# Modicon TM3

## Expansion Modules

## Programming Guide

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www.se.com

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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 document describes the configuration of the TM3 expansion modules for EcoStruxure Machine Expert. For further information, refer to the separate documents provided in the EcoStruxure Machine Expert online help.

## Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V2.2.

## Available Languages of this Document

This document is available in these languages:

- English (EIO0000003119)
- French (EIO0000003120)
- German (EIO0000003121)
- Spanish (EIO0000003122)
- Italian (EIO0000003123)
- Chinese (EIO0000003124)

## Related Documents

| Title of Documentation | Reference Number |
|---|---|
| TM3 Digital I/O Modules - Hardware Guide | EIO0000003125 (ENG)<br>EIO0000003126 (FRE)<br>EIO0000003127 (GER)<br>EIO0000003128 (SPA)<br>EIO0000003129 (ITA)<br>EIO0000003130 (CHS)<br>EIO0000003424 (POR)<br>EIO0000003425(TUR) |
| TM3 Analog I/O Modules - Hardware Guide | EIO0000003131 (ENG)<br>EIO0000003132 (FRE)<br>EIO0000003133 (GER)<br>EIO0000003134 (SPA)<br>EIO0000003135 (ITA)<br>EIO0000003136 (CHS)<br>EIO0000003426 (POR)<br>EIO0000003427 (TUR) |

| Title of Documentation | Reference Number |
|---|---|
| TM3 Expert Modules - Hardware Guide | EIO0000003137 (ENG)<br>EIO0000003138 (FRE)<br>EIO0000003139 (GER)<br>EIO0000003140 (SPA)<br>EIO0000003141 (ITA)<br>EIO0000003142 (CHS)<br>EIO0000003428 (POR)<br>EIO0000003429 (TUR) |
| TM3 Safety Modules - Hardware Guide | EIO0000003353 (ENG)<br>EIO0000003354 (FRE)<br>EIO0000003355 (GER)<br>EIO0000003356 (SPA)<br>EIO0000003357 (ITA)<br>EIO0000003358 (CHS)<br>EIO0000003359 (POR)<br>EIO0000003360 (TUR) |
| TM3 Transmitter and Receiver Modules - Hardware Guide | EIO0000003143 (ENG)<br>EIO0000003144 (FRE)<br>EIO0000003145 (GER)<br>EIO0000003146 (SPA)<br>EIO0000003147 (ITA)<br>EIO0000003148 (CHS)<br>EIO0000003430 (POR)<br>EIO0000003431 (TUR) |
| TM3 Expert I/O Modules - HSC Library Guide | EIO0000003683 (ENG)<br>EIO0000003684 (FRE)<br>EIO0000003685 (GER)<br>EIO0000003686 (SPA)<br>EIO0000003687 (ITA)<br>EIO0000003688 (CHS)<br>EIO0000003689 (POR)<br>EIO0000003690 (TUR) |

To find documents online, visit the Schneider Electric download center (www.se.com/ww/en/download/).

## Product Related Information

**⚠WARNING**

**LOSS OF CONTROL**

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

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

[1] 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.**

## Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

## Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in the information contained herein, 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 13849-1:2023 | Safety of machinery: Safety related parts of control systems.<br>General principles for design. |
| EN 61496-1:2020 | Safety of machinery: Electro-sensitive protective equipment.<br>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 62061:2021 | 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 61784-3:2021 | 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.

# I/O Configuration General Information

## Introduction

This chapter provides general information to help you configure TM3 expansion modules for EcoStruxure Machine Expert.

# I/O Configuration General Practices

## Match Software and Hardware Configuration

The I/O that may be embedded in your controller is independent of the I/O that you may have added in the form of I/O expansion. It is important that the logical I/O configuration within your program matches the physical I/O configuration of your installation. If you add or remove any physical I/O to or from the I/O expansion bus or, depending on the controller reference, to or from the controller (in the form of cartridges), then you must update your application configuration. This is also true for any field bus devices you may have in your installation. Otherwise, there is the potential that the expansion bus or field bus no longer function while the embedded I/O that may be present in your controller continues to operate.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

Update the configuration of your program each time you add or delete any type of I/O expansions on your I/O bus, or you add or delete any devices on your field bus.

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

Use the `GetRightBusStatus` function regularly to monitor the expansion bus status.

## The Optional Feature for I/O Expansion Modules

I/O expansion modules can be marked as optional in the configuration. The **Optional module** feature provides a more flexible configuration by the acceptance of the definition of modules that are not physically attached to the controller. Therefore, a single application can support multiple physical configurations of I/O expansion modules, allowing a greater degree of scalability without the necessity of maintaining multiple application files for the same application.

You must be fully aware of the implications and impacts of marking I/O modules as optional in your application, both when those modules are physically absent and present when running your machine or process. Be sure to include this feature in your risk analysis.

## ⚠WARNING

**UNINTENDED EQUIPMENT OPERATION**

Include in your risk analysis each of the variations of I/O configurations that can be realized marking I/O expansion modules as optional, and in particular the establishment of TM3 Safety modules (TM3S…) as optional I/O modules, and make a determination whether it is acceptable as it relates to your application.

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

**NOTE:** For more details about this feature, refer to Optional I/O Expansion Modules, page 27.

# TM3 Expansion Modules

## Introduction

The range of TM3 expansion modules includes:

- Digital modules, classified as follows:
  - Input modules, page 12
  - Output modules, page 13
  - Mixed input/output modules, page 15
- Analog modules, classified as follows:
  - Input modules, page 16
  - Output modules, page 17
  - Mixed input/output modules, page 18
- Expert modules, page 19
- Safety modules, page 20
- Transmitter and receiver modules, page 21

## TM3 Digital Input Modules

The following table shows the TM3 digital input expansion modules (see Modicon TM3, Digital I/O Modules, Hardware Guide), with corresponding channel type, nominal voltage/current, and terminal type. For information on configuration of these modules, refer to the TM3 Digital I/O Modules Configuration, page 30 section.

| Reference | Channels | Channel Type | Voltage<br>Current | Terminal Type / Pitch |
|---|---|---|---|---|
| TM3DI8A | 8 | Regular inputs | 120 Vac<br>7.5 mA | Removable screw terminal block / 5.08 mm |
| TM3DI8 | 8 | Regular inputs | 24 Vdc<br>7 mA | Removable screw terminal block / 5.08 mm |
| TM3DI8G | 8 | Regular inputs | 24 Vdc<br>7 mA | Removable spring terminal block / 5.08 mm |
| TM3DI16 | 16 | Regular inputs | 24 Vdc<br>7 mA | Removable screw terminal block / 3.81 mm |
| TM3DI16G | 16 | Regular inputs | 24 Vdc<br>7 mA | Removable spring terminal block / 3.81 mm |
| TM3DI16K | 16 | Regular inputs | 24 Vdc<br>5 mA | HE10 (MIL 20) connector |
| TM3DI32K | 32 | Regular inputs | 24 Vdc<br>5 mA | HE10 (MIL 20) connector |

# TM3 Digital Output Modules

The following table shows the TM3 digital output modules (see Modicon TM3, Digital I/O Modules, Hardware Guide), with corresponding channel type, nominal voltage/current, and terminal type. For information on configuration of these modules, refer to the TM3 Digital I/O Modules Configuration, page 30 section.

| Reference | Channels | Channel Type | Voltage<br><br>Current | Terminal Type / Pitch |
|---|---|---|---|---|
| TM3DQ8R | 8 | Relay outputs | 24 Vdc / 240 Vac<br><br>7 A maximum per common line / 2 A maximum per output | Removable screw terminal block / 5.08 mm |
| TM3DQ8RG | 8 | Relay outputs | 24 Vdc / 240 Vac<br><br>7 A maximum per common line / 2 A maximum per output | Removable spring terminal block / 5.08 mm |
| TM3DQ8T | 8 | Regular transistor outputs (source) | 24 Vdc<br><br>4 A maximum per common line/0.5 A maximum per output | Removable screw terminal block / 5.08 mm |
| TM3DQ8TG | 8 | Regular transistor outputs (source) | 24 Vdc<br><br>4 A maximum per common line/0.5 A maximum per output | Removable spring terminal block / 5.08 mm |
| TM3DQ8U | 8 | Regular transistor outputs (sink) | 24 Vdc<br><br>4 A maximum per common line/0.5 A maximum per output | Removable screw terminal block / 5.08 mm |
| TM3DQ8UG | 8 | Regular transistor outputs (sink) | 24 Vdc<br><br>4 A maximum per common line/0.5 A maximum per output | Removable spring terminal block / 5.08 mm |
| TM3DQ16R | 16 | Relay outputs | 24 Vdc / 240 Vac<br><br>8 A maximum per common line / 2 A maximum per output | Removable screw terminal block / 3.81 mm |
| TM3DQ16RG | 16 | Relay outputs | 24 Vdc / 240 Vac<br><br>8 A maximum per common line / 2 A maximum per output | Removable spring terminal block / 3.81 mm |
| TM3DQ16T | 16 | Regular transistor outputs (source) | 24 Vdc<br><br>4 A maximum per common line / 0.5 A maximum per output | Removable screw terminal block / 3.81 mm |
| TM3DQ16TG | 16 | Regular transistor outputs (source) | 24 Vdc<br><br>4 A maximum per common line / 0.5 A maximum per output | Removable spring terminal block / 3.81 mm |
| TM3DQ16U | 16 | Regular transistor outputs (sink) | 24 Vdc<br><br>2 A maximum per common line / 0.3 A maximum per output | Removable screw terminal block / 3.81 mm |
| TM3DQ16UG | 16 | Regular transistor outputs (sink) | 24 Vdc<br><br>2 A maximum per common line / 0.3 A maximum per output | Removable spring terminal block / 3.81 mm |

| Reference | Channels | Channel Type | Voltage<br><br>Current | Terminal Type / Pitch |
|---|---|---|---|---|
| TM3DQ16TK | 16 | Regular transistor outputs (source) | 24 Vdc<br><br>2 A maximum per common line / 0.1 A maximum per output | HE10 (MIL 20) connector |
| TM3DQ16UK | 16 | Regular transistor outputs (sink) | 24 Vdc<br><br>2 A maximum per common line / 0.1 A maximum per output | HE10 (MIL 20) connector |
| TM3DQ32TK | 32 | Regular transistor outputs (source) | 24 Vdc<br><br>2 A maximum per common line / 0.1 A maximum per output | HE10 (MIL 20) connector |
| TM3DQ32UK | 32 | Regular transistor outputs (sink) | 24 Vdc<br><br>2 A maximum per common line / 0.1 A maximum per output | HE10 (MIL 20) connector |

# TM3 Digital Mixed Input/Output Modules

This following table shows the TM3 mixed I/O modules (see Modicon TM3, Digital I/O Modules, Hardware Guide), with corresponding channel type, nominal voltage/ current, and terminal type. For information on configuration of these modules, refer to the TM3 Digital I/O Modules Configuration, page 30 section.

| Reference | Channels | Channel Type | Voltage<br>Current | Terminal Type / Pitch |
|---|---|---|---|---|
| TM3DM8R | 4 | Regular inputs | 24 Vdc<br>7 mA | Removable screw terminal block / 5.08 mm |
| | 4 | Relay outputs | 24 Vdc / 240 Vac<br>7 A maximum per common line / 2 A maximum per output | |
| TM3DM8RG | 4 | Regular inputs | 24 Vdc<br>7 mA | Removable spring terminal block / 5.08 mm |
| | 4 | Relay outputs | 24 Vdc / 240 Vac<br>7 A maximum per common line / 2 A maximum per output | |
| TM3DM16R (1) | 8 | Regular inputs | 24 Vdc<br>5 mA | Removable screw terminal block / 3.81 mm |
| | 8 | Relay outputs | 24 Vdc / 240 Vac<br>4 A maximum per common line / 2 A maximum per output | |
| TM3DM24R | 16 | Regular inputs | 24 Vdc<br>7 mA | Removable screw terminal block / 3.81 mm |
| | 8 | Relay outputs | 24 Vdc / 240 Vac<br>7 A maximum per common line / 2 A maximum per output | |
| TM3DM24RG | 16 | Regular inputs | 24 Vdc<br>7 mA | Removable spring terminal block / 3.81 mm |
| | 8 | Relay outputs | 24 Vdc / 240 Vac<br>7 A maximum per common line / 2 A maximum per output | |
| TM3DM32R (1) | 16 | Regular inputs | 24 Vdc<br>5 mA | Removable screw terminal block / 3.81 mm |
| | 16 | Relay outputs | 24 Vdc / 240 Vac<br>4 A maximum per common line / 2 A maximum per output | |
| **(1)** This expansion module is available only in selected countries. | | | | |

# TM3 Analog Input Modules

The following table shows the TM3 analog input expansion modules, with corresponding channel type, nominal voltage/current, and terminal type. For information on configuration of these modules, refer to the TM3 Analog Input Modules Configuration, page 31 section.

| Reference | Resolution | Channels | Channel Type | Mode | Terminal Type / Pitch |
|---|---|---|---|---|---|
| TM3AI2H, page 31 | 16 bit, or 15 bit + sign | 2 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable screw terminal block / 5.08 mm |
| TM3AI2HG, page 31 | 16 bit, or 15 bit + sign | 2 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable spring terminal block / 5.08 mm |
| TM3AI4, page 33 | 12 bit, or 11 bit + sign | 4 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable screw terminal block / 3.81 mm |
| TM3AI4G, page 33 | 12 bit, or 11 bit + sign | 4 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable spring terminal blocks / 3.81 mm |
| TM3AI8, page 35 | 12 bit, or 11 bit + sign | 8 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA<br>0...20 mA extended<br>4...20 mA extended | Removable screw terminal block / 3.81 mm |
| TM3AI8G, page 35 | 12 bit, or 11 bit + sign | 8 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA<br>0...20 mA extended<br>4...20 mA extended | Removable spring terminal blocks / 3.81 mm |
| TM3TI4, page 38 | 16 bit, or 15 bit + sign | 4 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA<br>Thermocouple<br>PT100/1000<br>NI100/1000 | Removable screw terminal block / 3.81 mm |

| Reference | Resolution | Channels | Channel Type | Mode | Terminal Type / Pitch |
|---|---|---|---|---|---|
| TM3TI4G, page 38 | 16 bit, or 15 bit + sign | 4 | inputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA<br>Thermocouple<br>PT100/1000<br>NI100/1000 | Removable spring terminal blocks / 3.81 mm |
| TM3TI4D, page 41 | 16 bit, or 15 bit + sign | 4 | inputs | Thermocouple | Removable screw terminal block / 3.81 mm |
| TM3TI4DG, page 41 | 16 bit, or 15 bit + sign | 4 | inputs | Thermocouple | Removable spring terminal blocks / 3.81 mm |
| TM3TI8T, page 44 | 16 bit, or 15 bit + sign | 8 | inputs | Thermocouple<br>NTC/PTC | Removable screw terminal block / 3.81 mm |
| TM3TI8TG, page 44 | 16 bit, or 15 bit + sign | 8 | inputs | Thermocouple<br>NTC/PTC | Removable spring terminal blocks / 3.81 mm |

# TM3 Analog Output Modules

The following table shows the TM3 analog output modules, with corresponding channel type, nominal voltage/current, and terminal type. For information on configuration of these modules, refer to the TM3 Analog Output Modules Configuration, page 49 section.

| Reference | Resolution | Channels | Channel Type | Mode | Terminal Type / Pitch |
|---|---|---|---|---|---|
| TM3AQ2, page 49 | 12 bit, or 11 bit + sign | 2 | outputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable screw terminal block / 5.08 mm |
| TM3AQ2G, page 49 | 12 bit, or 11 bit + sign | 2 | outputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable spring terminal block / 5.08 mm |
| TM3AQ4, page 51 | 12 bit, or 11 bit + sign | 4 | outputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable screw terminal block / 5.08 mm |
| TM3AQ4G, page 51 | 12 bit, or 11 bit + sign | 4 | outputs | 0...10 Vdc<br>-10…+10 Vdc<br>0...20 mA<br>4...20 mA | Removable spring terminal block / 5.08 mm |

# TM3 Analog Mixed Input/Output Modules

This following table shows the TM3 analog mixed I/O modules, with corresponding channel type, nominal voltage/current, and terminal type. For information on configuration of these modules, refer to the TM3 Analog Mixed I/O Modules Configuration, page 53 section.

| Reference | Resolution | Channels | Channel Type | Mode | Terminal Type / Pitch |
|---|---|---|---|---|---|
| TM3AM6, page 53 | 12 bit, or 11 bit + sign | 4 | inputs | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA | Removable screw terminal block / 3.81 mm |
| | | 2 | outputs | | |
| TM3AM6G, page 53 | 12 bit, or 11 bit + sign | 4 | inputs | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA | Removable spring terminal block / 3.81 mm |
| | | 2 | outputs | | |
| TM3TM3, page 56 | 16 bit, or 15 bit + sign | 2 | inputs | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA<br>Thermocouple<br>PT100/1000<br>NI100/1000 | Removable screw terminal block / 5.08 mm |
| | 12 bit, or 11 bit + sign | 1 | output | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA | |
| TM3TM3G, page 56 | 16 bit, or 15 bit + sign | 2 | inputs | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA<br>Thermocouple<br>PT100/1000<br>NI100/1000 | Removable spring terminal block / 5.08 mm |
| | 12 bit, or 11 bit + sign | 1 | output | 0...10 Vdc<br>-10...+10 Vdc<br>0...20 mA<br>4...20 mA | |

# TM3 Expert Modules

The following table shows the TM3 expert expansion modules, with corresponding terminal type. For information on configuration of these modules, refer to the TM3 Expert I/O Modules Configuration, page 63 section.

| Reference | Description | Terminal Type / Pitch |
|---|---|---|
| TM3XTYS4 | TeSys module | 4 front connectors RJ-45<br>1 removable power supply connector / 5.08 mm |
| TM3XFHSC202 | High Speed Counting (HSC) module with events | Removable screw terminal blocks / 3.81 mm |
| TM3XFHSC202G | High Speed Counting (HSC) module with events | Removable spring terminal blocks / 3.81 mm |
| TM3XHSC202 | High Speed Counting (HSC) module | Removable screw terminal blocks / 3.81 mm |
| TM3XHSC202G | High Speed Counting (HSC) module | Removable spring terminal blocks / 3.81 mm |

# TM3 Safety Modules

This table contains the TM3 safety modules (see Modicon TM3, Safety Modules, Hardware Guide), with the corresponding channel type, nominal voltage/current, and terminal type:

| Reference | Function<br>Category | Channels | Channel type | Voltage<br>Current | Terminal type |
|---|---|---|---|---|---|
| TM3SAC5R | 1 function, up to category 3 | 1 or 2 (1) | Safety-related input | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable screw terminal block |
| | | Start (2) | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAC5RG | 1 function, up to category 3 | 1 or 2 (1) | Safety-related input | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable spring terminal block |
| | | Start (2) | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAF5R | 1 function, up to category 4 | 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable screw terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAF5RG | 1 function, up to category 4 | 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable spring terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAFL5R | 2 functions, up to category 3 | 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable screw terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAFL5RG | 2 functions, up to category 3 | 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable spring terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAK6R | 3 functions, up to category 4 | 1 or 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable screw terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |
| TM3SAK6RG | 3 functions, up to category 4 | 1 or 2 (1) | Safety-related inputs | 24 Vdc<br>100 mA maximum | 3.81 mm (0.15 in.) and 5.08 mm (0.20 in.), removable spring terminal block |
| | | Start | Input | | |
| | | 3 in parallel | Relay outputs<br>Normally open | 24 Vdc / 230 Vac<br>6 A maximum per output | |

| Reference | Function<br>Category | Channels | Channel type | Voltage<br>Current | Terminal type |
|---|---|---|---|---|---|
| (1) Depending on external wiring<br>(2) Non-monitored start | | | | | |

For more information on the terms methods used concerning functional safety as they apply to the TM3 Safety Modules, refer to the sections TM3 Safety Functionality modes, page 73 and TM3 Safety Operation Modes, page 78.

# TM3 Transmitter and Receiver Modules

The following table shows the TM3 transmitter and receiver expansion modules, with corresponding terminal type. For information on configuration of these modules, refer to the TM3 Transmitter and Receiver I/O Modules Configuration, page 87 section.

| Reference | Description | Terminal Type / Pitch |
|---|---|---|
| TM3XTRA1 | Data transmitter module for remote I/O | 1 front connector RJ-45<br>1 screw for functional ground connection |
| TM3XREC1 | Data receiver module for remote I/O | 1 front connector RJ-45<br>1 removable power supply connector / 5.08 mm |

# Adding an Expansion Module

## Adding a Module

To add an expansion module to your controller, select the expansion module in the **Hardware Catalog**, drag it to the **Devices tree**, and drop it on one of the highlighted nodes.

For more information on adding a device to your project, refer to:

• Using the Drag-and-drop Method (see EcoStruxure Machine Expert, Programming Guide)

• Using the Contextual Menu or Plus Button (see EcoStruxure Machine Expert, Programming Guide)

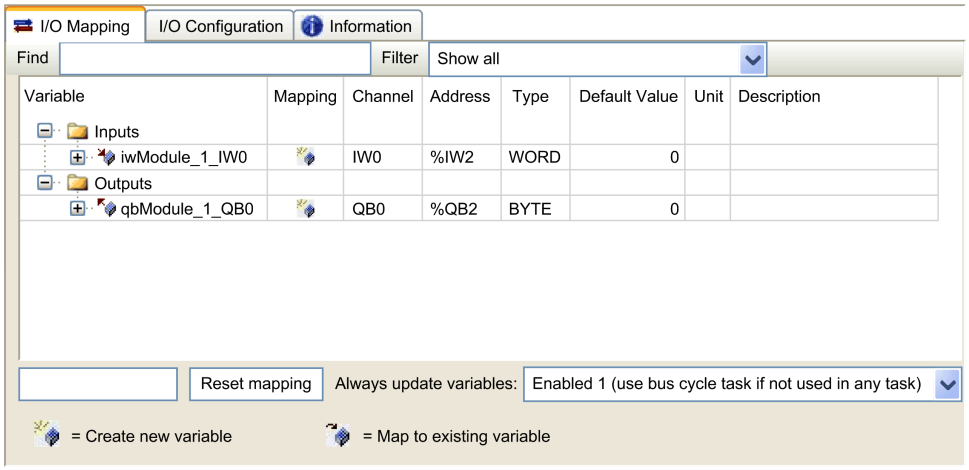
## I/O Mapping Tab

The I/O mapping of an expansion module is carried out through the **I/O Mapping** tab of the expansion module configuration.

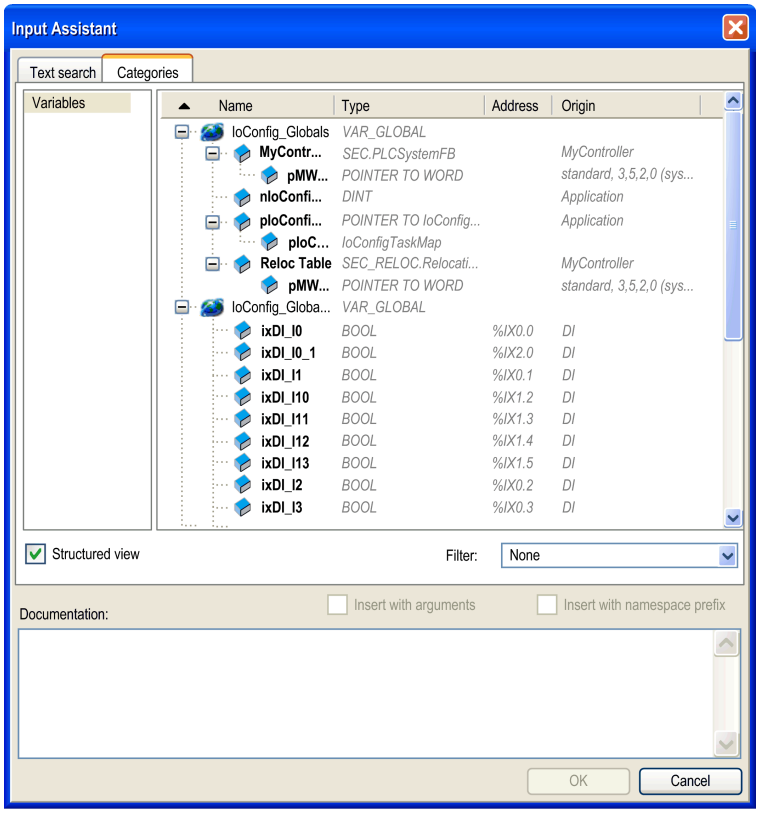
This table describes how to configure an expansion module:

| Step | Action |
|---|---|
| 1 | Double-click the expansion module node in the **Devices tree** to display the **I/O Mapping** tab. |
| 2 | Edit the parameters of the **I/O Mapping** tab to configure the expansion module. |

This figure shows the **I/O Mapping** tab:



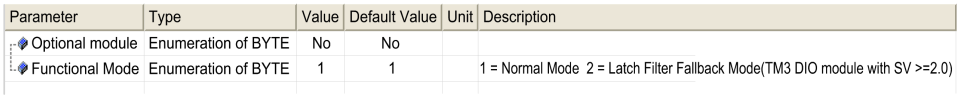
This table describes each parameter of the **I/O Mapping** tab:

| Parameter | Description |
|---|---|
| **Variable** | Allows you to map the channel on a variable.<br>**NOTE:** Expand the list of variables from the category **Inputs** or **Outputs**.<br>You can map a channel by either creating a new variable or mapping to an existing variable.<br>**Create new variable**:<br>Double-click the variable to enter the new variable name. A new variable is created if the variable does not already exist.<br>**Map to existing variable**:<br>Double-click the variable and click **[...]** to open the **Input Assistant** window. Select the variable from the list and press **OK**.<br>This figure shows the **Input Assistant** window:<br>  |
| **Mapping** | Indicates whether the channel is mapped on a new variable or an existing variable. |
| **Channel** | Displays the channel name of the device. |
| **Address** | Displays the address of the channel.<br>**NOTE:** If the channel is mapped to an existing variable, corresponding address appears as strikethrough text in the table. |
| **Type** | Displays the data type of the channel. |
| **Default Value** | Indicates the value taken by the output when the controller is in a **STOPPED** or **HALT** state.<br>Double-click the cell to change the default value.<br>You can toggle between the following values:<br>• No value (*empty cell*)<br>• *TRUE*<br>• *FALSE* |
| **Unit** | Displays the unit of the channel value. |

| Parameter | Description |
|---|---|
| **Description** | Allows you to enter a short description of the channel. |
| **Bus cycle options** | Depending on the controller reference, you can configure the **Bus cycle options**.<br>This configuration setting is the parent for all **Bus cycle task** parameters used in the application device tree.<br>Some devices with cyclic calls, such as a **CANopen manager**, can be attached to a specific task. In the device, when this setting is set to **Use parent bus cycle setting**, the setting set for the controller is used.<br>The selection list offers all tasks currently defined in the active application. The default setting is **Use parent bus cycle setting**. |

# I/O Configuration Tab

This tab allows you to configure the I/O module:



| Parameter | Type | Value | Default Value | Unit | Description |
|---|---|---|---|---|---|
| Optional module | Enumeration of BYTE | No | No | | |
| Functional Mode | Enumeration of BYTE | 1 | 1 | | 1 = Normal Mode 2 = Latch Filter Fallback Mode(TM3 DIO module with SV >=2.0) |

**NOTE:** With **SV >=2.0**, the firmware version of the digital I/O module is greater than or equal to 28.

**NOTE:** To configure the module as an optional module, refer to Optional I/O Expansion Modules, page 27.

# Configuring the Latch and Filter Parameters

You can select the type of edge for the latch parameter, refer to Latch Principles, page 26:

- Rising edge
- Falling edge
- Both edge
- None

The filter parameter reduces the effect of bounce on a controller digital input.

**NOTE:** The more the filter value is low, the more the effects of electromagnetic interference are maximized.

You can configure these parameters on the following modules:

- TM3DI• except TM3DI8A
- TM3DM• except TM3DM16R and TM3DM32R
- TM3XHSC202 / TM3XHSC202G and TM3XFHSC202 / TM3XFHSC202G

This table describes how to configure the latch and filter parameters.

| Step | Action |
|---|---|
| 1 | Click the module node > **I/O Configuration** tab. |
| 2 | Select **2** as **Value** for **Functional Mode**. |
| 3 | Select an input. |
| 4 | Configure the parameters. |

This table describes the latch and filter parameters:

| Parameter | Type | Value | Unit | Description |
|---|---|---|---|---|
| **Fonctional Mode** | **Enumeration of BYTE** | **1***<br>**2** | – | **Fonctional Mode 2** allows you to configure latch and filter parameters. |
| **Inputs** | | | | |
| **Latch** | **Enumeration of BYTE** | **No***<br>**Both edges**<br>**Rising edge**<br>**Falling edge** | – | Latching allows incoming pulses with amplitude widths shorter than controller scan time to be captured and recorded.<br>**NOTE: Latch** is not supported when the expansion module is used with a Modicon TM3 Bus Coupler. |
| **Filter** | **Enumeration of BYTE** | **0**<br>**0.3**<br>**0.5**<br>**1**<br>**2**<br>**4***<br>**12** | ms | Integrator filtering value reduces the effect of bounce on a controller input.<br>**NOTE:** TM3XHSC202 / TM3XHSC202G expansion modules have different filter values, see Configuration of Inputs, page 68.<br>**NOTE:** TM3XFHSC202 / TM3XFHSC202G expansion modules have different filter values, see Configuration of Inputs, page 71. |
| * Parameter default value | | | | |

# Configuring the Outputs

This table describes how to configure the fallback parameters:

| Step | Action |
|---|---|
| 1 | Click the module node **> I/O Configuration** tab. |
| 2 | Select **2** as **Value** for **Functional Mode**. |
| 3 | Select an output. |
| 4 | Configure the parameters. |

This table presents the function of the different parameters:

| Parameter | Value | Description |
|---|---|---|
| **Fallback mode** | **Fallback Value***<br>**Maintain** | Allows you to set the fallback mode when the connection between the controller and the module is lost. |
| **Force value** | **0***<br>**1** | Allows you to set the force value. Only available if the **Fallback mode** is set to **Fallback Value**. |
| * Parameter default value | | |

**NOTE:** TM3DM16R and TM3DM32R expansion modules do not support fallback mode.

**NOTE:** Additional configuration options are available for the following expansion modules:

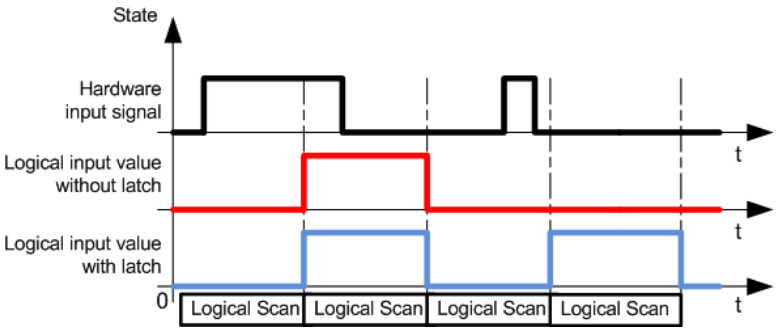
- TM3XHSC202 / TM3XHSC202G, refer to Configuration of Outputs, page 68
- TM3XFHSC202 / TM3XFHSC202G, refer to Configuration of Outputs, page 72

# Latch Principles

## Introduction

The **Latch** parameter allows incoming pulses with amplitude widths shorter than the controller scan time to be captured and recorded.

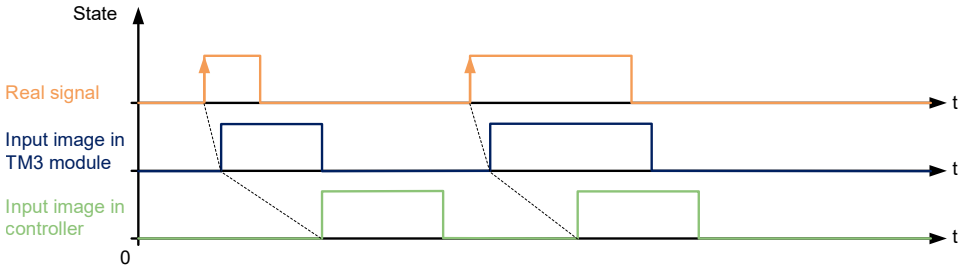
The following timing diagram illustrates the latching effects:




Several edge types can be selected for this parameter.

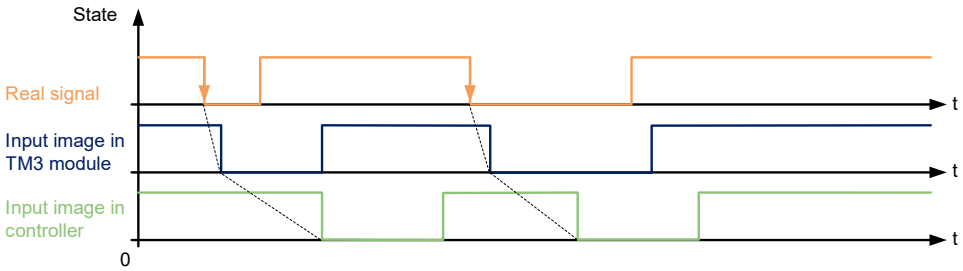
## Rising edge

Latch rising edge allows the detection of a positive pulse whose width corresponds to the bounce filter value.




## Falling edge

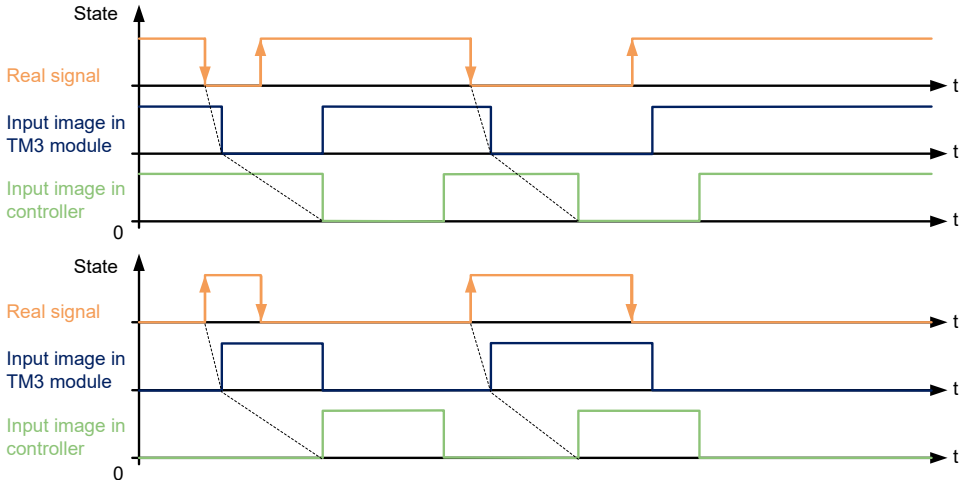
Latch falling edge allows the detection of a negative pulse whose width corresponds to the bounce filter value.



## Both edge

Latch both edge allows the detection of an inverted pulse whose width corresponds to the bounce filter value.

When the I/O module is read by the controller, the level-state of the input is taken as reference to detect the next pulse.




# Optional I/O Expansion Modules

## Presentation

I/O expansion modules can be marked as optional in the configuration. The **Optional module** feature provides a more flexible configuration by the acceptance of the definition of modules that are not physically attached to the controller. Therefore, a single application can support multiple physical configurations of I/O expansion modules, allowing a greater degree of scalability without the necessity of maintaining multiple application files for the same application.

Without the **Optional module** feature, when the controller starts up the I/O expansion bus (following a power cycle, application download or initialization command), it compares the configuration defined in the application with the physical I/O modules attached to the I/O bus. Among other diagnostics made, if the controller determines that there are I/O modules defined in the configuration that are not physically present on the I/O bus, an error is detected and the I/O bus does not start.

With the **Optional module** feature, the controller ignores the absent I/O expansion modules that you have marked as optional, which then allows the controller to start the I/O expansion bus.

The controller starts the I/O expansion bus at configuration time (following a power cycle, application download, or initialization command) even if optional expansion modules are not physically connected to the controller.

The following module types can be marked as optional:

- TM3 I/O expansion modules
- TM2 I/O expansion modules

**NOTE:** TM3 Transmitter/Receiver modules (the TM3XTRA1 and the TM3XREC1) and TMC4 cartridges cannot be marked as optional.

You must be fully aware of the implications and impacts of marking I/O modules as optional in your application, both when those modules are physically absent and present when running your machine or process. Be sure to include this feature in your risk analysis.

**⚠WARNING**

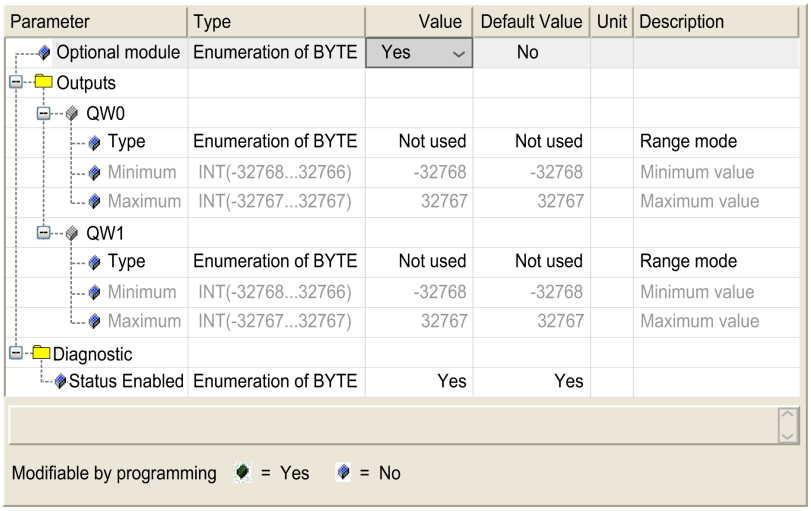
**UNINTENDED EQUIPMENT OPERATION**

Include in your risk analysis each of the variations of I/O configurations that can be realized marking I/O expansion modules as optional, and in particular the establishment of TM3 Safety modules (TM3S…) as optional I/O modules, and make a determination whether it is acceptable as it relates to your application.

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

## Marking an I/O Expansion Module as Optional

To add an expansion module and mark it as optional in the configuration:

| Step | Action |
|---|---|
| 1 | Add the expansion module to your controller. |
| 2 | In the **Devices tree**, double-click the expansion module. |
| 3 | Select the **I/O Configuration** tab. |
| 4 | In the **Optional module** line, select **Yes** in the **Value** column:  |



## Internal ID Codes

Controllers and bus couplers identify expansion modules by an internal ID code. This ID code is not specific to each reference, but identifies the logical structure of the expansion module. Therefore, different references can share the same ID code.

You cannot have two modules with the same internal ID code declared as optional without at least one mandatory module placed between them.

This table shows the internal ID codes of expansion modules:

| Modules sharing the same internal ID code | ID code |
|---|---|
| TM2DDI16DT, TM2DDI16DK | 0 |
| TM2DRA16RT, TM2DDO16UK, TM2DDO16TK | 1 |
| TM2DDI8DT, TM2DAI8DT | 4 |
| TM2DRA8RT, TM2DDO8UT, TM2DDO8TT | 5 |
| TM2DDO32TK, TM2DDO32UK | 3 |
| TM2DMM24DRF, TM2DDI32DK | 2 |
| TM2DMM8DRT | 6 |
| TM2ALM3LT, TM2AMI2HT, TM2AMI2LT, TM2AMI4LT, TM2AMI8HT, TM2AMM3HT, TM2AMM6HT, TM2AMO1HT, TM2ARI8HT, TM2ARI8LRJ, TM2ARI8LT, TM2AVO2HT | 96 |
| TM3DI16K, TM3DI16, TM3DI16G | 128 |
| TM3DI8, TM3DI8G, TM3DI8A | 132 |
| TM3DQ16R, TM3DQ16RG, TM3DQ16T, TM3DQ16TG, TM3DQ16TK, TM3DQ16U, TM3DQ16UG, TM3DQ16UK | 129 |
| TM3DQ32TK, TM3DQ32UK | 131 |
| TM3DQ8R, TM3DQ8RG, TM3DQ8T, TM3DQ8TG, TM3DQ8U, TM3DQ8UG | 133 |
| TM3DM8R, TM3DM8RG | 134 |
| TM3DM16R | 141 |
| TM3DM24R, TM3DM24RG | 135 |
| TM3DM32R | 143 |
| TM3SAK6R, TM3SAK6RG | 144 |
| TM3SAF5R, TM3SAF5RG | 145 |
| TM3SAC5R, TM3SAC5RG | 146 |
| TM3SAFL5R, TM3SAFL5RG | 147 |
| TM3AI2H, TM3AI2HG | 192 |
| TM3AI4, TM3AI4G | 193 |
| TM3AI8, TM3AI8G | 194 |
| TM3AQ2, TM3AQ2G | 195 |
| TM3AQ4, TM3AQ4G | 196 |
| TM3AM6, TM3AM6G | 197 |
| TM3TM3, TM3TM3G | 198 |
| TM3TI4, TM3TI4G | 199 |
| TM3TI4D, TM3TI4DG | 203 |
| TM3TI8T, TM3TI8TG | 200 |
| TM3DI32K | 130 |
| TM3XTYS4 | 136 |
| TM3XFHSC202, TM3XFHSC202G | 216 |
| TM3XHSC202, TM3XHSC202G | 217 |

# TM3 Digital I/O Modules Configuration

## Introduction

This chapter describes how to configure the TM3 digital I/O modules.

# Configuring the TM3 Digital I/O Modules

## Introduction

The range of TM3 digital I/O expansion modules includes:

- TM3 Digital Input Modules, page 12
- TM3 Digital Output Modules, page 13
- TM3 Digital Mixed Input/Output Modules, page 15

## Configuring the Modules

Refer to the I/O Configuration, page 24 for detailed information on the configuration of the digital I/O expansion modules in EcoStruxure Machine Expert.

# TM3 Analog I/O Modules Configuration

## Introduction

This chapter describes how to configure the TM3 analog I/O modules.

The range of TM3 analog I/O expansion modules includes:

- TM3 Analog Input Modules, page 16
- TM3 Analog Output Modules, page 17
- TM3 Analog Mixed Input/Output Modules, page 18

# TM3 Analog Input Modules

## TM3AI2H / TM3AI2HG

### Introduction

The TM3AI2H (screw terminal block) / TM3AI2HG (spring terminal block) expansion module features 2 analog input channels with 16-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3AI2H / TM3AI2HG (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

| ***NOTICE*** |
| --- |
| **INOPERABLE EQUIPMENT**<br>Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.<br>**Failure to follow these instructions can result in equipment damage.** |

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767 | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767 | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **1ms/Channel** | **1ms/Channel** | Specifies the sampling period of the channel. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIW0` and `IBStatusIW1` do not contain relevant information. |

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Current value of the input 0 |
| | IW1 | INT | Current value of the input 1 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3AI4 / TM3AI4G

## Introduction

The TM3AI4 (screw terminal block) / TM3AI4G (spring terminal block) expansion module features 4 analog input channels with 12-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3AI4 / TM3AI4G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

***NOTICE***

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **1ms/Channel**<br>**10ms/Channel** | **1ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 1 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |
| (1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767. | | | | |

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Current value of the input 0 |
| | IW1 | INT | Current value of the input 1 |
| | IW2 | INT | Current value of the input 2 |
| | IW3 | INT | Current value of the input 3 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | Status of input 3, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3AI8 / TM3AI8G

## Introduction

The TM3AI8 (screw terminal block) / TM3AI8G (spring terminal block) expansion modules feature 8 analog input channels with 12-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA
- 0...20 mA extended
- 4...20 mA extended

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3AI8 / TM3AI8G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

***NOTICE***

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**,<br>**0 - 10 V**,<br>**-10 - +10 V**,<br>**0 - 20 mA**,<br>**4 - 20 mA**,<br>**0 - 20 mA extended**,<br>**4 - 20 mA extended**. | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| | **0 - 20 mA extended**(2) | | 0 | Not editable. |
| | **4 - 20 mA extended**(2) | | 1200 | Not editable. |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| | **0 - 20 mA extended**(2) | | 23540 | Not editable. |
| | **4 - 20 mA extended**(2) | | 23170 | Not editable. |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **1ms/Channel**<br>**10ms/Channel** | **1ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 1 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |

(1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767.

(2) The extended ranges are supported by modules from product version (PV) 03, firmware version (SV) 1.4.

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Current value of the input 0 |
| | IW1 | INT | Current value of the input 1 |
| | IW2 | INT | Current value of the input 2 |
| | IW3 | INT | Current value of the input 3 |
| | IW4 | INT | Current value of the input 4 |
| | IW5 | INT | Current value of the input 5 |
| | IW6 | INT | Current value of the input 6 |
| | IW7 | INT | Current value of the input 7 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | Status of input 3, page 60 |
| | IBStatusIW4 | BYTE | Status of input 4, page 60 |
| | IBStatusIW5 | BYTE | Status of input 5, page 60 |
| | IBStatusIW6 | BYTE | Status of input 6, page 60 |
| | IBStatusIW7 | BYTE | Status of input 7, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3TI4 / TM3TI4G

## Introduction

The TM3TI4 (screw terminal block) / TM3TI4G (spring terminal block) expansion module features 4 analog input channels with 16-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA
- K thermocouple
- J thermocouple
- R thermocouple
- S thermocouple
- B thermocouple
- E thermocouple
- T thermocouple
- N thermocouple
- C thermocouple
- PT100
- PT1000
- NI100
- NI1000

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3TI4 / TM3TI4G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

***NOTICE***

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA**<br>**K Thermocouple**<br>**J Thermocouple**<br>**R Thermocouple**<br>**S Thermocouple**<br>**B Thermocouple**<br>**E Thermocouple**<br>**T Thermocouple**<br>**N Thermocouple**<br>**C Thermocouple**<br>**PT100**<br>**PT1000**<br>**NI100**<br>**NI1000** | **Not used** | Choose the mode of the channel. |
| **Scope** | | **Customized**<br>**Celsius (0.1°C)**<br>**Fahrenheit (0.1°F)**<br>**Fahrenheit (0.2°F)*** | **Customized** | The range of values for a channel.<br>* Only for B and C thermocouples. |
| **Min.** | **0 - 10 V** | -32768...32767 | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| | **Temperature** | See the table below | | |
| **Max.** | **0 - 10 V** | -32768...32767 | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| | **Temperature** | See the table below | | |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **10ms/Channel**<br>**100ms/Channel** | **100ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 10 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |

| Type | Customized | | Celsius (0.1 °C) | | Fahrenheit | | |
|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | Unit |
| K Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| J Thermocouple | -32768 | 32767 | -2000 | 10000 | -3280 | 18320 | 0.1 °F |
| R Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| S Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| B Thermocouple | -32768 | 32767 | 0 | 18200 | 160 | 16540 | 0.2 °F |
| E Thermocouple | -32768 | 32767 | -2000 | 8000 | -3280 | 14720 | 0.1 °F |
| T Thermocouple | -32768 | 32767 | -2000 | 4000 | -3280 | 7520 | 0.1 °F |
| N Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| C Thermocouple | -32768 | 32767 | 0 | 23150 | 160 | 20995 | 0.2 °F |
| PT100 | -32768 | 32767 | -2000 | 8500 | -3280 | 15620 | 0.1 °F |
| PT1000 | -32768 | 32767 | -2000 | 6000 | -3280 | 11120 | 0.1 °F |
| NI100 | -32768 | 32767 | -600 | 1800 | -760 | 3560 | 0.1 °F |
| NI1000 | -32768 | 32767 | -600 | 1800 | -760 | 3560 | 0.1 °F |

## I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Current value of the input 0 |
| | IW1 | INT | Current value of the input 1 |
| | IW2 | INT | Current value of the input 2 |
| | IW3 | INT | Current value of the input 3 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | Status of input 3, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3TI4D / TM3TI4DG

## Introduction

The TM3TI4D (screw terminal block) / TM3TI4DG (spring terminal block) expansion module features 4 analog input channels with 16-bit resolution.

The channel input types are:

- K thermocouple
- J thermocouple
- R thermocouple
- S thermocouple
- B thermocouple
- E thermocouple
- T thermocouple
- N thermocouple
- C thermocouple

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3TI4D / TM3TI4DG.

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**K Thermocouple**<br>**J Thermocouple**<br>**R Thermocouple**<br>**S Thermocouple**<br>**B Thermocouple**<br>**E Thermocouple**<br>**T Thermocouple**<br>**N Thermocouple**<br>**C Thermocouple** | **Not used** | Choose the mode of the channel. |
| **Scope** | | **Customized**<br>**Celsius (0.1°C)**<br>**Fahrenheit (0.1°F)**<br>**Fahrenheit (0.2°F)*** | **Customized** | The range of values for a channel.<br>* Only for B and C thermocouples. |
| **Min.** | **Temperature** | See the table below | | Specifies the lower measurement limit. |
| **Max.** | **Temperature** | See the table below | | Specifies the upper measurement limit. |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **10ms/Channel**<br>**100ms/Channel** | **100ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 10 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |

| Type | Customized | | Celsius (0.1 °C) | | Fahrenheit | | |
|---|---|---|---|---|---|---|---|
| | **Minimum** | **Maximum** | **Minimum** | **Maximum** | **Minimum** | **Maximum** | **Unit** |
| K Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| J Thermocouple | -32768 | 32767 | -2000 | 10000 | -3280 | 18320 | 0.1 °F |
| R Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| S Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| B Thermocouple | -32768 | 32767 | 0 | 18200 | 160 | 16540 | 0.2 °F |
| E Thermocouple | -32768 | 32767 | -2000 | 8000 | -3280 | 14720 | 0.1 °F |
| T Thermocouple | -32768 | 32767 | -2000 | 4000 | -3280 | 7520 | 0.1 °F |
| N Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| C Thermocouple | -32768 | 32767 | 0 | 23150 | 160 | 20995 | 0.2 °F |

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Value of the input 0 |
| | IW1 | INT | Value of the input 1 |
| | IW2 | INT | Value of the input 2 |
| | IW3 | INT | Value of the input 3 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | Status of input 3, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3TI8T / TM3TI8TG

## Introduction

The TM3TI8T (screw terminal block) / TM3TI8TG (spring terminal block) expansion module features 8 analog input channels with 16-bit resolution.

The channel input types are:

- K thermocouple
- J thermocouple
- R thermocouple
- S thermocouple
- B thermocouple
- E thermocouple
- T thermocouple
- N thermocouple
- C thermocouple
- NTC thermistor
- PTC thermistor
- Ohmmeter

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

For further hardware information, refer to TM3TI8T / TM3TI8TG (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

***NOTICE***

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

# Configuring the Module

For each input, you can define the following parameters:

| Parameter | Value | Default Value | Description |
|---|---|---|---|
| **Type**<br>• **Not used** | - | **Not used** | Choose the parameter type and scope for the channel. |
| **Type**<br>• **K Thermocouple**<br>• **J Thermocouple**<br>• **R Thermocouple**<br>• **S Thermocouple**<br>• **E Thermocouple**<br>• **T Thermocouple**<br>• **N Thermocouple**<br>• **NTC Thermistor** | **Scope**<br>• **Customized**<br>• **Celsius (0.1 °C)**<br>• **Fahrenheit (0.1 °F)** | **Celsius (0.1 °C)** | |
| **Type**<br>• **B Thermocouple**<br>• **C Thermocouple** | **Scope**<br>• **Customized**<br>• **Celsius (0.1 °C)**<br>• **Fahrenheit (0.2 °F)** | **Celsius (0.1 °C)** | |
| **Type**<br>• **PTC Thermistor** | **Scope**<br>• **Customized**<br>• **Threshold** | **Threshold** | |
| **Type**<br>• **Ohmmeter** | **Scope**<br>• **Resistance (Ω)** | **Resistance** | |
| **Minimum** | See the table below | | Specifies the low measurement limit. |
| **Maximum** | See the table below | | Specifies the high measurement limit. |
| **Rref** (used only with NTC probe, page 46) | 1...65535 | 330 | Reference resistance in Ohm at temperature Tref. |
| **Tref** (used only with NTC probe) | 1...1000 | 25 | Reference temperature value in Celsius. |
| **Beta** (used only with NTC probe) | 1...32767 | 3569 | Sensitivity of NTC probe in Kelvin. |
| **Input Filter** | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | **100ms/Channel** | **100ms/Channel** | Specifies the sampling period of the channel. |
| **Status Enabled** | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |
| **High Threshold** (used only with PTC probe, page 46) | 100...10000 | 3100 | Activation threshold |
| **Low Threshold** (used only with PTC probe) | 100...10000 | 1500 | Reactivation threshold |

The following table indicates the possible range values for the selected type of thermocouple:

| Type | Customized | Range in Celsius | Range in Fahrenheit |
|---|---|---|---|
| K Thermocouple | -32768...32767 | -2000...13000 (0.1°C) | -3280...23720 (0.1°F) |
| J Thermocouple | | -2000...10000 (0.1°C) | -3280...18320 (0.1°F) |
| R Thermocouple | | 0...17600 (0.1°C) | 320...32000 (0.1°F) |
| S Thermocouple | | 0...17600 (0.1°C) | 320...32000 (0.1°F) |
| B Thermocouple | | 0...18200 (0.1°C) | 160...16540 (0.2°F) |
| E Thermocouple | | -2000...8000 (0.1°C) | -3280...14720 (0.1°F) |
| T Thermocouple | | -2000...4000 (0.1°C) | -3280...7520 (0.1°F) |
| N Thermocouple | | -2000...13000 (0.1°C) | -3280...23720 (0.1°F) |
| C Thermocouple | | 0...23150 (0.1°C) | 160...20995 (0.2°F) |
| NTC Thermistor | | -900...1500 (0.1°C) | -1300...3020 (0.1°F) |
| PTC Thermistor | | – | – |

## NTC Thermistor

The temperature (Tm) varies in relation to the resistance (r) following the equation below:

$$Tm(r) = \frac{1}{\frac{1}{T} + \frac{1}{B}\ln\left[\frac{r}{R}\right]}$$

Where:

- Tm = temperature measured by the probe, in Kelvin
- r = physical value of the resistance in Ohm
- R = reference resistance in Ohm at temperature T
- T = reference temperature in Kelvin
- B = sensitivity of the NTC probe in Kelvin

R, T and B must be greater or equal to 1.

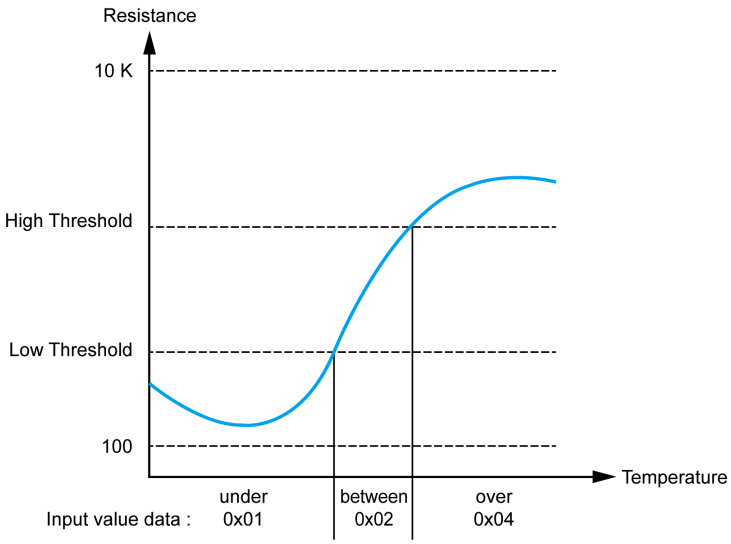
**NOTE:** 25 °C = 77 °F = 298.15 K

## PTC Thermistor

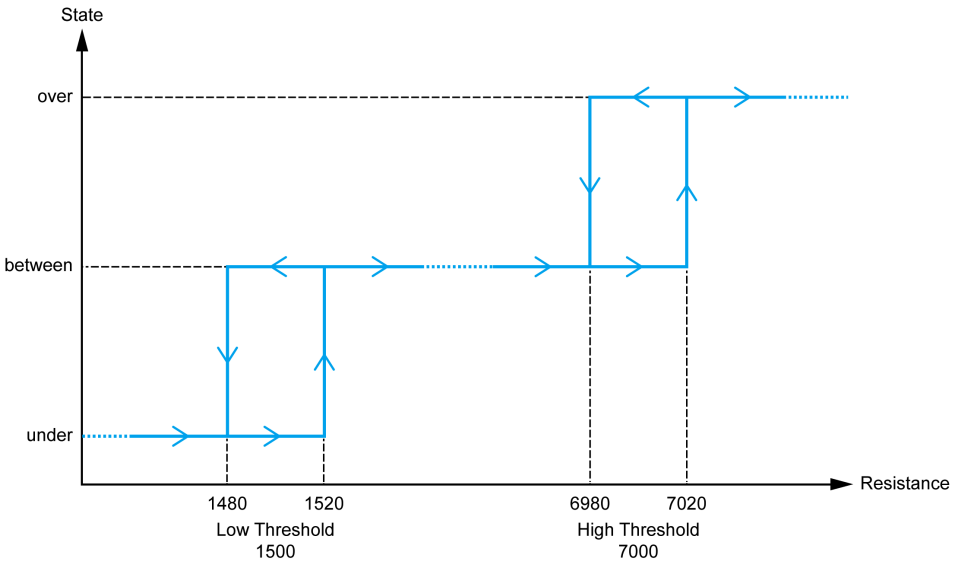
This table describes the read value according to the resistance:

| Resistance Value | Read Value |
|---|---|
| Under the low threshold | 1 |
| Between thresholds | 2 |
| Over the high threshold | 4 |

This figure represents the threshold operation:




This figure represents an example hysteresis curve:




## Ohmmeter

This table describes the minimum and maximum values:

| Parameter | Value |
|---|---|
| Minimum | 100 Ω |
| Maximum | 32 kΩ |

## I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Description |
|---|---|---|---|
| Inputs | IW0 | INT | Current value of the input 0 |
| | IW1 | INT | Current value of the input 1 |
| | IW2 | INT | Current value of the input 2 |
| | IW3 | INT | Current value of the input 3 |
| | IW4 | INT | Current value of the input 4 |
| | IW5 | INT | Current value of the input 5 |
| | IW6 | INT | Current value of the input 6 |
| | IW7 | INT | Current value of the input 7 |
| Diagnostic | IBStatusIW0 | BYTE | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | Status of input 3, page 60 |
| | IBStatusIW4 | BYTE | Status of input 4, page 60 |
| | IBStatusIW5 | BYTE | Status of input 5, page 60 |
| | IBStatusIW6 | BYTE | Status of input 6, page 60 |
| | IBStatusIW7 | BYTE | Status of input 7, page 60 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3 Analog Output Modules

## TM3AQ2 / TM3AQ2G

### Introduction

The TM3AQ2 (screw terminal block) / TM3AQ2G (spring terminal block) expansion module features 2 analog output channels with 12-bit resolution.

The channel output types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For further hardware information, refer to TM3AQ2 / TM3AQ2G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

| ***NOTICE*** |
|---|
| **INOPERABLE EQUIPMENT**<br>Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.<br>**Failure to follow these instructions can result in equipment damage.** |

### Configuring the Module

For each output, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusQWx` do not contain relevant information. |
| (1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767. | | | | |

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Default Value | Description |
|---|---|---|---|---|
| Outputs | QW0 | INT | -32768...32767 | Command word of the output 0 |
| | QW1 | INT | -32768...32767 | Command word of the output 1 |
| Diagnostic | IBStatusQW0 | BYTE | - | Status of output 0, page 61 |
| | IBStatusQW1 | BYTE | - | Status of output 1, page 61 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3AQ4 / TM3AQ4G

## Introduction

The TM3AQ4 (screw terminal block) / TM3AQ4G (spring terminal block) expansion modules feature 4 analog output channels with 12-bit resolution.

The channel output types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For further hardware information, refer to TM3AQ4 / TM3AQ4G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

**NOTICE**

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

## Configuring the Module

For each output, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Scope** | | **Customized** | **Customized** | The range of values for a channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusQWx` do not contain relevant information. |

(1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767.

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Default Value | Description |
|---|---|---|---|---|
| Outputs | QW0 | INT | -32768...32767 | Command word of the output 0 |
| | QW1 | INT | -32768...32767 | Command word of the output 1 |
| | QW2 | INT | -32768...32767 | Command word of the output 2 |
| | QW3 | INT | -32768...32767 | Command word of the output 3 |
| Diagnostic | IBStatusQW0 | BYTE | - | Status of output 0, page 61 |
| | IBStatusQW1 | BYTE | - | Status of output 1, page 61 |
| | IBStatusQW2 | BYTE | - | Status of output 2, page 61 |
| | IBStatusQW3 | BYTE | - | Status of output 3, page 61 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3 Analog Mixed Input/Output Modules

## TM3AM6 / TM3AM6G

### Introduction

The TM3AM6 (screw terminal block) / TM3AM6G (spring terminal block) expansion modules feature 4 analog input channels and 2 analog output channels with 12-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

The channel output types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For further hardware information, refer to TM3AM6 / TM3AM6G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

| ***NOTICE*** |
| --- |
| **INOPERABLE EQUIPMENT**<br>Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.<br>**Failure to follow these instructions can result in equipment damage.** |

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **1ms/Channel**<br>**10ms/Channel** | **1ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 1 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |
| (1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767. | | | | |

For each output, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusQWx` do not contain relevant information. |
| (1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767. | | | | |

# I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Default Value | Description |
|---|---|---|---|---|
| Inputs | IW0 | INT | - | Current value of the input 0 |
| | IW1 | INT | - | Current value of the input 1 |
| | IW2 | INT | - | Current value of the input 2 |
| | IW3 | INT | - | Current value of the input 3 |
| Outputs | QW0 | INT | -32768...32767 | Command word of the output 0 |
| | QW1 | INT | -32768...32767 | Command word of the output 1 |
| Diagnostic | IBStatusIW0 | BYTE | - | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | - | Status of input 1, page 60 |
| | IBStatusIW2 | BYTE | - | Status of input 2, page 60 |
| | IBStatusIW3 | BYTE | - | Status of input 3, page 60 |
| | IBStatusQW0 | BYTE | - | Status of output 0, page 61 |
| | IBStatusQW1 | BYTE | - | Status of output 1, page 61 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3TM3 / TM3TM3G

## Introduction

The TM3TM3 (screw terminal block) / TM3TM3G (spring terminal block) expansion module features 2 analog input channels with 16-bit resolution and 1 analog output with 12-bit resolution.

The channel input types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA
- K thermocouple
- J thermocouple
- R thermocouple
- S thermocouple
- B thermocouple
- E thermocouple
- T thermocouple
- N thermocouple
- C thermocouple
- PT100
- PT1000
- NI100
- NI1000

For information on the diagnostic codes produced by each input type, refer to Analog I/0 Modules Diagnostics, page 60.

The channel output types are:

- 0...10 V
- -10...+10 V
- 0...20 mA
- 4...20 mA

For further hardware information, refer to TM3TM3 / TM3TM3G (see Modicon TM3, Analog I/O Modules, Hardware Guide).

**NOTE:**

If you have physically wired the analog channel for a voltage signal and you configure the channel for a current signal in EcoStruxure Machine Expert, you may damage the analog circuit.

***NOTICE***

**INOPERABLE EQUIPMENT**

Verify that the physical wiring of the analog circuit is compatible with the software configuration for the analog channel.

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

# Configuring the Module

For each input, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA**<br>**K Thermocouple**<br>**J Thermocouple**<br>**R Thermocouple**<br>**S Thermocouple**<br>**B Thermocouple**<br>**E Thermocouple**<br>**T Thermocouple**<br>**N Thermocouple**<br>**C Thermocouple**<br>**PT100**<br>**PT1000**<br>**NI100**<br>**NI1000** | **Not used** | Choose the mode of the channel. |
| **Scope** | | **Customized**<br>**Celsius (0.1°C)**<br>**Fahrenheit (0.1°F)**<br>**Fahrenheit (0.2°F)*** | **Customized** | The range of values for a channel.<br>* Only for B and C thermocouples. |
| **Min.** | **0 - 10 V** | -32768...32767 | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| | **Temperature** | See the table below | | |
| **Max.** | **0 - 10 V** | -32768...32767 | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| | **Temperature** | See the table below | | |
| **Input Filter** | | 0...1000 | 0 | Specifies the first order filter time constant (0...10 s) in increments of 10 ms. |
| **Sampling** | | **10ms/Channel**<br>**100ms/Channel** | **100ms/Channel** | Specifies the sampling period of the channel.<br>If an input filter is active, sampling is set internally to 10 ms. |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status bytes `IBStatusIWx` do not contain relevant information. |

| Type | Customized | | Celsius (0.1 °C) | | Fahrenheit | | |
|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | Unit |
| K Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| J Thermocouple | -32768 | 32767 | -2000 | 10000 | -3280 | 18320 | 0.1 °F |
| R Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| S Thermocouple | -32768 | 32767 | 0 | 17600 | 320 | 32000 | 0.1 °F |
| B Thermocouple | -32768 | 32767 | 0 | 18200 | 160 | 16540 | 0.2 °F |
| E Thermocouple | -32768 | 32767 | -2000 | 8000 | -3280 | 14720 | 0.1 °F |
| T Thermocouple | -32768 | 32767 | -2000 | 4000 | -3280 | 7520 | 0.1 °F |
| N Thermocouple | -32768 | 32767 | -2000 | 13000 | -3280 | 23720 | 0.1 °F |
| C Thermocouple | -32768 | 32767 | 0 | 23150 | 160 | 20995 | 0.2 °F |
| PT100 | -32768 | 32767 | -2000 | 8500 | -3280 | 15620 | 0.1 °F |
| PT1000 | -32768 | 32767 | -2000 | 6000 | -3280 | 11120 | 0.1 °F |
| NI100 | -32768 | 32767 | -600 | 1800 | -760 | 3560 | 0.1 °F |
| NI1000 | -32768 | 32767 | -600 | 1800 | -760 | 3560 | 0.1 °F |

For the output, you can define:

| Parameter | | Value | Default Value | Description |
|---|---|---|---|---|
| **Type** | | **Not used**<br>**0 - 10 V**<br>**-10 - +10 V**<br>**0 - 20 mA**<br>**4 - 20 mA** | **Not used** | Choose the mode of the channel. |
| **Min.** | **0 - 10 V** | -32768...32767(1) | 0 | Specifies the lower measurement limit. |
| | **-10 - +10 V** | | -10000 | |
| | **0 - 20 mA** | | 0 | |
| | **4 - 20 mA** | | 4000 | |
| **Max.** | **0 - 10 V** | -32768...32767(1) | 10000 | Specifies the upper measurement limit. |
| | **-10 - +10 V** | | 10000 | |
| | **0 - 20 mA** | | 20000 | |
| | **4 - 20 mA** | | 20000 | |
| **Status Enabled** | | **Yes**<br>**No** | **Yes** | Enables the diagnostic byte of each channel.<br>If the status is disabled (value = No), the status byte `IBStatusQW0` does not contain relevant information. |
| (1) The 12-bit data (0 to 4095) processed in the analog I/O module can be linear-converted to a value between -32768 and 32767. | | | | |

## I/O Mapping Tab

Variables can be defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | Type | Default Value | Description |
|---|---|---|---|---|
| Inputs | IW0 | INT | - | Current value of the input 0 |
| | IW1 | INT | - | Current value of the input 1 |
| Outputs | QW0 | INT | -32768...32767 | Command word of the output 0 |
| Diagnostic | IBStatusIW0 | BYTE | - | Status of input 0, page 60 |
| | IBStatusIW1 | BYTE | - | Status of input 1, page 60 |
| | IBStatusQW0 | BYTE | - | Status of output 0, page 61 |

For further generic descriptions, refer to I/O Mapping Tab Description, page 22.

# TM3 Analog I/O Modules Diagnostic

## Analog I/O Modules Diagnostics

### Introduction

The operating status of each I/O channel is given by the diagnostic bytes in the **I/O Mapping** tab:

- IBStatusIWx for input channel x
- IBStatusQWx for output channel x

**NOTE:** If the **Status Enabled** parameter in the **I/O Configuration** tab is deactivated, it is possible to update the value of the diagnostic bytes by calling the *TM3_GetModuleInternalStatus* function.

For more information about *TM3_GetModuleInternalStatus* function:

- Refer to *M241 Controller PLCSystem Library Guide* for Modicon M241 Logic Controller.
- Refer to *M251 Controller PLCSystem Library Guide* for Modicon M251 Logic Controller.
- Refer to *M262 Controller System Library Guide* for Modicon M262 Logic/ Motion Controller.

### Input Diagnostic Byte Description

This table describes the IBStatusIWx diagnostic byte:

| Byte value | Description |
|---|---|
| 0 | Normal |
| 1 | Undefined |
| 2 | Undefined |
| 3 | Configuration error detected. |
| 4 | External power supply error detected. |
| 5 | Wiring error detected (input voltage/current high limit exceeded). |
| 6 | Wiring error detected (input voltage/current low limit exceeded). |
| 7 | Hardware error detected. |
| 8 | The measured value is in the High extended zone. |
| 9 | The measured value is in the Low extended zone. |
| 10...255 | Undefined |

## Output Diagnostic Byte Description

This table describes the IBStatusQWx diagnostic byte:

| Byte value | Description |
|---|---|
| 0 | Normal |
| 1 | Undefined |
| 2 | Undefined |
| 3 | Configuration error detected |
| 4 | External power supply voltage limits exceeded |
| 5 | Undefined |
| 6 | Undefined |
| 7 | Hardware error detected |
| 8...255 | Undefined |

## Status Byte Values Produced By Channel Input Types

The following tables shows the Input Channel Status Byte, page 60 values generated by different channel input types of the TM3 Analog expansion modules.

0...10 V channel input type:

| Input voltage | Status Code Generated |
|---|---|
| ≤ -0.20 V | 6 |
| -0.19 V...10.19 V | 0 |
| ≥ 10.20 V | 5 |

-10...+10 V input channel type:

| Input voltage | Status Code Generated |
|---|---|
| ≤ -10.40 V | 6 |
| -10.39 V...10.39 V | 0 |
| ≥ 10.40 V | 5 |

0...20 mA input channel type:

| Input voltage | Status Code Generated |
|---|---|
| ≤ -0.40 mA | 6 |
| -0.39 mA...20.39 mA | 0 |
| ≥ 20.40 mA | 5 |

4...20 mA input channel type:

| Input voltage | Status Code Generated |
|---|---|
| ≤ 3.68 mA | 6 |
| 3.69 mA...20.31 mA | 0 |
| ≥ 20.32 mA | 5 |

0...20 mA extended mode of the TM3AI8 / TM3AI8G expansion modules:

| Input voltage | Status Code Generated |
|---|---|
| ≤ -0.40 mA | 6 |
| -0.39 mA...20.00 mA | 0 |
| 20.01 mA...23.54 mA | 8 |
| ≥ 23.55 mA | 5 |

4...20 mA extended mode of the TM3AI8 / TM3AI8G expansion modules:

| Input voltage | Status Code Generated |
|---|---|
| < 1.19 mA | 6 |
| 1.20 mA...3.99 mA | 9 |
| 4.00 mA...20.00 mA | 0 |
| 20.01 mA...23.17 mA | 8 |
| ≥ 23.18 mA | 5 |

# TM3 Expert I/O Modules Configuration

## Introduction

This chapter describes how to configure the TM3 expert I/O modules, page 19.

# TM3XTYS4 Module

## TM3XTYS4 Module Overview

### Introduction

The TeSys expansion module TM3XTYS4 is equipped with:

- 4 RJ-45 connectors to connect to Tesys motor starter devices
- 3 digital inputs for each channel:
  - Ready
  - Run
  - Trip
- 2 digital outputs for each channel:
  - Forward
  - Reverse
- Removable 24 Vdc power supply

The TeSys expansion module is connected to the controller through the TM3 bus. TM3XTYS4 expansion modules can be connected to the controller in any order.

### Adding and Configuring the TM3XTYS4 Module

To add a TM3XTYS4 module to a project:

1. Add the expansion module, page 22 to your controller.
2. Configure the expansion module, page 63 inputs and outputs.
3. Insert a channel, page 64 that is connected to the device.
4. Select the device type, page 65 that is associated with the channel.
5. Add the FB_TeSysU function block, page 65 to your application and configure it in order to control the device directly from the application.

## TM3XTYS4 Module Configuration

### Introduction

This chapter describes how to configure the TM3XTYS4 expert I/O module, page 19.

### Configuring the Module

Configuration of the TM3XTYS4 module is carried out through the **I/O Mapping** tab of the module.

In the **Devices tree**, double-click the **Module_*n*** subnode of the module, where *n* is the unique identifier of the module. The **I/O Mapping** tab appears.

The digital inputs of this module are:

| Channel | Address | Description |
|---|---|---|
| CH1_Ready | %IXx.0 | Input active if the selector of TeSys is in the ON position. |
| CH1_Run | %IXx.1 | Input active if the power contacts of TeSys are closed. |
| CH1_Trip | %IXx.2 | Input active if the selector of TeSys is in the TRIP position. |
| CH2_Ready | %IXx.3 | Input active if the selector of TeSys is in the ON position. |
| CH2_Run | %IXx.4 | Input active if the power contacts of TeSys are closed. |
| CH2_Trip | %IXx.5 | Input active if the selector of TeSys is in the TRIP position. |
| CH3_Ready | %IXx.6 | Active if the selector of TeSys is in the ON position. |
| CH3_Run | %IXx.7 | Input active if the power contacts of TeSys are closed. |
| CH3_Trip | %IXx.8 | Input active if the selector of TeSys is in the TRIP position. |
| CH4_Ready | %IXx.9 | Input active if the selector of TeSys is in the ON position. |
| CH4_Run | %IXx.10 | Input active if the power contacts of TeSys are closed. |
| CH4_Trip | %IXx.11 | Input active if the selector of TeSys is in the TRIP position. |
| Error | %IXx.12 | Over current error flag of protect source outputs (0:Error, 1:Normal). |

The digital outputs of this module are:

| Tesys | Address | Description |
|---|---|---|
| CH1_Dir1Control | %QXx.0 | This 24 V output drives the direct (forward) command of the motor. |
| CH1_Dir2Control | %QXx.1 | This 24 V output drives the reverse (backward) command of the motor. |
| CH2_Dir1Control | %QXx.2 | This 24 V output drives the direct (forward) command of the motor. |
| CH2_Dir2Control | %QXx.3 | This 24 V output drives the reverse (backward) command of the motor. |
| CH3_Dir1Control | %QXx.4 | This 24 V output drives the direct (forward) command of the motor. |
| CH3_Dir2Control | %QXx.5 | This 24 V output drives the reverse (backward) command of the motor. |
| CH4_Dir1Control | %QXx.6 | This 24 V output drives the direct (forward) command of the motor. |
| CH4_Dir2Control | %QXx.7 | This 24 V output drives the reverse (backward) command of the motor. |

## Inserting a Channel

Each channel connected to a device can be separately configured.

To add channels to the configuration:

| Step | Action |
|---|---|
| 1 | Select the **Module_**x node in the **Devices tree** and click  , or right-click the module node and select **Add Device** from the context menu.<br>**Result:** The **Add Device** dialog box is displayed. |
| 2 | Select the channel to insert in the **Name** list. |
| 3 | Click **Add Device**.<br>**Result:** The selected channel is added to the project and displayed in the **Devices tree** as a new **Tesys_Channel_***x* subnode of the expansion module.<br>The **Add Device** dialog box remains open. You can do the following:<br>• Add another channel by repeating step 2 of this procedure.<br>• Or, click the **Close** button. |

## Selecting the Associated Device Type

To configure the type of device associated with a channel:

| Step | Action |
|---|---|
| 1 | Double-click the **Tesys_Channel_***x* node in the **Devices tree**. |
| 2 | On the **I/O Configuration** tab, double-click in the **Value** column and select the type of Tesys motor starter connected to the channel. |

# FB_TesysU: Control the TM3 Expert I/O Module

## Overview

The *FB_TeSysU* function block is included in the TM3 library.

## Graphical Representation

# I/O Variable Description

This table describes the input variables:

| Input | Type | Comment |
|---|---|---|
| *xRev* | BOOL | State determines the direction command:<br>• FALSE: forward direction (DIR1)<br>• TRUE: reverse direction (DIR2) |
| *xRun* | BOOL | Activates/deactivates the direction command to the associated motor starter:<br>• FALSE: no direction command is activated (neither DIR1 nor DIR2)<br>• TRUE: depending on the state of the xRev input, the corresponding command (DIR1 or DIR2) is activated |
| *xEnable* | BOOL | True enables the function block. |

This table describes the output variables:

| Output | Type | Comment |
|---|---|---|
| *xDiag* | TU_ CONSTANTS | The current status when *q_xError* is set to True:<br>• *TU_STDBY*. Tesys: off, xRun: on<br>• *TU_OFF*. Tesys: off, xRun: off<br>• *TU_RUN*. Tesys: on, xRun: on<br>• *TU_RDY*. Tesys: on, xRun: off<br>• *TU_TRIP*. Tesys: on, xRun: on<br>• *TU_ERR_REV_ON_DOL*. Tesys: on, xRun: on<br>• *TU_ERR_REV_AT_RUN*. Tesys: on, xRun: on<br>• *TU_ERR_OVERCURRENT*. Tesys: on, xRun: on<br>• *FB_DISABLED*. Tesys: on, xRun: on |
| *q_xReady* | BOOL | True sets the selector of the module to the ON position. |
| *q_xRun* | BOOL | True closes the power contacts of the module. |
| *q_xTrip* | BOOL | True sets the selector of the module to the TRIP position. |
| *q_xError* | BOOL | True retrieves the current detected error status. |

# TM3XHSC202 / TM3XHSC202G Modules

## TM3XHSC202 / TM3XHSC202G Module Overview

### Introduction

The TM3XHSC202 (screw) / TM3XHSC202G (spring) expansion modules are equipped with:

- 10 inputs for each channel
- 8 outputs for each channel
- 24 Vdc power supply

TM3XHSC202 / TM3XHSC202G expansion modules can be connected to the controller in any order. They support advanced counting functions. For more information, refer to the TM3 Expert I/O Modules - HSC Library Guide.

### Adding and Configuring the TM3XHSC202 / TM3XHSC202G Modules

To add a TM3XHSC202 / TM3XHSC202G module to a project:

| Step | Action |
|---|---|
| 1 | Add the expansion module to your controller. |
| 2 | Configure the expansion module inputs and outputs. |
| 3 | Double click **Counters** node. |
| 4 | Configure the counting function. For more information, refer to the TM3 Expert I/O Modules - HSC Library Guide. |

## TM3XHSC202 / TM3XHSC202G Module Configuration

### Overview

The embedded I/O function allows configuration of the inputs and outputs.

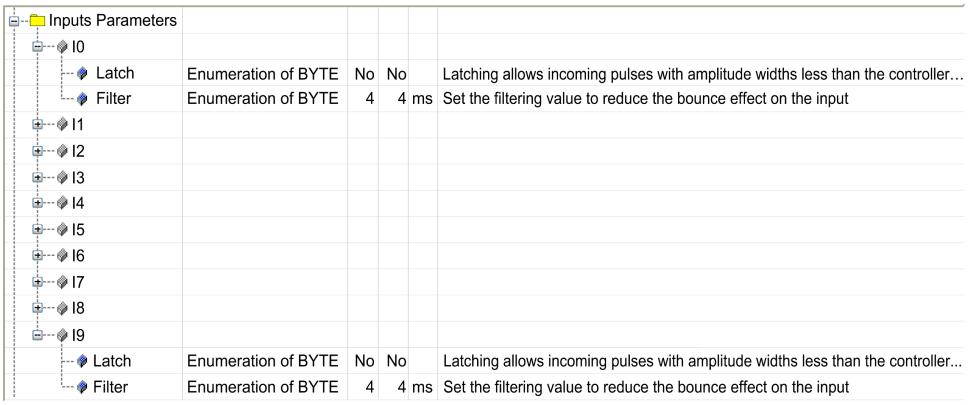
### Accessing the I/O Configuration Window

Follow these steps to access the I/O configuration window:

| Step | Description |
|---|---|
| 1 | In the Devices tree, under the **IO_Bus** node, double-click the module name. |
| 2 | Select the **I/O Configuration** tab. |

# Configuration of Inputs

This figure shows the **I/O Configuration** tab for inputs:



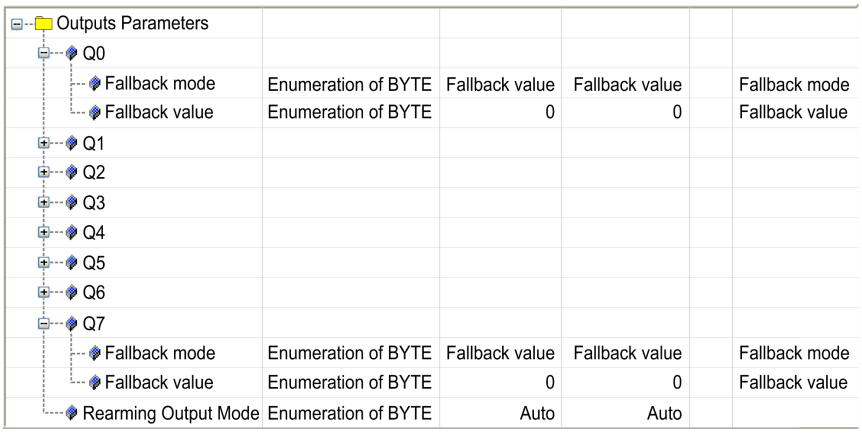
| Inputs Parameters | | | | | |
|---|---|---|---|---|---|
| I0 | | | | | |
| Latch | Enumeration of BYTE | No | No | | Latching allows incoming pulses with amplitude widths less than the controller… |
| Filter | Enumeration of BYTE | 4 | 4 | ms | Set the filtering value to reduce the bounce effect on the input |
| I1 | | | | | |
| I2 | | | | | |
| I3 | | | | | |
| I4 | | | | | |
| I5 | | | | | |
| I6 | | | | | |
| I7 | | | | | |
| I8 | | | | | |
| I9 | | | | | |
| Latch | Enumeration of BYTE | No | No | | Latching allows incoming pulses with amplitude widths less than the controller... |
| Filter | Enumeration of BYTE | 4 | 4 | ms | Set the filtering value to reduce the bounce effect on the input |

For each input not used by a counting function, you can configure the following parameters:

| Parameter | Value | Description | Constraint |
|---|---|---|---|
| **Latch** | **No*** <br> **Yes** | Allows incoming pulses with amplitude widths shorter than the controller scan time to be captured and recorded. | Use latch inputs in the task configured in the Bus cycle task, page 22. |
| **Filter** | 0.000 ms <br> 0.001 ms <br> 0.002 ms <br> 0.005 ms <br> 0.01 ms <br> 0.05 ms <br> 0.08 ms <br> 0.5 ms <br> 1 ms <br> 4 ms* <br> 12 ms | Reduces the effect of noise, such as contact bounce or other transient interference, on a controller input. | Increased filter times reduce the effective speed of the high speed counter. |
| * Parameter default value | | | |

# Configuration of Outputs

This figure shows the **I/O Configuration** tab for outputs:



| Outputs Parameters | | | | | |
|---|---|---|---|---|---|
| Q0 | | | | | |
| Fallback mode | Enumeration of BYTE | Fallback value | Fallback value | | Fallback mode |
| Fallback value | Enumeration of BYTE | 0 | 0 | | Fallback value |
| Q1 | | | | | |
| Q2 | | | | | |
| Q3 | | | | | |
| Q4 | | | | | |
| Q5 | | | | | |
| Q6 | | | | | |
| Q7 | | | | | |
| Fallback mode | Enumeration of BYTE | Fallback value | Fallback value | | Fallback mode |
| Fallback value | Enumeration of BYTE | 0 | 0 | | Fallback value |
| Rearming Output Mode | Enumeration of BYTE | Auto | Auto | | |

This table presents the function of the different parameters:

| Parameter | Value | Description | |
|---|---|---|---|
| **Fallback mode** | **Maintain** | **Reflex Output** configured | **Reflex Output** not configured |
| | **Fallback Value*** | Allows you to set the fallback mode when:<br>• The controller is in `STOPPED` or `HALTED` state.<br>• The connection between the controller and the module is lost.<br>**NOTE: Maintain** is disabled. | Allows you to set the fallback mode when the connection between the controller and the module is lost.<br>**NOTE:** When the controller is in `STOPPED` state, the behavior is defined in **PLC Settings** tab. |
| **Fallback value** | 0*<br>1 | Allows you to set the fallback value.<br>Available if **Fallback mode** set to **Fallback Value**. | |
| **Rearming Output Mode** | **Auto***<br>**Manual** | Select the rearming output mode:<br>• **Automatic rearming**: as soon as the detected error is corrected, the output is set again according to the current value assigned to it and the diagnostic value is reset.<br>• **Manual rearming**: when an error is detected, the status is memorized and the output is forced to tri-state until user manually clears the status (see I/O mapping channel). | |
| * Parameter default value | | | |

In the case of a short-circuit or current overload, the common group of outputs automatically enters into thermal protection mode (all outputs in the group are set to 0), and are then periodically rearmed (each 10 seconds) to test the connection state. However, you must be aware of the effect of this rearming on the machine or process being controlled.

**⚠WARNING**

**UNINTENDED MACHINE START-UP**

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

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

## I/O Mapping Tab

For more information on the **I/O Mapping** tab, refer to the EcoStruxure Machine Expert Programming Guide.

# TM3XFHSC202 / TM3XFHSC202G Modules

## TM3XFHSC202 / TM3XFHSC202G Module Overview

### Introduction

The TM3XFHSC202 (screw) / TM3XFHSC202G (spring) expansion modules are equipped with:

- 10 inputs for each channel
- 8 outputs for each channel
- 24 Vdc power supply

TM3XFHSC202 / TM3XFHSC202G expansion modules can be connected to the controller in any order. They support advanced counting and event functions. For more information, refer to the TM3 Expert I/O Modules - HSC Library Guide (see Modicon TM3 Expert I/O Modules, HSC Library Guide).

### Adding and Configuring the TM3XFHSC202 / TM3XFHSC202G Modules

To add a TM3XFHSC202 / TM3XFHSC202G module to a project:

| Step | Action |
|---|---|
| 1 | Add the expansion module to your controller. |
| 2 | Configure the expansion module inputs and outputs. |
| 3 | Double click **Counters** node. |
| 4 | Configure the counting function. For more information, refer to the TM3 Expert I/O Modules - HSC Library Guide (see Modicon TM3 Expert I/O Modules, HSC Library Guide). |

## TM3XFHSC202 / TM3XFHSC202G Module Configuration

### Overview

The embedded I/O function allows configuration of the inputs and outputs.

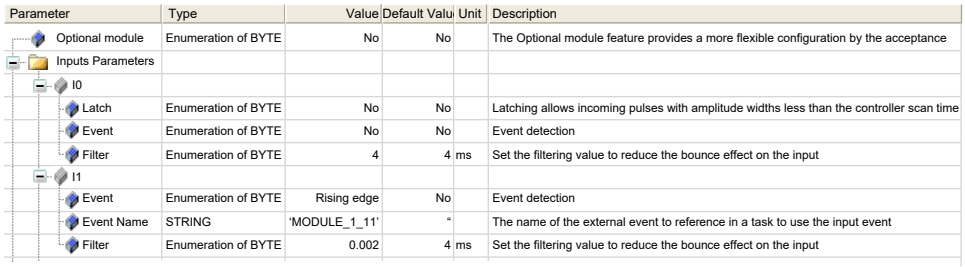
### Accessing the I/O Configuration Window

Follow these steps to access the I/O configuration window:

| Step | Description |
|---|---|
| 1 | In the Devices tree, under the **IO_Bus** node, double-click the module name. |
| 2 | Select the **I/O Configuration** tab. |

# Configuration of Inputs

This figure shows the **I/O Configuration** tab for inputs:



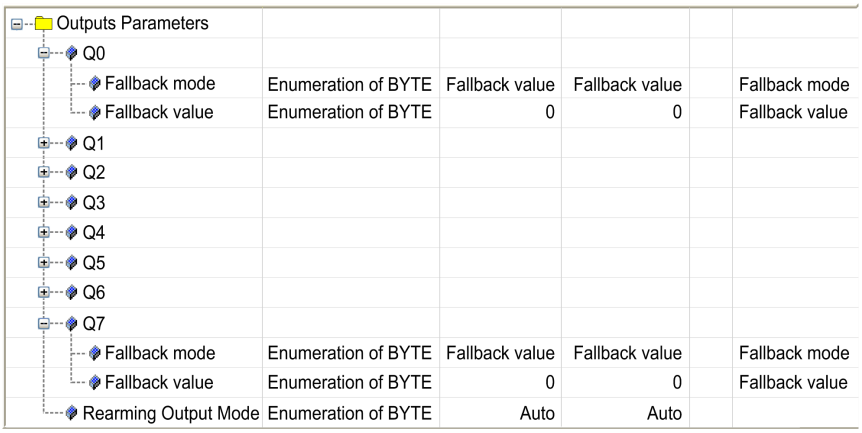
| Parameter | Type | Value | Default Valu | Unit | Description |
|---|---|---|---|---|---|
| Optional module | Enumeration of BYTE | No | No | | The Optional module feature provides a more flexible configuration by the acceptance |
| Inputs Parameters | | | | | |
| I0 | | | | | |
| Latch | Enumeration of BYTE | No | No | | Latching allows incoming pulses with amplitude widths less than the controller scan time |
| Event | Enumeration of BYTE | No | No | | Event detection |
| Filter | Enumeration of BYTE | 4 | 4 | ms | Set the filtering value to reduce the bounce effect on the input |
| I1 | | | | | |
| Event | Enumeration of BYTE | Rising edge | No | | Event detection |
| Event Name | STRING | 'MODULE_1_11' | '' | | The name of the external event to reference in a task to use the input event |
| Filter | Enumeration of BYTE | 0.002 | 4 | ms | Set the filtering value to reduce the bounce effect on the input |

For each input not used by a counting function, you can configure the following parameters:

| Parameter | Value | Description | Constraint |
|---|---|---|---|
| **Latch** | **No***<br>**Yes** | Allows incoming pulses with amplitude widths shorter than the controller scan time to be captured and recorded. | Available if **Event** is disabled.<br>Use latch inputs in MAST task only. |
| **Event** | **No***<br>**Rising edge**<br>**Falling edge**<br>**Both edges** | Event detection | Available if:<br>• **Latch** is disabled AND<br>• The module is one of the two first TM3XFHSC202 / TM3XFHSC202G modules on the bus (see Modicon TM3, Expert I/O Modules, Hardware Guide). |
| **Event Name** | – | Allows a unique name to be created for this event, and this unique name can then be referenced in a task. | Available if the value of **Event** is different from **No**.<br>49 characters maximum.<br>To use this event, create an **External Event** task and give it the same name as the **Event Name**. |
| **Filter** | 0.000 ms<br>0.001 ms<br>0.002 ms<br>0.005 ms<br>0.01 ms<br>0.05 ms<br>0.08 ms<br>0.5 ms<br>1 ms<br>4 ms*<br>12 ms | Reduces the effect of noise on a controller input. | – |
| * Parameter default value | | | |

# Configuration of Outputs

This figure shows the **I/O Configuration** tab for outputs:



| Outputs Parameters | | | | | |
|---|---|---|---|---|---|
| Q0 | | | | | |
| Fallback mode | Enumeration of BYTE | Fallback value | Fallback value | | Fallback mode |
| Fallback value | Enumeration of BYTE | 0 | 0 | | Fallback value |
| Q1 | | | | | |
| Q2 | | | | | |
| Q3 | | | | | |
| Q4 | | | | | |
| Q5 | | | | | |
| Q6 | | | | | |
| Q7 | | | | | |
| Fallback mode | Enumeration of BYTE | Fallback value | Fallback value | | Fallback mode |
| Fallback value | Enumeration of BYTE | 0 | 0 | | Fallback value |
| Rearming Output Mode | Enumeration of BYTE | Auto | Auto | | |

This table presents the function of the different parameters:

| Parameter | Value | Description | |
|---|---|---|---|
| **Fallback mode** | **Maintain** | **Reflex Output** configured | **Reflex Output** not configured |
| | **Fallback Value*** | Allows you to set the fallback mode when:<br>• The controller is in `STOPPED` or `HALTED` state.<br>• The connection between the controller and the module is lost.<br>**NOTE: Maintain** is disabled. | Allows you to set the fallback mode when the connection between the controller and the module is lost.<br>**NOTE:** When the controller is in `STOPPED` state, the behavior is defined in **PLC Settings** tab. |
| **Fallback value** | 0*<br>1 | Allows you to set the fallback value.<br>Available if **Fallback mode** set to **Fallback Value**. | |
| **Rearming Output Mode** | **Auto***<br>**Manual** | Select the rearming output mode:<br>• **Automatic rearming**: as soon as the detected error is corrected, the output is set again according to the current value assigned to it and the diagnostic value is reset.<br>• **Manual rearming**: when an error is detected, the status is memorized and the output is forced to tri-state until user manually clears the status (see I/O mapping channel). | |
| * Parameter default value | | | |

In the case of a short-circuit or current overload, the common group of outputs automatically enters into thermal protection mode (all outputs in the group are set to 0), and are then periodically rearmed (each 10 seconds) to test the connection state. However, you must be aware of the effect of this rearming on the machine or process being controlled.

**⚠WARNING**

**UNINTENDED MACHINE START-UP**

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

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

# I/O Mapping Tab

For more information on the **I/O Mapping** tab, refer to the EcoStruxure Machine Expert Programming Guide.

# TM3 Safety Modules Configuration

## Introduction

This chapter describes how to configure the TM3 Safety Modules, page 20.

# Configuration: TM3 Safety Modules

## Configuring the TM3 Safety Modules

### Introduction

For more information on the terms methods used concerning functional safety as they apply to the TM3 Safety Modules, refer to the TM3 Safety Modules Hardware Guide (see Modicon TM3, Safety Modules, Hardware Guide).

### Configuring the Modules

Refer to the I/O Mapping and Configuration tabs, page 22 for detailed information on the configuration of the safety expansion modules in EcoStruxure Machine Expert.

# General Principles: TM3 Safety Functionality Modes

## Interlock

### Description

In 2 channel operation, both inputs related to both channels must be seen open before a safety-related cycle can be started and the output can be closed. This functionality helps ensure that the output circuit cannot be activated if one of the input channels is not able to be open (for example in case of contact malfunction or short circuit).

The interlock function checks if both **K1** and **K2** relays are open before the safety-related cycle. In case of short power-supply interruption, one of the relays may be off while the other remains on. To allow the operation of the module on power return, the power-supply interruption should be at least 100 ms in duration.

### Power Cycle

The interlock condition is reset by a power cycle. Information about a possible malfunction detected, provided by the interlock, is interrupted and not recovered before the next safety-related cycle.

### Reset

The controller can request to reset the safety module by communicating with the safety module on the TM3 Bus.

When the reset signal is active, both safety module internal relays are deactivated.

The reset signal can be used to reset the module after the activation of the interlock function.

**NOTE:** The reset signal overwrites an activated interlock function. Information about a possible malfunction detected, provided by the interlock, is interrupted and not recovered before the next safety-related cyle.

The interruption of the interlock function could lead to the degradation of the safety-related level of the system. The reset of this function should only be done manually after verification of the intended functionality.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

- Do not use the reset function to reset an interlock programmatically.
- Always verify the interlock notification before using the reset function.

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

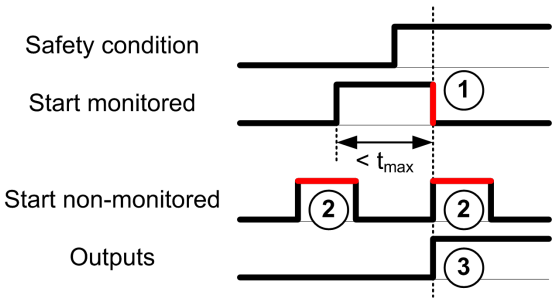
# Start

## Description

Two modes are available for the start functionality:

| | |
|---|---|
| Non-monitored start: | When non-monitored, the start mode can be:<br>• Manually controlled (conditioned by the input state)<br>• Automatic (hardwired) |
| Monitored start: | When monitored, the start mode is manually controlled (conditioned by the input edge). |

This figure represents the events sequence for the two start modes available:




Events description:

1. Monitored start condition is triggered by a falling edge on the **start** input.
2. Non-monitored start condition is available as long as the **start** input is on.

   The start condition can be valid before the safety-related input.
3. The outputs get activated only if start + safety-related input conditions are valid.

   **NOTE:** For a monitored start, the falling edge on the **start** input must appear within 20 seconds (± 5 seconds) after activation of the start input at nominal supply voltage.

Both the safety-related conditions and the start conditions must be valid before allowing the activation of outputs.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

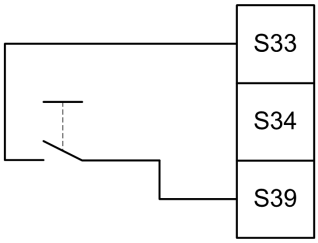
Do not use either the monitored start or the non-monitored start as a safety function.

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

## Manual Non-Monitored Start

The start condition is valid when the **start** input is closed (start switch is pressed).

This figure represents how to connect a switch on a TM3 safety module to configure a manual non-monitored start:




## Automatic Start

There is no start interlock when automatic start is used. After a power cycle, the output behavior depends solely on the state of the inputs.

**⚠WARNING**

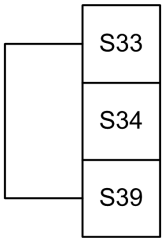
**UNINTENDED EQUIPMENT OPERATION**

Do not use automatic start if a start interlock is required in your application after a power cycle.

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

The module is in automatic start mode if the **start** input is permanently closed (hardwired).

This figure represents how to connect a switch on a TM3 safety module to configure an automatic start:




**NOTE:** There is no start interlock in automatic start after a power cycle.

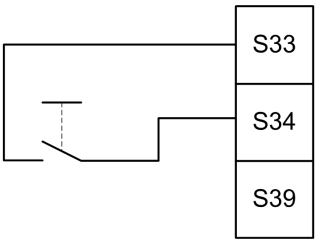
## Monitored Start

In monitored start mode, the outputs are activated when:

- All required inputs are closed
- A falling edge is applied to the **start** input. A falling edge means that the start switch is pressed and released again.

At nominal supply voltage, the start switch must be released within 20 seconds (± 5 seconds) after it has been closed. The exact delay depends on supply voltage and ambient temperature.

This figure represents how to connect a switch on a TM3 safety module to configure a monitored start (when available on the module):




# External Device Monitoring (EDM)

## Description

External device monitoring functionality is used to help ensure that external contactors controlled by the safety module outputs are able to interrupt the safety-related circuit. This functionality is implemented by adding the external contactor feedback to the start condition of the safety module.

The external contactor must provide a feedback through a normally closed auxiliary contact forcibly guided by its normally open safety-related contact. The start condition is valid only when the external feedback (normally closed) is closed.

External device monitoring can be performed on:

- 1 channel.

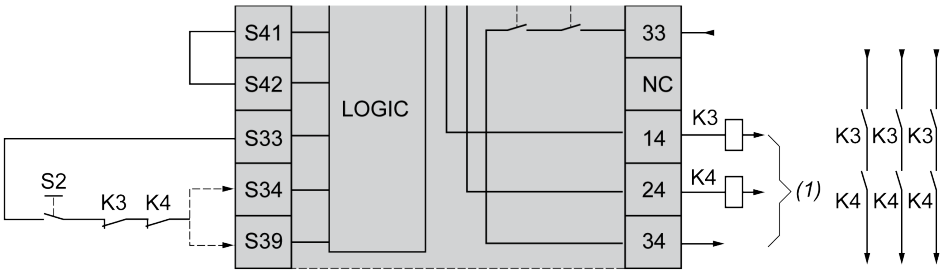
  External feedback is provided to the start condition.
- 2 channels for short circuit detection.

  External feedback is provided to the start condition and to the **S4** input.

  **NOTE:** The state of the external device is only monitored when the safety module is analyzing the start condition validity. When outputs are activated, the external device is not monitored.

## EDM Configuration With One Channel

This figure shows an example of 1 channel EDM with the external feedback (**K3** and **K4**) added to the start condition, and **S41** directly connected to **S42**:




**K3** External contactor with a normally closed feedback and normally open safety-related contact

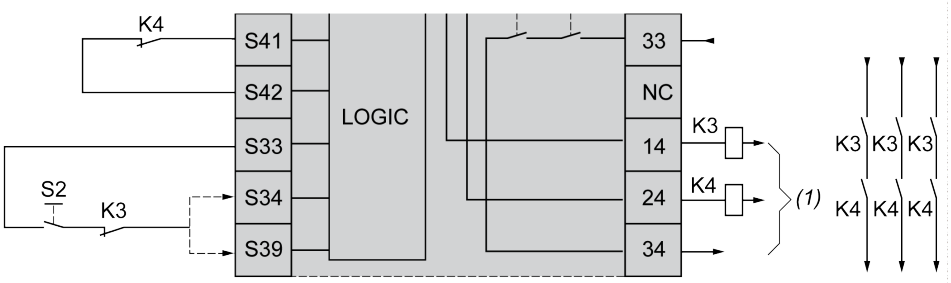
**K4** External contactor with a normally closed feedback and normally open safety-related contact

**S2** Start switch

***(1)*** Safety-related outputs

## EDM Configuration With Two Channels

This figure shows an example of 2 channels EDM with one external feedback added to the start condition (**K3**), and the other feedback (**K4**) connected to **S41** and **S42**:




**K3** External contactor with a normally closed feedback and normally open safety-related contact

**K4** External contactor with a normally closed feedback and normally open safety-related contact

**S2** Start switch

***(1)*** Safety-related outputs

# Synchronization Time Monitoring for TM3SAK6R / TM3SAK6RG

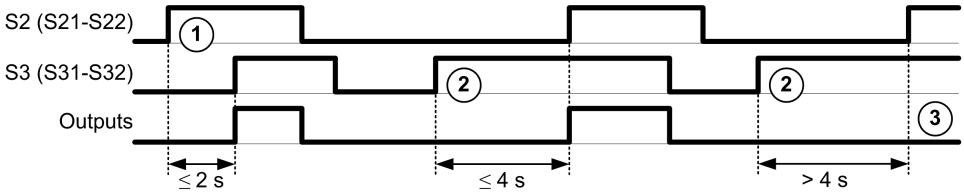
## Description

The synchronization time monitoring is relevant for 2-channel applications. It monitors both inputs to determine that they are activated simultaneously (within a defined time). The synchronization time monitoring allows to detect a contact error (short-circuit) before the activation of the other input.

When the synchronization time monitoring is enabled, the outputs are allowed to be activated if both input S21-S22 and input S31-S32 are activated within 2 or 4 seconds. The defined time depends on which input is activated first as explained

in the following figure. The outputs are not activated if the synchronization time is expired.

This figure represents the synchronization time monitoring chronogram on a TM3SAK6R• module in a 2-channel application:




Events description:

1. **S21-S22** operated before **S31-S32**
2. **S31-S32** operated before **S21-S22**
3. Outputs are not activated because the synchronization time is expired.

## Synchronization Time Monitoring Control

The synchronization time monitoring is enabled or disabled by the system controller through a communication with the safety module on the TM3 Bus.

The synchronization time monitoring is an additional feature that contributes to the safety-related system, but cannot itself provide for functional safety.

**⚠WARNING**

**INCORRECT USE OF THE INTERNAL SYNCHRONIZATION TIME CONDITION**

Do not use the synchronization time monitoring to control safety-related operations.

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

When enabled, the synchronization time is monitored by the module internal safety-related microcontroller.

In a 2-channel application, **S21-S22** and **S31-S32** simultaneous activation is monitored if `SyncOn` bit is set to 1.

# General Principles: TM3 Safety Operation Modes

## Power-On Condition

### Description

When applying power to the safety module, the outputs are activated only if these four conditions are fulfilled:

- The start condition, page 74 is valid.
- The safety-related conditions (safety-related inputs) indicate to activate the outputs.
- The internal enable, page 79 condition is valid.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

Do not use automatic start if a start interlock is required in your application after a power cycle.

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

# Enable Condition

## Description

The enable condition is a module internal control required to allow the internal relay **K2** to be closed. The internal relays can only be closed if the following conditions are fulfilled:

- The start condition, page 74 is valid.
- The safety-related conditions (safety-related inputs) indicate to authorize activation of the outputs.
- The internal enable condition is valid for **K2**.

The safety-related outputs are deactivated:

- if the enable condition is not valid, or
- if the safety-related conditions are no longer valid.

## Enable Condition

The enable condition is set by the controller through a communication with the safety module on the TM3 Bus.

**⚠WARNING**

**INCORRECT USE OF THE INTERNAL ENABLE CONDITION**

Do not use the internal enable condition to control safety-related operations.

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

The enable condition is enabled by the system controller through a communication on the TM3 Bus.

The enable condition is disabled by:

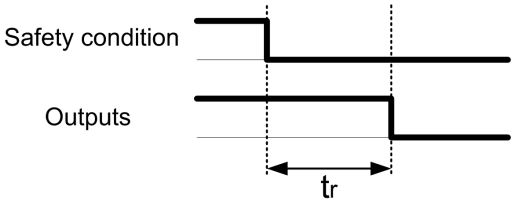
- The system controller through a communication on the TM3 Bus.
- The module internal safety-related microcontroller when:
  - The synchronization time, page 77 is enabled and a time-out occurs.
  - The TM3 Bus time-out occurs.

  **NOTE:** The enable condition only affects to internal relay **K2**. Internal relay **K1** may be active even when the enable condition is not valid.

# Output Response Time

## Description

This figure represents the response time ($t_r$) between the opening of one input (safety-related condition invalid) and all outputs deactivation:




**NOTE:** $t_r \leq 20$ ms

# On Delay and Restart Delay

## On Delay Description

On delay represents the time elapsed between the enabling of the condition for activation and the activation of the outputs.

**NOTE:** On delay ≤ 100 ms

## Restart Delay Description

Restart delay represents the time required to reactivate internal relays after their deactivation.

**NOTE:** Restart delay ≤ 300 ms

# I/O Mapping: TM3 Safety Modules

## TM3SAC5R / TM3SAC5RG I/O Mapping

### I/O Mapping Tab

Variables are defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | | Type | Description |
|---|---|---|---|---|
| Diagnostics | IW0 | | WORD | - |
| ixModule_x_OutputOn | Bit 0 | OutputOn | BOOL | Safety-related output on |
| ixModule_x_Supply | Bit 1 | Supply | BOOL | Supply available (A1/A2) |
| ixModule_x_SupplyFail | Bit 2 | SupplyFail | BOOL | Supply out of tolerance<br>Acceptable range: 20.4...28.8 Vdc |
| - | Bit 3 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| - | Bit 4 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| ixModule_x_Start | Bit 5 | Start | BOOL | Start active |
| ixModule_x_K1 | Bit 6 | K1 | BOOL | Relay K1 activated |
| ixModule_x_K2 | Bit 7 | K2 | BOOL | Relay K2 activated |
| - | Bit 8...11 | Not applicable | BOOL | Not valid as a TM3 safety function block outputs |
| ixModule_x_WaitingForStart | Bit 12 | WaitingForStart | BOOL | Waiting for start condition, page 74 |
| - | Bit 13 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| - | Bit 14, bit 15 | Reserved | BOOL | - |
| Outputs | QB0 | | BYTE | - |
| qxModule_x_Enable | Bit 0 | Enable | BOOL | TRUE enables the activation of safety-related outputs. |
| qxModule_x_ResetModule | Bit 1 | ResetModule | BOOL | TRUE resets the module: current source switched off, outputs deactivated, and interlock reset. |
| qxModule_x_KeepAlive | Bit 2 | KeepAlive | BOOL | TRUE defines the safety function remains active even when a TM3 Bus time-out occurs. |

For further generic descriptions, refer to I/O Configuration Tab Description, page 22.

# TM3SAF5R / TM3SAF5RG I/O Mapping

## I/O Mapping Tab

Variables are defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | | Type | Description |
|---|---|---|---|---|
| Diagnostics | IW0 | | WORD | - |
| ixModule_x_OutputOn | Bit 0 | OutputOn | BOOL | Safety-related output on |
| ixModule_x_Supply | Bit 1 | Supply | BOOL | Supply available (A1/A2) |
| ixModule_x_SupplyFail | Bit 2 | SupplyFail | BOOL | Supply out of tolerance<br>Acceptable range: 20.4...28.8 Vdc |
| ixModule_x_CH1 | Bit 3 | CH1 | BOOL | Channel 1 active |
| ixModule_x_CH2 | Bit 4 | CH2 | BOOL | Channel 2 active |
| ixModule_x_Start | Bit 5 | Start | BOOL | Start active |
| ixModule_x_K1 | Bit 6 | K1 | BOOL | Relay K1 activated |
| ixModule_x_K2 | Bit 7 | K2 | BOOL | Relay K2 activated |
| - | Bit 8 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| ixModule_x_S1 | Bit 9 | S1 | BOOL | S1 active |
| ixModule_x_S2 | Bit 10 | S2 | BOOL | S2 active |
| ixModule_x_S4 | Bit 11 | S4 | BOOL | S4 active |
| ixModule_x_WaitingForStart | Bit 12 | WaitingForStart | BOOL | Waiting for start condition, page 74 |
| - | Bit 13 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| - | Bit 14, bit 15 | Reserved | BOOL | - |
| Outputs | QB0 | | BYTE | - |
| qxModule_x_Enable | Bit 0 | Enable | BOOL | TRUE enables the activation of safety-related outputs. |
| qxModule_x_ResetModule | Bit 1 | ResetModule | BOOL | TRUE resets the module: current source switched off, outputs deactivated, and interlock reset. |
| qxModule_x_KeepAlive | Bit 2 | KeepAlive | BOOL | TRUE defines the safety function remains active even when a TM3 Bus time-out occurs. |

For further generic descriptions, refer to I/O Configuration Tab Description, page 22.

# TM3SAFL5R / TM3SAFL5RG I/O Mapping

## I/O Mapping Tab

Variables are defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | | Type | Description |
|---|---|---|---|---|
| Diagnostics | IW0 | | WORD | - |
| ixModule_x_OutputOn | Bit 0 | OutputOn | BOOL | Safety-related output on |
| ixModule_x_Supply | Bit 1 | Supply | BOOL | Supply available (A1/A2) |
| ixModule_x_SupplyFail | Bit 2 | SupplyFail | BOOL | Supply out of tolerance<br>Acceptable range: 20.4...28.8 Vdc |
| ixModule_x_CH1 | Bit 3 | CH1 | BOOL | Channel 1 active |
| ixModule_x_CH2 | Bit 4 | CH2 | BOOL | Channel 2 active |
| ixModule_x_Start | Bit 5 | Start | BOOL | Start active |
| ixModule_x_K1 | Bit 6 | K1 | BOOL | Relay K1 activated |
| ixModule_x_K2 | Bit 7 | K2 | BOOL | Relay K2 activated |
| ixModule_x_S1 | Bit 8 | S1 | BOOL | S1 active |
| - | Bit 9 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| ixModule_x_S2 | Bit 10 | S2 | BOOL | S2 active |
| ixModule_x_S4 | Bit 11 | S4 | BOOL | S4 active |
| ixModule_x_WaitingForStart | Bit 12 | WaitingForStart | BOOL | Waiting for start condition, page 74 |
| - | Bit 13 | Not applicable | BOOL | Not valid as a TM3 safety function block output |
| - | Bit 14, bit 15 | Reserved | BOOL | - |
| Outputs | QB0 | | BYTE | - |
| qxModule_x_Enable | Bit 0 | Enable | BOOL | TRUE enables the activation of safety-related outputs. |
| qxModule_x_ResetModule | Bit 1 | ResetModule | BOOL | TRUE resets the module: current source switched off, outputs deactivated, and interlock reset. |
| qxModule_x_KeepAlive | Bit 2 | KeepAlive | BOOL | TRUE defines the safety function remains active even when a TM3 Bus time-out occurs. |

For further generic descriptions, refer to I/O Configuration Tab Description, page 22.

# TM3SAK6R / TM3SAK6RG I/O Mapping

## I/O Mapping Tab

Variables are defined and named in the **I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the **I/O Mapping** tab:

| Variable | Channel | | Type | Description |
|---|---|---|---|---|
| Diagnostics | IW0 | | WORD | - |
| ixModule_x_OutputOn | Bit 0 | OutputOn | BOOL | Safety-related output on |
| ixModule_x_Supply | Bit 1 | Supply | BOOL | Supply available (A1/A2) |
| ixModule_x_SupplyFail | Bit 2 | SupplyFail | BOOL | Supply out of tolerance<br>Acceptable range: 20.4...28.8 Vdc |
| ixModule_x_CH1 | Bit 3 | CH1 | BOOL | Channel 1 active |
| ixModule_x_CH2 | Bit 4 | CH2 | BOOL | Channel 2 active |
| ixModule_x_Start | Bit 5 | Start | BOOL | Start active |
| ixModule_x_K1 | Bit 6 | K1 | BOOL | Relay K1 activated |
| ixModule_x_K2 | Bit 7 | K2 | BOOL | Relay K2 activated |
| ixModule_x_S1 | Bit 8 | S1 | BOOL | S1 active |
| ixModule_x_S2 | Bit 9 | S2 | BOOL | S2 active |
| ixModule_x_S3 | Bit 10 | S3 | BOOL | S3 active |
| ixModule_x_S4 | Bit 11 | S4 | BOOL | S4 active |
| ixModule_x_WaitingForStart | Bit 12 | WaitingForStart | BOOL | Waiting for start condition, page 74 |
| ixModule_x_SyncFailure | Bit 13 | SyncFailure | BOOL | Synchronization time expired, page 77 |
| Outputs | QB0 | | BYTE | - |
| qxModule_x_Enable | Bit 0 | Enable | BOOL | TRUE enables the activation of safety-related outputs. |
| qxModule_x_ResetModule | Bit 1 | ResetModule | BOOL | TRUE resets the module: current source switched off, outputs deactivated, and interlock reset. |
| qxModule_x_KeepAlive | Bit 2 | KeepAlive | BOOL | TRUE defines the safety function remains active even when a TM3 Bus time-out occurs. |
| qxModule_x_SyncOn | Bit 3 | SyncOn | BOOL | TRUE enables the synchronization time monitoring of S2 and S3 inputs. |

For further generic descriptions, refer to I/O Configuration Tab Description, page 22.

# Function Blocks: TM3 Safety Modules

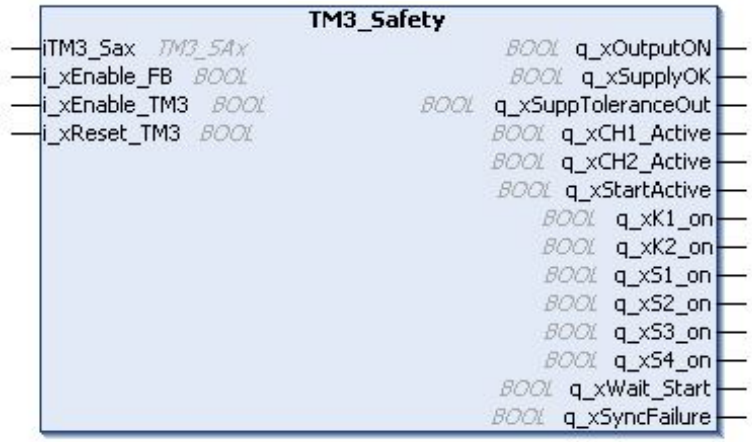
## TM3_Safety: Control the TM3 Safety Module

### Overview

The *TM3_Safety* function block is included in the TM3 Safety library.

The **IEC Objects** tab is only available if a function block instance of a device has been created, which can be accessed by the application. To access the IEC objects, double click the module node **> I/O Mapping** tab.

### Graphical Representation




### I/O Variable Description

This table describes the input variables:

| Input | Type | Comment |
|---|---|---|
| *iTM3_Sax* | TM3_SAx | Reference to the local TM3 safety modules. |
| *i_xEnable_FB* | BOOL | TRUE enables the function block. |
| *i_xEnable_TM3* | BOOL | TRUE enables the activation of the hardware module outputs.<br>**NOTE:** Enable/disable **i_xEnable_FB** before enabling/disabling **i_xEnable_TM3**. |
| *i_xReset_TM3* | BOOL | TRUE deactivates the module: the current source is switched off, the outputs are deactivated, and the interlock is reset. |

This table describes the output variables:

| Output | Type | Comment |
|---|---|---|
| *q_xOutputON* | BOOL | 0: safety-related output is off.<br>1: safety-related output is on. |
| *q_xSupplyOK* | BOOL | Supply is available. |
| *q_xSuppToleranceOut* | BOOL | Supply is out of tolerance. |
| *q_xCH1_Active* | BOOL | Channel 1 is active. |
| *q_xCH2_Active* | BOOL | Channel 2 is active. |
| *q_xStartActive* | BOOL | Start is active. |
| *q_xK1_on* | BOOL | Relay K1 is activated. |
| *q_xK2_on* | BOOL | Relay K2 is activated. |
| *q_xS1_on* | BOOL | S1 is active. |
| *q_xS2_on* | BOOL | S2 is active. |
| *q_xS3_on* | BOOL | S3 is active. |
| *q_xS4_on* | BOOL | S4 is active. |
| *q_xWait_Start* | BOOL | Waiting for start condition, page 74. |
| *q_xSyncFailure* | BOOL | Synchronization time expired, page 77. |

**NOTE:** Not all outputs are valid for all TM3 safety module references. To determine which outputs are valid for which TM3 safety module references, see the I/O mapping for the individual references, page 81.

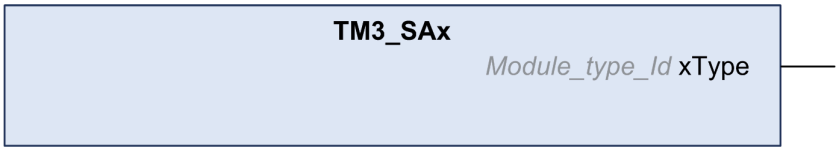
# TM3_SAx: Get the name of the I/O

## Function Block Description

The *TM3_SAx* function block gets the name of the I/O.

After you get the name of the I/O, *TM3_SAx* becomes an input parameter of the *TM3_Safety* function block.

## Graphical Representation



# TM3 Transmitter and Receiver I/O Modules Configuration

## Introduction

This chapter describes how to configure the TM3 transmitter and receiver I/O modules, page 21.

# Configuring the TM3 Transmitter and Receiver I/O Modules

## Introduction

The TM3XTRA1 transmitter module is equipped with:

- 1 RJ-45 connector
- 1 functional ground screw
- 2 status LEDs (link and power)

The TM3XREC1 receiver module is equipped with:

- 1 RJ-45 connector
- 2 status LEDs (link and power)
- Removable 24 Vdc power supply

The transmitter expansion module is connected to the controller through the TM3 bus.The transmitter must be the last physical module directly connected to the controller.

The receiver module is connected to the transmitter module using a specific cable (VDIP1845460••).

Additional TM3 modules can then be connected to the receiver module through the extended TM3 bus.

**NOTE:** You cannot use TM2 expansion modules in configurations that include the TM3 transmitter/receiver modules.

## Configuring the Modules

The TM3XTRA1 and TM3XREC1 expansion modules have no configurable properties in EcoStruxure Machine Expert.

# Behavior of the TM3 Transmitter and Receiver Modules

## Overview

The following exceptional behaviors can occur with TM3 transmitter and receiver modules:

- Transmitter/receiver cable disconnected or broken during operation
- Removing receiver module power during operation
- Receiver module disconnected during startup
- Receiver module powered on after the controller

The TM3 modules before the transmitter module are called "Local", and those after the receiver module are called "Remote".

The I/O that may be embedded in your controller is independent of the I/O that you may have added in the form of I/O expansion. It is important that the logical I/O configuration within your program matches the physical I/O configuration of your installation. If you add or remove any physical I/O to or from the I/O expansion bus or, depending on the controller reference, to or from the controller (in the form of cartridges), then you must update your application configuration. This is also true for any field bus devices you may have in your installation. Otherwise, there is the potential that the expansion bus or field bus no longer function while the embedded I/O that may be present in your controller continues to operate.

**⚠WARNING**

**UNINTENDED EQUIPMENT OPERATION**

Update the configuration of your program each time you add or delete any type of I/O expansions on your I/O bus, or you add or delete any devices on your field bus.

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

## Transmitter/Receiver Cable Disconnected or Broken During Operation

The controller continuously retries to access the modules attached to the receiver module.

When the receiver module detects cable disconnection:

- All local modules continue operating.
- All remote modules are put into the **Reset** state.
- I/O LED is on, and TM3 status bit (`plc_r.i_lwSystemFault_1.1)` is set to 0.
- Diagnostic information for the remote modules is available in the `TM3_MODULE_R` array.
- In EcoStruxure Machine Expert a red sign appears in front of the TM3 module with detected errors.

Reconnecting the cable does not restore normal operation. Only a controller power cycle or reset restores normal operation after disconnecting and then reconnecting the cable.

## Removing Receiver Module Power During Operation

When the receiver module detects cable disconnection:

- All local modules continue operating.
- I/O LED is on, and TM3 status bit (`plc_r.i_lwSystemFault_1.1)` is set to 0.
- Diagnostic information for the remote modules is available in the `TM3_MODULE_R` array.
- In EcoStruxure Machine Expert a red sign appears in front of the TM3 module with detected errors.

Restoring power results in the TM3 modules attached to the receiver module assuming a **Reset** state. Only a controller power cycle or reset restores normal operation.

# Receiver Module Disconnected During Start-up

If the receiver module was not connected at controller start-up, nothing happens because the TM3 bus is not started.

# Receiver Module Powered on After the Controller

If two separate power supplies are used for the receiver module and the controller, the power supply of the receiver module must be switched on before the controller power supply. The TM3 bus does not start if the correct order of power application is not respected, and all modules are in **Reset** state (all outputs are forced to 0).

If the receiver module and the controller are supplied by the same power supply, the whole configuration starts operating.

If only the receiver module is powered (controller not supplied):

- The TM3 modules after the receiver module are in **Reset** state (all outputs are forced to 0).
- The TM3XFHSC202 / TM3XHSC202 and TM3XFHSC202G / TM3XHSC202G modules after the receiver module are in **Fallback mode** (all outputs forced to the configured values).

# Firmware Management

## Downloading Firmware to TM3 Digital, Analog and Expert Expansion Modules

The firmware can be updated in:

- TM3D• and TM3XTYS4 with firmware version ≥ 28 (SV ≥ 2.0), except TM3DM16R and TM3DM32R (which are not updatable)
- TM3A• and TM3T• with firmware version ≥ 26 (SV ≥ 1.4)
- TM3XHSC202 and TM3XHSC202G
- TM3XFHSC202 and TM3XFHSC202G, only with a Modicon M262 Logic/Motion Controller

**NOTE:** The software version (SV) is found on the packaging and product labels.

Refer to the programming guide of your controller for detailed information on the firmware update procedure of TM3 expansion modules in EcoStruxure Machine Expert.

# Glossary

## A

**application:**

A program including configuration data, symbols, and documentation.

## C

**configuration:**

The arrangement and interconnection of hardware components within a system and the hardware and software parameters that determine the operating characteristics of the system.

**controller:**

Automates industrial processes (also known as programmable logic controller or programmable controller).

## D

**digital I/O:**

(*digital input/output*) An individual circuit connection at the electronic module that corresponds directly to a data table bit. The data table bit holds the value of the signal at the I/O circuit. It gives the control logic digital access to I/O values.

## E

**expansion bus:**

An electronic communication bus between expansion I/O modules and a controller or bus coupler.

## F

**function:**

A programming unit that has 1 input and returns 1 immediate result. However, unlike FBs, it is directly called with its name (as opposed to through an instance), has no persistent state from one call to the next and can be used as an operand in other programming expressions.

Examples: boolean (AND) operators, calculations, conversions (BYTE_TO_INT)

## H

**HE10:**

Rectangular connector for electrical signals with frequencies below 3 MHz, complying with IEC 60807-2.

## I

**I/O:**

(*input/output*)

## R

**RJ45:**

A standard type of 8-pin connector for network cables defined for Ethernet.

## T

**terminal block:**

(*terminal block*) The component that mounts in an electronic module and provides electrical connections between the controller and the field devices.

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.



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