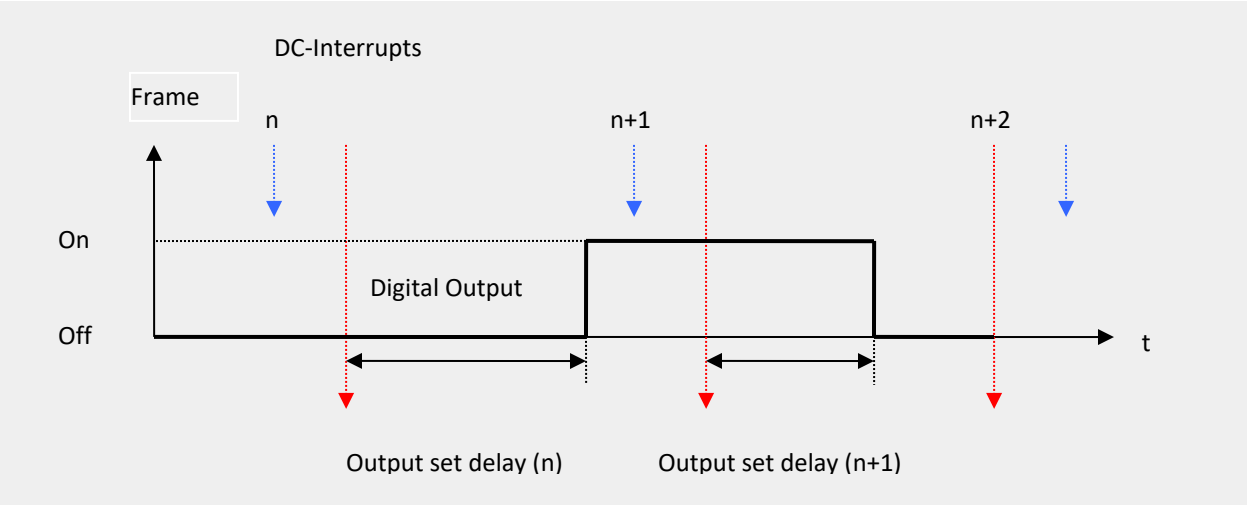
In frame-synchronous mode:



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

n+1	FALSE	Output set delay (n+1)

In DC-synchronous mode:



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

Analog Outputs

These variables define the Voltage of the analog outputs. For information on Output values, see Analog Voltage/Current Values on page 91.

Variable	Data type	Explanation
AnalogOutput_1	UINT	Analog Output 1
AnalogOutput_2	UINT	Analog Output 2

Examples

Enable Counter

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

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

Counter Set/Clear

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

```
Term2_SetValue_1:=diCounterValue;     (*Copy a number into the source var*)
```

```
                                        (* 0 = Clear*) and
Term2_SetCounter_1:=TRUE;               (*copy to the counter current value*)
Term2_CounterSet_1;                     (*TRUE, if set*)
```

Set Compare Value

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

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

Set Preset Value

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

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

Set Maximum Value

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

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

Set Counter Range

The counter range is controlled by an internal 'maximum value' register which defaults to 2,147,483,647 which means the overall counter range is 0 to 2,147,483,647. To change this range, load SetValue_1 (SetValue_2) to the desired maximum value and then set the Boolean SetMax_1 (SetMax_2) which will transfer the maximum value into the internal register. Once this is loaded the Boolean MaxSet_1 (MaxSet_2) will reflect that it has been updated.

```
SetValue_1 := 2,147,485,647;          (*Desired range is 0 to 2,147,483,647*)
SetMax_1:= TRUE;                      (* Set the new maximum value *)
```

Or

```
SetValue_1 := 4,294,967,294;          (*Desired range is -2,147,483,647 to
2,147,483,647*)
SetMax_1:= TRUE;                      (* Set the new maximum value *)
```

Here is a sample state machine:

```
CASE State OF            (* Configure the PACIO454-01 Encoder/Counter Module
channel 1 as a quadrature incremental encoder input port *)

(* The variables EnableCounter1, SetValue1, SetMax1, EnableCounter1, and Counting1
are declared as global variables directly in the PACIO_Counter_Enc_5V EtherCAT I/O
Mapping page.  Encoder_Configured1 is just a local variable to flag the counter is
enabled. *)

      0:          (* Ready to change config *)
            EnableCounter1 :=FALSE;
            SetValue1 := 4294967294;       (* Configure counter to have range of
-2,147,483,647 to 2,147,483,647 *)
            //SetValue1 := 2147483647;     (* Configure counter to have range of
0 to 2,147,483,647 *)
            SetMax1 := FALSE;
```

```
            STATE := 1;

      1:          (* Set new config values *)
            SetMax1 := TRUE;
            IF MaxSet1 THEN
                  SetMax1 := FALSE;
                  STATE := 2;
            END_IF

      2:          (* Enable Encoder/Counter *)
            EnableCounter1 := TRUE;
            IF Counting1 THEN
                  STATE := 3;
            END_IF

      3:          (* Encoder/Counter enabled *)
            Encoder_Configured1 := TRUE;

END_CASE
```

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 must 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.

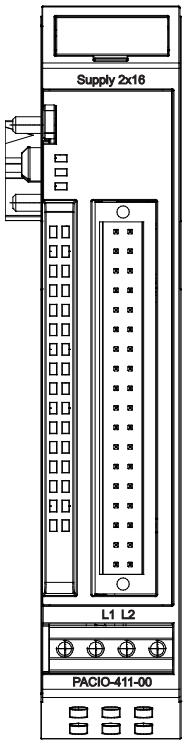
```
Term2_Input_0_0;          (*Status of Input 0*)
Term2_Input_0_1;          (*Status of Input 1*)
Term2_Input_0_2;          (*Status of Input 2*)
Term2_Input_0_3;          (*Status of Input 3*)
```

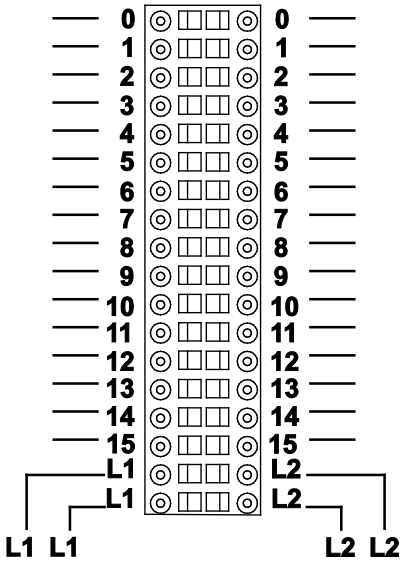
Analog Outputs

The output values of the analog outputs are written into the variables "AnalogOutput _x". For Output values, See “Analog Voltage/Current Values” on page 91.

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

PACIO-411-00 - 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

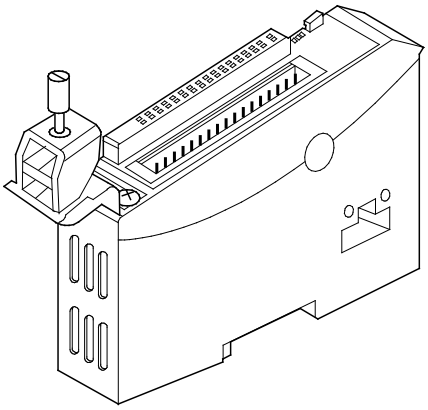
The PACIO Power Distribution 2 x 16 Module has two separate potential lines. The Module distributes the potential (optional 0 VDC or 24 VDC) attached at the pins L1 or L2 on the pins 0 to 15 of the same row.

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

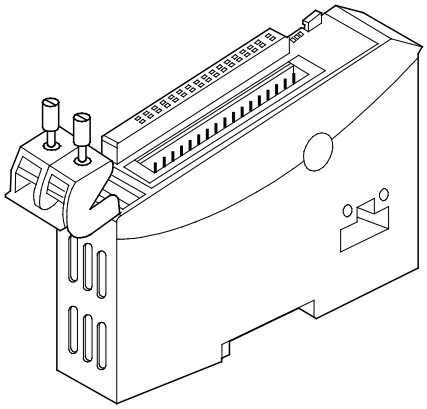
STATUS LEDS

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

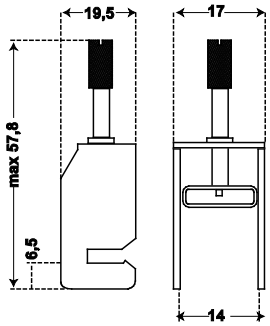
PACIO-412-01 & PACIO-412-02 Shield Connection Terminal Blocks



PACIO Shield 14 mm



PACIO Shield 2x8mm



14mm Clamp

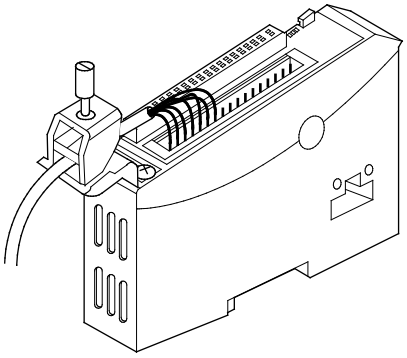
The **PACIO Shield Connection Terminal Block** consists of the shield clamp, the clamp holder, two screws M3x5, two washers, and two spring washers.

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

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

Installation

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



Shield Terminal Block Example

Function

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

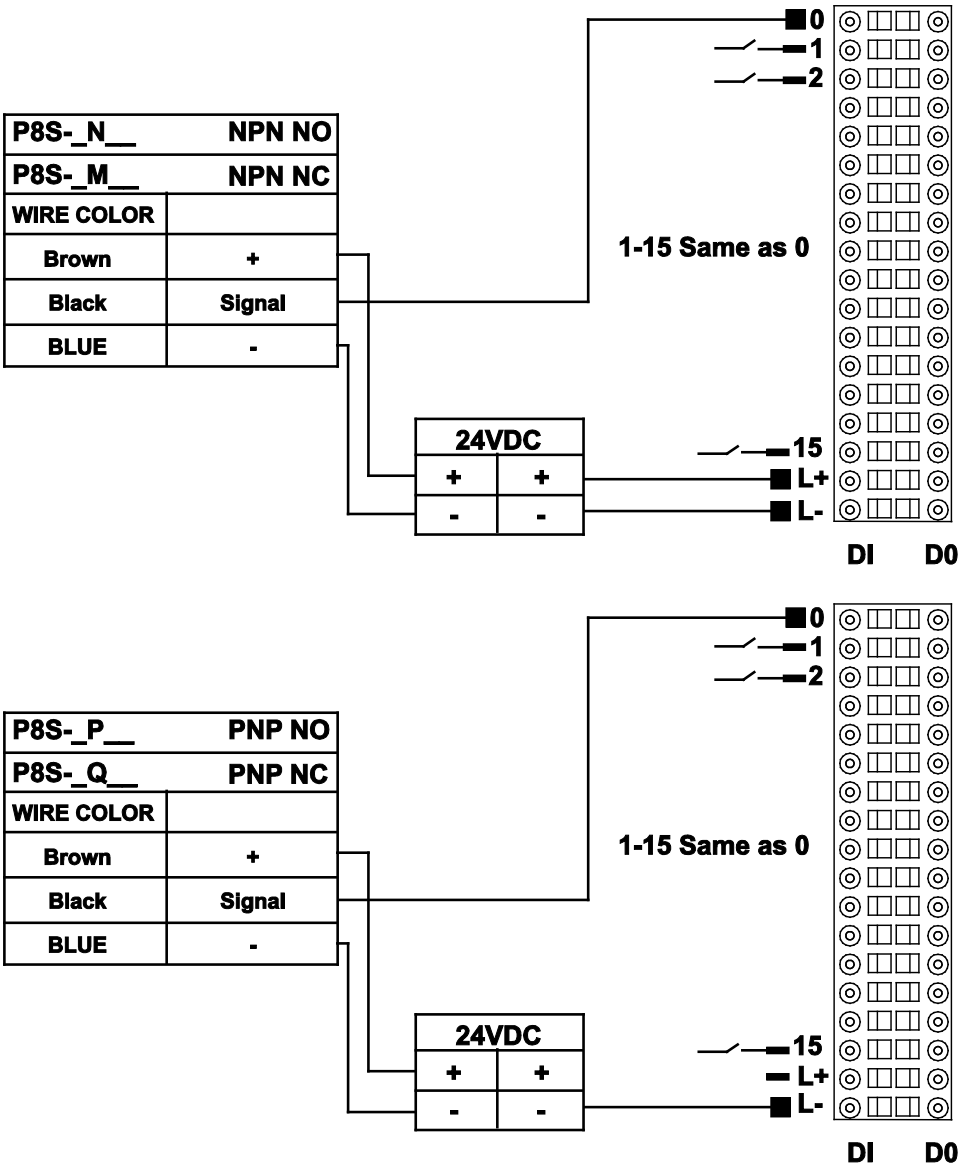
CAUTION: Ensure that the mounting rail has a suitable earth connection. For more information, see the chapter “Installation Guidelines.”

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

PACIO Connections to Parker Sensors

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

PAC with P8S sensors

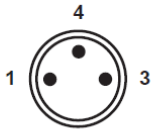


The above connections apply to both the P8S and P8S Mini-Global Sensors, shown on the next two pages.

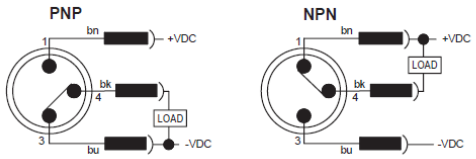
P8S Global Drop-In Solid State Sensors

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

Flying lead or 8 mm connector (shown)



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

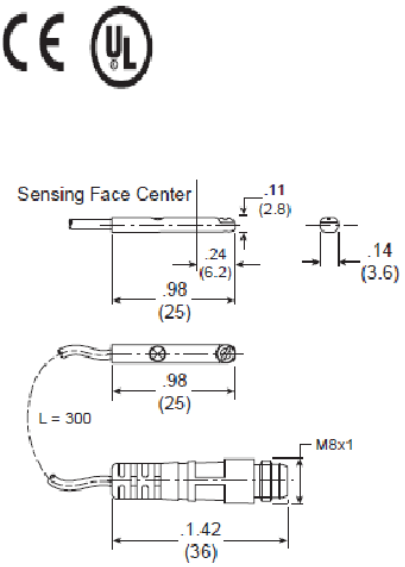


-XX	PART#	NPN/PNP	N.O. / N.C.	CABLE
003-3743-01	P8S-GNSHX	NPN	N.O.	0.2M with M8
	P8S-GNCHX	NPN	N.O.	0.2M with M8
003-3743-02	P8S-GPSHX	PNP	N.O.	0.2M with M8
	P8S-GPCHX	PNP	N.O.	0.2M with M8
003-3743-03	P8S-GMSHX	NPN	N.C.	0.2M with M8
	P8S-GMCHX	NPN	N.C.	0.2M with M8
003-3743-04	P8S-GQSHX	PNP	N.C.	0.2M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

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

P8S Mini-Global Drop-In Solid State Sensors

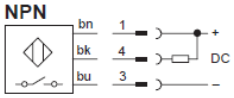
OPERATING VOLTAGE..... 10-30VDC
CONTINUOUS CURRENT..... <70mA
RESPONSE SENSITIVITY..... <48 GAUSS
SWITCHING FREQUENCY..... 1000HZ
POWER CONSUMPTION.....<8mA WITHOUT LOAD
VOLTAGE DROP .....<2.5 VDC
RIPPLE.....10% OPERATING VOLTAGE
HYSTERESIS.....<15 GAUSS
REPEATABILITLITY.....+/- 0.1MM
EMC.....EN 60 947-5-2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



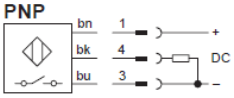
Wiring connection

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

NPN



PNP



-XX	PART#	NPN/PNP	N.O. / N.C.	CABLE
003-4475-01	P8S-MQFLX	PNP	N.C.	3.0M FLY LEADS
	P8S-MQFLY	PNP	N.C.	3.0M FLY LEADS
003-4475-02	P8S-MQSHX	PNP	N.C.	0.3M with M8
	P8S-MQCHY	PNP	N.C.	0.3M with M8
003-4475-03	P8S-MMFLX	NPN	N.C.	3.0M FLY LEADS
	P8S-MMFLY	NPN	N.C.	3.0M FLY LEADS
003-4475-04	P8S-MMSHX	NPN	N.C.	0.3M with M8
	P8S-MMCHY	NPN	N.C.	0.3M with M8
003-4475-05	P8S-MPFLX	PNP	N.O.	3.0M FLY LEADS
	P8S-MPFLY	PNP	N.O.	3.0M FLY LEADS
003-4475-06	P8S-MPSHX	PNP	N.O.	0.3M with M8

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

PAC with 400XR series

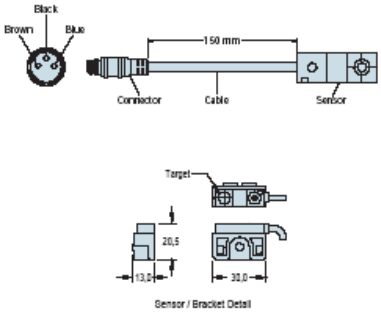
Home H_ or Limit Sensor L_

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

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

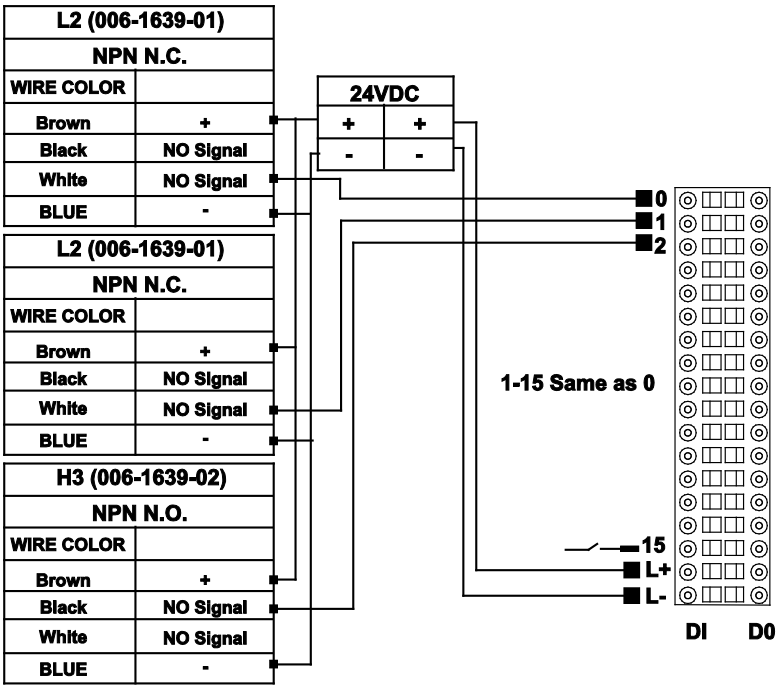
Input Power	5-30VDC, 20mA
Output	100mA max
Wire Color Code	(+) Supply: Brown (-) Supply: Blue NO Output: Black NC Output: White

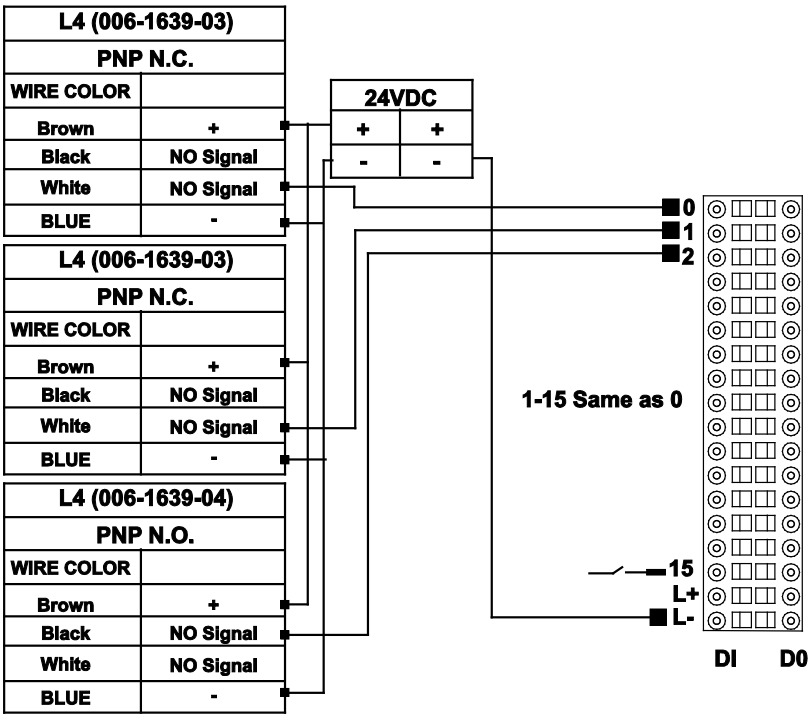
Order Code	Part No.** (Includes Mounting Bracket)	Switch Type	Logic	Cable Length	Connector Option
H2 or L2	006-1639-01	N.C.	Sinking	2,0 m	Flying Leads
H3 or L3	006-1639-02	N.O.	Sinking	2,0 m	Flying Leads
H4 or L4	006-1639-03	N.C.	Sourcing	2,0 m	Flying Leads
H5 or L5	006-1639-04	N.O.	Sourcing	2,0 m	Flying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



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

**Sensor triggers (targets) ordered separately.




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

PAC with 400LXR

Limit and Home Sensor Specifications

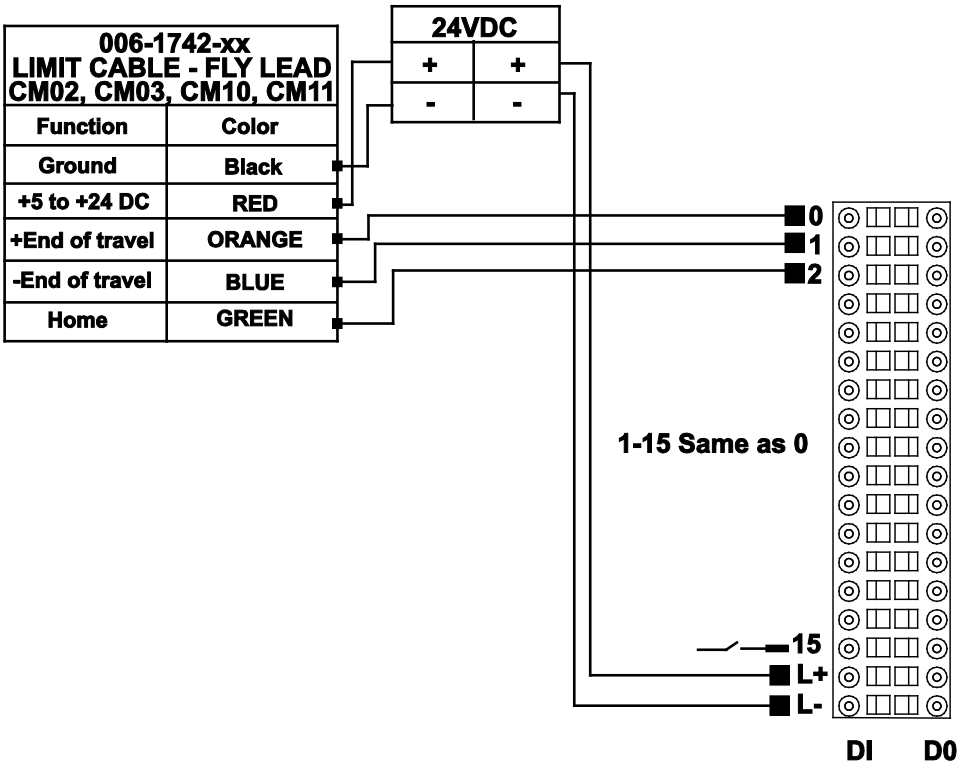
Description	Specification
Input Power	+5 to +24 VDC 60 mA (20 mA per sensor)
Output	Output form is selectable with product: Normally Closed Current Sinking Normally Open Current Sinking Normally Closed Current Sourcing Normally Open Current Sourcing All types Sink or Source maximum of 50 mA
Repeatability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

Home Sensor

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

Limit Sensor

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

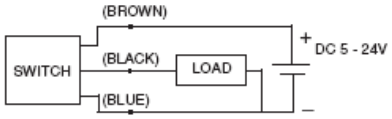


PAC with SMH sensors

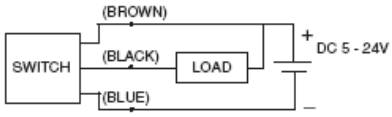
Hall Effect Sensors

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.

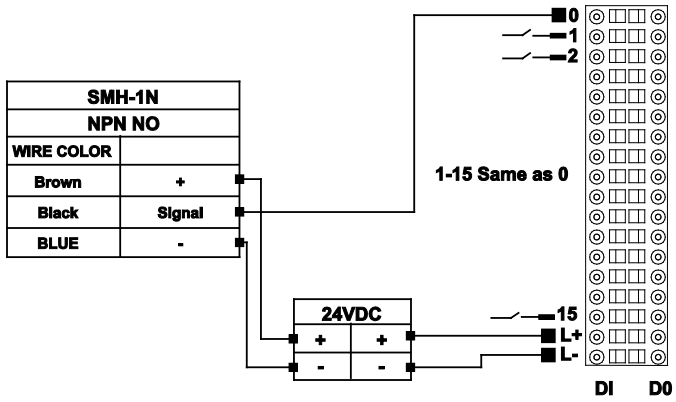
ZETA6104 controls use NPN sensors for Home and End-of-Travel.

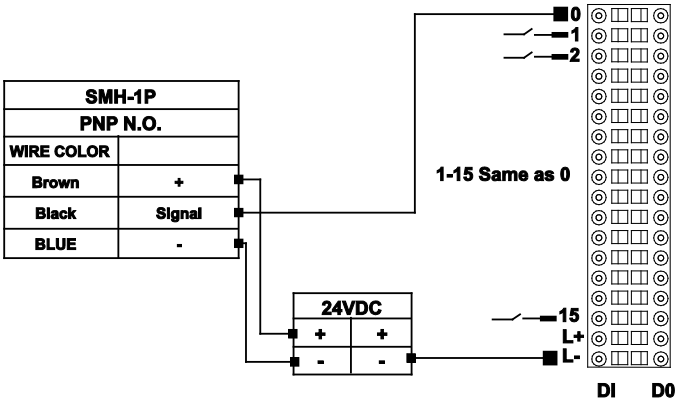
Specifications

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/sec²

Basic Connection Diagram (PNP and NPN)

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





PACIO Technical Data

PACIO Module System Properties

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