

# TM5SE4IOL IO-Link Module

## User Guide

EIO0000004071.03  
12/2021

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As part of a group of responsible, inclusive companies, we are updating our communications that contain non-inclusive terminology. Until we complete this process, however, our content may still contain standardized industry terms that may be deemed inappropriate by our customers.

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# Safety Information

## Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

**DANGER** indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

### **WARNING**

**WARNING** indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

### **CAUTION**

**CAUTION** indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

### **NOTICE**

**NOTICE** is used to address practices not related to physical injury.

## Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

# About the Book

## Document Scope

This manual describes installation, commissioning, and operation of the IO-Link master module TM5SE4IOL.

## Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V2.0.2.

The characteristics that are described in the present document, as well as those described in the documents included in the Related Documents section below, can be found online. To access the information online, go to the Schneider Electric home page [www.se.com/ww/en/download/](http://www.se.com/ww/en/download/).

The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

For product compliance and environmental information (RoHS, REACH, PEP, EOL, etc.), go to [www.se.com/ww/en/work/support/green-premium/](http://www.se.com/ww/en/work/support/green-premium/).

## Related Documents

Title of Documentation	Reference Number
TM5SE4IOL Instruction Sheet	GDE41395
PacDrive TM5 / TM7 Flexible System, Planning and Installation Guide	EIO0000001058 (eng) EIO0000001060 (ger)
IoLinkHandling Library Guide	EIO0000004573 (eng) EIO0000004574 (fra) EIO0000004575 (ger) EIO0000004576 (ita) EIO0000004577 (spa) EIO0000004578 (chs)
Modicon TM5 Sercos III Interface - Hardware Guide	EIO0000003221 (eng) EIO0000003222 (fre) EIO0000003223 (ger) EIO0000003224 (spa) EIO0000003719 (its) EIO0000003226 (chs)
Modicon TM5 EtherNet/IP Fieldbus Interface - Hardware Guide	EIO0000003715 (eng) EIO0000003716 (fre) EIO0000003717 (ger) EIO0000003718 (spa) EIO0000003719 (its) EIO0000003720 (chs)

## Product Related Information

### **⚠️ DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

**Failure to follow these instructions will result in death or serious injury.**

### **⚠️ DANGER**

#### **POTENTIAL FOR EXPLOSION**

- Only use this equipment in non-hazardous locations, or in locations that comply with Class I, Division 2, Groups A, B, C and D.
- Do not substitute components which would impair compliance to Class I, Division 2.
- Do not connect or disconnect equipment unless power has been removed or the location is known to be non-hazardous.
- Do not use the USB port(s), if so equipped, unless the location is known to be non-hazardous.

**Failure to follow these instructions will result in death or serious injury.**

### **⚠️ WARNING**

#### **LOSS OF CONTROL**

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.<sup>1</sup>
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

<sup>1</sup> For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

## ⚠ WARNING

### UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2015	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2015	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2016	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive



In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive (2006/42/EC)* and *ISO 12100:2010*.

**NOTE:** The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

# Introduction

## General Information

### Introduction

The module is an IO-Link master that can be used to connect sensors and actuators (IO-Link devices) to the TM5 system in accordance with the IO-Link standard.

The TM5SE4IOL module requires the following bus couplers:

- Operation with PacDrive controllers: TM5NS31 bus coupler via Sercos
- Operation with M262 Logic/Motion controllers: TM5NS31 bus coupler via Sercos and/or TM5NEIP1 bus coupler via Ethernet/IP

Feature overview TM5SE4IOL:

- Four IO-Link devices.
- Four digital channels, which can be configured as input or output.
- 24 Vdc and 0 V for sensor/actuator supply.

The four channels provided by the TM5SE4IOL module can be used as IO-Link channels or, in Standard Input Output (SIO) mode, as standard digital inputs or outputs, depending on the capabilities and configuration of the connected IO-Link devices.

The suitability of an IO-Link device for a given application depends, among other things, on the fieldbus cycle time, the bus task time, the bitrate of the IO-Link device, etc.

The IO-Link master module TM5SE4IOL must be operated with a bus base and a terminal block. Refer to *Ordering Information*, page 19 for details.

## Third-Party Sensors and Actuators

Third-party sensors and actuators can be connected to the IO-Link master module TM5SE4IOL. You must fully read and understand the documentation of the third-party sensors and actuators to be familiar with the I/O mapping of the sensors and actuators connected to the IO-Link master module TM5SE4IOL. The code you create to control third-party sensors and actuators via the IO-Link module is not verified by EcoStruxure Machine Expert.

### **⚠ WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

- Thoroughly read and understand the documentation of the third-party sensors and actuators.
- Understand the I/O mapping of the sensors and actuators connected to the IO-Link master module TM5SE4IOL.
- Individually and thoroughly test each implementation of the IO-Link master module TM5SE4IOL for proper operation before placing into service.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Characteristics Digital Inputs

Commercial reference	Number of channels	Voltage/current per channel	Wiring	Source/sink
TM5SE4IOL	Up to 4	24 Vdc / 4 mA	3 wires	Sink

## Characteristics Digital Outputs

Commercial reference	Number of channels	Voltage/current per channel	Wiring	Source/sink
TM5SE4IOL	Up to 4	24 Vdc / 0.25 A	3 wires	Source

## Sensor/Actuator Supply

Characteristic	Value and description
Voltage	24 Vdc power segment supply minus voltage drop for internal protection
Voltage drop for internal protection at 500 mA	0.3 Vdc maximum
Current	2 A
Internal protection	Overcurrent and short circuit
Overcurrent protection	<ul style="list-style-type: none"><li>Delay for removing power to the sensors/actuators if an overcurrent is detected in the module: 10 ms</li><li>Duration of removing power to the sensors/actuators if an overcurrent is detected in the module: 20 ms</li></ul>

# Installation

## Mechanical Installation

## Installation and Maintenance Requirements

### Before Starting

Read and understand this chapter before beginning the installation of your TM5 System.

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, and maintenance of the machine or process, and can therefore determine the automation and associated equipment and the related safeties and interlocks which can be effectively and properly used. When selecting automation and control equipment, and any other related equipment or software, for a particular application, you must also consider any applicable local, regional or national standards and/or regulations.

Pay particular attention in conforming to any safety information, different electrical requirements, and normative standards that would apply to your machine or process in the use of this equipment.

### **NOTICE**

#### **ELECTROSTATIC DISCHARGE**

- Store all components in their protective packaging until immediately before assembly.
- Never touch exposed conductive parts such as contacts or terminals.

**Failure to follow these instructions can result in equipment damage.**

### Disconnecting Power

All options and modules should be assembled and installed before installing the control system on a mounting rail, onto a mounting plate or in a panel. Remove the control system from its mounting rail, mounting plate or panel before disassembling the equipment.

### **DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

**Failure to follow these instructions will result in death or serious injury.**

## Programming Considerations

### ⚠ WARNING

#### UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Operating Environment

For important hazardous location information, refer to the individual product descriptions contained in their hardware guides.

### ⚠ DANGER

#### POTENTIAL FOR EXPLOSION

- Only use this equipment in non-hazardous locations, or in locations that comply with Class I, Division 2, Groups A, B, C and D.
- Do not substitute components which would impair compliance to Class I, Division 2.
- Do not connect or disconnect equipment unless power has been removed or the location is known to be non-hazardous.
- Do not use the USB port(s), if so equipped, unless the location is known to be non-hazardous.

**Failure to follow these instructions will result in death or serious injury.**

### ⚠ WARNING

#### UNINTENDED EQUIPMENT OPERATION

Install and operate this equipment according to the conditions described in the Environmental Characteristics.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

**NOTE:** Individual I/O modules may differ in terms of operating temperature deratings or other important environmental characteristics. For the specific information, refer to the hardware guide for your particular module.

## Installation Considerations

### ⚠ WARNING

#### UNINTENDED EQUIPMENT OPERATION

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure appropriately rated for its intended environment and secured by a keyed or tooled locking mechanism.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety-critical machine functions unless the equipment is otherwise designated as functional safety equipment and conforming to applicable regulations and standards.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as No Connection (N.C.).

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

**NOTE:** JDYX2 or JDYX8 fuse types are UL-recognized and CSA approved.

## TM5 Environmental Characteristics

### Enclosure Requirements

TM5 components are designed as Zone B, Class A industrial equipment according to IEC/CISPR Publication 11. If they are used in environments other than those described in the standard, or in environments that do not meet the specifications in this manual, your ability to meet electromagnetic compatibility requirements in the presence of conducted and/or radiated interference may be reduced.

The TM5 components meet European Community (CE) requirements for open equipment as defined by EN61131-2. You must install them in an enclosure designed for the specific environmental conditions and to minimize the possibility of unintended contact with hazardous voltages. The enclosure should be constructed of metal to improve the electromagnetic immunity of your TM5 System. The enclosure should, and in the case of UL compliance, must, have a keyed locking mechanism to minimize unauthorized access.

### Environmental Characteristics

This equipment meets UL and CSA standards and, for the majority of the modules, carry both certification marks. In addition, all modules are certified as CE compliant. This equipment is intended for use in a Pollution Degree 2 industrial environment.

**NOTE:** Some module characteristics may differ from those presented in the following tables. Refer to the chapter concerning your specific module for more information.

The table below provides the general environmental characteristics:

Characteristic		Minimum Specification	Tested Range	
Standard		IEC61131-2	–	
Agency Standards		UL 508  CSA 22.2 No. 142-M1987  CSA 22.2 No. 213-M1987	–	
Ambient operating temperature		–	Horizontal installation	-25...60 °C (-13...140 °F)
		–	Vertical installation	-25...50 °C (-13...122 °F)
Storage temperature		–	-40...85 °C (-40...185 °F)	
Relative humidity		–	5...95% (non-condensing)	
Degree of pollution		IEC60664	2	
Degree of protection		IEC60529	IP20	
Corrosion immunity		None	–	
Operating altitude		–	0...2000 m (0...6.560 ft.)  > 2000 m (> 6.560 ft.): Derating by 0.5 °C (0.9 °F) per 100 m (328 ft.)	
Storage altitude		–	0...3000 m (0...9.842 ft.)	
Vibration resistance		–	Mounted on a DIN rail	3.5 mm (0.138 in.) fixed amplitude from 5...8.4 Hz  9.8 m/s² (1 g <sub>n</sub> ) fixed acceleration from 8.4...150 Hz
Mechanical shock resistance		–	147 m/s² (15 g <sub>n</sub> ) for a duration of 11 ms	
Connection type	Removable spring terminal block	–	–	
Connector insertion/removal cycles		–	50	
<b>NOTE:</b> The tested ranges may indicate values beyond that of the IEC Standard. However, our internal standards define what is necessary for industrial environments. In all cases, we uphold the minimum specification if indicated.				

## Electromagnetic Susceptibility

The following table provides the TM5 System electromagnetic susceptibility specifications:

Characteristic		Minimum Specification	Tested Range
Electrostatic discharge		IEC/EN 61000-4-2	8 kV (air discharge), criteria B 4 kV (contact discharge), criteria B
Electromagnetic fields		IEC/EN 61000-4-3	10 V/m (80 MHz...1 GHz), criteria A 3 V/m (1.4 GHz...2 GHz), criteria A 1 V/m (2 GHz...2.7 GHz), criteria A
Fast transients burst		IEC/EN 61000-4-4	Power lines: 2 kV, criteria B I/O: 1 kV, criteria B Shielded cable: 1 kV, criteria B Repetition rate: 5 and 100 KHz
Surge immunity 24 Vdc circuit		IEC/EN 61000-4-5	1 kV in common mode, criteria B 0.5 kV in differential mode, criteria B
Surge immunity 230 Vac circuit		IEC/EN 61000-4-5	2 kV in common mode, criteria B 1 kV in differential mode, criteria B

Characteristic	Minimum Specification	Tested Range
Induced electromagnetic field	IEC/EN 61000-4-6	10 V <sub>eff</sub> (0.15...80 MHz), criteria A
Conducted emission	EN 55011 (IEC/CISPR11)	150...500 kHz, quasi peak 79 dB (μV) 500 kHz...30 MHz, quasi peak 73 dB (μV)
Radiated emission	EN 55011 (IEC/CISPR11)	30...230 MHz, 10 m@40 dB (μV/m) 230 MHz...1 GHz, 10 m@47 dB (μV/m)
<b>Criteria A</b> Uninterrupted operation during test. <b>Criteria B</b> Brief interruption during the test allowed. <b>NOTE:</b> The tested ranges may indicate values beyond that of the IEC Standard. However, our internal standards define what is necessary for industrial environments. In all cases, we uphold the minimum specification if indicated.		

## Installation Guidelines

### Installation

The following table provides documentation references for spacing requirements and installation of electronic modules and accessories:

<b>Spacing requirement</b>	For mounting positions and minimum clearances, the electronic modules are mounted according to the rules defined for the controllers. Refer to the <i>Enclosing the TM5 System</i> (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide).
<b>Electronic modules installation</b>	Refer to: <ul style="list-style-type: none"> <li>• <i>TM5 Association Table</i> (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide).</li> <li>• <i>Expanding the TM5 System</i> (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide).</li> </ul>
<b>Accessories installation</b>	Refer to the <i>Installation of Accessories</i> (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

## Physical Description

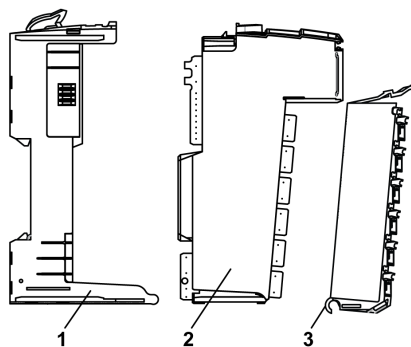
### Introduction

Each slice consists of three elements. These elements are the bus base, the electronic module and the terminal block.



## Elements

The following illustration shows the elements of a slice.



**1** Bus base

**2** Electronic module

**3** Terminal block

When assembled the three components form an integral unit that resists vibration and electrostatic discharge.

### NOTICE

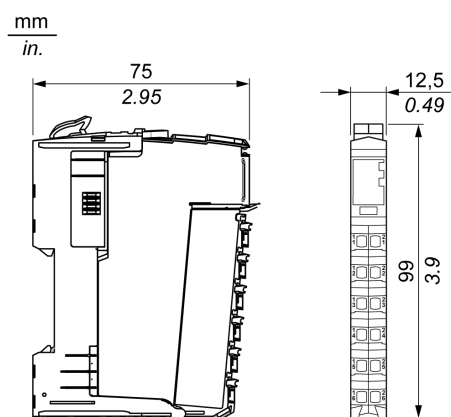
#### ELECTROSTATIC DISCHARGE

- Never touch the contacts of the electronic module.
- Always keep the connector in place during normal operation.

**Failure to follow these instructions can result in equipment damage.**

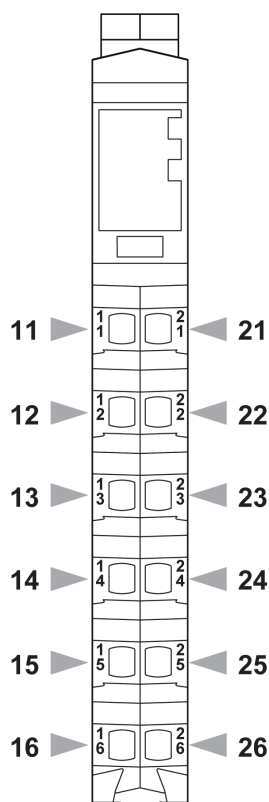
## Dimensions

The following illustration shows the dimensions of a slice:



## Pin Assignment

The following illustration shows the pin assignments for the 12-pin terminal block:



## Accessories

Refer to the *Installation of Accessories* (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

## Labeling

Refer to the *Labeling the TM5 System* (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

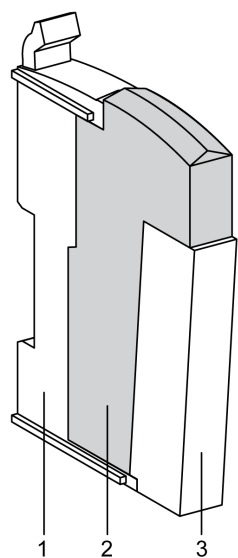
## TM5SE4IOL Presentation

### Main Characteristics

Characteristic	Value/description
Power consumption of the module	<ul style="list-style-type: none"> <li>TM5 bus: 0.01 W</li> <li>24 Vdc I/O segment: 0.71 W</li> </ul>
Number of input channels	<ul style="list-style-type: none"> <li>Up to four IO-Link devices</li> <li>Up to four digital channels (configurable as input or output)</li> </ul>
IO-Link	IO-Link master
Input type	Refer to Characteristics, page 20.
Input signal type	Sink
Output type	Refer to Characteristics, page 20.

Output signal type	Source
Output current	0.25 A per channel
Rated input voltage	24 Vdc

## Ordering Information



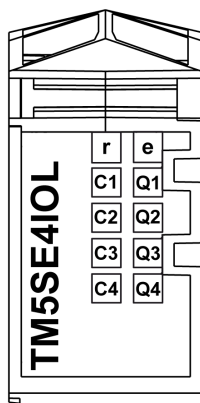
The following table lists the commercial references of the terminal blocks and the bus bases to be used with the IO-Link module TM5SE4IOL:

Number	Commercial reference	Description	Color
1	TM5ACBM11	Bus base	White
2	TM5SE4IOL	Electronic module	White
3	TM5ACTB12	Terminal block, 12 pins	White

**NOTE:** For more information, refer to *TM5 bus bases and terminal blocks* (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

## Status LEDs

Status LEDs of the IO-Link module TM5SE4IOL:



The following table explains the status LEDs of the IO-Link module TM5SE4IOL:

LED	Color	Status	Description
r	Green	Off	No power supply

LED	Color	Status	Description
		Single flash	Reset state
		Flashing	Preoperational state
		Double flash	Boot state (during firmware update) <sup>1</sup>
		On	Regular operation
e	Red	Off	OK or no power supply
		On	Error detected or reset state
		Double flash	Internal error detected
C1 - C4	Red	On	Overcurrent/short circuit on the supply or on the C/Q line of the channel
	Green/Red	Off	Interface in SIO (Standard Input Output)
		Single flash	Channel in Operate mode, no IO-Link communication
		Double flash	Channel in Operate mode, inspection level, page 32 error detected.
	Green	On	Channel in Operate mode, IO-Link communication active
Q1 - Q4	Orange	-	Input/output state of corresponding IO-Link interface
<sup>(1)</sup> Depending on the configuration, a firmware update can take up to several minutes.			

## TM5SE4IOL Characteristics

### Introduction

This is the description of the TM5SE4IOL electronic module characteristics. Also refer to *Environmental Characteristics*, page 14.

#### **⚠ DANGER**

##### **FIRE HAZARD**

Use only the correct wire sizes for the maximum current capacity of the I/O channels and power supplies.

**Failure to follow these instructions will result in death or serious injury.**

#### **⚠ WARNING**

##### **UNINTENDED EQUIPMENT OPERATION**

Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

### General Characteristics

General Characteristics	
Rated power supply voltage	24 Vdc
Power supply source	Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc

General Characteristics	
24 Vdc I/O segment current draw	29.6 mA
TM5 Bus 5 Vdc current draw	2 mA
Weight	25 g (0.9 oz)
ID code for firmware update	CAC0 hex = 51904 dec

## Characteristics in IO-Link Master Mode

Characteristics in IO-Link Master Mode	
Transfer rates	<ul style="list-style-type: none"> <li>COM1: 4.8 kbaud</li> <li>COM2: 38.4 kbaud</li> <li>COM3: 230.4 kbaud</li> </ul>
Limit values for COM3	<ul style="list-style-type: none"> <li>Maximum connection capacity 22 nF (cable + IO-Link device)</li> <li>Maximum load 96 <math>\Omega</math> / 250 mA</li> </ul>
Data format	1 start bit, 8 data bits, 1 parity bit (even), 1 stop bit
Bus level	24 Vdc (active), 0 Vdc (resting voltage)

## Characteristics in IO-Link Master Mode or in Digital Output Mode

Characteristics in IO-Link Master Mode or in Digital Output Mode	
IO-Link channels	Up to four outputs
Wiring type	3 wires
Variant	Bipolar, positive, and negative switching
Short-circuit output peak current	< 1.3 A
Residual voltage	< 0.7 Vdc at rated current 0.25 A
Switching voltage	I/O power supply minus voltage drop for short circuit protection and semiconductor switch
Voltage drop	< 0.5 V at 0.25 A rated current
Switching frequency	25 kHz (300 kHz in IO-Link master mode)
Turn on time	< 10 $\mu$ s
Turn off time	< 10 $\mu$ s
Automatic rearming after short-circuit or overload	Configurable with software
Isolation between IO-Link and bus	500 Vac RMS <sup>1</sup>

<sup>1</sup> The isolation of the electronic module is 500 Vac RMS between the electronics powered by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the TM5 electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

## Characteristics in IO-Link Digital Output Mode

Characteristics in IO-Link Digital Output Mode	
Output channels	Up to four outputs
Wiring type	3 wires
Maximum continuous output current	0.25 A per output
Maximum over-current threshold	0.5 A per output
Total output current	1 A maximum
Output voltage	24 Vdc
Output voltage range	20.4...28.8 Vdc
Output circuit	Source
Switching frequency (resistive load)	500 Hz maximum
Output protection <sup>1</sup>	<ul style="list-style-type: none"> <li>Thermal cutoff for over-current and short-circuit</li> <li>Integrated protection for switching inductances</li> </ul>
1 = Interrupting current during overload: Between 0.3 A and 0.8 A.	

## Characteristics in IO-Link Digital Input Mode

Characteristics in IO-Link Digital Input Mode		
Number of input channels		Up to four inputs
Wiring type		3 wires
Rated input voltage		24 Vdc
Input voltage range		20.4...28.8 Vdc
Rated input current at 24 Vdc		4 mA
Input impedance		6 kΩ
OFF state		< 5 Vdc
ON state		> 15 Vdc
Input circuit		Sink
Input filter	Hardware	300 ns
	Software	-
Isolation	Between IO-Link and bus	See note <sup>1</sup> .
	Between IO-Links	Not isolated

<sup>1</sup> The isolation of the electronic module is 500 Vac RMS between the electronics powered by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the TM5 electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

# Electrical Installation

## Wiring Best Practices

### Introduction

There are several rules that must be followed when wiring the TM5 System.

### Wiring Rules

The following rules must be applied when wiring the TM5 System:

- I/O and communication wiring must be kept separate from the power wiring. Route these 2 types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors only.
- Use twisted pair, shielded cables for analog, expert, or fast I/O and TM5 bus signals.
- Use twisted pair, shielded cables for encoder, networks and Sercos bus.

#### **⚠ DANGER**

##### **HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

**Failure to follow these instructions will result in death or serious injury.**

Use shielded, properly grounded cables for all analog and high-speed inputs or outputs and communication connections. If you do not use shielded cable for these connections, electromagnetic interference can cause signal degradation. Degraded signals can cause the controller or attached modules and equipment to perform in an unintended manner.

#### **WARNING**

##### **UNINTENDED EQUIPMENT OPERATION**

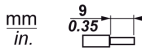




- Use shielded cables for all fast I/O, analog I/O and communication signals.
- Ground cable shields for all analog I/O, fast I/O and communication signals at a single point<sup>1</sup>.
- Route communication and I/O cables separately from power cables.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

<sup>1</sup>Multipoint grounding is permissible (and in some cases inevitable) if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

To ground the shielded cables, refer to the section Grounding the TM5 System (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

This table provides the wire sizes to use with the removable terminal block TM5ACTB12:

				
mm <sup>2</sup>	0,08...2,5	0,25...2,5	0,25...1,5	2 x 0,25...2 x 0,75
AWG	28...14	24...14	24...16	2 x 24...2 x 18

## ⚠ DANGER

### FIRE HAZARD

Use only the correct wire sizes for the maximum current capacity of the I/O channels and power supplies.

**Failure to follow these instructions will result in death or serious injury.**

The spring clamp connectors of the terminal block are designed for only one wire or one cable end. Two wires to the same connector must be installed with a double wire cable end to help prevent loosening.

## ⚡⚠ DANGER

### LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not insert more than one wire per connector of the spring terminal blocks unless using a double wire cable end (ferrule).

**Failure to follow these instructions will result in death or serious injury.**

## TM5 Terminal Block

Inserting an incorrect terminal block into the electronic module can cause unintended operation of the application and/or damage the electronic module.

## ⚡⚠ DANGER

### ELECTRIC SHOCK OR UNINTENDED EQUIPMENT OPERATION

Connect the terminal blocks to their designated location.

**Failure to follow these instructions will result in death or serious injury.**

**NOTE:** To help prevent a terminal block from being inserted incorrectly, ensure that each terminal block and electronic module is clearly and uniquely coded (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide).

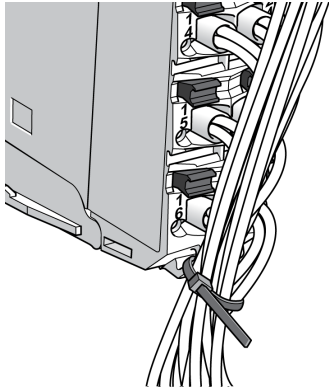
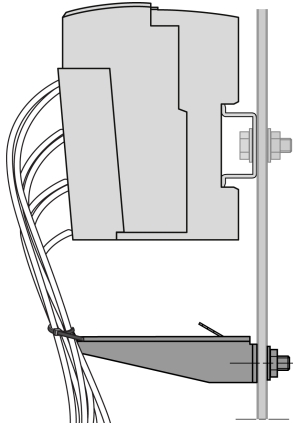
## TM5 Strain Relief Using Cable Tie

There are 2 methods to reduce the stress on cables:

- The terminal blocks (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide) have slots to attach cable ties. A cable tie can be fed through this slot to secure cables and wires to reduce stress between them and the terminal block connections.
- After grounding the TM5 System by means of the grounding plate TM2XMTGB, wires can be bundled and affixed to the grounding plate tabs using wire ties to reduce stress on the cables.



The following table provides the size of the cable tie and presents the two methods to reduce the stress on the cables:

Cable Tie Size	Terminal Block	TM2XMTGB Grounding Plate
Thickness	1.2 mm (0.05 in.) maximum	1.2 mm (0.05 in.)
Width	4 mm (0.16 in.) maximum	2.5...3 mm (0.1...0.12 in.)
Mounting illustration		

## ⚠ WARNING

### ACCIDENTAL DISCONNECTION FROM PROTECTIVE GROUND (PE)

- Do not use the TM2XMTGB Grounding Plate to provide a protective ground (PE).
- Use the TM2XMTGB Grounding Plate only to provide a functional ground (FE).

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Protecting Outputs from Inductive Load Damage

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

## ⚠ WARNING

### INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Choose a protection circuit from the following diagrams according to the power supply used. Connect the protection circuit to the outside of the controller or relay output module.

If your controller or module contains relay outputs, these types of outputs can support up to 240 Vac. Inductive damage to these types of outputs can result in welded contacts and loss of control. Each inductive load must include a protection device such as a peak limiter, RC circuit or flyback diode. Capacitive loads are not supported by these relays.

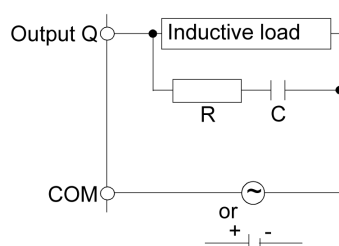
## ⚠ WARNING

### RELAY OUTPUTS WELDED CLOSED

- Always protect relay outputs from inductive alternating current load damage using an appropriate external protective circuit or device.
- Do not connect relay outputs to capacitive loads.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

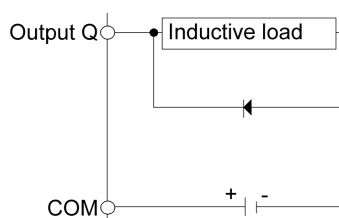
**Protective circuit A:** this protection circuit can be used for both AC and DC load power circuits.



**C** Value from 0.1 to 1  $\mu\text{F}$

**R** Resistor of approximately the same resistance value as the load

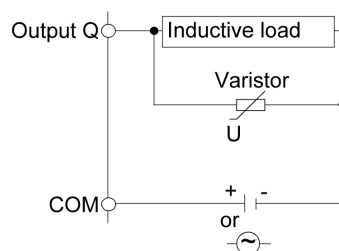
**Protective circuit B:** this protection circuit can be used for DC load power circuits.



Use a diode with the following ratings:

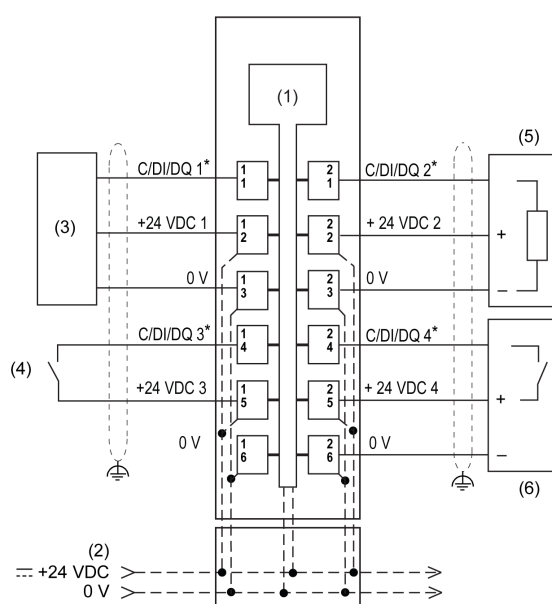
- Reverse withstand voltage: power voltage of the load circuit x10.
- Forward current: more than the load current.

**Protective circuit C:** this protection circuit can be used for both AC and DC load power circuits.



In applications where the inductive load is switched on and off frequently and/or rapidly, ensure that the continuous energy rating (J) of the varistor exceeds the peak load energy by 20 % or more.

Wiring diagram IO-Link module TM5SE4IOL:



- \* C/DI/DQ: Configurable as communication, input, or output 24 Vdc

## UNINTENDED EQUIPMENT OPERATION

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## UNINTENDED EQUIPMENT OPERATION

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

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# Software

## TM5SE4IOL Software Requirements

### Introduction

To use the IO-Link master module TM5SE4IOL, the following requirements must be met:

- The programming software EcoStruxure Machine Expert V2.0.2 or greater must be installed on your system.
- The TM5 Sercos bus Interface TM5NS31 (firmware version 1.62.5.4 or greater) and/or the TM5 Ethernet/IP bus interface TM5NEIP1 (firmware version 1.0.1.9 or greater) must be available in EcoStruxure Machine Expert.
- The IO-Link master module TM5SE4IOL (firmware version 1.68.0.19 or greater) must be available in EcoStruxure Machine Expert.

# Commissioning

## Adding the TM5SE4IOL Module and IO-Link Devices to Your Application

### Adding the TM5SE4IOL Module to Your Application

Step	Action
1	Launch the programming software EcoStruxure Machine Expert.
2	Create a new project with <b>File &gt; New Project</b> with a PacDrive LMC Eco/PacDrive LMC Pro/Pro2 or Modicon M262 Logic/Motion controller.
3	In the <b>Devices</b> tree, right-click the corresponding node and select <b>Add Device</b> from the contextual menu.
4	In the <b>Add Device</b> dialog box, select the bus Interface <b>TM5NS31</b> or the bus interface <b>TM5NEIP1</b> and confirm with <b>Add Device</b> .
5	In the <b>Devices</b> tree, right-click the <b>TM5NS31</b> node or the <b>TM5NEIP1</b> node and select <b>Add Device</b> from the contextual menu.
6	In the <b>Add Device</b> dialog box, select <b>TM5 Communication Modules &gt; TM5SE4IOL</b> or <b>TM5 Communication Modules &gt; TM5NEIP1</b> and confirm with <b>Add Device</b> .
7	In the <b>Devices</b> tree, double-click the <b>TM5SE4IOL</b> node to open its module editor where you can edit the module parameters.

After you have added the TM5SE4IOL module, four slots for IO-Link devices are available. Empty slots are identified by the entry <Empty>. Slots to which an IO-Link device have been assigned have the name of the IO-Link device.

### Importing IO-Link Devices Into Your Application

Step	Action
1	Download the IODD (IO-Link Device Description) XML file for your IO-Link device from the IO-Link website at <a href="https://ioddfinder.io-link.com/">https://ioddfinder.io-link.com/</a> .
2	In EcoStruxure Machine Expert, select <b>Tools &gt; Device Repository</b> .
3	In the <b>Device Repository</b> window, click the <b>Install ...</b> button.
4	In the dialog box, navigate to the storage location of the IODD XML file of your IO-Link device, select the XML file and click the <b>Close</b> button.

### Adding an IO-Link Device to Your Application

Step	Action
1	In the <b>Devices</b> tree below the <b>TM5SE4IOL</b> node, right-click the first <Empty> slot and select <b>Plug Device</b> from the contextual menu. <b>NOTE:</b> If you right-click a slot that is not <Empty>, the IO-Link device already assigned to this slot is replaced by the new IO-Link device to be added.
2	In the <b>Plug Device</b> window, select <All Vendors> from the <b>Vendor</b> listbox.
3	Select the IO-Link device you want to add and click the <b>Plug Device</b> button.

**NOTE:** To modify parameter values of an IO-Link device, double-click the corresponding device entry below the TM5SE4IOL node in the Devices tree. Refer to IO-Link Devices - Parameter Configuration, page 33 for details.

## Removing an IO-Link Device From Your Application

Step	Action
1	Right-click the IO-Link device to be removed from your application and select <b>Delete</b> from the contextual menu.

## TM5SE4IOL Modules - Parameter Configuration

### TM5SE4IOL - Tab “TM5 Module I/O Mapping”

#### Introduction

The tab **TM5 Module I/O Mapping** is used for I/O mapping. The tab also provides additional information such as addressing data.

#### Status Bit Mapping

Channel	Data type	Description
<i>ModuleOK</i>		
<i>DiagIn</i>	BYTE	State of the module
<i>DcOk</i>	BOOL	Voltage range: <ul style="list-style-type: none"> <li>0: Invalid</li> <li>1: Valid</li> </ul>
<i>Reserved</i>	BOOL	Reserved
<i>NetworkOk</i>	BOOL	TM5 bus: <ul style="list-style-type: none"> <li>0: Bus error detected</li> <li>1: OK</li> </ul>
<i>I/O data valid</i>	BOOL	Data validity: <ul style="list-style-type: none"> <li>0: Valid</li> <li>1: Invalid</li> </ul>
<i>Reserved</i>	BOOL	Reserved
<i>Reserved</i>	BOOL	Reserved
<i>Reserved</i>	BOOL	Reserved
<i>Reserved</i>	BOOL	Reserved

#### ChannelStatus01...04

The following table explains the states of the IO-Link channels available via *ChannelStatus01...04*. The data type of *ChannelStatus01...04* is USINT:

Value	Description	Additional information
0	Channel INACTIVE	Disabled
1	Channel used as digital output.	Channel used as Standard Input or Output (SIO)
2	Channel used as digital input.	
3	Startup of IO-Link device, operating stage PREOPERATIONAL.	Communication is running, but no process data is exchanged. However, acyclic access is possible.
4	IO-Link device in operating stage OPERATIONAL.	Communication is running.

Value	Description	Additional information
5	IO-Link device parameter server data is OK.	
6	Parameter server: Upload ongoing.	Communication is running, process data is being returned, and the data storage feature is used.
7	Parameter server: Download ongoing.	
8...20	Reserved	–
21	Error detected in the parameter server, page 32, for example: <ul style="list-style-type: none"> <li>Parameter server not supported.</li> <li>Error detected: Access to an object that is managed by the parameter server.</li> <li>Internal error detected.</li> </ul>	Communication is running. However, an error has been detected in the parameter server.  Acknowledge parameter server errors via the <i>DsControl</i> parameter.
22	Parameter server is locked.	-
23	Parameter server is empty.	Attempt to load data to the IO-Link device even though no data is saved in the nonvolatile memory.
24	New serial number detected.	User input required via the parameter <i>DsControl</i> : uploading, downloading, or restoring default parameters.
25...29	Reserved	–
30	Invalid process data	Communication is running. However, invalid process data has been detected by the IO-Link device.
31...39	Reserved	–
40	No connection established.	No communication is running.
41	Reserved	–
42	The <i>DeviceID</i> and <i>VendorID</i> of the connected IO-Link device do not match the defined IDs.	Communication is running, but no process data is exchanged. However, acyclic access is possible.
43...44	Reserved	–
45	An error has been detected during startup of the IO-Link device.	No communication is running.
46...255	Reserved	–

## *DsControl01...04*

The following table explains the values of *DsControl01...04*. The data type of *DsControl01...04* is USINT:

Value	Description
0	Parameter server inactive.
1	Parameter server automatic upload/download.
2	Upload if data storage parameters are available on the device.
3	Download if data storage parameters are available in the memory of the IO-Link master and the device can process them.
4	Parameter server error state acknowledged.
5	Data storage parameters on the memory of the IO-Link master removed.
6	Dummy upload started.
7...255	Reserved

## Input/Output Mapping

Channel	Data type	Description
<i>DigitalInputs</i>	BYTE	Bits 0...3: Physical state of the channel.
<i>DigitalOutputs</i>	BYTE	<ul style="list-style-type: none"> <li>Bits 0...3: Physical state of digital output if channel is configured as SIO output.</li> <li>Bits 4...7: Disable supply of SIO channels 1...4.</li> </ul>

Under Sercos, the outputs of the bus coupler TM5NS31 need to be explicitly activated. Refer to the user guide of the bus coupler TM5NS31 for details on activating the outputs via *ActivateOutputs*.

## TM5SE4IOL - Tab “User Parameter”

### Module Configuration

Name	Value	Data type	Default	Description
<i>DeviceID 01...04</i>	Device ID of IO-Link device	BitArea	0	Unique device ID of the IO-Link device.
<i>VendorID 01...04</i>	Vendor ID of IO-Link device	BitArea	0	Unique vendor ID of the IO-Link device. The value is set automatically.
<i>Operating mode 01...04</i>	<ul style="list-style-type: none"> <li>Inactive</li> <li>Digital output</li> <li>Digital input</li> <li>Operate</li> </ul>	BitArea	Inactive	<p>Operating mode of the channel 01...04.</p> <p>The operating mode of a channel can be modified during runtime via the application program.</p>
<i>Inspection level 01...04</i>	<ul style="list-style-type: none"> <li>No check</li> <li>Type comparison</li> </ul>	BitArea	No check	<p>Type of verification for channel 01...04.</p> <p>The <i>VendorID</i> and the <i>DeviceID</i> are verified.</p>
<i>Parameter server 01...04</i>	<ul style="list-style-type: none"> <li>Off</li> <li>Automatic</li> <li>Automatic (Check serial number)</li> </ul>	BitArea	Off	<ul style="list-style-type: none"> <li>Off: The parameter server is deactivated. The parameters of the IO-Link device are not stored in the memory of the IO-Link master.</li> <li>Automatic: The parameter server is used. The parameters of the IO-Link device are downloaded/updated during startup if conditions are met.</li> <li>Automatic (Check serial number): The parameter server is used. The parameters of the IO-Link device are downloaded/updated during startup if conditions are met. If the serial number of the IO-Link device has changed, user action is required.</li> </ul> <p>Also refer to <i>IO-Link Data Storage - Parameter Server</i>, page 36.</p>

The parameters *DeviceID*, *VendorID*, and *Operating mode* are updated to the corresponding values each time an IO-Link device is added. The parameters are set to their default value each time an IO-Link device is removed.

Under Sercos, the outputs of the bus coupler TM5NS31 need to be explicitly activated. Refer to the user guide of the bus coupler TM5NS31 for details on activating the outputs via *ActivateOutputs*.



## IO-Link Devices - Parameter Configuration

### IO-Link Devices - Tab “IO-Link Device Info”

To access the **IO-Link Device Info** tab, double-click the node for the IO-Link device below the TM5SE4IOL node in the Devices tree and select the tab.

This tab displays detailed information on the IO-Link device such as:

- Vendor name, ID and URL
- Device ID and family
- Product name, ID and text
- Profile characteristics

### IO-Link Devices - Tab “IO-Link Parameter”

To access the **IO-Link Parameter** tab, double-click the node for the IO-Link device below the TM5SE4IOL node in the Devices tree and select the tab.

This tab allows you to read parameters of an IO-Link device. If a parameter is not read-only and if the appropriate user role is selected, you can modify the parameter value and write it to the IO-Link device. This can be done online and offline.

The following table describes the user interface of the tab. Since the functionality of IO-Link devices is vendor-specific, certain user interface elements may not be available for a given device (for example, the **Diagnostics** menu may not be available or certain buttons may work differently). Refer to the documentation of your IO-Link device for details.

User interface element	Description
Listbox <b>User role</b>	<p>This listbox provides the following user roles:</p> <ul style="list-style-type: none"> <li>• Specialist</li> <li>• Maintenance</li> <li>• Observer</li> </ul> <p>The number of parameters displayed in the table depends on the selected user role. The rights assigned to the role depend on the IO-Link device and can be different for each IO-Link device.</p> <p>The user role Observer generally does not permit write access.</p> <p>The user role Maintenance generally permits write access to a limited subset of writable parameters of the IO-Link device. Passwords cannot be changed with this user role.</p> <p>The user role Specialist enables write access to the writable parameters of the IO-Link device. Passwords can be changed with this user role.</p>
Checkbox <b>Identification menu</b>	Checking this checkbox displays identification parameters on the IO-Link device in the table.
Checkbox <b>Parameter menu</b>	Checking this checkbox displays the device parameters of the IO-Link device in the table.
Checkbox <b>Diagnostics menu</b>	Checking this checkbox displays diagnostics messages (such as detected voltage error) for the IO-Link device in the table.
Checkbox <b>Observation menu</b>	Checking this checkbox displays status information (such as sensor condition) for the IO-Link device in the table.
Button <b>Set to Defaults</b>	<p>Clicking this button sets the parameters of the IO-Link device to their default values.</p> <p>If you want to set an individual parameter to its default value, right-click the parameter in the table and select <b>Set to Default</b> from the contextual menu.</p>
Button <b>Read this Page</b>	Clicking this button reads the values of the parameters of the IO-Link device and updates the table.

	If you want to read the value of an individual parameter, right-click the parameter in the table and select <b>Read from Device</b> from the contextual menu.
Button <b>Write this Page</b>	Clicking this button writes the modified values of the parameters to the IO-Link device.  If you want to write the modified value of an individual parameter, right-click the parameter in the table and select <b>Write to Device</b> from the contextual menu.
Table	The contents of the table depends on the selected menu (checkboxes <b>Identification menu</b> , <b>Parameter menu</b> , <b>Diagnostics menu</b> , <b>Observation menu</b> ). If the parameter menu is selected, the table provides details on the parameters in the columns <b>Name</b> , <b>Value</b> , <b>Unit</b> , <b>r/w</b> (ro: read only, rw: read and write), and <b>Description</b> .  To modify the value of a parameter, double-click the value in the <b>Value</b> column and select a value from the dialog box that is displayed.

## IO-Link Devices - Tab “IO-Link I/O Mapping”

To access the **IO-Link I/O Mapping** tab, double-click the node for the IO-Link device below the TM5SE4IOL node in the Devices tree and select the tab.

This tab allows you to display the data that is cyclically exchanged with the IO-Link master (*Process Data Input/Output*), such as status, received signal.

# Operation

## Modifying the Configuration of the TM5SE4IOL Module via the Application

### Overview

You can modify the configuration of the TM5SE4IOL module via your application. Refer to the IoLinkHandling library guide for details.

Under Sercos, the configuration of an IO-Link device is written to the device at the start of communication phase 4.

Under Ethernet/IP, the configuration of an IO-Link device is written to the device when the application starts to run.

If a TM5SE4IOL module is not ready in time, no configuration is written to this device. Instead, writing of the configuration of the next device in the **Devices** tree is started.

# IO-Link Data Storage - Parameter Server

## Parameter Server

The IO-Link parameter server allows you to store the configuration of IO-Link devices in the nonvolatile memory of the TM5SE4IOL module. If an IO-Link device is replaced, the configuration can be automatically restored to the new device (Fast Device Replacement).

The module is capable of processing the data storage upload request (event code 0xFF91) as per IO-Link specification. The request is triggered if parameter values of the IO-Link device are modified. In such a case, depending on the configuration, an upload of data storage data can be started (default).

## Automatic Management of Data Storage Parameters

Automatic management conforms to the IO-Link specification. However, certain IO-Link devices may have to be handled differently. This can be achieved by using the parameter, page 30 *DsControl0x*, page 31.

If the value of *Parameter server* is set to “Off”, automatic management of disabled.

If the value of *Parameter server* is set “Automatic” or “Automatic (Check serial number)”, the following actions are performed when an IO-Link device starts or when *DsControl* is set to 1 for the corresponding channel:

Stage	Description
1	<p>The <i>DeviceID</i> of the IO-Link device in the stored parameter set is compared to the <i>DeviceID</i> of the connected IO-Link device.</p> <p>If the value of <i>Parameter server</i> is “Automatic” or “Automatic (Check serial number)”:</p> <ul style="list-style-type: none"> <li>If the <i>DeviceID</i> values are identical: Go to stage 2.</li> <li>If the <i>DeviceID</i> values are not identical: Start the upload and terminate the process after successful completion.</li> </ul>
2	<p>The serial number of the IO-Link device in the stored parameter set is compared to the serial number of the connected IO-Link device.</p> <p>If the value of <i>Parameter server</i> is “Automatic”:</p> <ul style="list-style-type: none"> <li>If the serial numbers are identical: Go to stage 3.</li> <li>If the serial numbers are not identical: Start the download and terminate the process after successful completion.</li> </ul> <p>If the value of <i>Parameter server</i> is “Automatic (Check serial number)”:</p> <ul style="list-style-type: none"> <li>If the serial numbers are identical: Go to stage 3.</li> <li>If the serial numbers are not identical: The process is stopped and the value of <i>ChannelStatus</i> is set to 24. The application has to determine the next steps and set the value of <i>DsControl</i> accordingly.</li> </ul>
3	<p>The system determines whether an upload request is pending for the connected IO-Link device. An upload request is triggered if a device with the same <i>DeviceID</i> and serial number was detected, and the device explicitly requests an upload, for example, because the values of one or more of its parameters were modified.</p> <p>If the value of <i>Parameter server</i> is “Automatic” or “Automatic (Check serial number)”:</p> <ul style="list-style-type: none"> <li>No upload request pending: Go to stage 4.</li> <li>Upload request pending: Start the upload and terminate the process after successful completion.</li> </ul>
4	<p>The system verifies the parameter checksums.</p> <p>If the value of <i>Parameter server</i> is “Automatic” or “Automatic (Check serial number)”:</p> <ul style="list-style-type: none"> <li>If the checksums are identical: Terminate the process.</li> <li>If the checksums are not identical: Start the download and terminate the process after successful completion.</li> </ul>

An upload can also be triggered at any time if the IO-Link sends an upload request via *DsControl* in the I/O mapping.

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